SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)
Puducherry

2nd Board of Studies Meeting in the department of
Biomedical Engineering

for the Programme
B.Tech – Biomedical Engineering

Venue
Seminar Hall, Department of BME
Sri Manakula Vinayagar Engineering College
Madagadipet, Puducherry – 605 107

Date & Time
31-03-2021 & 10.30 a.m

Minutes of Board of Studies

The second Board of Studies meeting for B.Tech. Biomedical Engineering was held on 31st March 2021 at 10.30 A.M in the Seminar Hall, Department of BME, Sri Manakula Vinayagar Engineering College with the Head of the Department in the Chair.

The following members were present for the BoS meeting

Sl.No	Name of the Member with Designation and official Address	Responsibility in the BoS
1	**Dr.A.Vijayalakshmi,** Professor and Head Department of Biomedical Engineering, Sri Manakula Vinayagar Engineering College,Puducherry	Chairman
2	**Dr A K Jayanthy** Professor Department of Biomedical Engineering SRM Institute of Science and Technology, Kattankulathur	Academic Expert
3	**Dr.M.Arivamudhan** Professor, Department of Electronics and Communication Engineering Government College of Engineering,	Academic Expert

	Dharmapuri-636704	
4	**Dr.R.Premkumar** Professor Department of Biomedical Engineering, Rajalakshmi Engineering College, Chennai	Academic Expert
5	**Mr.V.Ashok** Manager(Technical) Intel Technology India Pvt.Ltd. SRR Elite, Bellandur, Bengaluru, Karnataka 560103	Industry Expert
6	**Dr.A. Jayachitra** Professor Specialization: Process Control and Instrumentation	Internal Member
7	**Mr. P Arunagiri** Professor Specialization: Communication Systems	Internal Member
8	**Dr.S.Senthil Kumar** Assistant Professor Specialization: Biomedical Instrumentation	Internal Member
9	**Ms. A.Kavinilavu** Assistant Professor Specialization: Biomedical Instrumentation	Internal Member
10	Dr. S B Lenin Associate Professor Specialization:VLSI Design	Internal Member
11	**Mrs S Jayanthi** Assistant Professor: Specialization: Communication Systems	Internal Member
12	Mr..M.Egalite Francis Assistant Professor Specialization: Maths	Internal Member
13	**Ms. R. Sughanya** Assistant Professor Specialization:English	Internal Member
14	**Dr.S.Savithri** Assistant Professor Specialization:Chemistry	Internal Member
15	**Mr.S.Gowtham** Software Quality Engineer, Rockwell Automation India Pvt.Ltd., Bengaluru- 560 025	Alumni Member

Agenda of the Meeting

Item No.	Particulars
BoS/UG/BME 2.1	To discuss about the appraisal of first BoS meeting and Confirmation of minutes of the meeting.
BoS/UG/BME 2.2	To discuss the Curriculum Structure of V and VI semester courses for B.Tech – Biomedical Engineering under Regulations R2019 and R2020
BoS/UG/BME 2.3	To discuss and approve the syllabi for V and VI semesters under R2019 Regulations for the UG Programme: B.Tech. Biomedical Engineering for the students admitted in the year 2019-20
BoS/UG/BME 2.4	To discuss and approve the syllabi for V and VI Semesters under R - 2020 Regulations for the UG Programme: B.Tech. Biomedical Engineering for the students admitted in the year 2020-21
BoS/UG/BME 2.5	To discuss and approve the Professional electives and open electives syllabi offered for V and VI semester for the students admitted in the academic year 2019-20 and 2020-21
BoS/UG/BME 2.6	To discuss about the Certification and Skill Development Courses for Regulations 2019 and 2020
BoS/UG/BME 2.7	To discuss about the assessment of quality of question papers for end semester examinations
BoS/UG/BME 2.8	To discuss the Students Admission status for the Academic Year 2020-21, academic schedule and To discuss and approve the Eligible Diploma Programmes for the Lateral entry students' admission for Second year under Autonomous Regulations R-2020 for B.Tech Biomedical Engineering programme.
BoS/UG/BME 2.9	To discus and review the Biomedical Engineering Department Vision, Mission, Program Educational Objectives (PEOs) and Program Specific Outcomes (PSOs) from the suggestions received from stakeholders
BoS/UG/BME 2.10	To consider and approve the revised list of panel of examiners and question paper setters for the end semester examinations

Minutes of the Meeting

Dr. A.Vijayalakshmi, Chairman, BoS opened the meeting by a warm welcome and introduced the external experts to the internal members and thanked them for accepting the invitation to conduct second Board of Studies meeting on 31st march 2021.

The Chairman proceeded with the presentation, and the meeting deliberated on agenda items.

BoS/UG/BME 2.1	The BoS Chairman reviewed the first BoS meeting with the members, its implementation and confirmed with the approval for the incorporation of minor modifications as mentioned below. In the curriculum structure of Regulations 2019 and 2020 ❖ Biosignal Processing course specified in VI semester can be moved to fourth semester ❖ Biomedical Instrumentation course specified in IV semester can be shifted to fifth semester ❖ Physiological System Modeling in Professional elective I can be shifted to Professional Elective III ❖ To include 2 more experiments related to human physiology in Biochemistry and Human Physiology lab **The above modifications are approved by BoS members and the details are given in Annexure- I.**
BoS/UG/BME 2.2	The BoS members reviewed the curriculum structure of V and VI semester of B.Tech. Biomedical Engineering **The BoS members approved the curriculum structure** and recommended to Academic Council.
BoS/UG/BME 2.3	The BoS members discussed the syllabi for V and VI Semesters under R - 2019 Regulations for the UG Programme: B.Tech. Biomedical Engineering and suggested the following points. **Semester – V** • In Bio Statistics course case study can be included in Unit 5 • Biomechanics course unit-4 content should be reduced and unit- 5 can be modified • Biomedical instrumentation course unit-5 content should not be overlapped with diagnostic and therapeutic equipment course. • Statistical laboratory simulation can be done using ANOVA tool **Semester – VI** • All the courses of sixth semester are approved by the BoS members with the following suggestion • In Medical Internet of Things Laboratory Arduino can be used The BoS members resolved R-2019 fifth and sixth semester syllabi with above mentioned changes. **The modifications are incorporated and the Syllabi is given in**

	Annexure II and approved by BoS members**.**
BoS/UG/BME 2.4	The BoS members reviewed Syllabi from V to VI semesters for Regulations 2020 (R-2020), B.Tech-Biomedical Engineering and suggested the following points. **Semester – V** • In Bio Statistics course case study can be included in Unit 5 • Biomechanics course unit-4 content should be reduced and unit- 5 can be modified • Biomedical instrumentation course unit-5 content should not be overlapped with diagnostic and therapeutic equipment course. • Statistical laboratory simulation can be done using ANOVA tool **Semester – VI** • All the courses of sixth semester are approved by the BoS members with the following suggestion • In Medical Internet of Things Laboratory Arduino can be used The BoS members resolved R-2020 fifth and sixth semester syllabi with above mentioned changes. **The modifications are incorporated and the Syllabi is given in Annexure II** and approved by BoS members**.**
BoS/UG/BME 2.5	The BoS members reviewed the elective courses and suggested the following points for implementation in the syllabi. • Environmental Biotechnology course unit- 5 should be modified. **The suggestions are incorporated and the Syllabi is given in Annexure III** and approved.
BoS/UG/BME 2.6	The BoS Members discussed and approved the list of certification and skill development courses followed in the Regulations 2019 and 2020 and recommended to the Academic Council. **The course details are given in Annexure IV**.
BoS/UG/BME 2.7	Discussed and approved the assessment of quality of question papers of end semester examinations.
BoS/UG/BME 2.8	The BoS Members reviewed the Admission status and academic activities for the Academic Year 2020-21 The following eligible Diploma Programmes for the Lateral entry student's admission into Second year B.Tech – Biomedical Engineering programme under Autonomous Regulations 2020 are discussed and **approved by the BoS members.** Applied Electronics Biomedical Engineering Computer Engineering

	Computer Networking Computer Science and Engineering Computer Technology Electrical Engineering Electronics Engineering Electronics and Communication Engineering Electrical and Electronics Engineering Electronics and Instrumentation Engineering Information Technology Instrumentation and Control Engineering Instrumentation Engineering /Technology Mechatronics Engineering Medical Electronics
BoS/UG/BME 2.9	Discussed the suggestions received from stakeholders about Biomedical Engineering Department Vision, Mission, Program Educational Objectives (PEOs) and Program Specific Outcomes (PSOs) and recommended to maintain the same. **(Annexure-V)**
BoS/UG/BME 2.10	The BoS members discussed the Revised list of panel of examiners and approved. **(Annexure-VI)**

Dr. A.Vijayalakshmi, Chairman – BoS and Head of Department, Biomedical Engineering, concluded the meeting at 1:00 pm with vote of thanks.

Dr. A.Vijayalakshmi
Chairman-BOS/BME

CURRICULUM STRUCTURE

SI. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
SEMESTER – IV										
				L	T	P		CAM	ESM	Total
Theory										
1	U19BMT41	Probability and Queuing Theory	BS	2	2	0	3	25	75	100
2	U19BMT42	Programming in Java	ES	3	0	0	3	25	75	100
3	U19BMT43	Biosignal Processing	PC	2	2	0	3	25	75	100
4	U19BMT44	Analog and Digital Integrated Circuits	PC	3	0	0	3	25	75	100
5	U19BME4X	Professional Elective –I	PE	3	0	0	3	25	75	100
6	U19XXO4X	Open Elective-I	OE	3	0	0	3	25	75	100
Practical										
7	U19BMP41	Programming in Java Laboratory	ES	0	0	2	1	50	50	100
8	U19BMP42	Biosignal Processing using MATLAB	PC	0	0	2	1	50	50	100
9	U19BMP43	Integrated Circuits Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19BMC4X	Certification Course – II	EEC	0	0	4	-	100	-	100
11	U19BMS41	Skill Development Course 3: General Proficiency - II	EEC	0	0	2	-	100	-	100
12	U19BMS42	Skill Development Course 4	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19BMM41	Indian Constitution	MC	2	0	0	-	100	-	100
							21	700	600	1300

SI. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
SEMESTER – V										
				L	T	P		CAM	ESM	Total
Theory										
1	U19BMT51	Bio Statistics	BS	2	2	0	3	25	75	100
2	U19BMT52	Biomechanics	PC	3	0	0	3	25	75	100
3	U19BMT53	Biomedical Instrumentation	PC	3	0	0	3	25	75	100
4	U19BMT54	Biocontrol Systems	PC	2	2	0	3	25	75	100
5	U19BME5X	Professional Elective – II	PE	3	0	0	3	25	75	100
6	U19XXO5X	Open Elective-II	HS	3	0	0	3	25	75	100
Practical										
7	U19BMP51	Statistical Laboratory	BS	0	0	2	1	50	50	100
8	U19BMP52	Biomedical Instrumentation Laboratory	PC	0	0	2	1	50	50	100
9	U19BMP53	Computation Laboratory	PC	0	0	2	1	50	50	100

10	U19BMP54	Hospital Training	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U19BMC5X	Certification Course – III	EEC	0	0	4	-	100	-	100
12	U19BMS51	Skill Development Course 5: Foreign Language / IELTS - I	EEC	0	0	2	-	100	-	100
13	U19BMS52	Skill Development Course 6: Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U19BMM51	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							22	750	650	1400

PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U20BME401	Medical Physics
2	U20BME402	Hospital Equipment Safety and Management
3	U20BME403	Environmental Biotechnology
4	U20BME404	Biometric Reorganization System
5	U20BME405	Laser and Fiber Optics in Medicine
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U20BME506	Bio Telemetry and Telemedicine
2	U20BME507	Transportation in Living Systems
3	U20BME508	Medical Informatics
4	U20BME509	VLSI Design
5	U20BME510	Computers in Medicine
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U20BME611	Hospital Engineering and Information Systems
2	U20BME612	Physiological System Modeling
3	U20BME613	Soft Computing Techniques
4	U20BME614	Medical Image Acquisition Techniques
5	U20BME615	Troubleshooting and Quality Control in Medical Equipment's

U20BSP112	**BIOCHEMISTRY AND HUMAN PHYSIOLOGY LABORATORY**	**L**	**T**	**P**	**C**	**Hrs**
		0	0	2	1	30

Course Objectives

- To give an insight into the chemical aspects of biological molecules and their importance
- To study the measurements of pH
- To understand the known amount of Macromolecules
- To know the significance of blood and its grouping system
- To understand the counting mechanisms of Blood cells

Course Outcomes

After completion of the course, the students will be able to

CO1 - Evaluate data and design experiments to test relevant to the practice of Biochemistry **(K4)**

CO2 - Identify the biochemical analyser tools for biological study and research **(K4)**

CO3 - Apply the principles of blood tests and serum separation from blood **(K3)**

CO4 - Analyse the type of antigen, antibody and components of blood **(K3)**

CO5 - Apply the principles of hearing aids to investigate the hearing capabilities of ear **(K3)**

List of Experiments

1. General tests for carbohydrates, proteins and lipids
2. Preparation of Serum and Plasma from blood
3. Quantitative estimation of Blood Glucose
4. Quantitative estimation of Creatinine
5. Quantitative estimation of Cholesterol
6. Study of Measurement of pH and conductivity of body fluids
7. Identification of Blood Groups
8. Estimation of Bleeding and Clotting time
9. Count RBC
10. Count WBC
11. Estimation of Haemoglobin
12. Estimation of ESR
13. Study of Hearing test –Tuning fork

Text Books

1. Edward L. Alpen," Radiation Biophysics", Second Edition, Academic Press, 2011
2. Glaser, Roland, "Bio-Physics an Introduction", Springer 2012
3. Chatterjea M.N ,Rana Shinde, "Textbook of Medical Biochemistry", Jaypee Brothers Medical Publishers, 8th Edition, 2012.

Reference Books

1. Donald Voet, Judith .Voet, Charlotte W. Pratt. "Fundamentals of Biochemistry", Fifth Edition, Wiley Publisher, 2016
2. U. Satyanarayana and U. Chakrapani. "Biochemistry", Fourth Edition, Elsevier, 2013
3. Murray R K, "Harper's Illustrated Biochemistry". 29th Edition, McGraw Hill Professional, 2012.
4. Keith Wilson & John Walker, "Practical Biochemistry – Principles & Techniques", Oxford university press, 2011
5. Michael M. Cox and David L. Nelson, "Lehninger Principles of Biochemistry", W. H. Freeman and Company, Sixth Edition, 2012.

Web References

1. https://ocw.mit.edu/courses/biology/7-012-introduction-to-biology-fall-2004/videolectures/lecture-2-biochemistry-1/
2. https://ocw.mit.edu/courses/biology/8-012-introduction-to-biology-fall-2004/videolectures/lecture-2-biochemistry-1
3. nptel.ac.in/courses/102105034/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1
2	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1
3	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1
4	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1
5	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

	L	T	P	C	Hrs
U19BMT51 **BIO STATISTICS**	2	2	0	3	60

Course Objectives

- To familiarize the concept Mean, median, mode and Standard deviation.
- To understand the concept of Correlation and Regression analysis
- To learn Analysis of variance.
- To learn the concept of testing of hypothesis using statistical analysis.
- To learn the concept of Small sampling.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Solve problems related to Bar diagrams and Pie diagrams. **(K3)**
CO2 - Find the nature of correlation and regression. **(K3)**
CO3 - Know the applications of analysis of variance. **(K2)**
CO4 - Understand the applications of large samples. **(K2)**
CO5 - Solve the problems related to testing of hypothesis in small samples. **(K3)**

UNIT I MEASURE OF DISPERSION   **(12 Hrs)**

Collection - Classification and Tabulation of data, Bar diagrams and Pie diagrams, Histogram-Frequency curve and frequency polygon, Ogive, Mean, median, mode, Standard deviation.

UNIT II CORRELATION AND REGRESSION ANALYSIS   **(12 Hrs)**

Correlation and Regression analysis: Relation between two variables- scatter diagram- definition of correlations - Two regression lines- Karl Pearson's coefficient of correlation, Rank correlation, Tied ranks.

UNIT III DESIGN OF EXPERIMENTS   **(12 Hrs)**

Analysis of variance – One way and two-way classifications – Completely randomized design – Randomized block design – Latin square design - 22 Factorial design.

UNIT IV LARGE SAMPLES   **(12 Hrs)**

Curve fitting by the method of least squares – fitting of straight lines – second degree parabolas and more general curves – Test of significance: Large samples test for single proportions, differences of proportions, single mean, difference of means and standard deviations.

UNIT V SMALL SAMPLES   **(12 Hrs)**

Test for single mean – Difference of means and correlations of coefficients – Test for ratio of variances – Chi-square test for goodness of fit and independence of attributes. Case study under t-test and Chi square test

Text Books

1.Irfan A Khan,"Fundamentals of Biostatistics",Ukaaz Publication 5th edition, 2016.
2. PSS Sunder Rao,"An introduction to Biostatistics",PHI Learning Pvt Ltd ,2012
3.Moore and McCabe, "Introduction to the Practice of Statistics",WH Freeman, 9th Edition ,2009.

Reference Books

1. Marcello Pagano, "Principles of Biostatistics",7th edition, 2015.
2. Course Manuals: S-PLUS Command Line Essentials, the Analysis of Microarrays

3. Richard.A. Johnson, Irwin Miller and John E.Freund ," Probability and Statistics for Engineers",
   Pearson Education, Asia, 9th Edition, 2018
4. P. Kandasamy K. Thilagavathy and K. Gunavathi.,"Probability and Queuing Theory",S.Chand & Co,
   Pvt.Ltd.2015
5.Dr.G. Balaji," Probability and Statistics",G.Balaji Publishers,2017

Web Resources

1. https://www.youtube.com/watch?v=_e4mwlqCQrc
2. https://www.youtube.com/watch?v=lQW_sWL_sfQ
3. https://www.youtube.com/watch?v=75pQPB1RF50
4. https://www.digimat.in/nptel/courses/video/102101056/L01.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-
2	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-
3	2	1	-	-	-	1	-	-	-	-	-	1	2	2	-
4	2	1	-	-	-	1	-	-	-	-	-	1	2	2	-
5	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-

Department of BME – Second BoS Meeting

	L	**T**	**P**	**C**	**Hrs**
U19BMT52 **BIOMECHANICS**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the basics of biomechanics
- To describe the properties of blood, bone and soft tissues
- To gain knowledge about the mechanics of moving systems
- To be able to understand Cardiac mechanisms
- To study respiratory Biomechanics

Course Outcomes

After completion of the course, the students will able to

CO1 - To describe the fundamental of biomechanics.
CO2 - To Analyse the properties, functions of hard and flexible tissues
CO3 - To describe the types and mechanics of skeletal joints and movement mechanics
CO4 - To explain the mechanical properties of Cardiac system.
CO5 - To understand the respiratory mechanisms

UNIT I INTRODUCTION TO BIOMECHANICS (9 Hrs)

Review of the principles of mechanics, Vector mechanics- Resultant forces of Coplanar and Non coplanar, Concurrent and non-concurrent forces, parallel force in space, Equilibrium of coplanar forces, Newton's laws of motion, Work and energy, Moment of inertia.

UNIT II TISSUE BIOMECHANICS (9 Hrs)

Hard Tissues: Bone structure and properties of bones, cortical and cancellous bones, type of fractures, biomechanics of fracture healing. **Soft Tissues:** Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle; Material Properties: Cartilage, Tendon, Ligament, and Muscle.

UNIT III JOINTS AND MOVEMENT BIOMECHANICS (9 Hrs)

Joints - forces and stresses in human joints, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, hip, knee and ankle. Body and limbs- mass and motion characteristics actions, forces transmitted by joints. Biomechanics of push - like motions, Biomechanics of throw - like motions.

UNIT IV CARDIAC BIOMECHANICS (9 Hrs)

Cardiovascular system, Mechanical properties of blood vessels: arteries, arterioles, capillaries, and veins. artificial heart valves, biological and mechanical valves development, testing of valves.

UNIT V RESPIRATORY BIOMECHANICS (9 Hrs)

Alveoli mechanics, Interaction of blood and lung, P-V curve of lung, breathing mechanism, Airway resistance, lung diseases.

Text Books

1. Gerhard A. Holzapfel, Ray W. Ogden, "Mechanics of Biological Tissue", Springer, 2010.
2. Sean P. Flanagan and Flanagan, "Biomechanics: A case based Approach",Jones and Bartlett Publishers, 2018.
3. Carol A. Oatis, "The Mechanics and Pathomechanics of Human Movement", Lippincott Williams and Wilkins, 2010.

Reference Books

1. Ozkaya, N, Leger, D, Goldsheyder, D, Nordin, M, "Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation", 4th edition. Springer International Publishing, 2017.
2. Donald R. Peterson and Joseph D. Bronzino," Biomechanics: principles and applications", third edition. CRC Press, 2011.
3. Ray W. Ogden, "Biomechanics of Soft Tissue in Cardiovascular Systems", Springer Vienna, 2014.

Web Resources

1. https://tinyurl.com/y9bm4f9q
2. https://tinyurl.com/y8osnq6d
3. https://tinyurl.com/y78y4cvy

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
2	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
3	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
4	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
5	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2

	L	T	P	C	Hrs
U19BMT53 **BIOMEDICAL INSTRUMENTATION**	3	0	0	3	45

Course Objectives

- To acquire knowledge in the basics of bio medical instrumentation
- To understand the different types of electrodes and its placement for various recordings
- To design bio amplifier for various physiological recording
- To learn the different measurement techniques for non-physiological parameters.
- Understand the design aspects of various assist and therapeutic devices

Course Outcomes

After completion of the course, students will be able to
CO1- Gain knowledge in electrodes and its functions
CO2- Illustrate different electrode placement for various physiological recordings
CO3- Design bio amplifier for various physiological recordings
CO4- Explain various techniques for non-electrical physiological measurements
CO5- Investigate various assist and therapeutic devices

UNIT I BIOPOTENTIAL ELECTRODES   (9 Hrs)

Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes – Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes, Needle electrodes

UNITII BIOPOTENTIAL MEASUREMENTS   (9 Hrs)

Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven 's triangle, standard 12 lead system, Principles of vector cardiography.EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of ERG, EOG and EGG

UNIT III SIGNAL CONDITIONING CIRCUITS   (9 Hrs)

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS   (9 Hrs)

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT V ASSIST DEVICES AND RESPIRATORY DEVICES   (9 Hrs)

Pacemakers - Defibrillators – Audiometry – Hearing aid, Ventilators, Spirometer, Lung Volume and capacities, Pneumo tachometers: different types

Text Books

1. R. S. Khandpur, "Biomedical Instrumentation Technology and Applications", McGraw-Hill Professional, 2014.
2. Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd edition. PHI, 2008.
3. Raja Rao, C and Guha S.K, "Principles of Medical Electronics and Biomedical Instrumentation", Orient Longman Publishers, 2001

Reference Books

1. R. Anandanatarajan, "Biomedical Instrumentation", 2nd edition, PHI Learning, 2016.
2. Andrew G. Webb, "Principles of Biomedical Instrumentation", Cambridge University Press, 2018.
3. John G. Webster, "Medical Instrumentation: Application and Design", 4th edition. John Wiley and Sons, New York, 2010.
4. A.K. Sawhney, "A Course in Electrical and Electronic measurements and Instruments", DhanpatRai and Sons, 2015
5. M. Arumugam, "Biomedical Instrumentation",Anuradha Agencies Publishers, 2002.

Web Resources

1. https://apm.iitm.ac.in/biomedical/sai/
2. https://www.youtube.com/watch?v=iK-6q4nnmtA
3. https://www.youtube.com/watch?v=8m8yNSaCMpg

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	2	-	-	-	-	-	2	2	-	2
2	3	3	2	2	2	2	-	-	-	-	-	2	2	-	2
3	3	3	2	2	2	2	-	-	-	-	-	2	1	-	2
4	3	3	2	2	2	2	-	-	-	-	-	2	1	-	2
5	3	3	2	2	2	2	-	-	-	-	-	2	1	-	2

	L	T	P	C	Hrs
U19BMT61 **DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS**	3	0	0	3	45

Course Objectives

- To impart knowledge on Ultrasonic Techniques.
- To describe patient monitoring and Biotelemetry equipment's.
- To make student understand Diathermy.
- To introduce special diagnostic techniques.
- To study patient safety.

Course Outcomes

After completion of the course, students shall have ability to,

CO1 - Understand Ultrasonic Techniques.
CO2 - Describe the patient monitoring and Biotelemetry.
CO3 - Learn the basics of Diathermy.
CO4 - Gain knowledge on special diagnostic techniques.
CO5 – Acquire knowledge in patients safely.

UNIT I ULTRASONIC TECHNIQUES   (9Hrs)

Diagnosis: Basic principles of Echo technique, display techniques A, B and M mode, Application of ultrasound as diagnostic tool – Echocardiogram, abdomen, obstetrics and gynaecology.

UNIT II PATIENT MONITORING AND BIOTELEMETRY   (9Hrs)

ICU/CCU Equipment's, Infusion pumps, bed side monitors, Central consoling controls. Radio Telemetry (single, multi), Portable and Landline Telemetry unit, Applications in ECG and EEG Transmission.

UNIT III DIATHERMY   (9Hrs)

IR and UV lamp and its application. Thermography – Recording and clinical application. Short wave diathermy, ultrasonic diathermy, Microwave diathermy, Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level.

UNIT IV SPECIAL DIAGNOSTIC TECHNIQUES   (9Hrs)

Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, electronic monitoring of functional parameter. Haemo Dialyzer unit, Lithotripsy, Principles of Cryogenic technique and application, Endoscopy, Laparoscopy.

UNIT V PATIENT SAFETY   (9Hrs)

Physiological effects of electricity – important susceptibility parameters – Macro shock – Micro shock hazards – Patient's electrical environment – Isolated Power system – Conductive surfaces – Electrical safety codes and standards – Basic Approaches to protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system

Text Books

1. Leslie Cromwell," Biomedical Instrumentation and Measurement", Second edition. Prentice Hall, 2015.
2. John G. Webster, "Medical Instrumentation Application and Design", Fifth edition, John Willey and sons, 2020.

3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Third edition, John Willey and sons, New York, 2003.

Reference Books

1.Khandpur,R.S,"Handbook of Biomedical Instrumentation ",Second Edition. Tata Mc Graw Hill, 2003

2.Rick Krohn, David Metcalf, Patricia Salber, "Health-e Everything: Wearables and The Internet of Things for Health, 2013.

3. Principles of Applied Biomedical Instrumentation L.A Geddas and L.E.Baker – 2004.

4.John G. Webster, "Medical Instrumentation: Application and Design", 4th edition. John Wiley and Sons, New York, 2010.

5.Samuel A. Fricker, Christoph Thümmler , Anastasius Gavras, "Requirements Engineering For Digital Health", Springer, 2015

Web Resources

1. https://www.nap.edu/read/21794/chapter/7
2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapeutic-systems.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	2	-	-	-	-	-	2	2	-	2
2	3	3	2	2	2	2	-	-	-	-	-	2	2	-	2
3	3	3	2	2	2	2	-	-	-	-	-	2	1	-	2
4	3	3	2	2	2	2	-	-	-	-	-	2	1	-	2
5	3	3	2	2	2	2	-	-	-	-	-	2	1	-	2

		L	T	P	C	Hrs
U19BMP62	**MEDICAL INTERNET OF THINGS LABORATORY**	0	0	2	1	30

Course Objectives

- To study Embedded programming, REST API and its commands.
- To develop systems like human fall detection, ECG system, surgical automation system.
- To introduce students to Thingspeak cloud.
- To integrate Raspberry pi and Thingspeak.
- To train students develop smart and automated systems.

Course Outcomes

After completion of the course, students shall have ability to,
CO1 – Familiarize with Embedded applications.
CO2 - Develop human fall detection, ECG system, surgical automation system.
CO3 - Work with Thing speak cloud.
CO4 - Integrate Raspberry pi and Thingspeak.
CO5 - Develop smart and automated systems.

List of Experiments

Conduct the Experiments using Arduino / Raspberry pi

1. Study of Raspberry pi, UART Communication
2. Study of REST and HTTP protocols, PUSH, PUT and GET commands, Linux CLI, Raspbian OS
3. Human Fall detection system using an Accelerometer sensor
4. Study of ECG system, which gets Heart beat sensor reading from different modes
5. Surgical automation system, which runs 2 motor using a Servo Motor based inputs given on console in pc and operates the motor operation.
6. Baby Monitoring system, to prevent Sudden Infant Death Syndrome
7. Clinical Management system consisting of RFIDs tags and cards which constantly uploads inpatient and outpatient details to Thinkspeak server
8. Smart Ventilator system to control through various modes of ventilator connected to Thinkspeak server, and remotely operated.
9. Waste Management system consisting of moisture and Gas sensor connected to Thinkspeak server thus remotely indicating the recycle process of medical waste
10. Smart watch system, to indicate and alert users of their routine works and also monitor the pulse and temperature readings and display it though LCD display attached to the watch through Thinkspeak server

Text Books

1. Hands-on Artificial Intelligence for IoT, Packet Publishing, 2019.
2. Smart Medical Data Sensing and IoT Systems Design in Healthcare, Business Science Reference, 1st edition, 2020.

Reference Books

1. Medical Big Data and Internet of Medical Things, CRC Press, 1st ed, 2018.
2. P. Venkata Krishna, Sasikumar Gurumorrthy, Mohammad S.Obaidat, Internet of Things and Personalized Healthcare systems, Springer, 1st ed, 2019.

Web Resources

1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/
2. https://www.digimat.in/nptel/courses/video/108105091/L01.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	2	1	3	2	1	1	3	3	2	1
2	3	3	3	3	3	2	1	3	2	1	1	3	3	2	1
3	3	3	3	3	3	2	1	3	2	1	1	3	3	2	1
4	3	3	3	3	3	2	1	3	2	1	1	3	3	2	1
5	3	3	3	3	3	2	1	3	2	1	1	3	3	2	1

U19BME52	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn about the basic concepts of environmental biotechnology.
- To understand about the biodegradation and bioremediation.
- To understand the scientific and engineering principles of microbiological treatment technologies to clean up contaminated environments.
- To replace of conventional treatment methodologies by using biocatalyst and bioreactors
- To learn about various fermentation process in agricultural, food and beverage industries

Course Outcomes

After completion of the course, the students will be able to

CO1 -Understand about the role of various environmental pollutants,
CO2 -Understand about the biodegrading and bioremediation modules and its functions.
CO3 -Understand the principles of microbiological treatment technologies to clean up contaminated environments.
CO4 -Replace of conventional treatment methodologies by using different bioreactors
CO5 -Understand the various bioproducts production and composting technology.

UNIT I INTRODUCTION TO ENVIRONMENTAL BIOTECHNOLOGY   (9Hrs)

Biotechnology in the reduction of carbon dioxide emission- Microbial flora of soil - Microbial treatment of heavy Metal – bioleaching, bioaccumulation, biosorption and bioprecipitation of heavy metals - Soil,water and air - sources and effects - Removal of Pollutants.

UNIT II BIODEGRADATION AND BIOREMEDIATION   (9Hrs)

Aerobic degradation of aliphatic and aromatics compounds - Anaerobic degradation of aromatic compounds - Biodegradation of herbicides and pesticides - Remediation Technologies - Bioventing, biosparging and bioslurping, phytoremediation - Biodesulphurization of coal and oil - microbial treatment of oil pollution.

UNIT III MICROBIAL TREATMENT OF WASTE AND WASTE WATER   (9Hrs)

Biological treatment of anaerobic and aerobic- methanogenesis, methanogenic, acetogenic- Use of genetically engineered organisms - Biotechnological Processes in waste - water treatment; Applications include treatment of municipal and industrial wastewaters.

UNIT IV BIOCATALYSTS AND BIOREACTORS   (9Hrs)

Enzymes isolation, whole cell systems - Biocatalytic Application - Advantages & Disadvantages- Design of activated sludge process and anaerobic digestion system - Trickling Filter - Rotating biological contactors - Fluidized bed reactor - Up-flow anaerobic sludge blanket reactor (UASB) - High-rate anaerobic wastewater treatment.

UNIT V BIOPRODUCTS AND RENEWABLE SOURCES   (9Hrs)

Biofertilizers – Biopesticides - Biofuel production – Bioethanol – Biohydrogen – Biodiesel - Bioplastics and biopolymers - Composting technologies, composting systems, compost quality.

TEXT BOOKS:

1. Bhattacharya B. C. and Banerjee R, " Environmental Biotechnology", Oxford University Press, 2017.
2. Jordening H. J. and Winter J., "Environmental Biotechnology: Concepts and Application", Wiley , 2015.
3. Bruce Rittmann and Perry McCarty," Environmental Biotechnology", McGraw-Hill, 2011.

REFERENCE BOOKS:

1. W.D. Grant & P.E. Long, Blakie, Environmental Microbiology, Springer, 2019.
2. H. Polasa,Microbial Gene Technology, South Asian Publishers, 2011.
3. D. L. Wise, Biotreatment Systems.CRC Press, 2010.

Web Resources

1. https://en.wikipedia.org/wiki/Environmental_biotechnology
2. http://dbtindia.gov.in/schemes-programmes/research-development/energy-environment-and-bio-resource-based-applications-0
3. https://www.hindawi.com/journals/scientifica/si/269412/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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1	2	2	3	2	2	2	-	-	-	-	-	2	2	-	-
2	2	2	2	2	2	2	-	-	-	-	-	2	2	-	-
3	2	2	2	2	2	2	-	-	-	-	-	2	1	-	-
4	2	2	2	2	2	2	-	-	-	-	-	2	1	-	-
5	2	2	2	2	2	2	-	-	-	-	-	2	1	-	-

Annexure -IV

Regulations 2019

EMPLOYABILITY ENHANCEMENT COURSES – (A). CERTIFICATION COURSES

Sl. No.	Course Code	Course Title
1	U19BMCX1	Android Medical app development
2	U19BMCX2	Data Science using R
3	U19BMCX3	Design of Biomedical Devices and Systems
4	U19BMCX4	Embedded system using Arduino
5	U19BMCX5	Fuzzy Logic and Neural Networks
6	U19BMCX6	Introduction to C++ Programming
7	U19BMCX7	Machine Learning for medical Diagnosis
8	U19BMCX8	Medical Robotics
9	U19BMCX9	Python Programming

Regulations 2020

EMPLOYABILITY ENHANCEMENT COURSES – (A). CERTIFICATION COURSES

Sl. No.	Course Code	Course Title
1	U20BMCX01	3ds Max
2	U20BMCX02	Advance Structural Analysis of Building using ETABS
3	U20BMCX03	Advanced Java Programming
4	U20BMCX04	Advanced Python Programming
5	U20BMCX05	Analog System Lab Kit
6	U20BMCX06	Android Medical App Development
7	U20BMCX07	Android Programming
8	U20BMCX08	ANSYS -Multiphysics
9	U20BMCX09	Artificial Intelligence
10	U20BMCX10	Artificial Intelligence and Edge Computing
11	U20BMCX11	Artificial Intelligence in Medicines
12	U20BMCX12	AutoCAD for Architecture

13	U20BMCX13	AutoCAD for Civil
14	U20BMCX14	AutoCAD for Electrical
15	U20BMCX15	AutoCAD for Mechanical
16	U20BMCX16	Azure DevOps
17	U20BMCX17	Basic Course on ePLAN
18	U20BMCX18	Basic Electro Pneumatics
19	U20BMCX19	Basic Hydraulics
20	U20BMCX20	Bio Signal and Image Processing Development System
21	U20BMCX21	Blockchain
22	U20BMCX22	Bridge Analysis
23	U20BMCX23	Building Analysis and Construction Management
24	U20BMCX24	Building Design and Analysis Using AECO Sim Building Designer
25	U20BMCX25	CATIA
26	U20BMCX26	CCNA (Routing and Switching)
27	U20BMCX27	CCNA (Wireless)
28	U20BMCX28	Cloud Computing
29	U20BMCX29	Computer Programming for Medical Equipments
30	U20BMCX30	Corel Draw
31	U20BMCX31	Creo (Modeling and Simulation)
32	U20BMCX32	Cyber Security
33	U20BMCX33	Data Science and Data Analytics
34	U20BMCX34	Data Science using Python
35	U20BMCX35	Data Science using R
36	U20BMCX36	Deep Learning
37	U20BMCX37	Design and Documentation using ePLAN Electric P8
38	U20BMCX38	Design of Biomedical Devices and Systems
39	U20BMCX39	Digital Marketing
40	U20BMCX40	Digital Signal Processing Development System
41	U20BMCX41	DigSILENT Power Factory
42	U20BMCX42	Electro Hydraulic Automation with PLC
43	U20BMCX43	Embedded System using Arduino
44	U20BMCX44	Embedded System using C
45	U20BMCX45	Embedded System with IoT
46	U20BMCX46	ePLAN Data Portal
47	U20BMCX47	ePLAN Electric P8
48	U20BMCX48	ePLAN Fluid
49	U20BMCX49	ePLAN PPE
50	U20BMCX50	Fusion 360
51	U20BMCX51	Fuzzy Logic and Neural Networks
52	U20BMCX52	Google Analytics
53	U20BMCX53	Hydraulic Automation
54	U20BMCX54	Industrial Automation
55	U20BMCX55	Industry 4.0

56	U20BMCX56	Internet of Things
57	U20BMCX57	Introduction to C Programming
58	U20BMCX58	Introduction to C++ Programming
59	U20BMCX59	IoT using Python
60	U20BMCX60	Java Programming
61	U20BMCX61	Machine Learning
62	U20BMCX62	Machine Learning and Deep Learning
63	U20BMCX63	Machine Learning for Medical Diagnosis
64	U20BMCX64	Mechatronics
65	U20BMCX65	Medical Robotics
66	U20BMCX66	Microsoft Dynamics 365 ERP for HR , Marketing and Finance
67	U20BMCX67	Mobile Edge Computing
68	U20BMCX68	Modeling and Visualization using Micro station
69	U20BMCX69	MX Road
70	U20BMCX70	Photoshop
71	U20BMCX71	PLC
72	U20BMCX72	Pneumatics Automation
73	U20BMCX73	Project Management
74	U20BMCX74	Python Programming
75	U20BMCX75	Revit Architecture
76	U20BMCX76	Revit Inventor
77	U20BMCX77	Revit MEP
78	U20BMCX78	Robotics
79	U20BMCX79	Search Engine Optimization
80	U20BMCX80	Software Testing
81	U20BMCX81	Solar and Smart Energy System with IoT
82	U20BMCX82	Solid Works
83	U20BMCX83	Solid Works with Electrical Schematics
84	U20BMCX84	Speech Processing
85	U20BMCX85	STAAD PRO V8i
86	U20BMCX86	Structural Design and Analysis using Bentley
87	U20BMCX87	Total Station
88	U20BMCX88	Video and Image Processing Development System
89	U20BMCX89	VLSI Design
90	U20BMCX90	Web Programming - I
91	U20BMCX91	Web Programming - II

DEPARTMENT OF BIOMEDICAL ENGINEERING

DEPARTMENT VISION AND MISSION

Vision

To provide quality education in Biomedical Engineering focused on promoting continuous enrichment in the relevant research field and innovations in medical diagnosis for human health care.

Mission

M1: Medical science Engineering

To provide quality biomedical engineering education that integrates engineering principles with biomedical sciences

M2: Research and Development

To develop biomedical engineers to apply innovative strategies for the design and development of medical equipments

M3: Industrial Intelligence

To incorporate novel technologies towards the healthcare industrial needs for medical applications and to become an entrepreneur.

M4: Ethical Responsibilities

To impart the desirable skill sets to become a globally competent ethical professionals.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Professional Skills

To become outstanding professionals to demonstrate their skills in solving challenges for healthcare diagnosis

PEO2: Higher Education and Research

Work successfully in multi-disciplinary environments or pursue higher studies

PEO3: Entrepreneurial Competencies

To address the challenges in biomedical engineering that supports employment and entrepreneurship to serve the society.

PEO4: Leadership Quality

To enable the graduates to exhibit leadership, make decisions with ethical responsibilities

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Knowledge in Biomedical Engineering

Comprehending fundamental concepts in biomedical engineering to meet the Emerging trends

PSO2: Problem Solving in Medical Diagnosis

Apply Biosignal and Image processing techniques to solve real time problems in medical field

PSO3: Troubleshooting and Design of Medical Equipment's

Troubleshoot the faulty medical Equipment's used in health care industry.

Department of Biomedical Engineering

Panel of Examiners

S. No.	Name of the Examiner	Highest Qualification	Specialization	Experience (in Years)	Communication Address	Email ID with Mobile Number
1.	Dr.P.Shanmugaraja	Ph.D	Medical Electronics	26	Professor, Department of Electronics and Instrumentation, Annamalai University, Chidambaram	psraja70@gmail.com 9443275120
2.	Dr S Bagyaraj	Ph.D	Biomedical Instrumentation	12	Associate Professor, Department of Biomedical Engineering SSN College of Engineering, Old Mahabalipuram Rd, OMR, Kalavakkam, Chennai	bagyarajs@ssn.edu.in 9841982250
3.	Dr. B.Hema Kumar	Ph.D	Biomedical Engineering	21	Associate Professor, Department of Electronics and Instrumentation Pondicherry Engineering College, Puducherry	hemakumarb@pec.edu 9944929804
4.	Dr.S.J.Thiruvengadam	Ph.D	Signal processing Wireless communication	25	Professor, Department of ECE, Thiagarajar College of Engineering, Thiruparankundram, Madurai Tamil Nadu 625015	sjtece@tce.edu 9865079402

5.	Dr.V.Janakiraman	Ph.D	VLSI, Signal processing	20	Professor Department of Electronics and Communication Engineering Dhanalakshmi Srinivasan College of Engineering and Technology, East Coast Road, Mallapuram, Chennai, Tamil Nadu 603104	vjramece@gmail.co 9444255029, 7358374100
6.	Dr. V.Kamatchi Sundari	Ph.D	Image Processing	22	Professor Department of Electronics Engineering, SRM Institute of Science and Technology, Chennai,	vkamatchisundari@gmail.com Phone : 9952041393
7.	Dr. P. Vijayakumar	Ph.D	Wireless Communication, Network Security	13	Associate Professor, Department of Electronics Engineering, Vellore Institute of Technology, Kelambakkam - Vandalur Rd, Rajan Nagar, Chennai, Tamil Nadu 600127	vijayrgcet@gmail.com 9894727271
8.	Dr Jobin Christ	Ph.D	Biomedical, signal processing	24	Professor, Department of Biomedical Engineering, Rajalakshmi Engineering College, Rajalakshmi Nagar, Thandalam, Chennai.- 602105	jobinchrist@gmail.com jobinchrist.mc@rajalakshmi.edu.in 9842666844
9.	Dr.M.Vijaya karthik	Ph.D	Electronics and Instrumentation	18	Associate Professor, Department of Electronics and Instrumentation, Madras Institute of Technology, Chennai	vijayakarthick@yahoo.co.in 9976995692

Department of BME – Second BoS Meeting

10.	Dr. J. Mohan	Ph.D	Bio-medical Signal and Image Processing	18	Valliammai Engineering college, National Highway 45, Potheri, SRM Nagar, Kattankulathur, Tamil Nadu 603204	mohanjece@valliammai.co.in, 9840791532
11.	Dr.D.Kathirvelu	Ph.D	Physiology, Image Processing	21	Associate Professor , Department of Biomedical Engineering Kattankulathur Campus, SRM Institute of Science and Technology, Chennai	:kathir297@gmail.com 9443283639
12.	Dr.S.Sathish Babu	Ph.D	Biosignals and Systems	26	Associate Professor, Department of Electronics and Communication, Thanthai Periyar Government Institute of Technology, Vellore.	sathish3575@gmail.com 9894235162
13	Dr.Ramji Kalidoss	Ph.D	Human Anatomy and Physiology	28	Associate Professor, Department of Biomedical Engineering Bharath Institute of Higher Education and Research, Chennai	ramji.sat@gmail.com 9840959835
14	Dr. P. Thirunavukkarasu	Ph.D	Biotechnology	12	Assistant Professor Cancer Biology &Animal tissue culture Department of Biotechnology Dr. MGR Educational and Research University Maduravoyal, Chennai-600095	ppthirunacas@gmail.com. 9952172249
15	Dr.M.Phemina Selvi	Ph.D	ECE	26	Assistant professor, Department of Electronics and Communication Engineering,	vm.femina@gmail.com 9994267707

					University College of Engineering, Villupuram	
16	Dr. R. Sandanalakshmi	Ph.D	ECE	22	Assistant Professor Department of Electronics and Communication Engineering, Pondicherry Engineering College, Puducherry	sandanalakshmi@pec.edu 9790972173
17	Dr. N. M. Hariharan	Ph.D	Biotechnology	12	Professor and Head, Department of Biotechnology, Sree Sastha Institute of Engineering and Technology, Chennai - 600 123.	biotechhod@ssiet.in 904062599 .
18	Dr. C. Siva	Ph.D	Nano-technology	12	Assistant Professor, Department of Nano science and Technology, SRM Institute of Science and Technology Kattankulathur - 603 203, Tamil Nadu, India	chumshiva@gmail.com. 9944567367
19	Dr. Ashokan	Ph.D	Biomedical Engineering	10	Professor and Head, Department of Biomedical Engineering Kongunadu College of Engineering and Technology, 621215.	hodbme@kongunadu.ac.in 8012505054
20	Dr.Srigitha.S. Nath	Ph.D	Applied Electronics	22	Associate Professor, Department of Electronics and Communication Engineering Saveetha Engineering college, Thandalam, Chennai-602105	hod.ece@saveetha.ac.in 9840367678

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B.TECH.

BIOMEDICAL ENGINEERING

ACADEMIC REGULATIONS 2019
(R-2019)

CURRICULUM AND SYLLABI

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society

Mission

M1: Quality Education

To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation

To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues

M3: Employability and Entrepreneurship

To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society

DEPARTMENT VISION AND MISSION

Vision

To provide quality education in Biomedical Engineering focused on promoting continuous enrichment in the relevant research field and innovations in medical diagnosis for human health care.

Mission

M1: Medical science Engineering

To provide quality biomedical engineering education that integrates engineering principles with biomedical sciences

M2: Research and Development

To develop biomedical engineers to apply innovative strategies for the design and development of medical equipments

M3: Industrial Intelligence

To incorporate novel technologies towards the healthcare industrial needs for medical applications and to become an entrepreneur.

M4: Ethical Responsibilities

To impart the desirable skill sets to become a globally competent ethical professionals**.**

B.Tech. Biomedical Engineering

PROGRAM OUTCOMES (POs)

PO1: Engineering knowledge:

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis:

Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions:

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage:

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society:

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability:

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

PO8: Ethics:

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication:

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance:

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning:

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

B.Tech. Biomedical Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Professional Skills
To become outstanding professionals to demonstrate their skills in solving challenges for healthcare diagnosis

PEO2: Higher Education and Research
Work successfully in multi-disciplinary environments or pursue higher studies

PEO3: Entrepreneurial Competencies
To address the challenges in biomedical engineering that supports employment and entrepreneurship to serve the society.

PEO4: Leadership Quality
To enable the graduates to exhibit leadership, make decisions with ethical responsibilities

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Knowledge in Biomedical Engineering
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Apply Biosignal and Image processing techniques to solve real time problems in medical field

PSO3: Troubleshooting and Design of Medical Equipments
Troubleshoot the faulty medical Equipment's used in health care industry.

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

Sl.No	Course Category	Breakdown of Credits
1	Humanities and Social Sciences (HS)	9
2	Basic Sciences (BS)	38
3	Engineering Sciences (ES)	36
4	Professional Core (PC)	61
5	Professional Electives (PE)	18
6	Open Electives (OE)	9
7	Project work and Internship (PW)	12
8	Employability Enhancement Courses (EEC)*	-
9	Mandatory courses (MC)*	-
Total		**183**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl.No	AICTE Suggested Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences (HS)	4				3		1	1	9
2	Basic Sciences(BS)	16	12	3	3	4	-	-	-	38
3	Engineering Sciences (ES)	10	18	4	4	-	-	-	-	36
4	Professional Core (PC)	-	-	14	8	12	15	9	3	61
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	-	3	3	-	9
7	Project work (PW)	-	-	-	-	-	-	2	8	10
8	Internship (PW)	-	-	-	-	-	-	2	-	2
9	Employability Enhancement Courses (EEC) *	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC) *	-	-	-	-	-	-	-	-	-
Total		**30**	**30**	**21**	**21**	**22**	**21**	**20**	**18**	**183**

EEC and MC credits are not included for CGPA calculation

A. [signature]

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SI. No.	Course Code	Course Title	Category	Periods L	T	P	Credits	Max. Marks CAM	ESM	Total

SEMESTER – I

Theory

SI. No.	Course Code	Course Title	Category	L	T	P	Credits	CAM	ESM	Total
1	T101	Mathematics –I	BS	3	1	0	4	25	75	100
2	T102	Physics	BS	4	0	0	4	25	75	100
3	T103	Chemistry	BS	4	0	0	4	25	75	100
4	T110	Basic Civil and Mechanical Engineering	ES	4	0	0	4	25	75	100
5	T111	Engineering Mechanics	ES	3	1	0	4	25	75	100
6	T112	Communicative English	HS	4	0	0	4	25	75	100
Practical										
7	P104	Physics Laboratory	BS	0	0	3	2	50	50	100
8	P105	Chemistry Laboratory	BS	0	0	3	2	50	50	100
9	P106	Workshop Practice	ES	0	0	3	2	50	50	100
							30	300	600	900

SEMESTER – II

Theory

SI. No.	Course Code	Course Title	Category	L	T	P	Credits	CAM	ESM	Total
1	T107	Mathematics –II	BS	3	1	0	4	25	75	100
2	T108	Material Science	BS	4	0	0	4	25	75	100
3	T109	Environmental Science	BS	4	0	0	4	25	75	100
4	T104	Basic Electrical and Electronics Engineering	ES	3	1	0	4	25	75	100
5	T105	Engineering Thermodynamics	ES	3	1	0	4	25	75	100
6	T106	Computer Programming	ES	3	1	0	4	25	75	100
Practical										
7	P101	Computer Programming Laboratory	ES	0	0	3	2	50	50	100
8	P102	Engineering Graphics	ES	0	0	3	2	50	50	100
9	P103	Basic Electrical & Electronics Laboratory	ES	0	0	3	2	50	50	100
Mandatory Course										
11	P107	NCC / NSS *	MC	-	-	-	-	-	-	-
							30	300	600	900

* To be completed in I and II semesters, under Pass / Fail option only and not counted for CGPA calculation

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SI. No.	Course Code	Course Title	Category	L	T	P	Credits	CAM	ESM	Total
SEMESTER – III										
				Periods			Credits	Max. Marks		
Theory										
1	U19BMT31	Numerical Methods	BS	2	2	0	3	25	75	100
2	U19BMT32	Data Structures	ES	3	0	0	3	25	75	100
3	U19BMT33	Electron Devices and Circuits	PC	3	0	0	3	25	75	100
4	U19BMT34	Biosensors and Transducers	PC	3	0	0	3	25	75	100
5	U19BMT35	Human Anatomy and Physiology	PC	3	0	0	3	25	75	100
6	U19BMT36	Biosignals and systems	PC	2	2	0	3	25	75	100
Practical										
7	U19BMP31	Data Structures Laboratory	ES	0	0	2	1	50	50	100
8	U19BMP32	Electron Devices and Circuits Laboratory	PC	0	0	2	1	50	50	100
9	U19BMP33	Biosensors and Transducers Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19BMC3X	Certification Course – I **	EEC	0	0	4	-	100	-	100
11	U19BMS31	Skill Development Course 1: General Proficiency - I	EEC	0	0	2	-	100	-	100
12	U19BMS32	Skill Development Course 2 *	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19BMM31	Physical Education	MC	0	0	2	-	100	-	100
							21	700	600	1300

SI. No	Course Code	Course Title	Category	L	T	P	Credits	CAM	ESM	Total
SEMESTER – IV										
				Periods			Credits	Max. Marks		
Theory										
1	U19BMT41	Probability and Queuing Theory	BS	2	2	0	3	25	75	100
2	U19BMT42	Programming in Java	ES	3	0	0	3	25	75	100
3	U19BMT43	Biosignal Processing	PC	2	2	0	3	25	75	100
4	U19BMT44	Analog and Digital Integrated Circuits	PC	3	0	0	3	25	75	100
5	U19BME4X	Professional Elective –I #	PE	3	0	0	3	25	75	100
6	U19XXO4X	Open Elective-I $	OE	3	0	0	3	25	75	100
Practical										
7	U19BMP41	Programming in Java Laboratory	ES	0	0	2	1	50	50	100
8	U19BMP42	Biosignal Processing using MATLAB	PC	0	0	2	1	50	50	100
9	U19BMP43	Integrated Circuits Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19BMC4X	Certification Course – II **	EEC	0	0	4	-	100	-	100
11	U19BMS41	Skill Development Course 3: General Proficiency - II	EEC	0	0	2	-	100	-	100
12	U19BMS42	Skill Development Course 4 *	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19BMM41	Indian Constitution	MC	2	0	0	-	100	-	100
							21	700	600	1300

 # Professional Electives are to be selected from the list given in Annexure I
$ Open electives are to be selected from the list given in Annexure II
** Certification courses are to be selected from the list given in Annexure III
* Skill Development Courses (2 and 4) are to be selected from the list given in Annexure IV

SEMESTER – V										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19BMT51	Bio Statistics	BS	2	2	0	3	25	75	100
2	U19BMT52	Biomechanics	PC	3	0	0	3	25	75	100
3	U19BMT53	Biomedical Instrumentation	PC	3	0	0	3	25	75	100
4	U19BMT54	Biocontrol Systems	PC	2	2	0	3	25	75	100
5	U19BME5X	Professional Elective – II #	PE	3	0	0	3	25	75	100
6	U19XXO5X	Open Elective-II $	HS	3	0	0	3	25	75	100
Practical										
7	U19BMP51	Statistical Laboratory	BS	0	0	2	1	50	50	100
8	U19BMP52	Biomedical Instrumentation Laboratory	PC	0	0	2	1	50	50	100
9	U19BMP53	Computation Laboratory	PC	0	0	2	1	50	50	100
10	U19BMP54	Hospital Training	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U19BMC5X	Certification Course – III **	EEC	0	0	4	-	100	-	100
12	U19BMS51	Skill Development Course 5: Foreign Language / IELTS - I	EEC	0	0	2	-	100	-	100
13	U19BMS52	Skill Development Course 6: Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U19BMM51	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							22	750	650	1400

SEMESTER – VI										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19BMT61	Diagnostic and Therapeutic Equipment's	PC	3	0	0	3	25	75	100
2	U19BMT62	Medical Internet of Things	PC	3	0	0	3	25	75	100
3	U19BMT63	Microcontroller and Embedded Systems	PC	3	0	0	3	25	75	100
4	U19BMT64	Artificial Intelligence and Machine learning in Medicines	PC	2	2	0	3	25	75	100
5	U19BME6X	Professional Elective – III #	PE	3	0	0	3	25	75	100
6	U19XXO6X	Open Elective – III $	OE	3	0	0	3	25	75	100
Practical										
7	U19BMP61	Diagnostic and Therapeutic Equipment's Laboratory	PC	0	0	2	1	50	50	100
8	U19BMP62	Medical Internet of Things Laboratory	PC	0	0	2	1	50	50	100
9	U19BMP63	Microcontroller and Embedded Systems Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19BMC6X	Certification Course – IV **	EEC	0	0	4	-	100	-	100
11	U19BMS61	Skill Development Course 7: Foreign Language / IELTS - II	EEC	2	0	0	-	100	-	100

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12	U19BMS62	Skill Development Course 8: Technical Seminar	EEC	0	0	2	-	100	-	100
13	U19BMS63	Skill Development Course 9: NPTEL / MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U19BMM61	Professional Ethics	MC	2	0	0	-	100	-	100
							21	800	600	1400

				SEMESTER – VII						
Sl. No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	T	P		CAM	ESM	Total
Theory										
1	U19BMT71	Virtual Bioinstrumentation	PC	3	0	0	3	25	75	100
2	U19BMT72	Medical Image Processing	PC	3	0	0	3	25	75	100
3	U19BME7X	Professional Elective – IV #	PE	3	0	0	3	25	75	100
4	U19XXO7X	Open Elective – IV $	OE	3	0	0	3	25	75	100
Practical										
5	U19BMP71	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U19BMP72	Virtual Bioinstrumentation Laboratory	PC	0	0	2	1	50	50	100
7	U19BMP73	Medical Image Processing Laboratory	PC	0	0	2	1	50	50	100
8	U19BMP74	Comprehensive Viva-voce	PC	0	0	2	1	50	50	100
Project Work										
9	U19BMW71	Project Phase – I	PW	0	0	4	2	50	50	100
10	U19BMW72	Internship / Inplant Training	PW	0	0	0	2	100	-	100
							20	500	500	1000

				SEMESTER – VIII						
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	T	P		CAM	ESM	Total
Theory										
1	U19BMT81	Biomaterials and Artificial Organs	PC	3	0	0	3	25	75	100
2	U19BME8X	Professional Elective – V #	PE	3	0	0	3	25	75	100
3	U19BME8X	Professional Elective – VI #	PE	3	0	0	3	25	75	100
Practical										
4	U19BMP81	Entrepreneurship Management	HS	0	0	2	1	100	-	100
Project Work										
5	U19BMW81	Project phase – II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U19BMS81	Skill Development Course 10: NPTEL / MOOC -II	EEC	0	0	0	-	100	-	100
							18	315	285	600

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ANNEXURE – I
PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)

Sl. No.	Course Code	Course Title
1	U19BME41	Pathology and Microbiology
2	U19BME42	Hospital Equipment Safety and Management
3	U19BME43	Medical Physics
4	U19BME44	Communication Systems
5	U19BME45	VLSI Design

Professional Elective – II (Offered in Semester V)

Sl. No.	Course Code	Course Title
1	U19BME51	Biotelemetry and Telemedicine
2	U19BME52	Environmental Biotechnology
3	U19BME53	Laser and Fiber Optics in Medicine
4	U19BME54	Medical Informatics
5	U19BME55	Computers in Medicine

Professional Elective – III (Offered in Semester VI)

Sl. No.	Course Code	Course Title
1	U19BME61	Hospital Engineering and Information Systems
2	U19BME62	Transportation in Living Systems
3	U19BME63	Soft Computing Techniques
4	U19BME64	Medical Image Acquisition Techniques
5	U19BME65	Troubleshooting and Quality Control in Medical Equipment's

Professional Elective – IV (Offered in Semester VII)

Sl. No.	Course Code	Course Title
1	U19BME71	Physiological System Modelling
2	U19BME72	Pattern Recognition and Expert Systems in Medicine
3	U19BME73	Radiological Equipments
4	U19BME74	Acoustics and Optical Imaging
5	U19BME75	Dynamics of Biofluids

Professional Elective – V (Offered in Semester VIII)

Sl. No.	Course Code	Course Title
1	U19BME80	Nanotechnology in Medicine
2	U19BME81	Human Assist Devices

3	U19BME82	Neural Networks
4	U19BME83	Biometric Recoginzation system
5	U19BME84	Tissue Engineering

Professional Elective – VI (Offered in Semester VIII)

Sl. No.	Course Code	Course Title
1	U19BME85	Brain Computer Interface and Application
2	U19BME86	Rehabilitation Engineering
3	U19BME87	Bio MEMS
4	U19BME88	Wearable Systems
5	U19BME89	Biomedical Laser Instruments

Annexure – II
OPEN ELECTIVE COURSES

Sl. No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U19EEO41	Solar Photovoltaic Fundamentals and Applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics
2	U19EEO42	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, BME, IT, CSE
3	U19ECO41	Engineering Computation with MATLAB	ECE	ICE, EEE, MECH, CIVIL, BME, Mechatronics
4	U19ECO42	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO41	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U19CSO42	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19CSO43	Programming in JAVA	CSE	ECE, MECH, Mechatronics
8	U19ITO41	Database System: Design & Development	IT	EEE, ECE, ICE, BME
9	U19ITO42	R programming	IT	EEE, ECE, ICE, BME, MECH, Mechatronics
10	U19ICO41	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL
11	U19ICO42	Control System Engineering	ICE	CSE, IT, MECH
12	U19MEO41	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME
13	U19MEO42	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
14	U19MEO43	Power Plants for Electrical Engineering	MECH	EEE
15	U19CEO41	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics
16	U19CEO42	Building Science and Engineering	CIVIL	EEE, MECH, BME
17	U19BMO41	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
18	U19BMO42	Telemedicine	BME	EEE, ECE, CSE, IT, ICE
19	U19CCO41	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19CCO42	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics
Open Elective – II / Open Elective – III				
1	U19HSO51/ U19HSO61	Product Development and Design	MBA	**Common to B. Tech**

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2	U19HSO52/ U19HSO62	Intellectual Property and Rights	MBA	(Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME**)
3	U19HSO53/ U19HSO63	Marketing Management and Research	MBA	(Offered in Semester VI for **CSE, IT, MECH, Mechatronics**)
4	U19HSO54/ U19HSO64	Project Management for Engineers	MBA	
5	U19HSO55/ U19HSO65	Finance for Engineers	MBA	

Open Elective – II / Open Elective – III
(Offered in Semester V for **CSE, IT, MECH, Mechatronics**)
(Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME**)

1	U19EEO53/ U19EEO63	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
2	U19EEO54/ U19EEO64	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics
3	U19ECO53/ U19ECO63	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE MECH, BME, Mechatronics
4	U19ECO54/ U19ECO64	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U19CSO54/ U19CSO64	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
6	U19CSO55/ U19CSO65	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME
7	U19ITO53/ U19ITO63	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
8	U19ITO54/ U19ITO64	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
9	U19ITO55/ U19ITO65	Data Structures	IT	MECH
10	U19ICO53/ U19ICO63	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME
11	U19ICO54/ U19ICO64	Measurement and Instrumentation	ICE	ECE, Mechatronics
12	U19MEO54/ U19MEO64	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
13	U19MEO55/ U19MEO65	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
14	U19CEO53/ U19CEO63	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
15	U19CEO54/ U19CEO64	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
16	U19BMO53/ U19BMO63	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
17	U19BMO54/ U19BMO64	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, MECH, CIVIL , Mechatronics
18	U19CCO53/ U19CCO63	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
19	U19CCO54/ U19CCO64	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19ADO51/ U19ADO61	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL

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21	U19ADO52/ U19ADO62	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics
Open Elective – IV (Offered in Semester VII)				
1	U19EEO75	Hybrid and Electrical Vehicle	EEE	ECE, Mechatronics , MECH
2	U19EEO76	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
3	U19ECO75	IoT and its Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL
4	U19ECO76	Cellular and Mobile Communications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO76	Artificial Intelligence	CSE	EEE, ICE, CIVIL, MECH
6	U19CSO77	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19ITO76	Automation Techniques & Tools-DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, BME, Mechatronics
8	U19ITO77	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, BME
9	U19ICO75	Process Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, BME, Mechatronics.
10	U19ICO76	Virtual Instrumentation	ICE	EEE, ECE, MECH, Mechatronics
11	U19MEO76	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U19MEO77	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U19CEO75	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH
14	U19CEO76	Global Warming and Climate Change	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME
15	U19MCO71	Building Automation	Mechatronics	MECH, CIVIL
16	U19MCO72	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL
17	U19BMO75	Internet of Things for Healthcare	BME	EEE, ECE, ICE
18	U19BMO76	Telehealth Technology	BME	EEE, ECE, ICE
19	U19CCO75	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME,
20	U19CCO76	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME,
21	U19ADO73	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics
22	U19ADO74	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME

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Annexure - III
EMPLOYABILITY ENHANCEMENT COURSES – (A). CERTIFICATION COURSES

Sl. No.	Course Code	Course Title
1	U19BMCX1	Android Medical app development
2	U19BMCX2	Data Science using R
3	U19BMCX3	Design of Biomedical Devices and Systems
4	U19BMCX4	Embedded system using Arduino
5	U19BMCX5	Fuzzy Logic and Neural Networks
6	U19BMCX6	Introduction to C++ Programming
7	U19BMCX7	Machine Learning for medical Diagnosis
8	U19BMCX8	Medical Robotics
9	U19BMCX9	Python Programming

Annexure - IV
EMPLOYABILITY ENHANCEMENT COURSES – (B). SKILL DEVELOPMENT COURSES

Sl. No.	Course Code	Course Title
1	U19BMS31	Skill Development Course 1 : General Proficiency - I
2	U19BMS32	Skill Development Course 2 *
		1) PowerPoint Presentation Design and Animation
		2) Masters in Microsoft Excel
		3) Microsoft Word Documentation
3	U19BMS41	Skill Development Course 3 : General Proficiency - II
4	U19BMS42	Skill Development Course 4 *
		1) Trouble Shooting of Medical Instruments
		2) PCB Board Designing
		3) Testing of Electronic and Medical Devices
5	U19BMS51	Skill Development Course 5 : Foreign Language/ IELTS -I
6	U19BMS52	Skill Development Course 6 : Presentation Skills using ICT
7	U19BMS61	Skill Development Course 7 : Foreign Language/ IELTS - II
8	U19BMS62	Skill Development Course 8 : Technical Seminar
9	U19BMS63	Skill Development Course 9 : NPTEL/MOOC - I
10	U19BMS81	Skill Development Course 10 : NPTEL/MOOC-II

Choose any one skill development course in the list for SDC 2 and SDC 4

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T101	**MATHEMATICS - I**	**L**	**T**	**P**	**C**	**Hrs**
	(Common to all branches)	**3**	**1**	**0**	**4**	**60**

Course Objectives
- To introduce the idea of applying calculus concepts to problems in Engineering.
- To understand the concept of partial differentiation
- To develop logical thinking and analytic skills in evaluating multiple integrals.
- To introduce mathematical tools to solve first order differential equations.
- To learn linear differential equations of higher order with constant coefficients.

Course Outcomes
After completion of the course, the students will be able to
CO1 – Understand the concept of curvature. **(K2)**
CO2 – Solve different types of partial differential equation. **(K3)**
CO3 – Understand the concept of double and triple integrals. **(K2)**
CO4 – Solve differential equations**. (K3)**
CO5 – Solve higher order differential equations. **(K3)**

UNIT I CALCULUS   (12 Hrs)
Curvature, radius of curvature, evolutes and involutes. Beta and Gamma functions and their properties.

UNIT II FUNCTIONS OF SEVERAL VARIABLES   (12 Hrs)
Partial derivatives, Total derivatives, Differentiation of implicit functions, Change of Variables, Jacobians and their properties, Taylor's series for functions of two variables, Maxima and minima, Lagrange's method of undetermined multipliers.

UNIT III MULTIPLE INTEGRALS AND APPLICATIONS   (12 Hrs)
Multiple Integrals, change of order of integration and change of variables in double integrals (Cartesian to polar). Applications: Areas by double integration and volumes by triple integration (Cartesian and polar).

UNIT IV DIFFERENTIAL EQUATIONS   (12 Hrs)
Exact equations, First order linear equations, Bernoulli's equation, orthogonal Trajectories, growth, decay and geometrical applications. Equations not of first degree: Equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT V DIFFERENTIAL EQUATIONS (Higher order)   (12 Hrs)
Linear differential equations of higher order - with constant coefficients, the operator D, Euler's linear equation of higher order with variable coefficients, simultaneous linear Differential equations, solution by Variation of parameters method simple application to Electric circuits.

Text Books
1. Venkataraman M.K, Engineering Mathematics-First year, National Publishing Company, Chennai, 2010
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41st Edition, 2011.

Reference Books
1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Kandasamy P. et al, Engineering Mathematics, Vol.1 & 2, S. Chand & Co., New Delhi.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi, 8th Edition.
5. Bali N.P and Goyal M., Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010.

Web References

1. https://www.youtube.com/watch?v=rAof9Ld5sOg
2. https://nptel.ac.in/courses/111/104/111104092/
3. https://nptel.ac.in/courses/111/107/111107108/
4. https://www.youtube.com/watch?v=BJ_0FURo9RE
5. https://www.youtube.com/watch?v=p_di4Zn4wz4

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	1	-	-	-	-	1	3	2	-
2	3	2	1	1	-	1	1	-	-	-	-	1	3	2	-
3	2	1	-	-	-	-	-	-	-	-	-	1	3	2	-
4	3	2	1	1	-	1	1	-	-	-	-	1	3	2	-
5	3	2	1	1	-	1	1	-	-	-	-	1	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

T102	**PHYSICS** (Common to all branches)	**L**	**T**	**P**	**C**	**Hrs**
		4	**0**	**0**	**4**	**45**

Course Objectives

- To understand the concepts of physics and its significant contributions in the advancement of technology and invention of new products that dramatically transformed modern-day society.
- To expose the students to different areas of physics which have direct relevance and applications to different Engineering disciplines
- To understand the concepts and applications of Ultrasonics, optics and some optical devices, Lasers and Fiber optics, Nuclear energy sources and wave mechanics

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the basic concepts of sound Engineering and ideas to get good audibility inside a hall. Also gain knowledge about the production, propagation, properties and application of ultrasonic waves. **(K2)**

CO2 - Interpret the different characteristic behavior of light waves with air, glass, lens, grating, prism etc., Gain adequate knowledge about the interference, diffraction and polarization phenomenon of light waves and their applications. **(K2)**

CO3 - Understand the principle mechanism of laser light; distinguish between ordinary light and laser light. Basic idea about the various laser sources. Also gain knowledge about the optical fibers and their importance in communication**. (K3)**

CO4 - Understand the basic concept of quantum mechanics, dual nature of matter, and importance of energy of electrons associated with the properties of the materials. Also able to calculate energy of electron in an energy level by solving Schrodinger's equation**. (K1)**

CO5 - Gain knowledge about the structure of nucleus its constituents, nature. Understanding the nuclear energy fission and fusion concepts. Basic ideas of nuclear reactors to produce energy. **(K3)**

UNIT I – ACOUSTICS & NDT   (9 Hrs)

Ultrasonics - Ultrasonic Waves Productions (Piezoelectric & Magnetostriction method) – Detections (Acoustic Grating) NDT applications – Ultrasonic Pulse Echo Method - Liquid Penetrant Method

Acoustics - Factors affecting Acoustic of Buildings (Reverberation, Loudness, Focusing, Echo, Echelon Effect and Resonance) and their Remedies - Sabine's formula for Reverberation Time – Doppler effect and its application to Radarrs.(elementary ideas)

UNIT II – OPTICS   (9 Hrs)

Interference - Air Wedge – Michelson's Interferometer - Wavelength Determination – Interference Filter – Antireflection Coatings Diffraction - Diffraction Grating – Dispersive power of grating - Resolving Power of Grating & Prism Polarisation Basic concepts of Double Refraction - Huygens Theory of Double Refraction- Quarter and Half Wave Plates – Specific Rotary Power – Laurent Half Shade Polarimeter

UNIT III – LASERS & FIBER OPTICS   (9 Hrs)

Lasers - Principles of Laser – Spontaneous and Stimulated Emissions - Einstein's Coefficients – Population Inversion and Laser Action – types of Optical resonators (qualitative ideas) – Types of Lasers - NdYAG, CO_2 laser, GaAs Laser-applications of lasers

Fiber Optics - Principle and Propagation of light in optical fiber – Numerical aperture and acceptance angle – Types of optical fibers (material, refractive index, mode)-applications to sensors and Fibre Optic Communication

UNIT IV – WAVE MECHANICS   (9 Hrs)

Matter Waves – de Broglie Wavelength – Uncertainty Principle – Schrödinger Wave Equation – Time Dependent – Time Independent – Application to Particle in a One Dimensional potential Box – Quantum Mechanical Tunneling – Tunnel Diode.

UNIT V – NUCLEAR ENERGY SOURCE   (9 Hrs)

General Properties of Nucleus (Size, Mass, Density, Charge) – Mass Defect – Binding Energy - Disintegration in fission –Nuclear Reactor: Materials Used in Nuclear Reactors. – PWR – BWR – FBTR. Nuclear fusion reactions for fusion reactors-D-D and D-T reactions, Basic principles of Nuclear Fusion reactors.

Text Books

1. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011(For units I to IV only)
2. Arthur Beiser, Concepts of Modern Physics, 6th Edition, TMH, New Delhi 2008.(For unit V only)

Reference Books

1. Ajoy Ghatak, Optics, 5th Edition TMH, New Delhi, 2012.
2. K. Thyagarajan and Ajoy Ghatak, Lasers Fundamentals and Applications, 2nd Edition, Springer 2010.
3. R. Murugesan, Modern Physics, S. Chand & Co, New Delhi 2006.
4. K.R.Nambiar, Lasers, New Age International, New Delhi, 2008.
5. Science of Engineering Materials, 2nd Edition, C.M. Srivastava and C. Srinivasan, New Age Int. (P) Ltd, New Delhi, 1997.
6. Avadhanulu M N, Engineering Physics, S. Chand & Co, 2009.

Web References

1. https://swayam.gov.in/nd1_noc20_ph15/preview
2. https://swayam.gov.in/nd1_noc20_ph22/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	3	-	-	-	-	-	-	-	1	3	1
2	3	3	2	2	3	-	-	-	-	-	-	-	1	2	2
3	3	3	2	3	3	-	-	-	-	-	-	-	2	2	2
4	3	3	3	3	2	-	-	-	-	-	-	-	-	-	-
5	3	3	3	1	3	-	-	-	-	-	-	-	2	3	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

		L	**T**	**P**	**C**	**Hrs**
T103	**CHEMISTRY** (Common to all branch)	**4**	**0**	**0**	**4**	**45**

Course Objectives

- Know the fundamental principles of Engineering Chemistry required solving engineering problems.
- Practical implementation of fundamental theory concepts.
- Introducing new techniques and latest information that motivates the students to bring out his or her views and work effectively.
- To enable the students understand the role of engineering materials such as polymers, energy production, electrical field basic concepts of material behavior and study the environmental applications in the field of engineering and technology
- To acquire knowledge of engineering materials and about fuels and batteries

Course Outcomes

After completion of the course, the students will be able to

CO1 – Understand the basic concept of hardness of water, the chemicals responsible for it, measurement of hardness, its disadvantages and its removal **(K2)**

CO2 – Understand the synthesis of various organic and inorganic polymer. **(K2)**

CO3 – Understand the application of the concept of oxidation and reduction reaction to various cells. **(K2)**

CO4 – Understand the application of electrochemistry in corrosion of metals and also about different types of corrosion control methods**. (K3)**

CO5 – Understand the concept of phase equilibrium and its application to different types of heterogeneous equilibrium system like eutectic alloys.**(K3)**

UNIT I – WATER (9 Hrs)

Hardness of water – units and calcium carbonate equivalent. Determination of hardness of water-EDTA method. Disadvantages of hard water –boiler scale and sludge, caustic embrittlement, priming & foaming and boiler corrosion. Water softening methods– internal & external conditioning–Lime-Soda process, Zeolite process and Ion-exchange process. Desalination–reverse osmosis & electrodialysis

UNIT II – POLYMER (9 Hrs)

Classification, types of polymerization reactions – mechanism of radical, ionic and Ziegler-Natta polymerizations. Polymer properties –chemical resistance, crystallinity and effect of temperature, Mn and Mw. Thermoplastics and thermosets. Preparation, properties and uses ofPVC, TEFLON, Nylons, Bakelite, Polyurithane, Rubbers– vulcanization, synthetic rubber, BuNa-S, BuNa-N, silicone and butyl rubber. Conducting polymers–classification and applications. Polymer composites–FRP–laminar composites. Moulding constituents of plastic, moulding techniques–compression, injection, transfer and extrusion moulding

UNIT III – ELECTROCHEMICAL CELLS (9 Hrs)

Galvaniccells,single electrode potential, standard electrode potential, electromotive series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes–hydrogen, calomel, Ag/AgCl& glass electrodes. Batteries– primary and secondary cells, Leclanche cell, Lead acid storage cell, Ni-Cd battery& alkaline battery. Fuelcells–H2-O2fuelcell

UNIT IV – CORROSION ANDITSCONTROL (9 Hrs)

Chemical & electrochemical corrosion–Galvanic, pitting, stress and concentration cell corrosion. Factors influencing corrosion – corrosion control methods – cathodic protection and corrosion inhibitors. Protectivecoating–typesofprotectivecoatings–metalliccoating–tinning and galvanizing, cladding, electroplating and anodizing.

UNIT V – PHASE RULE (9 Hrs)

Definition and derivation of phase rule. Application to one component system– water and sulphur systems. Thermalanalysis, condensed phase rule. Two component systems– Pb-Ag, Cu-Ni and Mg-Zn systems.

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Text Books
1. P.C. Jain and Monika Jain, Engineering Chemistry, DhanpatRai and Sons, New Delhi 15th Ed,2010.
2. B.Sivasankar (2008) , "Engineering Chemistry ", Tata McGraw Hill , India
3. Shaley Oberoi & Monica Malik (2009), "Engineering Chemistry made easy", Cengage Learning,   Delhi.
4. Engineering Chemistry by Rama Devi, VenkataRamana Reddy and Rath, Cengage learning, New Delhi. (2016)
5. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi (2015)

Reference Books
1. S. S. Dara, A Textbook of Engineering Chemistry, 11th Ed, S.Chand& Co., Ltd. New Delhi, 2008.
2. B. K. Sharma, Engineering Chemistry, 3rdedition Krishna Prakashan Media (P) Ltd., Meerut, 2001.
3. P. Kannan and A. Ravi Krishnan "Engineering Chemistry" Hi-Tech Sri Krishna Publications, Chennai, 9th Ed, 2009
4. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, Engineering Chemistry, 2ndEd. PHI Learning PVT., LTD, New Delhi, 2008
5. C.V.Agarwal , C.P.Naidu , "A text book of Engineering Chemistry", BS Publication , Hyderabad.

Web References
1. https://water.usgs.gov/edu/hardness.html
2. https://www.polymer-project.org/
3. www.materials.unsw.edu.au/tutorials/online-tutorials/corrosion
4. www.electrochem.org/redcat-blog/4-useful-electrochemistry-websites-2/
5. https://serc.carleton.edu/research_education/equilibria/phaserule.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	1	-	-	-	-	1	-	-	-
2	2	1	-	-	-	1	1	-	-	-	-	1	-	-	-
3	2	1	-	-	-	1	1	-	-	-	-	1	3	2	1
4	2	1	-	-	-	1	1	-	-	-	-	1	1	2	1
5	2	1	-	-	-	1	1	-	-	-	-	1	-	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

B.Tech. Biomedical Engineering

T110	**BASIC CIVIL AND MECHANICAL ENGINEERING** (Common to all branches)	L	T	P	C	Hrs
		4	0	0	4	45

Course Objectives

- To be able to differentiate the type of buildings according to national building code.
- To understand building components and their functions.
- Discuss the different types of roads, bridges and dams.
- To describe different types of combustion systems such as Internal and External Combustion systems
- To discuss various Energy Resources available for power generation.
- To explain the working of various different manufacturing process.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the basic concepts of different types of buildings and building materials. **(K3)**

CO2 - Learn various types of building components and their functions. **(K3)**

CO3 - Describe the importance of the basic infrastructure. **(K3)**

CO4 - Understand the classification of engines, low pressure Steam generators, its mounting and accessories**. (K2)**

CO5 - Apply the knowledge of thermal systems and equipment's in power plants and analyze the way of harnessing the renewable energies and its utilization. **(K3)**

CO6 - Understand the basic principles of machining, manufacturing and metal joining processes such as Lathe machine, Drilling, Grinding, Welding, green sand moulding foundry process. **(K2)**

PART – A CIVIL ENGINEERING

UNIT I BUILDINGS, BUILDING MATERIALS (8 Hrs)

Buildings-Definition-Classification according to NBC-plinth area, Floor area, carpet area, floor space index-construction materials-stone, brick , cement, cement-mortar, concrete, steel-their properties and uses.

UNIT II BUILDINGS AND THEIR COMPONENTS (8 Hrs)

Buildings: Various Components and their functions. Soils and their classification. Foundation: function and types. Masonry-function and types. Floors: definition and types of floors. Roofs: definition and types.

UNIT III BASIC INFRASTRUCTURE (7 Hrs)

Surveying: classification, general principles, types, Uses, instruments used. Roads- types: components, types and their advantage and disadvantages. Bridges: components and types of bridges. Dams: purpose, types of dams. Water supply- sources and quality requirements, need and principles of rainwater harvesting

PART- B MECHANICAL ENGINEERING

UNIT – IV INTERNAL AND EXTERNAL COMBUSTION SYSTEMS (7 Hrs)

IC engines – Classification – Working principles – Diesel and petrol engines: two stroke and four stroke engines – Merits and demerits. Steam generators (Boilers) – Classification – Constructional features (of only low pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications.

UNIT – V POWER GENERATION SYSTEMS (7 Hrs)

Conventional and Non-Conventional: Hydraulic – Thermal – Nuclear Power plants – Schemes and layouts (Description only) Solar – Wind – Geothermal – Wave – Tidal and Ocean Thermal Energy Conversion systems – Basic power plant schemes and layouts (Description only).

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UNIT – VI MANUFACTURING PROCESS   (8 Hrs)

Machines – Lathe – Drilling – Bending – Grinding – Shearing (Description only) Machine Process – Turning – Planning – Facing – Blanking – Drilling – Punching – Shearing – Bending – Drawing – Filling – Sawing – Grinding. Moulding and Metal Joining – Pattern making – Green and dry sand moulding – Arc and Gas welding – Brazing – Soldering (process description only).

Text Books

1. Natarajan, K V, Basic Civil Engineering, 11th edition, Dhanalakshmi publications Chennai, 2011.
2. Venugopal , K and Prabhu Raja, Basic Mechanical Engineering, Anuradha Publisher, 2012.
3. K.Pravin Kumar, Basic Mechanical Engineering, Pearson Publications, 2009.
4. Shanmugam G, Palanichamy MS, Basic Civil and Mechanical Engineering, 1st Edition, McGraw Hill Education, 2018.
5. R.Vaishnavi, M.Prabhakaran,V.Vijayan, Basic Civil and Mechanical Engineering, S. Chand Publisher, 2013

Reference Books

1. Purushothama Raj.P., Basic civil engineering, 3rd Edn., Dhanam Publications, Chennai, 2001
2. Rajput, R K, Engineering Materials, S Chand & Co. Ltd., New delhi, 2012.
3. Punmia, B.C., et. al., surveying, Vol-1, Laxmi publishers, New Delhi, 2012.
4. Punmia, B.C., et. al., Building Construction, Laxmi publishers, New Delhi, 2012
5. El. Wakil, M.M., Power Plant Technology, Mc Graw Hill Book Co., 1985.
6. Hajra Choudhry, et. al., Workshop Technology Vol I and II, Media promoters publishers Pvt. Ltd., Bombay, 2004.
7. Lindberg, R.A. Process and Materials of Manufacture, PHI, 1999.
8. H.N.Gupta, R.C. Gupta and Arun Mittal, Manufacturing Process, New Age Publications, 2001.
9. Nagpal, Power Plant Engineering, Khanna Publishers, Delhi, 1998.

Web References

1. https://nptel.ac.in/courses/112107291/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/lecture-notes/
4. https://nptel.ac.in/courses/105102088/
5. https://nptel.ac.in/courses/105104101/

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	3	1	1	2	1	-	1	2	1	3	-	-	-
2	3	1	3	1	1	2	1	-	1	2	1	3	-	-	-
3	3	1	3	1	1	2	1	-	1	2	1	3	-	-	-
4	3	2	1	-	-	1	2	-	-	-	-	3	3	2	1
5	3	2	2	2	2	2	2	-	-	-	-	3	3	2	1
6	3	2	2	2	2	2	2	-	-	-	-	3	3	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

T111	**ENGINEERING MECHANICS** (Common to all branches)	**L** **3**	**T** **1**	**P** **0**	**C** **4**	**Hrs** **60**

Course Objectives

- To understand the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions.
- To comprehend the effect of friction on equilibrium
- To analysis of trusses and friction
- To understand the laws of motion, the kinematics of motion and the interrelationship and to learn to write the dynamic equilibrium equation
- To emphasis the concepts through solved examples

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the concepts of Equilibrium of a body, Moment of a force and to convert multiple forces into a single resultant force **(K2)**

CO2 - Apply the principles of internal forces, support reactions on Trusses/beams and friction between two surfaces. **(K3)**

CO3 - Interpret the knowledge of Centroid and center of gravity for different sections to calculate the moment of inertia for sections. **(K3)**

CO4 - Analyze and compare the principle of conservative forces, conservation of energy and D'Alembert's principle **(K4)**

CO5 - Analyze and compare the kinematics and kinetics of rigid bodies.**(K4)**

UNIT I FUNDAMENTAL OF MECHANICS   (12 Hrs)

Basic Concepts Force System and Equilibrium, Definition of force, Moment and Couple, Principle of Transmissibility, Varignon's theorem, Resultant of force system – Concurrent and non concurrent coplanar forces, Condition of static equilibrium for coplanar force system, stability of equilibrium, applications in solving the problems on static equilibrium of bodies.

UNIT II PRACTICAL APPLICATION OF FORCE SYSTEM   (12 Hrs)

Structural member: Definition, degree of freedom, concept of free body diagrams, types of supports and reactions, types of loads, Analysis of trusses-method of joints, method of sections.
Friction: Introduction, Static dry friction, simple contact friction problems, ladders, wedges.

UNIT III PROPERTIES OF SURFACES   (12 Hrs)

Properties of sections – area, centroids of lines, areas and volumes, moment of inertia first moment of inertia, second moment of inertia and product of moment of inertia, polar moment of inertia, radius of gyration, mass moment of inertia.

UNIT IV   KINEMATICS AND KINETICS OF PARTICLES   (12 Hrs)

Equations of motion – Rectilinear motion, curvelinear motion, relative motion, D'Alembert's principle, work-Energy equation – conservative forces and principle of conservation of energy, Impulse – momentum, Impact – Direct central impact and oblique central impact

UNIT V   KINEMATICS AND KINETICS OF RIGID BODIES   (12 Hrs)

Plane motion, absolute motion, Relative motion, translating axes and rotating axes, work and energy, impulse and momentum

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Text Books

1. K Rajesekaran, S and Sankara Subramanian., G., Engineering Mechanics, Vikas Publishing House Private Ltd., 2002.
2. Dr.I.S.Gujral, "Engineering Mechanicas" second edition, Lakshmi Publication (P), Ltd., 2011.
3. Dr. Sadhu Singh, A Textbook Of Engineering Mechanics, SChand & company Pvt Ltd., 2013.

Reference Books

1. Palanichamy, M.S. Nagan, S., Engineering Mechanics – Statics & Dynamics, Tata McGraw-Hill, 2011.
2. Beer, F.P and Johnson Jr. E.R, Vector Mechanics for Engineers, Vol. 1 Statics and Vol.2 Dynamics, McGraw - Hill International Edition, 1997.
3. Bhavikatti,S.S and K.G. Rajashekarappa, Engineering Mechanics, New Age International (p) Ltd, New Delhi, 2010.
4. Arthur P. Boresi and Richard J. Schmidt, "Engineering Mechanics: Statics and Dynamics", Thomson Asia Private Limited, Singapore, 2010.
5. D.P.Sharma "Engineering Mechanics", Dorling Kindersley India Pvt. Ltd, New Delhi, 2010.

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2. http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR / Engineering mechanics / Table of Contents.html
3. https://nptel.ac.in/courses/112/106/112106286/
4. https://www.coursera.org/learn/engineering-mechanics-statics
5. https://nptel.ac.in/courses/122/104/122104014/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	3	-	-	-	-	-	-	-	1	1	-	-
2	3	2	2	3	-	-	-	-	-	-	-	1	1	-	-
3	3	2	2	3	-	-	-	-	-	-	-	1	1	-	-
4	3	2	2	3	-	-	-	-	-	-	-	1	1	-	-
5	3	2	2	3	-	-	-	-	-	-	-	1	1	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

	COMMUNICATIVE ENGLISH	**L**	**T**	**P**	**C**	**Hrs**
112	(Common to all branches)	**4**	**0**	**0**	**4**	**45**

Course Objectives
- To improve the LSRW skills of I B.Tech students
- To instil confidence and enable the students to communicate with ease
- To equip the students with the necessary skills and develop their language   prowess
- To sequence the thought of writing with cohesion and coherence
- To extend knowledge on varied aspects of business correspondence

Course Outcomes
After completion of the course, the students will be able to
CO1 - Procure holistic development of LSRW skills **(K2)**
CO2 - Gain efficacies to compete confidently in the interviews **(K3)**
CO3 - Effectively enhances the oral communication skills **(K3)**
CO4 - Select compile and synthesize information for written mode of communication **(K2)**
CO5 - Familiarize and Excels in different business correspondence in work place **(K3)**

UNIT – I   (9Hrs)
Basic Communication Theory: Importance of Communication – stages of Communication - modes of communication – barriers to communication – strategies for effective communication – Listening: Importance, types, barriers – Developing effective - listening skills.

UNIT – II   (9Hrs)
Comprehension and Analysis: Comprehension of technical and non-technical material – Skimming, scanning, inferring-Note making and extension of vocabulary, predicting and responding to context- Intensive Reading and Reviewing

UNIT – III   (9Hrs)
Writing: Effective sentences, cohesive writing, clarity and conciseness in writing – Introduction to Technical Writing – Better paragraphs, Definitions, Practice in Summary - Writing – Four modes of writing – Use of dictionaries, indices, library references – making - bibliographical entries with regard to sources from books, journals, internet etc.

UNIT – IV   (9Hrs)
Business Writing / Correspondence: Report writing – Memoranda – Notice – Instruction– Letters – Resumes – Job applications

UNIT – V   (9Hrs)
Oral Communication: Basics of phonetics – Presentation skills – Group Discussions – Dialogue writing – Short Extempore – Debates-Role Plays-Conversation Practice

Text Book
1. Ashraf M.Rizvi., Effective Technical Communication. Tata-McGraw, 2005.

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Reference Books

1. Robert J.Dixson. ,Complete Course in English, Prentice-Hall of India Pvt. Ltd., New Delhi,2006.
2. Boove, Courtland R et al., Business Communication Today, Pearson Education, New Delhi, 2002.
3. Meenakshi Raman and Sangeeta Sharma., Technical Communication Principles and Practice,OUP, 2007.
4. Robert J.Dixson., Everyday Dialogues in English, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.
5. Sethi,J and Kamalesh Sadanand., A Practical Course in English Pronunciation, Prentice- Hall of India Pvt. Ltd, New Delhi, 2007

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2. http://www.prenhall.com/bov
3. https://global.oup.com/academic/product/technical-communication
4. https://www.amazon.in/Everyday-Dialogues-English-Dixson-R-J/dp
5. https://www.sapnaonline.com/books/practical-course-english-pronunciation-w-sethi-j-812032594x-9788120325944

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	3	-	1	1	-	-
2	1	-	-	-	-	-	-	-	-	3	-	1	1	-	-
3	1	-	-	-	-	-	-	-	-	3	-	1	1	-	-
4	1	-	-	-	-	-	-	-	-	3	-	1	1	-	-
5	1	-	-	-	-	-	-	-	-	3	-	1	1	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

P104	**PHYSICS LABORATORY** (Common to all branches)	**L** 0	**T** 0	**P** 3	**C** 2	**Hrs** 30

Course Objectives
- To provide a practical understanding of some of the concepts learnt in the theory course on Physics.

Course Outcomes
After completion of the course, the students will be able to
CO1 - Ability to operate optical equipments like Spectrometer, Polarimeter to find the optical properties like dispersive power, Resolving power and specific rotatory power. **(K2)**
CO2 - Capable of handling screw gauge, venire caliper and travelling microscope to calculate the required parameters. **(K4)**
CO3 - Acquired basic knowledge about Thermal conduction and magnetic field due to a current carrying coil. **(K3)**
CO4 - Ability to prepare formal laboratory reports describing the results of experiments and to interpret the data from the experiments**. (K5)**

List of experiments (Any 10 Experiments)
1. Thermal conductivity – Lee's DISC
2. Thermal conductivity - Radial flow
3. Spectrometer – Prism or Hollow prism
4. Spectrometer – Transmission grating
5. Spectrometer - Ordinary & Extraordinary rays
6. Newton's rings
7. Air – wedge
8. Half shade polarimeter – Determination of specific rotatory power
9. Jolly's experiment – determination of α
10. Magnetism: i – h curve
11. Field along the axis of coil carrying current
12. Vibration magnetometer – calculation of magnetic moment & pole strength
13. Laser experiment: wavelength determination using transmission grating, reflection grating (vernier calipers) & particle size determination
14. Determination of optical absorption coefficient of materials using laser
15. Determination of numerical aperture of an optical fiber
16. Electrical conductivity of semiconductor – two probe / four probe method
17. Hall effect in semiconductor

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	3	1	1	3	3	2	2	3	3	2	3	-	2	1
2	3	3	1	1	3	3	1	2	3	3	2	3	-	1	-
3	3	3	2	1	3	3	2	2	3	3	2	3	-	1	1
4	3	3	2	1	-	3	2	3	3	3	2	3	-	2	1

Correlation Level: 1- Low, 2 - Medium, 3 – High

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	CHEMISTRY LAB	**L**	**T**	**P**	**C**	**Hrs**
P105	(Common to all the branches)	**0**	**0**	**3**	**2**	**30**

Course Objectives

- To gain a practical knowledge of Engineering Chemistry in relevance to Industrial applications
- To enable the learners to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering.
- To understand and explain scientifically the various chemistry related problems in the industry
- To develop experimental skills for building technical competence.

Course Outcomes

After completion of the course, the students will be able to

CO1- Describe titrimetric analysis which can be used to estimate the amount of metal in a mineral. **(K2)**

CO2-Identify titrimetric analysis which can be used to estimate the amount of chemical present in a sample.**(K2)**

CO3- Demonstrate about titrimetric analysis which can be used to estimate the quality of any sample.**(K2)**

CO4- Perform conductometric titration and its uses to analyze any sample.**(K3)**

CO5- Use experiments by using colorimeter from which concentration of a sample can be determined from absorbance value**(K3)**

List of experiments

1. Determination of dissolved oxygen in water.
2. Determination of total hardness of water by EDTA method.
3. Determination of carbonate and bicarbonate in water.
4. Estimation of chloride content in water.
6.   Estimation of magnesium by EDTA.
7. Estimation of acetic acid in vinegar.
8. Estimation of ferrous by permanganometry.
9. Estimation of ferrous and ferric iron in a solution mixture by dichrometry.
10. Estimation of available chlorine in bleaching powder.
11. Estimation of copper in copper sulphate solution.

Demonstration Experiments

1. Determination of COD of water sample.
2. Determination of lead by conductometry.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	-	-	-	2	2	-	-	1	3	1	-	-	-	1	-
2	-	-	-	2	2	-	-	1	3	1	-	-	-	1	-
3	-	-	-	2	2	-	-	1	3	1	-	-	-	1	-
4	-	-	-	2	2	-	-	1	3	1	-	-	-	1	-
5	-	-	-	2	2	-	-	1	3	1	-	-	-	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

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P106	**WORKSHOP PRACTICE**	L	T	P	C	Hrs
	(Common to all branches)	0	0	3	2	30

Course Objectives

- To convey the basics of mechanical tools used in engineering
- To establish hands on experience on the working tools
- To develop basic joints and fittings using the hand tools
- To establish the importance of joints and fitting in engineering applications
- To explain the role of basic workshop in engineering and underlying physical mechanism used in mechanical machines.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the functioning and usage of basic hand tools of fitting, welding and carpentry. **(K2)**

CO2 - Apply the knowledge of fitting tools and machineries to perform the exercise on fitting joints like symmetric asymmetric and angular fitting. **(K3)**

CO3 - Apply the knowledge of gas and Arc welding principles to perform to join the metal with joints like Lap and V- Butt joints. **(K3)**

CO4 - Apply the knowledge of metal joining process using sheet metals and to perform to make tray and frustum. **(K3)**

CO5 - Apply the knowledge of carpentry tools and equipment's to perform the joints like mortise and half lap joint. **(K3)**

Sl. No.	Trade	List of Exercises
1	Fitting	Study of tools and Machineries. Exercises on symmetric joints and joints with acute angle.
2	Welding	Study of arc and gas welding equipment and tools – Edge preparation – Exercise on lap joint and V Butt joints – Demonstration of gas welding
3	Sheet metal work	Study of tools and Machineries – Exercise on simple products like Office tray and waste collection tray.
4	Carpentry	Study of tools and Machineries – Exercises on Lap joints and Mortise joints

LIST OF EXERCISES

I - FITTING

1. Study of tools and Machineries
2. Symmetric fitting
3. Acute angle fitting

II - WELDING

1. Study of arc and gas welding equipment and tools
2. Simple lap welding (Arc)
3. M Single V butt welding (Arc)

III - SHEET METAL WORK

1. Study of tools and machineries
2. Frustum
3. Waste collection tray

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IV - CARPENTRY

1. Study of tools and machineries
2. Half lap joint
3. Corner mortise joint.

Reference Books

1. HS Bawa, Workshop Practices, Tata Mc Graw Hill Publishing Co Ltd, 2015
2. S.K. Hajra Choudhury, A. K. Hajra Choudhury, "Elements of Workshop Technology", Vol I:Manufacturing Processes, 15th Edition Reprinted, Media Promoters & Publishers Pvt Ltd.,2013
3. D.Sathish, Engineering Workshop Practices Laboratory Manual, Notion press publisher, 2019
4. R.K. Rajput, Workshop Practice, Published by Laxmi Publications Pvt. Ltd. 2011
5. RS Khurmi and JK Gupta, Basics of Workshop Practice, S Chand Publisher, 2011

Web References

1. http://www.nptelvideos.in/2012/12/manufacturing-processes-ii.html
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=3804
3. https://www.tpctraining.com/collections/machine-shop-practices-training
4. https://www.vlab.co.in/broad-area-mechanical-engineering
5. https://nptel.ac.in/courses/112/107/112107219/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	1	1	-	-	-	-	-	-	-	1	-	-
2	2	1	-	-	-	-	-	-	-	-	-	-	1	-	-
3	2	1	-	1	-	-	-	-	-	-	-	-	1	-	1
4	2	1	-	-	1	-	-	-	-	-	-	-	1	-	-
5	2	1	1	1	-	-	-	-	-	-	-	-	1	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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T107	**MATHEMATICS - II** (Common to all branches)	**L** **T** **P** **C** **Hrs** **3** **1** **0** **4** **60**

Course Objectives
- To familiarize the concept of matrices.
- To introduce the concepts of curl, divergence and integration of vectors in vector calculus
- To equip themselves familiar with Laplace transform
- To solve the differential equations using Inverse Laplace transform techniques.
- To gain good knowledge in application of Fourier transform.

Course Outcomes
After completion of the course, the students will be able to
CO 1 – Understand the concept of Eigen values and Eigen vectors, Diagonalization of a matrix. **(K2)**
CO 2 – Understand the use of vector calculus. **(K2)**
CO 3 – Apply Laplace transform of simple function. **(K3)**
CO 4 – Apply inverse Laplace transform of simple functions**. (K3)**
CO 5 – Compute Fourier transforms of various functions. **(K3)**

UNIT I MATRICES   (12 Hrs)
Eigen values and Eigen vectors of a real matrix, Characteristic equation, Properties of Eigen values and Eigenvectors. Cayley-Hamilton Theorem, Diagonalization of matrices. Reduction of a quadratic form to canonical form by orthogonal transformation. Nature of quadratic forms.

UNIT II VECTOR CALCULUS   (12 Hrs)
Gradient, divergence and curl, their properties and relations. Gauss divergence theorem and Stoke's theorem (without proof).Simple application problems.

UNIT III LAPLACE TRANSFORMS   (12 Hrs)
Definition, Transforms of elementary functions, properties. Transform of derivatives and Integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and Final value theorems.

UNIT IV APPLICATIONS OF LAPLACE TRANSFORM   (12 Hrs)
Methods for determining inverse Laplace Transforms, convolution theorem, Application to differential equations and integral equations. Evaluation of integrals by Laplace transforms.

UNIT V FOURIER TRANSFORMS   (12 Hrs)
Fourier Integral theorem (statement only), Fourier transform and its inverse, properties. Fourier sine and cosine transforms their properties, convolution and Parseval's identity.

Text books
1.Venkataraman M.K., Engineering Mathematics, National Publishing Company, Chennai, 2012
2. Kandasamy P. et al, Engineering Mathematics, Vol.2 & 3, S. Chand & Co., New Delhi.

Reference books
1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 1st Edition, 2011.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Erwin Kreyszig Advanced Engineering Mathematics, John Wiley & Sons, New Delhi.
5. Bali N. and Goyal M., Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010.

Web References

1. https://www.youtube.com/watch?v=1wjXVdwzgX8
2. http://www.snggdcg.ac.in/pdf/study-material/mathematics/SMch18.pdf
3. https://www.youtube.com/watch?v=MLSfh33ZCwE
4. https://www.khanacademy.org/math/differential-equations/laplace-transform/convolution-integral/v/the-convolution-and-the-laplace-transform
5. http://www-users.math.umn.edu/~mille003/fouriertransform.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	1	-	-	-	-	1	3	2	2
2	2	1	-	-	-	1	1	-	-	-	-	1	3	2	-
3	3	2	1	1	-	1	-	-	-	-	-	1	3	3	-
4	3	2	1	1	-	1	-	-	-	-	-	1	3	3	-
5	3	2	1	1	-	1	-	-	-	-	-	1	3	3	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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T108	**MATERIAL SCIENCE** (Common to all branches)	**L** **4**	**T** **0**	**P** **0**	**C** **4**	**Hrs** **45**

Course Objectives

- To understand the importance of Material Science as a subject that revolutionized modern day technologies
- To understand the significance of material science in the development of new materials and devices for all branches of Engineering
- To impart knowledge to the Engineering students about some of the important areas of Materials Science so as to enable them perceive the significant contributions of the subject in Engineering and Technology

Course Outcomes

After completion of the course, the students will be able to

CO1-Identify crystal lattices and their structures, crystalline planes and directions in a crystal lattice in terms of Miller Indices. To interpret X-ray diffraction studies and different types of lattice defects and their impact. **(K2)**

CO2-To identify the nature of polarization in a dielectric material and to explain the various dielectric material and their characterization. **(K2)**

CO3-Understand the source of a materials magnetic behaviour and be able to distinguish types of magnetism. Having Basic idea about the read/ write mechanism of various magnetic storage devices. **(K3)**

CO4-Differentiate semiconductors; calculate the intrinsic carrier concentration in semiconductors.Understand the phenomenon of superconductivity: Student is able to define basic properties of superconducting materials and identify potential areas of their applications. **(K1)**

CO5 - Able to differentiate between nanomaterials and conventional materials. Have a broad understanding of the techniques used to synthesize nanomaterials, evaluate the properties of nanomaterials, identify the role of nanomaterials in current nanotechnology revolution, be prepared for more advanced courses in Materials Science and Engineering. **(K3)**

UNIT I - CRYSTAL STRUCTURE AND LATTICE DEFECTS   (9 Hrs)

Crystal structure - Bravais Lattices, Crystal Systems –– Coordination Number, Atomic Radius, Packing Factor for FCC & HCP structures – Miller Indices- Powder X Ray Diffraction Method Lattice defects – Qualitative ideas of point, line, surface and volume defects

UNIT II – DIELECTRIC PROPERTIES   (9 Hrs)

Dielectric Polarization and Mechanism –Temperature dependence of polarization, Internal or local Field-Clausius-Mossotti relation. Basic ideas of Dielectric loss - frequency dependence of dielectric constant – Measurement of Dielectric constant and loss using Scherring bridge – Elementary ideas of Piezoelectrics, Ferroelectrics and Pyroelectric materials and Applications

UNIT III – MAGNETIC PROPERTIES   (9 Hrs)

Origin of atomic magnetic moment – Bohr magneton-Elementary Ideas of classification of magnetic materials (Dia, Para, Ferro, antiferro & Ferri). – Quantum theory of Para & Ferro Magnetism – Domain Theory of Hysteresis – Heisenberg Theory of Exchange Interaction (without derivation) – Qualitative ideas of Anti ferromagnetic Ordering – Structure and Properties of Ferrites – Properties of Soft & Hard Magnetic Materials – Applications. Magnetic data storage – Magnetic tapes, Hard disks, Magneto optical recording

UNIT IV – SEMICONDUCTORS AND SUPERCONDUCTORS   (9 Hrs)

Semiconductors -Derivation of Carrier concentration in intrinsic Semiconductors –Basic ideas of Electrical conductivity in intrinsic and extrinsic semiconductors (without derivations) -temperature dependence of carrier concentration and electrical conductivity in semiconductors (qualitative ideas), Hall effect in Semiconductors -- Application of Hall Effect, Basic Ideas of Compound Semiconductors (II-VI & III-V)

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Superconductivity - Basic concepts – transition temperature – Meissener effect – Type I and II superconductors – high temperature superconductors – 123 superconductor – Applications of superconductors.

UNIT V – ADVANCED MATERIALS   (9 Hrs)
Liquid Crystals – Types – Application as Display Devices
Metallic Glasses – preparation by melt spinning. Twin roller system, properties and applications
Shape Memory alloys (SMA), Shape memory effect, Properties and applications of SMA
Nanomaterials- Nano materials (one, Two & three Dimensional) –Methods of synthesis (PVD, CVD, Laser Ablation, Solgel, Ball-milling Techniques), Properties and applications of nanomaterials. carbon nanotubes– Properties and applications.

Text books
1. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011.

Reference Books
1. Ali Omar M, Elementary Solid State Physics, Addison Wesley Publishing Co., 2009.
2. William D Callister Jr., Material Science and Engineering, 6th Edition, John Wiley and sons, 2009.
3. Charles Kittel, Introduction to Solid State Physics, 7th Edition, John Wiley & sons, Singapore, 2007.
4. V Raghavan , Materials Science and Engineering- A First Course, 5th Edition, Prentice Hall of India, 2008.
5. B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath, and James Murday, Text book of Nanoscience and Nanotechnology, Universities Press, Hyderabad 2012
6. M.N. Avadhanulu, Enginerring Physics- Volume-II, S.Chand &Co, New Delhi, 2009
7. Pillai S.O, Solid State Physics, 6th Edition – New Age International, 2005.

Web References
1. https://swayam.gov.in/nd1_noc20_ph15/preview
2. https://swayam.gov.in/nd1_noc20_ph22/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	2	3	1	1	1	2	3	3	2	2	1
2	3	3	3	1	2	3	1	1	1	2	1	3	3	1	1
3	3	3	3	1	3	3	2	1	1	2	1	3	3	2	2
4	3	3	3	1	3	3	2	1	1	2	2	3	2	1	-
5	3	1	3	1	3	3	2	1	1	2	3	3	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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T109	**ENVIROMENTAL SCIENCE** (Common to all branches)	**L**	**T**	**P**	**C**	**Hrs**
		3	**1**	**0**	**4**	**60**

Course Objectives

- To know about theenvironment
- To understand about environmentalpollution
- To apply the knowledge in understanding various environmental issues and problems.

Course Outcomes

After completion of the course, the students will be able to

CO1 – Understand the various environmental segments, its significance to life, also about various natural resources, effects of over utilization and its protection which can lead to sustainable development. **(K2)**

CO2 – Understand the study of ecology of various systems of nature and also about the diverse species present and its protection. **(K2)**

CO3 – Understand various sources of air pollution, the scientific basis behind it and its effect on nature. **(K2)**

CO4 – Understand the various ways of water pollution, its sources and effects, different water pollution monitoring technique, treatment of waste water and also the effects of solid waste and its management**. (K2)**

CO5 – Understand the concept of spectroscopy and its application to monitor pollution. **(K2)**

UNIT I ENVIRONMENT AND ENERGY RESOURCES   (12 Hrs)

Environmental segments – atmosphere, hydrosphere, lithosphere and biosphere. Atmospheric layers.Pollution definition and classification.Pollutants classification. Forest resources – use and over exploitation, deforestation, forest management. Water resources – use and conflicts over water, dams – benefits and problems.Mineral resources – mineral wealth of India, environmental effects of extracting and using mineral resources.Food resources – world food problems, environmental impact of modern Agriculture – fertilizer and pesticides.Energy resources – growing needs, renewable and non-renewable energy resources and use of alternate energy sources.From unsustainable to sustainable development..

UNIT II ECOSYSTEM AND BIODIVERSITY   (12 Hrs)

Concept of an ecosystem - structure and function of an ecosystem.Producers, consumers, and decomposers.Energy flow in the ecosystem.Food chains, food webs and ecological pyramids.Introduction, types, characteristic features, structure and function of forest, grassland, desert and aquatic (fresh water, esturine and marine) ecosystems.Biodiversity – definition, genetic species and ecosystem diversity. Value of biodiversity - consumptive use, productive use, social, ethical, aesthetic and option values. Hot spots of biodiversity.Threats to biodiversity, habitat loss, poaching of wildlife, human wildlife conflicts.Endangered and endemic species.Conservation of biodiversity – in-situ and ex-situ conservation of biodiversity.

UNIT III AIR POLLUTION   (12 Hrs)

Definition and classification.Chemical and photochemical reaction in different layers of atmosphere.Causes, sources, effects and control measures of air pollutants - oxides of Nitrogen, oxides of Carbon, oxides of Sulfur, hydrocarbons, chloro-fluoro carbons and particulates. Mechanism and effects of air pollution phenomenon – Global Warming, Ozone Depletion, Acid Rain, Sulfurous Smog and Photochemical Smog.

UNIT IV WATER AND LAND POLLUTION   (12 Hrs)

Water pollution – causes and effects of organic water pollutants – pesticides, insecticides, detergents and surfactants.Causes and effects of inorganic water pollutants – heavy metal pollution due to Hg, Pb, Cr & Cu. Water pollution control and monitoring – DO, COD, BOD & TOC. Land Pollution – Solid waste management – causes, effect and control measures of urban and industrial wastes. Thermal and radioactive pollution..

UNIT V POLLUTION CONTROL AND MONITORING   (12 Hrs)

Basic concepts and instrumentation of IR, UV-VIS, atomic absorption spectrometry, Gas Chromatography and Conductometry.Analysis of air pollutants – NOx, COx, SOx, H2S, Hydrocarbons and particulates.

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Text Books

1. PK. De, "Environmental chemistry" 7th Ed; New age international (P) Ltd, New Delhi, 2010.
2. K. RaghavanNambiar, "Text Book of Environmental Studies" 2ndEd, Scitech Publications (India) Pvt Ltd, India, 2010.
3. G. S. Sodhi, Fundamental concepts of environmental chemistry, I Ed, Alpha Science International Ltd, India, 2000.

Reference Books

1. 1. B.K. Sharma, "Environmental chemistry" 11th Ed, KRISHNA Prakashan Media (P) Ltd, Meerut, 2007.
2. 2. S.S.Dara, and D.D. Mishra "A text book of environmental chemistry and pollution control, 5th Ed, S.Chandand Company Ltd, New Delhi, 2012.
3. 3. Richard T. Wright, Environmental Science: Toward a Sustainable Future, 10thedition, Prentice Hall, 2008

Web Resources

1. www.ifpri.org/topic/environment-and-natural-resources
2. https://www.iucn.org/content/biodiversity
3. http://www.world.org/weo/pollution
4. www.water-pollution.org.uk/
5. https://www.tceq.texas.gov/airquality/monops/sites

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	-	1	3	-	-	-	-	2	-	-	2
2	2	1	1	1	-	1	3	-	-	-	-	2	2	-	2
3	3	1	1	1	-	1	3	-	-	-	-	2	2	-	-
4	3	1	1	1	-	1	3	-	-	-	-	2	-	1	2
5	3	1	1	1	-	1	3	-	-	-	-	2	2	1	2

Correlation Level: 1-Low, 2-Medium, 3- High

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		L	T	P	C	Hrs
T104	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING** (Common to all branches)	**3**	**1**	**0**	**4**	**60**

Course Objectives

- To understand and gain basic knowledge about magnetic and electrical circuits
- To gain basic knowledge about single phase and three phase power measurement
- To understand the operating principles of stationary and rotating machines
- To understand the characteristics and applications of semiconductor devices
- To provide the basic knowledge in Digital electronics
- To understand the purpose of communication and acquire knowledge on different communication systems

Course Outcomes

After completion of the course, the students will be able to

CO1 - Analyze the basic concepts, various laws and theorems used in DC circuits. **(K3)**

CO2 - Analyze and solve the AC circuits and develop resonance circuits for transmitter and receiver. **(K4)**

CO3 - Gain the knowledge of power production in power system and application of transformers and motors in real time. **(K2)**

CO4 - Understand the operations of semiconductor diode, BJT, FET and its applications. **(K2)**

CO5 - Summarize the digital electronics concepts for sequential and combinational circuits. **(K2)**

CO6 - Explain and Relate different Communication Systems. **(K2)**

PART A – ELECTRICAL

UNIT I DC CIRCUITS   (10 Hrs)

Definition of Voltage, Current, Power & Energy, circuit parameters, Ohm's law, Kirchoff's law & its applications – Simple Problems - Division of current in Series & parallel circuits - star/delta conversion - Node and mesh methods of analysis of DC circuits

UNIT II AC CIRCUITS   (10 Hrs)

Concepts of AC circuits – rms value, average value, form and peak factors – Simple RLC series circuits – Concept of real and reactive power – Power factor - Introduction to three phase system - Power measurement by two wattmeter method.

UNIT III ELECTRICAL MACHINES AND POWER PLANTS   (10 Hrs)

Law of Electromagnetic induction, Fleming's Right & Left hand rule - Principle of DC rotating machine, Single phase transformer and single phase induction motor (Qualitative approach only) - Simple layout of thermal and hydro generation (block diagram approach only).Fundamentals of fuses and circuit breakers.

PART B – ELECTRONICS

UNIT IV ELECTRONIC CIRCUITS   (10 Hrs)

V-I Characteristics of diode - Half-wave rectifier and Full-wave rectifier – with and without capacitor filter - Transistor - Construction & working - Input and output characteristics of CB and CE configuration - Transistor as an Amplifier - Principle and working of Hartley oscillator and RC phase shift oscillator - Construction and working of JFET & MOSFET.

UNIT V DIGITAL ELECTRONICS   (10 Hrs)

Boolean algebra – Reduction of Boolean expressions - De-Morgan's theorem - Logic gates -Implementation of Boolean expressions - Flip flops - RS, JK, T and D. Combinational logic - Half adder, Full adder and Subtractors. Sequential logic - Ripple counters and shift registers.

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UNIT VI COMMUNICATION AND COMPUTER SYSTEMS (10 Hrs)

Model of communication system - Analog and digital - Wired and wireless channel. Block diagram of various communication systems - Microwave, satellite, optical fiber and cellular mobile system. Network model - PAN, LAN, MAN and WAN - Circuit and packet switching - Overview of ISDN.

Text Books

1. Kothari D P and Nagrath I J , Basic Electrical Engineering, Tata McGraw Hill,2009.(For Units I to III)
2. Rajendra Prasad, "Fundamentals of Electronic Engineering", Cengage learning, New Delhi, First Edition, 2011. (For Unit IV)
3. Morris Mano, "Digital design", PHI Learning, Fourth Edition, 2008. (For Unit V)
4. Wayne Tomasi, "Electronic Communication Systems- Fundamentals Theory Advanced", Sixth Edition, Pearson Education, 2004. (For Unit VI)

Reference Books

1. R.Muthusubramaniam, S.Salivahanan and K.A. Mureleedharan, Basic Electrical Electronics and Computer Engineering, Tata McGraw Hill, 2004.
2. J.B.Gupta, A Course in Electrical Power, Katson Publishing House, New Delhi, 1993.
3. David. A. Bell, "Electronic Devices and Circuits", PHI Learning Private Ltd, India, Fourth Edition, 2008
4. Donald P Leach, Albert Paul Malvino and Goutam Saha, "Digital Principles and Applications," 6th edition,Tata McGraw Hill Publishing Company Ltd.,New Delhi,2008.
5. S.K. Sahdev, Fundamentals of Electrical Engineering and Electronics, Dhanpat Rai & Co, 2013.
6. Jacob Millman and Christos C. Halkias, "Electronic Devices and Circuits" Tata McGraw Hill
7. R.L. Boylestad and L. Nashelsky, "Electronic Devices and Circuit Theory", PHI Learning Private Limited, Ninth Edition, 2008
8. M.S.Sukija and T.K.Nagasarkar, "Basic electrical and Electronics Engineering", Oxford University Press, 2012.

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2. https://www.electrical4u.com/
3. https://nptel.ac.in/courses/108/102/108102146/
4. http://electrical-engineering-portal.com/
5. http://www.electronics-tutorials.ws
6. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
7. https://nptel.ac.in/courses/117/102/117102059/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	3	-	-	-	-	-	-	-	1	-	2
2	3	3	2	2	3	-	-	-	-	-	-	-	1	-	2
3	3	3	2	2	3	-	-	-	-	-	-	-	-	-	2
4	3	1	2	2	-	-	-	-	-	-	-	-	2	2	2
5	3	2	2	2	-	-	-	-	-	-	-	-	2	1	2
6	3	-	2	-	-	-	-	-	-	-	-	-	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 – High

B.Tech. Biomedical Engineering

T105	ENGINEERING THERMODYNAMICS	L	T	P	C	Hrs
	(Common to all branches)	3	1	0	4	60

Course Objectives
- To understand the basics of the thermodynamic principles
- To establish the relationship of these principles to thermal system behaviors
- To develop methodologies for predicting the system behavior
- To establish the importance of laws of thermodynamics applied to energy systems
- To explain the role of refrigeration and heat pump as energy systems and develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world

Course Outcomes
After completion of the course, the students will be able to
CO1- Understand the fundamental thermodynamic concepts and its basic laws**. (K2)**
CO2 - Apply first law of thermodynamics concepts to calculate the system work for closed and open systems **(K3**)
CO3 - Apply Second Law of Thermodynamics and entropy concepts to evaluate the performance of heat engine, heat pump and refrigerator**.(K3)**
CO4 - Apply the principles of gas power cycles to calculate its thermal performance. **(K3)**
CO5 - Understand the basic working principle of refrigeration systems**.(K2)**

UNIT I BASIC CONCEPTS AND DEFINITIONS   (12 Hrs)
Energy conversion and efficiencies - system, property and state – Thermal equilibrium – Temperature – Zeroth law of Thermodynamics – Pure substance – P, V and T diagrams – Thermodynamic diagrams.

UNIT II FIRST LAW OF THERMODYNAMICS   (12 Hrs)
The concept of work and adiabatic process – First law of thermodynamics – conservation of Energy Principle for closed and open systems – Calculation of work for different processes of expansion of gases

UNIT III SECOND LAW OF THERMODYNAMICS   (12 Hrs)
Equilibrium and the second law – Heat engines – Kelvin-Plank statement of second law of thermodynamics – Reversible and irreversible processes – Carnot principle – Clausius inequality – Entropy

UNIT IV GAS POWER CYCLES   (12 Hrs)
Air standard cycles: The air standard carnot cycle – Air standard Otto cycle, Diesel cycle, Dual cycle and Brayton cycles and their efficiencies

UNIT V REFRIGERATION CYCLES AND SYSTEMS   (12 Hrs)
Reverse Carnot cycle – COP – Vapor compression refrigeration cycle and systems (only theory) – Gas refrigeration cycle – Absorption refrigeration system – Liquefaction – Solidification (only theory).

Text Books
1. P.K.Nag, "Engineering Thermodynamics", 4th edition, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2008.
2. R. K. Singal, Mridul Singal "A text book of Engineering Thermodynamics", I.K. International Publishing House Pvt. Limited, 2010.
3. Er.S.K.Gupta, "Engineering Thermodynamics", S. Chand publishers, 2013.

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Reference Books

1. Arora, C.P., "Thermodynamics", Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2010.
2. Burghardt, M.D., "Engineering Thermodynamics with Applications", 4th edition, Harper & Row, N.Y., 2009.
3. Huang, F.F., "Engineering Thermodynamics" 2nd edition, Macmillan Publishing Co. Ltd., N.Y., 2011.
4. Cengel, Y.A. and Boles, M.A., "Thermodynamics – An Engineering approach", 5th edition, Mc Graw Hill, 2008.
5. Wark, K., "Thermodynamics", 4th edition Mc-Graw Hill, N.Y., 2009.

Web References

1. https://nptel.ac.in/courses/112105266/
2. https://nptel.ac.in/courses/112108148/
3. https://nptel.ac.in/courses/112/103/112103275/
4. https://www.linkedin.com/company/heat-transfer-and-process-design-htpd
5. https://www.udemy.com/course/an-introduction-to-heat-transfer/

Cos Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2	-	-	-	-	-	-	-	1	-	-
2	3	2	2	2	2	-	-	-	-	-	-	-	1	-	-
3	3	2	3	3	2	-	-	-	-	-	-	-	-	-	-
4	3	2	3	3	-	-	-	-	-	-	-	-	-	-	-
5	3	2	3	3	-	-	-	-	-	-	-	-	1	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

	COMPUTER PROGRAMMING	L	T	P	C	Hrs
T106	(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL,BME,MECHTRONICS, CCE)	3	1	0	4	60

Course Objectives

- To introduce the basics of computers and information technology.
- To educate problem solving techniques.
- To impart programming skills in C language.
- To practice structured programming to solve real life problems.
- To study the basic concepts of File operations.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Identify and understand the working components of a computer system. **(K1)**

CO2 - Understand, analyze and implement like algorithm, pseudo codes and programming structures. **(K2)**

CO3 - Analyze and make use of logical structure of a C program. **(K3)**

CO4 - Make use of pointers, memory allocation and data handling to implement C programs. **(K3)**

CO5 - Understand the working of files and directives. **(K3)**

UNIT I   **(12 Hrs)**

History of Computers – Block diagram of a Computer – Components of a Computer system –Classification of computers - Hardware – Software – Categories of Software – Operating System – Applications of Computers – Network structure – Internet and its services – Intranet – Study of word processor – Preparation of worksheets.

UNIT II   **(12 Hrs)**

Problem solving techniques – Program – Program development cycle – Algorithm design– Flowchart - Pseudo code.

Introduction to C – History of C – Importance of C - C tokens – data types – Operators and expressions – I/O functions.

UNIT III   **(12 Hrs)**

Decision making statements – branching and looping – arrays – multidimensional arrays– Functions – Recursion – Passing array to functions. Storage classes – Strings – String library functions.

UNIT IV   **(12 Hrs)**

Structures – Arrays and Structures – nested structures – passing structures to functions – user defined data types – Union. Pointers – pointers and arrays – pointers and functions - pointers and strings - pointers and Structures.

UNIT V   **(12 Hrs)**

Files – operations on a file – Random access to files – command line arguments. Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives.

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Text Books

1. Balagurusamy. E, "Programming in ANSI C", Tata McGraw Hill, Sixth edition, 2012.
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Kenneth A. Reek, "Pointers on C", Pearson Education, 2007.

Reference Books

1. Vikas Verma, "A Workbook on C ", Cengage Learning, Second Edition,2012.
2. Ashok N Kamthane, "Computer Programming", Pearson education, Second Impression, 2008.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.
4. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007.
5. Stephen G. Kochan, "Programming in C", Third Edition, Pearson Education, 2007.

Web References

1. https://www.geeksforgeeks.org/classification-of-computers/
2. http://www.btechsmartclass.com/c_programming/C-Program-Development-Life-Cycle.html
3. https://www.learn-c.org/en/Multidimensional_Arrays
4. https://www.tutorialspoint.com/cprogramming/c_structures.htm
5. https://www.w3schools.in/c-tutorial/command-line-arguments/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	-	-	-
2	2	1	-	-	3	-	-	-	-	-	-	-	-	-	-
3	3	2	1	1	3	-	-	-	-	-	-	-	-	-	-
4	3	2	1	1	3	-	-	-	-	-	-	-	-	-	-
5	3	2	1	1	3	-	-	-	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

	COMPUTER PROGRAMMING LABORATORY	**L**	**T**	**P**	**C**	**Hrs**
P101	(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL,BME,MECHTRONICS, CCE)	**0**	**0**	**3**	**2**	**30**

Course Objectives

- To study and understand the use of OS commands
- To gain a hands on experience of compilation and execution of 'C' programs
- To understand the working of control statements
- To design functional methods.
- To make use pointers in various programs

Course Outcomes

After completion of the course, the students will be able to

CO1 - Apply and practice logical ability to solve the problems. Understand C programming development. Environment, compiling, debugging, linking and executing a program using the development environment. **(K2)**

CO2 - Analyzing the complexity of problems, Modularize the problems into small modules and then convert them into programs. **(K2)**

CO3 - Understand and apply the in-built functions and customized functions for solving the problems. **(K3)**

CO4 - Understand and apply the pointers, memory allocation techniques and use of files for dealing with variety of problems. **(K3)**

CO5 - Document and present the algorithm's, flowcharts and programs in form of user-manuals. **(K3)**

List of Exercises

1. Study of OS Commands
2. Write a simple C program to find the Area of the triangle.
3. Write a simple C program to find the total and average percentage obtained by a student for 6 subjects.
4. Write a simple C program to read a three digit number and produce output like
   a. 1 hundreds
   b. 7 tens
   c. 2 units
5. for an input of 172.
6. Write a simple C program to check whether a given character is vowel or not using Switch – Case statement.
7. Write a simple C program to print the numbers from 1 to 10 along with their squares.
8. Write a simple C program to find the sum of 'n' numbers using for, do – while statements.
9. Write a simple C program to find the factorial of a given number using Functions.
10. Write a simple C program to swap two numbers using call by value and call by reference.
11. Write a simple C program to find the smallest and largest element in an array.
12. Write a simple C program to perform matrix multiplication.
13. Write a simple C program to demonstrate the usage of Local and Global variables.
14. Write a simple C program to perform various string handling functions: strlen, strcpy, strcat, strcmp.
15. Write a simple C program to remove all characters in a string except alphabets.
16. Write a simple C program to find the sum of an integer array using pointers.
17. Write a simple C program to find the Maximum element in an integer array using pointers.

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18. Write a simple C program to create student details using Structures.
19. Write a simple C program to display the contents of the file on the monitor screen.
20. Create a File by getting the input from the keyboard and retrieve the contents of the file using file operation commands.
21. Write a simple C program to pass the parameter using command line arguments.

Text Books

1. Balagurusamy. E, "Programming in ANSI C", Tata McGraw Hill, Sixth edition,2012.
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Kenneth A. Reek, "Pointers on C", Pearson Education, 2007.

Reference Book

1. VikasVerma, "A Workbook on C ", Cengage Learning, SecondEdition,2012
2. Ashok N Kamthane, "Computer Programming", Pearson education, Second Impression,2008.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.
4. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007
5. Stephen G. Kochan, "Programming in C", Third Edition, Pearson Education, 2007

Web References

1. https://www.javatpoint.com/factorial-program-in-c
2. https://www.studytonight.com/c/programs/array/largest-and-smallest-element-in-array
3. https://www.programiz.com/c-programming/examples/information-structure-array
4. https://www.geeksforgeeks.org/c-program-print-contents-file/
5. https://www.studytonight.com/c/command-line-argument.php

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	-	-	-
2	2	1	-	-	3	-	-	-	-	-	-	-	-	-	-
3	3	2	1	1	3	-	-	-	-	-	-	-	-	-	-
4	3	2	1	1	3	-	-	-	-	-	-	-	-	-	-
5	3	2	1	1	3	-	-	-	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

P102	**ENGINEERING GRAPHICS**	**L**	**T**	**P**	**C**	**Hrs**
	(Common to all branches)	**2**	**0**	**3**	**2**	**60**

Course Objectives

- To convey the basics of engineering drawing
- To explain the importance of an engineering drawing
- To teach different methods of making the drawing
- To establish the importance of projects and developments mode in drawing that are used in real systems
- To develop the role of computer aided design Auto Cad and significance of using these drawings

Course Outcomes

After completion of the course, the students will be able to
CO1 - Understand the basic concepts of engineering drawings. **(K2)**
CO2 - Apply various concepts like dimensioning, conventions and BIS codes, the theory and methods of projection.**(K3)**
CO3 - Improve their imagination and visualization skills to design new products. **(K4)**
CO4 - Create engineering drawing of physical object representing engineering systems. **(K4)**
CO5 - Analysis the different views and computer aided drafting tools. **(K3)**

UNIT I (12 Hrs)

Introduction to Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning Conic sections, Involutes, Spirals, Helix. Projection of Points, Lines and planes

UNIT II (12 Hrs)

Projection of Solids and Sections of Solids

UNIT III (12 Hrs)

Development of surfaces – Intersection of surfaces (Cylinder-Cylinder, cylinder-cone)

UNIT IV (12 Hrs)

Isometric projections and Orthographic projections

UNIT V (12 Hrs)

Computer Aided Drafting: Introduction to computer Aided Drafting hardware- overview of application software – 2D drafting commands (Auto CAD) for simple shapes – Dimensioning.

Text Books

1. K.R. Gopalakrishna and Sudhir Gopalakrishna, Engineering Graphics, Inzinc Publishers, 2007.
2. Dhananjayan A. Jolhe, Engineering Drawing with introduction to Autocad, Tata McGrawHill Publishing company limited, 2008.
3. Basant Agrwal and Agarwal C W., Engineering Drawing, Tata Tata McGrawHill Publishing company limited, 2008.

Reference Books

1. N.D. Bhatt, Engineering Drawing, 49th edition, Chorotar Publishing House, 2006.
2. K. Venugopal, Engineering Drawing and Graphics + Auto CAD, 4th edition, New Age International Publication Ltd., 2004.
3. David I cook and Robert N Mc Dougal, Engineering Graphics and Design with computer applications, Holt – Sounders Int. Edn. 1985.
4. James D Bethune and et. al., Modern Drafting, Prentice Hall Int., 1989.
5. K.V. Natarajan, A Text Book of Engineering Drawing, Dhanalakshmi Publishers, 2006.
6. BIS, Engineering Drawing practice for Schools & Colleges, 1992.

Web References

1. http://nptel.ac.in/courses/112103019
2. https://en.wikipedia.org/wiki/Engineering drawing
3. https://nptel.ac.in/courses/105/104/105104148/
4. https://onlinecourses.nptel.ac.in/noc20_me79/preview
5. https://www.btechguru.com/courses--nptel--engineering-drawing----video-lecture.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	-	3	-	-	-	-	-	-	3	-	-	-
2	3	1	-	-	3	-	-	-	-	-	-	3	-	-	-
3	3	1	-	-	3	-	-	-	-	-	-	3	-	-	-
4	3	1	-	-	3	-	-	-	-	-	-	3	-	-	-
5	3	1	-	-	3	-	-	-	-	-	-	3	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

		L	T	P	C	Hrs
P103	**BASIC ELECTRICAL AND ELECTRONICS LABORATORY** (Common to all branches)	0	0	3	2	45

Course Objectives

- To get an exposure on the basic electrical tools, applications and precautions
- To gain training on different types of wiring used in domestic and industrial applications.
- To detect and find faults in electrical lamp and ceiling fan
- To get an exposure on the measurements of voltage and phase using CRO, basic operation and applications devices such as PN junction diode and transistor
- To gain a practical knowledge on the functions and application of basic logic gates and flip flops

Course Outcomes

After completion of the course, the students will be able to

CO1 - Follow the safety procedures when working with electricity and various tools. **(K4)**

CO2 - Do line diagram and wiring practices for domestic application. **(K5)**

CO3 - Use the protection circuits for electrical networks**. (K3)**

CO4 - Design and verify the kirchoff's law. **(K4)**

CO5 - Analyze the characteristics of PN diode and use it for rectifier applications. **(K4)**

CO6 - Gain knowledge on digital electronics to solve problems related to boolean algebra. **(K4)**

ELECTRICAL LAB

List of Experiments

1. Electrical Safety, Precautions, study of tools and accessories.
2. Practices of different joints.
3. Wiring and testing of series and parallel lamp circuits.
4. Staircase wiring.
5. Doctor's room wiring.
6. Bed room wiring.
7. Go down wiring.
8. Wiring and testing a ceiling fan and fluorescent lamp circuit.
9. Study of different types of fuses, circuits breakers and A.C and D.C meters.

ELECTRONICS LAB

List of Experiments

1. Study of CRO
   (a) Measurement of AC and DC voltages
   (b) Frequency and phase measurements (using Lissajou's figures)
2. Verification of Kirchoff's Voltage and Current Laws
   Determine the voltage and current in given circuits using Kirchoff"s laws theoretically and verify the laws experimentally.
3. Characteristics and applications of PN junction diode.
   Forward and Reverse characteristics of PN junction diode.
   Application of Diode as Half wave Rectifier – Measurement of ripple factor with and without capacitor filter
4. Frequency Response of RC Coupled Amplifiers
   Determination of frequency response of given RC coupled amplifier - Calculation of bandwidth.
5. Study of Logic Gates
   (a) Verification of Demorgan's theorems
   (b) Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR, EX-NOR gates and Flipflops - JK, RS, T and D
   (c) Implementation of digital functions using logic gates and Universal gates.

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Reference Books

1. Kothari D P and Nagrath I J, Basic Electrical Engineering, Tata McGraw Hill, 2009.
2. R.Muthusubramaniam, S.Salivahanan and K.A. Mureleedharan, Basic Electrical Electronics and Computer Engineering, Tata McGraw Hill, 2004
3. Sudhakar and S. P. Shyam Mohan, "Circuits and Networks Analysis and Synthesis", Tata McGraw Hill Publishing Company Ltd., New Delhi, 4th Edition, 2010.
4. Rajendra Prasad, "Fundamentals of Electronic Engineering", Cengage learning, New Delhi, First Edition, 2011.
5. Donald P Leach, Albert Paul Malvino and Goutam Saha, "Digital Principles and Applications," 6th edition, Tata McGraw Hill Publishing Company Ltd.,New Delhi,2008
6. Morris Mano, "Digital design", PHI Learning, Fourth Edition, 2008
7. Edward Hughes, John Hiley, Keith Brown, Ian McKenzie Smith, "Electrical and Electronics Technology", Pearson Education Limited, New Delhi, 10th Edition, 2010.

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1. https://www.electrical4u.com/
2. https://www.allaboutcircuits.com/
3. https://www.circuitlab.com/
4. http://www.electronics-tutorials.ws
5. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
6. https://nptel.ac.in/courses/117/102/117102059/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	-	-	-	3	-	-	-	3	3	3
2	3	3	3	3	3	-	-	-	3	-	-	-	1	1	1
3	3	3	2	3	3	-	-	-	3	-	-	-	2	2	2
4	3	3	2	3	2	-	-	-	3	-	-	-	2	2	2
5	3	3	2	3	2	-	-	-	3	-	-	-	2	2	2
6	3	3	2	3	2	-	-	-	3	-	-	-	2	2	2

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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		L	**T**	**P**	**C**	**Hrs**
P107	**NCC / NSS**	0	0	2	-	30

NCC/NSS training is compulsory for all the Undergraduate students

1. The above activities will include Practical/field activities/Extension lectures.
2. The above activities shall be carried out outside class hours.
3. In the above activities, the student participation shall be for a minimum period of 45 hours.
4. The above activities will be monitored by the respective faculty incharge and the First Year Coordinator.
5. Pass /Fail will be determined on the basis of participation, attendance, performance and behavior. If a candidate Fails, he/she has to repeat the course in the subsequent years
6. Pass in this course is mandatory for the award of degree.

B.Tech. Biomedical Engineering

U19BMT31	**NUMERICAL METHODS** (Common to CSE, IT, BME)	**L**	**T**	**P**	**C**	**Hrs**
		2	**2**	**0**	**3**	**60**

Course Objectives
- To know the solution of algebraic and transcendental equations.
- To learn the techniques of solving simultaneous equations.
- To introduce the numerical techniques of differentiation and integration.
- To solve ordinary differential equations by using numerical methods.
- To know the solution of partial differential equations by using numerical methods.

Course Outcomes
After completion of the course, the students will be able to
CO1 - Use numerical techniques to solve algebraic and transcendental equations. **(K2)**
CO2 - Find the solution of simultaneous equations. **(K2)**
CO3 - Analyze and apply the knowledge of differentiation and integration by using numerical methods. **(K3)**
CO4 - Solve the ordinary differential equations by various methods. **(K3)**
CO5 - Solve the partial differential equations by numerical methods. **(K3)**

UNIT I SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS AND EIGEN VALUE PROBLEMS (12 Hrs)
Bisection method- Method of false position -Newton Raphson method (single and system of two equations) - Eigen value and Eigen vector by power method.

UNIT II LINEAR SIMULTANEOUS EQUATIONS (12 Hrs)
Solution of linear simultaneous equations and matrix inversion - Gauss elimination method - Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel.

UNIT III INTERPOLATION (12 Hrs)
Finite Differences - Relation between operators - Interpolation by Newton's forward and backward difference formula for equal intervals - Newton's divided difference method and Lagrange's method for unequal intervals - Differentiation based on finite differences - Integrations by Trapezoidal and Simpson's rules.

UNIT IV SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS (12 Hrs)
Single step methods -Taylor series method -Picard's method -Euler method and Improved Euler method- RungeKutta method of fourth order only.

UNIT V SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)
Solution of Laplace and Poisson equations -Leibmann's iterative method -Diffusion equation: Bender-Schmitt method and Crank-Nicholson implicit difference method -Wave equation: Explicit difference method.

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Text Books

1. B.S.Grewal, "Numerical Methods in Engineering and Science", Mercury learning and Information, Kindle Edition, 2018.
2. Rajesh Kumar Gupta, "Numerical Methods - Fundamentals and Applications", Cambridge University Press, 2019
3. M.K. Jain, R.K. Jain, S.R.K. Iyengar, "Numerical Methods for Scientific and Engineering Computation",New Age International Pvt. Ltd., 7th Edition,2019.

Reference Books

1. C. Xavier, "C Language And Numerical Methods", New Age International, 2007.
2. P. Siva Ramakrishna Das, "Numerical Analysis", Kindle Edition, 2016.
3. Timo Heister, Leo G. Rebholz, FeiXue, "Numerical Analysisan Introduction", Publisher De Gruyter, 2019.
4. K. SankaraRao,"Numerical Methods for Scientists and Engineers", 3rd Edition, PHI Learning Pvt.Ltd, New Delhi, 2018.
5. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers"McGraw – Hill Higher Education, 2010.

Web References

1. http://nptel.ac.in/courses/111107063
2. http://nptel.ac.in/courses/122102009
3. https://nptel.ac.in/courses/111/107/111107105/
4. http://www.math.iitb.ac.in/~baskar/book.pdf
5. https://www.math.ust.hk/~machas/numerical-methods.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	-	-	-	-	-	1	1	2	-
2	2	1	-	-	-	1	-	-	-	-	-	1	1	2	-
3	3	2	1	1	-	1	-	-	-	-	-	1	1	2	-
4	3	2	1	1	-	-	-	-	-	-	-	1	1	2	-
5	3	2	1	1	-	-	-	-	-	-	-	1	1	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

	DATA STRUCTURES	**L**	**T**	**P**	**C**	**Hrs**
U19BMT32	(Common to ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS)	**3**	**0**	**0**	**3**	**45**

Course Objectives
- To impart the basic concepts of data structures and its terminologies.
- To understand concepts about stack and queue operations.
- To understand basic concepts about linked list and its various operations.
- To understand concepts about Tree and its applications.
- To understand basic concepts about Sorting, Hashing and Graph.

Course Outcomes
After completion of the course, the students will be able to
CO1 - Compute time and space complexity for given problems **(K3)**
CO2 - Demonstrate stack, queue and its operation. **(K3)**
CO3 - Illustrate the various operations of linked list. **(K3)**
CO4 - Use the concepts of tree for various applications. **(K3)**
CO5 - Outline the various sorting, hashing and graph techniques. **(K3)**

UNIT I BASIC TERMINOLOGIES OF DATA STRUCTURES **(9 Hrs)**
Introduction: Basic Terminologies: Elementary Data Organizations. Data Structure Operations: insertion, deletion, traversal. Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Array and its operations. Searching: Linear Search and Binary Search Techniques and their complexity analysis.

UNIT II STACK AND QUEUE OPERATIONS **(9 Hrs)**
Stacks and Queues: ADT Stack and its operations, Applications of Stacks: Expression Conversion and evaluation. ADT Queue: Types of Queue: Simple Queue, Circular Queue, Priority Queue. Operations on each type of Queues.

UNIT III LINKED LIST OPERATIONS **(9 Hrs)**
Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion, Deletion in linked list; Linked representation of Stack and Queue. Doubly linked list: operations. Circular Linked Lists: operations.

UNIT IV TREES **(9 Hrs)**
Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, Binary Tree Traversals, AVL Tree. Introduction to B-Tree and B+ Tree.

UNIT V SORTING, HASHING AND GRAPHS **(9 Hrs)**
Sorting: Bubble Sort, Selection Sort, Insertion Sort, Heap Sort, Shell Sort and Radix Sort. Performance and Comparison among the sorting methods. Hashing: Hash Table, Hash Function and its characteristics. Graph: Basic Terminologies and Representations, Graph traversal algorithms.

B.Tech. Biomedical Engineering

Text Books

1. Ellis Horowitz, Sartaj Sahni,"Fundamentals of Data Structures", Illustrated Edition, Computer Science Press, 2018.
2. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", PHI, Third Edition, 2010.
3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, "Data Structures and Algorithms", 4th Edition, 2009

Reference Books

1. Balagurusamy, "Data Structures", Tata McGraw-Hill Education, 2019.
2. D.Samanta, "Classic Data Structures, Prentice-Hall of India, Second Edition, 2012.
3. Robert Kruse, C.L. Tondo and Bruce Leung, "Data Structures and Program Design in c", Prentice-Hall of India, Second Edition, 2007.
4. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, Second Edition, 2006.
5. Mark Allen Weiss, "Algorithms, Data Structures and Problem Solving with C++", Addison-Wesley Publishing Company, Illustrated Edition, 1995.

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2. https://www.javatpoint.com/data-structure-tutorial/
3. https://www.studytonight.com/data-structures/
4. https://www.tutorialspoint.com/data_structures_algorithms/
5. https://www.w3schools.in/data-structures-tutorial/intro/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
2	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
3	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
4	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
5	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

U19BMT33	ELECTRON DEVICES AND CIRCUITS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives
- To study the basic semiconductor diodes and its applications.
- To understand the characteristics of transistors
- To enable the student to select appropriate devices for a particular application
- To classify and understand the types of amplifiers
- To know the functions of feedback amplifiers and oscillators

Course Outcomes
After completion of the course, the students will be able to
CO1 - Explain the operation of basic semiconductor diodes and its applications **(K2)**
CO2 - Categorize the transistors configuration and analyse its characteristics **(K3)**
CO3 - Distinguish the special semiconductor devices and its applications **(K3)**
CO4 - Analyse the transistor using small signal model and understand the operation of different categories of amplifiers **(K4)**
CO5 - Investigate the operation of different types of feedback amplifiers and oscillators **(K3)**

UNIT I DIODES AND THEIR APPLICATIONS   (9 Hrs)
Formation of P-N junction diode- forward and reverse biased P-N junction, V-I characteristics, diffusion and transition capacitance, Zener diode and its reverse characteristics, Zener breakdown, Avalanche breakdown, Rectifiers-half wave rectifier, full wave rectifier with and without filters, Clippers, Clampers, Voltage Regulator – Zener diode as Voltage regulator.

UNIT II BIPOLAR JUNCTION TRANSISTOR AND FIELD EFFECT TRANSISTOR   (9 Hrs)
Principle of transistor action–Current components, CE, CB, and CC Configurations, Input and output characteristics - Cut-off, active and saturation region, Transistor as a switch, Transistor as an amplifier.
FET Classification-Fundamentals of JFETs and its characteristics - JFET parameters, MOSFET - principle of operation- Depletion and enhancement modes.

UNIT III SPECIAL SEMICONDUCTOR DEVICES   (9 Hrs)
Unijunction Transistor (UJT), Tunnel diode, Varactor diode, Schottky diode, Gunn diode, Light Emitting Diode (LED), Laser, PIN diode, Photo diode, Liquid Crystal Display (LCD), Silicon Control Rectifier (SCR), DIAC, TRIAC, Applications of SCR, DIAC, TRIAC.

UNIT IV AMPLIFIERS   (9 Hrs)
BJT small signal low frequency model using h parameter – Analysis of CE, CB and CC amplifiers, Differential amplifier – Common mode and Differential mode analysis, RC coupled amplifiers, Cascade amplifier, Power amplifiers –Class A, Class B, Class AB, Push Pull amplifiers, Class C amplifiers.

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS   (9 Hrs)

Feedback amplifiers-Properties of negative feedback-voltage and current, series, Shunt feedback, Positive feedback, Barkhausen Condition for oscillations, Classification of Oscillators - RC phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators, Clapp Oscillator.

Text Books

1. Jacob Millman,Chritos C Halkias," Electronic Devices and Circuits", Fourth edition, McGraw Hill Education India Private Ltd., 2015.
2. Robert L. Boylestad, "Electronic Devices and Circuit Theory", Eleventh Edition, 2015
3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Prentice Hall of India, 2008

Reference Books

1. Thomas L. Floyd, "Electronic devices", Tenth Edition, Prentice Hall, 2018.
2. Donald A Neaman, "Semiconductor Physics and Devices", Fourth edition, McGraw Hill Education India Private Ltd., 2011
3. Salivahanan," Electron Devices and Circuits", Fourth edition, McGraw Hill Education India Private Ltd., 2016
4. Sedra and Smith, "Microelectronic Circuits, Fifth Edition, Oxford University Press 2012
5. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits", Second edition, PHI learning private limited, 2014.

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2. www.circuitstoday.com
3. http://www.electronics-tutorials.ws
4. https://nptel.ac.in/courses/108/108/108108112/
5. https://nptel.ac.in/courses/117/103/117103063/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	-	-	-	1	-	-	-	-	3	-	2
2	3	3	2	-	-	-	-	1	-	-	-	-	3	-	2
3	3	3	2	1	-	-	-	1	-	-	-	-	3	-	2
4	3	3	2	1	-	-	-	1	-	-	-	-	3	-	2
5	3	3	2	-	-	-	-	1	-	-	-	-	3	-	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

U19BMT34	BIOSENSORS AND TRANSDUCERS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the various measuring devices used in instruments.
- To know about the types of transducers available and their applications in different fields.
- To understand the concepts of optical sensors and its functions
- To study chemical biosensors and bio potential electrodes
- To compare various bridges and display devices

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the parameters of various measurement devices **(K2)**
CO2 - Realize the applications of various sensors and transducers available for physiological measurements **(K2)**
CO3 – Understand the fundamentals of optical sensors and transducers **(K2)**
CO4 – Gain knowledge in chemical biosensors and bio potential electrodes **(K2)**
CO5 - compare various bridges and display devices **(K3)**

UNIT I BASICS OF MEASUREMENTS (9 Hrs)

Functional elements of an instrument, Static and dynamic characteristics, Errors in measurement Statistical evaluation of measurement data, Standards and calibration.

UNIT II TRANSDUCERS AND SENSORS (9 Hrs)

Resistive Transducers: Strain Gauge: Gauge factor, sensing elements, configuration, biomedical applications; strain gauge as displacement and pressure transducers, RTD materials and range, Characteristics, thermistor characteristics, biomedical applications of Temperature sensors Capacitive transducer, Inductive transducer, LVDT, Active type: Thermocouple –characteristics.

UNIT III PHOTOELECTRIC AND PIEZOELECTRIC SENSORS (9 Hrs)

Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic, Photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectrophotometric applications of photo electric transducers. Piezoelectric active transducer and biomedical applications as pressure and Ultrasound transducer.

UNIT IV CHEMICAL BIOSENSORS AND BIOPOTENTIAL ELECTRODES (9 Hrs)

Blood gas and Acid-Base Physiology, Electrochemical sensors, reference electrode, pH, pO_2, pCO_2 electrodes, Half Cell potential, Surface electrodes and its types, Needle Electrodes, and Microelectrodes with its circuit diagram.

UNIT V COMPARISON METHODS OF MEASUREMENTS (9 Hrs)

D.C and A.C potentiometers, DC Bridges -Wheatstone, Kelvin, AC bridges- Maxwell, Hay, Schering and Wien bridge (only derivations), Cathode ray oscilloscope (CRT) and Digital storage oscilloscope (DSO), Liquid Crystal Display (LCD)

Text Books

1. A.K.Sawhney, "A Course in Electrical and Electronic measurements and Instruments", Dhanpat Rai and Sons, 2010.
2. Prof. Ping Wang andDr.QingjunLiu, "Biomedical Sensors and Measurement ", First Edition, Springer Publications", 2011.
3. Tatsuo Togawa ,Toshiyo Tamura and Ake Oberg, "Biomedical Sensors and Instruments", Second Edition, CRC Press Taylor and Francis Group, 2011.

Reference Books

1. R.Anandanatarajan, "Biomedical Instrumentation and measurements", Second Edition, PHI Learning, December 2015.
2. Ernest O Doebelin and Dhanesh N Manik, "Measurement Systems, Applications and Design", Fifth edition MC Graw-Hill, 2011.
3. Michael J. McGrath, CliodhnaNíScanaill, "Sensor Technologies: Healthcare, Wellness and Environmental Applications,Apress, 2013.
4. Richard S.C. Cobbold, "Transducers for Biomedical Measurements: Principles and Applications ", John Wiley and Sons, 2014.
5. Nandini K. Jog, "Electronics in Medicine and Biomedical Instrumentation", Second Edition, PHI, 2013.

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2. http://www.123seminarsonly.com/Seminar-Reports/018/31005914-Notes-on-Transducers.pdf
3. https://nptel.ac.in/courses/108/108/108108147/
4. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf
5. https://www.uvpce.ac.in/content/biomedical-transducers-and-biosensors-laboratory

Cos/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	-	-	-	1	-	-	-	-	3	2	1
2	3	2	-	-	-	-	-	1	-	-	-	-	3	2	1
3	3	2	2	2	-	-	-	1	-	-	-	-	3	2	1
4	3	2	2	-	-	-	-	1	-	-	-	-	3	2	1
5	3	2	3	3	-	-	-	1	-	-	-	-	3	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19BMT35	HUMAN ANATOMY AND PHYSIOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives
- To study the basic structural and functional elements of human body.
- To gain knowledge about cardiovascular systems and nervous system
- To understand the basic concepts of respiratory and human skeletal
- To understand the urinary system
- To understand the basic concepts of visual and hearing system

Course Outcomes
After completion of the course, the students will be able to
CO1 - Describe basic structural and functional elements of human body **(K2)**
CO2 - Explain the function of cardiovascular system and knowledge on nervous systems **(K2)**
CO3 - Distinguish the types of skeletal systems and functions of respiration **(K4)**
CO4 - Illustrate the Physiological function of Digestive and Excretory systems **(K4)**
CO5 - Elucidate special senses in the human body **(K3)**

UNIT I BASIC ELEMENTS OF HUMAN BODY   (9 Hrs)
Structure and function of Cell and Cellular components, Membrane Potential, Action Potential - Generation and Conduction, Blood Cell - Composition, Fluid and electrolytic balance, Blood Groups - ABO and Rh System, Estimation - RBC and WBC.

UNIT II CARDIOVASCULAR AND NERVOUS SYSTEM   (9 Hrs)
Cardiovascular system - Heart and vascular system, ECG, Blood Pressure, Homeostasis, Cardiac Cycle, Basics of Cardiac Output and Heart Sounds
Nervous System - Structure and functions of Neurons, Synapse, Reflex action and Receptors, Velocity of Conduction of Nerve Impulses, Nervous control of Heart.

UNIT III MUSCULO SKELETAL AND RESPIRATORY SYSTEM   (9 Hrs)
Musculo Skeletal System - Muscle Tissue, Structure of Skeletal Muscle, Types of Muscle, Types of Joints, Major Muscles of Limbs and their actions.
Respiratory system - Physiological aspects of respiration, Exchange of gases, Regulation of Respiration, Disturbance of respiration function, Pulmonary Function Test, Artificial respiration, Cardio-Pulmonary Resuscitation.

UNIT IV URINARYSYSTEM   (9 Hrs)
Gastro Urinal system - Digestion and absorption, Movement of GI tract, Structure and function of kidneys and Nephron, Mechanism of Urine formation, Urine Reflex, Skin and Sweat Gland - Temperature regulation.

UNIT V ENT SYSTEM   (9 Hrs)

Optics of Eye - Retina, Photochemistry of Vision, Accommodation Neurophysiology of Vision, EOG, Structure and functions Internal Ear, Mechanism of Hearing, Auditory pathway, Hearing Tests.

Text Books
1. Guyton, "Text book of Medical Physiology", Tenth edition, WB Jaunder company Philadelphia, 2010
2. Elaine.N. Marieb, "Essential of human Anatomy and Physiology", Eight edition, Pearson Education New Delhi, 2010
3. C.L.Ghai, "A textbook of Practical physiology" Fifth edition, Jaypee Medical Publishers, 2013

Reference Books
1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, "Fundamentals of Anatomy and Physiology", Pearson Publishers, 2014
2. Gillian Pocock, Christopher D. Richards, "The Human Body - An introduction for Biomedical and Health Sciences", Oxford University Press, USA, 2013
3. William F.Ganong, "Review of Medical Physiology", 22nd Edition, McGraw Hill, New Delhi, 2010
4. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", W.B. Saunders Company, 2015
5. Guyton and Hall, "Medical Physiology", Thirteenth Edition, Elsevier Saunders, 2015

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2. https://www.khanacademy.org/
3. https://www.youtube.com/channel/UCJayvjGvKEblkA3KYK1BQQw
4. https://www.britannica.com/browse/Anatomy-Physiology

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	-	-	-	1	-	-	-	-	1	-	-
2	3	3	2	-	-	-	-	1	-	-	-	-	2	-	-
3	3	3	2	-	-	-	-	1	-	-	-	-	2	-	-
4	3	3	2	-	-	-	-	1	-	-	-	-	2	-	-
5	3	3	2	-	-	-	-	1	-	-	-	-	2	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

L	T	P	C	Hrs
2	2	0	3	60

U19BMT36   **BIOSIGNALS AND SYSTEMS**

Course Objectives
- To understand classifications, properties of signal and systems
- To know the methods of characterization of LTI-CT systems in time domain
- To introduce Z transform and their properties
- To know the methods of characterization of LTI-DT systems in frequency domain
- To learn discrete fourier transform, properties of DFT and its application to linear filtering

Course Outcomes
After completion of the course, the students will be able to
CO1 - Distinguish the continuous and discrete-time signals and systems **(K2)**
CO2 - Capable of characterizing LTI-CT systems in the time domain **(K3)**
CO3 - Understand the concepts of Z-transform and discrete Fourier transform **(K3)**
CO4 - Capable of characterizing LTI-DT systems in the frequency domain **(K4)**
CO5 - Apply DFT for the analysis of digital signals and systems **(K4)**

UNIT I BASICS OF DISCRETE AND CONTINUOUS TIME SIGNALS AND SYSTEMS   **(12 Hrs)**
Generation, representation of discrete time signals and continuous time signals, standard discrete time signals, standard continuous time signals. **Classification of signals:** Continuous time (CT) Discrete time (DT) signals, Mathematical operations on CTS and DTS-scaling, folding, time shifting, addition and multiplication.
Classification of systems - static and dynamic systems, time invariant and time variant, linear and nonlinear systems, causal and non-causal systems, stable and unstable systems Basic bio signal measurements

UNIT II LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS   **(12 Hrs)**
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in analysis of CT systems - Systems connected in series / parallel.

UNIT III TRANSFORMS OF DISCRETE TIME SIGNALS   **(12 Hrs)**
Z transform-properties-region of convergence- representation of poles and zeros in z transform, Inverse z transform-Power series expansion, Partial Fraction method, residue method, Discrete time Fourier transform-properties, Relation between Z transform and DTFT

UNIT IV LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS   **(12 Hrs)**
Impulse response, Difference equations, Convolution sum, Discrete Fourier Transform and Z Transform Analysis of Recursive and Non-Recursive systems-DT systems connected in series and parallel.

UNIT V DISCRETE FOURIER TRANSFORMS   **(12 Hrs)**

Discrete Fourier transform (DFT) - properties of DFT, periodicity, symmetry, circular convolution, Linear filtering using DFT, Filtering long data sequences - overlap save and overlap add method, Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT), Linear filtering using FFT.

Text Books

1. B. P. Lathi, "Principles of Linear Systems and Signals", Third Edition, Oxford University Press, 2012.
2. Allan V. Oppenheim, Allan S.Willsky and S.HamidNawab, "Signals and Systems", Second Edition, PHI Learning, New Delhi, 2010.
3. P. Ramesh Babu, "Signals and Systems", Fifth Edition, Scitech Publishers, 2014.

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1. A. Anand Kumar, "Signals and systems", Third edition PHI learning Pvt. Ltd., 2015.
2. M.J. Roberts, "Signals and Systems: Analysis using transform methods and MATLAB", Second edition,Tata McGraw Hill, 2012.
3. Suresh R, Devashayam, "Signals and Systems in Biomedical Engineering", Second edition, Springer US, 2013.
4. Dr Chitode "Signals and system", Technical Publications 2014.
5. A.Nagoor Kani,"Digital Signal Processing", 2nd edition, McGraw Hill Education, 2016.

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2. http://freevideolectures.com/Course/3177/Signals-and-Systems
3. https://nptel.ac.in/courses/117/101/117101055/
4. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Electrical%20and%20Comm%20Engg/Signals%20and %20System/Course_home2.20.html
5. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Electrical%20and%20Comm%20Engg/Signals%20and %20System/Course_home4.30.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	2	2	-
2	3	2	1	1	-	-	-	-	-	-	-	-	2	2	-
3	3	2	1	1	-	-	-	-	-	-	-	-	2	2	-
4	3	2	1	1	-	-	-	-	-	-	-	-	2	2	-
5	3	2	1	1	-	-	-	-	-	-	-	-	2	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

	DATA STRUCTURES LABORATORY	L	T	P	C	Hrs
U19BMP31	(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS)	0	0	2	1	30

Course Objectives

- To understand the basic concepts of Data Structures.
- To learn about the concepts of Searching Techniques.
- To explore about the concepts of Sorting Techniques.
- To know about the linear Data Structures.
- To study about non-linear Data Structures.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Analyze the algorithm's / program's efficiency in terms of time and space complexity.**(K3)**
CO2 - Solve the given problem by identifying the appropriate Data Structure.**(K3)**
CO3 - Solve the problems of searching and sorting techniques. **(K3)**
CO4 - Solve problems in linear Data Structures.**(K4)**
CO5 - Solve problems in non-linear Data Structures. **(K4)**

List of Exercises

1. Write a C program to implement recursive and non-recursive i) Linear search ii) Binary Search.
2. Write a C program to implement i) Bubble sort ii) Selection sort iii) Insertion sort iv) Shell sort v) Heap sort.
3. Write a C program to implement the following using an array. a) Stack ADT b) Queue ADT
4. Write a C program to implement list ADT to perform following operations a) Insert an element into a list.
   b) Delete an element from list c) Search for a key element in list d) count number of nodes in list.
5. Write a C program to implement the following using a singly linked list. a) Stack ADT b) Queue ADT.
6. Write a C program to implement the dequeue (double ended queue) ADT using a doubly linked list and an array.
7. Write a C program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.

8. Write a C program that use recursive functions to traverse the given binary tree in
   a) Preorder b) Inorder and c) Postorder.
9. Write a C program to perform the AVL tree operations.
10. Write a C program to implement Graph Traversal Techniques.

Reference Books

A. பால்

1. Yashavant Kanetkar, "Data Structures through C", BPB Publications, 3rd edition, 2019.
2. Gav.pai, "Data Structures and Algorithms", McGraw-Hill India, 1st edition, 2013.
3. Manjunath Aradhya M and Srinivas Subramiam, "C Programming and Data Structures", Cengage India 1st edition, 2017.
4. Reema Thareja, "Data structures using C", 2nd edition, Oxford University, 2014.
5. Tenebaum Aaron M, "Data Structures using C', Pearson Publisher, 1st edition, 2019.

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2. https://www.w3schools.in/data-structures-tutorial/intro/
3. https://nptel.ac.in/courses/106103069/
4. https://swayam.gov.in/nd1_noc20_cs70/preview
5. https://nptel.ac.in/courses/106103069/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
2	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
3	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
4	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
5	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19BMP32	**ELECTRON DEVICES AND CIRCUITS LABORATORY**	**L**	**T**	**P**	**C**	**Hrs**
		0	0	2	1	30

Course Objectives
- To conduct experiment and verify the basic Semiconductor diode characteristics.
- To study experimentally the characteristics of BJT,FET
- To understand the operation of UJT and thyristors
- To understand the applications of diodes
- To study PCB Simulation Tool

Course Outcomes
After completion of the course, the students will be able to
CO1 - Analyse the characteristic of PN Junction diode and Zener diode **(K4)**
CO2 - Experiment the characteristics of various transistors and analyse its characteristics (**K4)**
CO3 - Construct and analyse the applications of diodes **(K4)**
CO4 - Measure voltage and frequency of the waveform using CRO and plot the frequency response **(K4)**
CO5 - Construct transistor circuit using PCB Simulation Tool **(K4)**

List of Experiments
1. Characteristic analysis of PN Junction Diode (V-I Characteristics of Forward and Reverse Bias)
2. Characteristic analysis of Zener Diode (V-I Characteristics of Forward and Reverse Bias)
3. Characteristic analysis of BJT (Input and output characteristics)
4. Characteristic analysis of JFET devices (Drain and Transfer Characteristics)
5. Negative resistance characteristics of UJT
6. Characteristic analysis of Thyristors
7. Analysis of wave shaping circuits (Clippers and Clampers)
8. Design and analysis of Half wave Rectifiers and Full wave rectifiers
9. Study of frequency response of BJT Amplifier
10. Study of PCB Simulation Tool
11. Deign and study of Transistor as a switch using Simulation tool
12. Soldering of components on the PCB and testing (Regulated power supply)

Text Books
1. Jacob Millman,Chritos C Halkias, "Electronic Devices and Circuits", Fourth edition. McGraw Hill Education India Private Ltd., 2015.
2. Robert L. Boylestad, "Electronic Devices and Circuit Theory", Eleventh Edition, 2015
3. Thomas L.Floyd, "Electronic device", Tenth Edition, Pearson prentice hall, 2018.

Reference Books

1. Donald A Neaman, "Semiconductor Physics and Devices", Fourth edition, McGraw Hill Education India Private Ltd., 2011
2. Salivahanan, "Electron Devices and Circuits", Fourth edition, McGraw Hill Education India Private Ltd., 2016
3. Sedra and Smith, "Microelectronic Circuits, Fifth Edition, Oxford University Press, 2012
4. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits", Second edition, PHI learning private limited, 2014.
5. David A. Bell, "Electronic Devices and Circuits", Prentice Hall of India, 5th Edition, 2008

Web References

1. www.allaboutcircuits.com
2. www.circuitstoday.com
3. www.tutorialspoint.com
4. www.nptel.ac.in

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	3	2	1	-	-	1	-	-	1	3	1	1
2	3	2	1	1	2	2	-	-	1	-	-	1	2	1	1
3	3	2	1	3	2	1	-	-	1	-	-	1	3	1	2
4	3	1	1	3	2	2	-	-	1	-	-	2	3	2	2
5	3	1	1	1	2	2	-	-	1	-	-	1	3	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19BMP33	**BIOSENSORS AND TRANSDUCERS LABORATORY**	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives
- To study and analyze the practical characteristics of the various transducers for the measurement of the vital physiological signals
- To get familiar with the various types of transducers and to study the compatibility for any clinical measurements
- To know the practical application of different biotransducers
- To get familiar with different types of bioelectrode placement
- To analyse the characteristics of ultrasound transducers

Course Outcomes
After completion of the course, the students will be able to

CO1 - Perform temperature, pressure and displacement measurement using relevant sensors / transducers **(K3)**

CO2 - Study the characteristics of an LDR, load cell and pH electrodes **(K3)**

CO3 - Perform torque measurement with strain gauge **(K4)**

CO4 - Study the characteristics of biotransducers and bioelectrodes **(K4)**

CO5 - Analyse the characteristics of Polarized Electrodes, Non-polarized Electrodes and Multi Point Electrodes **(K4)**

List of Experiments
1. Temperature measurement using AD590 IC sensor
2. Displacement measurement by using a capacitive transducer
3. Study of the characteristics of a LDR
4. Pressure and displacement measurement by using LVDT
5. Study of a load cell with tensile and compressive load
6. Torque measurement Strain gauge transducer
7. Study and characterize Biotransducers – Pressure, Temparature, Humidity
8. Study and characterize Bioelectrodes – ECG, EMG, EEG
9. Study and Characterize pH electrodes
10. Characteristics of Ultrasound Transducer and Phono Transducer.
11. Determination of characteristics of Polarized Electrodes, Non-polarized Electrodes and Multi Point Electrodes

Text Books
1. A.K.Sawhney, "A Course in Electrical and Electronic measurements and Instruments", DhanpatRai and Sons, 2010.
2. Prof. Ping Wang andDr.QingjunLiu , "Biomedical Sensors and Measurement ",First Edition, Springer Publications", 2011.
3. Tatsuo Togawa ,Toshiyo Tamura andAke Oberg, " Biomedical Sensors and Instruments", Second Edition, CRC Press Taylor and Francis Group, 2011.

Reference Books

1. R.Anandanatarajan, "Biomedical Instrumentation and measurements", Second Edition, PHI Learning, December 2015.
2. Ernest O Doebelin and Dhanesh N Manik, "Measurement Systems, Applications and Design", Fifth edition MC Graw-Hill, 2011.
3. Michael J. McGrath, CliodhnaNíScanaill, "Sensor Technologies: Healthcare, Wellness and Environmental Applications,Apress, 2013.
4. Richard S.C. Cobbold , " Transducers for Biomedical Measurements: Principles and Applications ", John Wiley and Sons, 2004.
5. Nandini K. Jog, "Electronics in Medicine and Biomedical Instrumentation ", Second Edition, PHI, 2013.

Web References

1. http://www.gvpcew.ac.in/unit%202.pdf
2. http://www.123seminarsonly.com/Seminar-Reports/018/31005914-Notes-on-Transducers.pdf
3. https://nptel.ac.in/courses/108/108/108108147/
4. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf
5. https://www.uvpce.ac.in/content/biomedical-transducers-and-biosensors-laboratory

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	1	-	-	1	3	1	1
2	3	-	-	-	-	-	-	-	1	-	-	1	3	1	1
3	3	3	3	3	3	-	-	-	1	-	-	1	3	1	1
4	3	3	3	3	3	-	-	-	1	-	-	1	3	1	1
5	3	3	3	3	3	-	-	-	1	-	-	1	3	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

		L	**T**	**P**	**C**	**Hrs**
U19BMC3X	**CERTIFICATION COURSE - I**	0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

	L	T	P	C	Hrs
U19BMS31 **GENERAL PROFICIENCY-I**	0	0	2	-	30

Course Objectives
- To enrich strong vocabulary and decoding skills through comprehension analysis
- To advance communication and leadership skills pragmatically
- To pronounce English sounds in isolation and in connected speech
- To expand effective written communication skills to meet organizational goals
- To extend knowledge on verbal aptitude and prepare for interviews

Course Outcomes
After completion of the course, the students will be able to
CO1 - Interpret *meaning and apply reading* strategies in technical and non-technical context **(K2)**
CO2 - Develop interpersonal communication skills professionally **(K3)**
CO3 - Infer the distinct speech sounds and overcome native language influence **(K2)**
CO4 - Demonstrate various forms of formal writing **(K2)**
CO5 - Apply the techniques of verbal aptitude in competitive exams **(K3)**

UNIT I COMPREHENSION ANALYSIS (6 Hrs)
Listening: Listening Comprehension (IELTS based) – **Speaking**: Break the iceberg - **Reading:** Reading technical passage (IELTS based) - **Writing:** Writing Task: 1 (IELTS: Graph/ Process /Chart Description) **Vocabulary:** Synonyms (IELTS)

UNIT II PERSONALITY DEVELOPMENT (6 Hrs)
Listening: Interview Videos- **Speaking:** Extemporeand Presentation (Soft Skills) - **Reading:** British and American Vocabulary, Read and review (Books, Magazines) - **Writing**: SWOT Analysis **Vocabulary:** Idioms (IELTS)

UNIT III INFERENTIAL LEARNING (6 Hrs)
Listening: Listening Speech sounds to overcome Mother Tongue Influence, Anecdotes– **Speaking**: Interpersonal Interaction and Situational attribution–**Reading**: Distinguish between facts and opinions - **Writing:** Writing Conversation to different context **Vocabulary:** Phrasal Verbs (IELTS)

UNIT IV INTERPRETATION AND FUNCTIONAL WRITING (6 Hrs)
Listening: Group Discussion videos - **Speaking:** Group Discussion Practice - **Reading:** Interpretation of data - Graph, table, chart, diagram (IELTS based) -**Writing**: Writing Task: 2 (IELTS) **Vocabulary:** Collocations (IELTS)

UNIT V APTITUDE (6 Hrs)
Language Enhancement: Articles**,** Preposition, Tenses
Verbal Ability Enhancement: Blood Relation, Completing Statements- Cloze test, Spotting Errors-Sentence Improvement, One Word Substitution, Word Analogy, Word Groups(**GATE**)

Reference Books
1. Jeff Butterfield, "Soft Skills for Everyone", Cengage Learning, New Delhi, 2012.
2. Mn,Taylor, and Grant Taylor. "English Conversation Practice". Tata McGraw-Hill Education, 1975.
3. Bailey, Stephen. "Academic writing: A practical guide for students". Psychology Press, 2003.
4. Aggarwal, R. S. "A Modern Approach to Verbal and Non Verbal Reasoning". S. Chand, 2010.

5. Wren, Percival Christopher, and Wren Martin. "High School English Grammar and Composition",S Chand, 2005.

Web References

1. https://www.ielts-exam.net/grammar/
2. https://ieltsfocus.com/2017/08/02/collocations-ielts/
3. https://www.fresherslive.com/online-test/blood-relations-questions-and-answers
4. https://www.toppr.com/guides/english-language/reading-comprehension/cloze-test/
5. https://www.examsbook.com/word-analogy-test-questions-with-answers

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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1	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
2	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
3	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
4	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
5	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

		L	T	P	C	Hrs
U19BMS32	**SKILL DEVELOPMENT COURSE 2**	0	0	2	-	30

1. POWERPOINT PRESENTATION DESIGN AND ANIMATION

Course Content:

Module I: Getting acquainted with PowerPoint **(6 Hrs)**
Understanding and working with the PowerPoint interface including: the Outline and Slides pane, the Ribbon, Quick Access toolbar, notes pane and the Status Bar.

Module II: Objects and Formatting **(6 Hrs)**
Working with objects in PowerPoint. Copying and moving objects. Formatting including the format painter. Fonts and effects. Inserting new slides. Slide layout. Selecting multiple objects. Grouping objects. The different objects that you can include on a slide. Six slides that demonstrate the six content types: Table, Chart, Graphic, Picture, Clip art, Media clip (movie).

Module III: Slide Design **(6 Hrs)**
Templates and Slide Masters, How to use themes, masters and templates to make slide design quick and consistent. Layouts and footers. Principles of slide design - Principles to guide good, clean design and formatting of slides. Making your slides clearer. Creating professional-looking slides with real impact.

Module IV: Making an Impact **(6 Hrs)**
When and why to use images. How to insert and edit images. Cropping, resizing and manipulating images. Screenshots and videos. Removing picture backgrounds. Applying artistic effects.

Module V: Animation **(6 Hrs)**
Adding and controlling transition effects between slides. Detailed animation and transition options. Animating individual elements of text boxes, charts and diagrams. Presenter tools and features. Custom slide shows. Annotating your slide during a talk. Navigating a presentation. Self-running presentations.

Text Books
1. Joan Lambert, "Microsoft PowerPoint step by step 2016", Microsoft Press, 2016
2. Curtis Frye, Joan Preppernau, and Joyce Cox, "Microsoft® Office PowerPoint® 2007 Step by Step", Microsoft Press, 2015
3. John Walkenbach, Michael R. Groh, Herb Tyson, Faithe Wempen, "Office 2010 Library: Excel 2010 Bible, Access 2010 Bible, PowerPoint 2010 Bible, Word 2010 Bible", John Wiley & Sons, 2010

Reference Books
1. Joan Lambert, "Microsoft PowerPoint step by step 2019", Microsoft Press, 2019
2. David W. Beskeen, "Illustrated Course Guide: Microsoft PowerPoint 2013 Advanced" Cengage Learning, 2014
3. Joan Preppernau and Joyce Cox, "PowerPoint 2010", Microsoft Press, 2010
4. "Microsoft PowerPoint 2013", John Wiley and Sons, 2013

5.   Ann Shaffer and Katherine T. Pinard, "New Perspectives Microsoft Office 365 & PowerPoint 2016: Intermediate", Course Technology, 2016

Web References

1.   https://smallbusiness.chron.com/bibliography-powerpoint-40572.html
2.   https://bookboon.com/en/powerpoint-ebooks
3.   https://penandthepad.com/cite-book-powerpoint-8344519.html
4.   https://www.bookdepository.com/category/1931/PowerPoint

2.   MASTERS IN MICROSOFT EXCEL

Course Content:

Module I: Excel Basics   (6 Hrs)
About Excel, The Excel environment, The Title Bar – The Ribbon – Scroll Bars – The MS Office Button – The Quick Access Toolbar – The Formula Bar – The Workbook Window – The Status bar – The Workbook View Buttons – The Zoom Slider – the Mini toolbar – Keyboard Shortcuts.

Module II: Data handling   (6 Hrs)
Sorting & Filtering: Techniques for sorting and filtering data, including controlling the order of precedence in a sort, advanced filters, and an introduction to PivotTables. Using sorting and filtering to check and 'clean' data. Controlling user input: Controlling the way users can enter data into a spreadsheet to reduce risk of error and increase efficiency. Covers Data Validation and using IS- functions to trap errors. Working with Text: Entering and formatting text, extracting or combining parts of text. 'Cleaning' data for typos and bugs. Lookup & Reference: Looking up information in a basic table, and more flexibly. VLOOKUP() and the more flexible INDEX()/MATCH() combination. Advanced lookups.

Module III: Formatting   (6 Hrs)
Cell Formatting - Basic font formatting, alignment – Including horizontal and vertical alignment, wrapping, merging, orientation, Alt-Return; consistent, sensible row heights & column. Number Formatting - Types of number (E.g., currency, %, decimal, negative numbers) – and Excel formats best employed. Custom number formats and how to maximise impact and clarity. Conditional Formatting - Changing the format of cells depending on their value. Graphical conditional formats. Writing conditional format formulas.

Module IV: Presentation   (6 Hrs)
Graphs and Charts - Creating simple charts and editing them to control and improve formatting. Choosing the right chart Principles and guidelines for communicating well with charts. Sparkline's and Maps (when and how to use). Page & Print Setup - Displaying spreadsheets as pages. Page layout view, page breaks, print area,. Printing from multiple Worksheets (and that default will be to print only from active Worksheet). Headers and footers. Adjusting page setup. Printing very large sheets of data And finally printing!

Module V: Advanced Excel Capabilities   (6 Hrs)
Conditional formatting, Importing data and text to columns, Functions – Mathematical, String, IF, AND, OR, Searching: match, search, vlookup, Dates, Misc, Pivot tables, Recording and editing Macros.

Text Books
1. Michael Alexander, "Excel 2007 Dashboards and Reports for Dummies", John Wiley & Sons, 2011
2. Ellen Monk, Spring Davidson, Joseph Brady, "Problem Solving Cases in Microsoft Access and Excel", Cengage Learning, 2009
3. Colleen Conmy, Bill Hazlett, Bill Jelen, Adrienne Soucy, "Excel for Teachers", Tickling Keys, 2010

Reference Books
1. Noreen Brown, Barbara Lave, Julie Romey, "Beginning Excel 2019", Open Oregon Educational Resources, 2017
2. Greg Harvey, "Excel 2019 All-in-One For Dummies", John Wiley & Sons, 2018
3. John Walkenbach, "Excel 2007 Bible", John Wiley & Sons, 2011
4. Matthew MacDonald, "Excel 2010: The Missing Manual", O'Reilly Media, Inc., 2010
5. Rob Bovey, Stephen Bullen, Dennis Wallentin, John Green, "Professional Excel Development: The Definitive Guide to Developing Applications Using Microsoft Excel, VBA, and .NET", Addison-Wesley Professional, 2009

Web References
1. https://www.google.com/search?q=ms+excel+working&oq=MS+Excel+working&aqs=chrome.0.0i457j0l3j0i22i30l4.9421j0j4&sourceid=chrome&ie=UTF-8
2. https://www.investintech.com/resources/blog/archives/5430-excel-data-tips.html
3. https://edu.gcfglobal.org/en/excel2010/working-with-basic-functions/1/
4. https://www.online-tech-tips.com/ms-office-tips/microsoft-excel-basics-tutorial-learning-how-to-use-excel/
5. https://spreadsheeto.com/how-to-use-excel/

3. MICROSOFT WORD DOCUMENTATION

Course Content:

Module I: Getting Familiar and Document Navigation   (6 Hrs)
Introduction, Interface Overview, Common Buttons, Tabs and Ribbons, What's The Flashing Line, How Navigation Tips Help, Using The Slider, Keyboard Navigation Tips, Using Browse Objects Tools, Selecting Text Options

Module II: Manipulating Text and Formatting   (6 Hrs)
Introduction, Page Layout, Cut, Copy, Paste, Move, Find and Replace, How Formatting Makes a Difference, Changing Fonts, Typical Text Format Options, Bullet and Numbered Lists, Other Formatting Tools, Line Spacing, What Are Quick Styles, More Quick Styles, Creating A New Quick Style, Paragraph Marks

Module III: Themes and Templates   (6 Hrs)
Introduction, Applying Themes, Opening Existing Templates, Creating Templates, Working With Existing Content, Quick Parts – Options, Creating Quick Parts, Quick Parts - Inserting Fields, Quick Parts - Inserting Images

Module IV: Organizing Content (6 Hrs)
Introduction, Creating Lists, Creating and Formatting Tables, Converting Text To Tables, Table Borders and Shading, Creating Columns, Creating Tabular Lists, Creating Charts, Character Spacing, Inserting Shapes, Inserting Images, Using Word Art, Using Text Boxes, Sorting Text, Using Smart Art

Module V: Review, Protect, Share, and Print (6 Hrs)
Introduction, Document Views, Split Screen View, Tracking Changes, Collaboration options, Combining and Approving Changes, Using Comments, Compatibility Checker, Previous Word Versions Compatibility, Digital Signatures, Restricting Permissions, Spell and grammar Check, Saving a Document, Printing and Preview Options

Text Books
1. Alexander Mamishev, Murray Sargent, "Creating Research and Scientific Documents Using Microsoft Word", Microsoft Press, 2014
2. Jennifer Duffy, Carol Cram, "Microsoft Word 2010: Illustrated Complete", Cengage Learning, 2010
3. Geoff Evelyn, John Pierce, "MOS 2010 Study Guide for Microsoft Word Expert, Excel Expert, Access, and SharePoint Exams", Pearson Education, 2011

Reference Books
1. Ann Shaffer and Katherine T. Pinard, "New Perspectives Microsoft Office 365 & PowerPoint 2016: Intermediate", Course Technology, 2016
2. Diane Koers, "Picture Yourself Learning Microsoft Word 2010", Cengage Learning, 2014
3. Gary B. Shelly, Misty E. Vermaat, "Microsoft Word 2010: Complete", Cengage Learning, 2010
4. Pasewark/Pasewark, Katherine T. Pinard, "Microsoft Word 2010 Introductory", Cengage Learning, 2012
5. Jennifer Duffy, "Microsoft Word 2013: Illustrated Introductory", Cengage Learning, 2013

Web References
1. https://www.investintech.com/resources/articles/beginnersmsoffice/
2. https://www.javatpoint.com/ms-word-tutorial
3. https://www.tutorialspoint.com/word/index.htm
4. https://www.thewindowsclub.com/microsoft-word-tutorial-for-beginners

		L	**T**	**P**	**C**	**Hrs**
U19BMM31	**PHYSICAL EDUCATION**	0	0	2	-	30

Physical Education is compulsory for all the Undergraduate students and Pass in this course is mandatory for the award of degree. Physical Education activities will include games and sports/extension lectures. The student participation shall be for minimum period of 30 hours. Physical Education activities will be monitored by the Director of Physical Education. Pass/Fail will be determined on the basis of participation, attendance, performance and conduct. If a candidate fails, he/she has to repeat the course in the subsequent years.

U19BMT41	**PROBABILITY AND QUEUEING THEORY**	L	T	P	C	Hrs
	(Common to MECHANICAL, BME)	2	2	0	3	60

Course Objectives

- Apply fundamental knowledge of the basic probability concepts.
- To introduce knowledge of standard discrete distributions.
- To acquire knowledge on Probability Distributions.
- To understand strength and weakness of Queuing model.
- To gain strong knowledge in principles of Queuing theory.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the fundamental knowledge of the probability concepts. **(K2)**
CO2 - Apply the basic rules of discrete random variables. **(K3)**
CO3 - Apply the fundamentals of probability theory and random processes. **(K3)**
CO4 - Understand and extend Queuing models to analyse real world systems. **(K2)**
CO5 - Apply the knowledge of Queuing theory in computer field. **(K3)**

UNIT I PROBABILITY AND RANDOM VARIABLE (12 Hrs)

Axioms of probability - Conditional probability - Total probability – Bayes theorem– Moments–Moment generating functions and their properties.

UNIT II DISCRETE RANDOM VARIABLES (12 Hrs)

Random Variables and their event spaces, Random variable – Probability mass function – Probability density function- Distribution functions, Binomial, Geometric, Negative Binomial and Poisson.

UNIT III CONTINUOUS RANDOM VARIABLES (12 Hrs)

Some important distributions: Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties – Functions of a random variable.

UNIT IV QUEUING MODELS (12 Hrs)

Markovian queues – Birth and Death processes – Single and multiple server queuing models – Little's formula – Queues with finite waiting rooms – Queues with impatient customers: Balking and reneging.(M/M/I):(∞/FIFO), (M/M/I):(N/FIFO), (M/M/C):(∞/FIFO), (M/M/C):(N/FIFO)

UNIT V ADVANCED QUEUING MODELS (12 Hrs)

Finite source models – M/G/1 queue – Pollaczek-Khinchin formula – M/D/1 and M/EK/1 as special cases – Series queues – Open Jackson networks.

Text Books

1. N.P Bali. and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.
2. T. Veerarajan," Probability and Statistics, Random Process and Queuing Theory", McGraw Hill Education, 2018

B.Tech. Biomedical Engineering

3. P. Sivaramakrishna Das, C. Vijayakumari , "Probability and Queuing Theory", Pearson Education, 6th Edition, 2019

Reference Books

1. C.Gupta, B. Shree Ram Singh, M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi,10thEdition 2019.
3. John F. Shortle, James M. Thomson, Donald Gross, "Fundamental of Queuing theory", 5th Edition, Wiley series., 2018.
4. M.Bhatt and Ravish R Singh, "Probability and Statistics", McGraw Hill Education, 2017.
5. P. Kandasamy, K. Thilagavathi. and K. Gunavathi., "Probability and Queuing Theory",S.Chand&Co. Pvt. Ltd,2015

Web References

1. http://www.maths.qmul.ac.uk/~pjc/notes/prob.pdf
2. https://nptel.ac.in/courses/117/103/117103017/
3. https://youtu.be/COI0BUmNHT8
4. https://nptel.ac.in/courses/111107119/
5. http://www.sasurieengg.com/e-course-material/

COs/POs/PSOs Mapping

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1	2	1	-	-	-	1	-	-	-	-	-	1	2	-	-
2	3	2	1	1	-	1	-	-	-	-	-	1	2	-	-
3	3	2	1	1	-	1	-	-	-	-	-	1	2	-	-
4	2	1	-	-	-	1	-	-	-	-	-	1	1	1	-
5	3	2	1	1	-	1	-	-	-	-	-	1	1	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

	PROGRAMMING IN JAVA	**L**	**T**	**P**	**C**	**Hrs**
U19BMT42	(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To gain and explore the knowledge of java programming
- To know the principles of inheritances, packages, interfaces
- To get familiarized to generic programming, multithreading concepts.
- To gain and explore the advanced concepts in Java.
- To explore database connectivity

Course Outcomes

After completion of the course, the students will be able to

CO1 - Write a maintainable java Program for a given algorithm and implement the same. **(K2)**

CO2 - Demonstrate the use of inheritance, interface and package in relevant applications. **(K3)**

CO3 - Create java applications using exception handling, thread and generic programming. **(K3)**

CO4 - Build java distributed applications using Collections and IO streams. **(K3)**

CO5 - Exemplify simple graphical user interfaces using GUI components and database programs. **(K3)**

UNIT I INTRODUCTION TO JAVA PROGRAMMING   (9 Hrs)

The History and Evolution of Java - Byte code - Java buzzwords - Data types – Variables – Arrays – operators - Control statements - Type conversion and casting. Concepts of classes and objects: Basic Concepts of OOPs, constructors, static keyword, Final with data, Access control, This key word - Garbage collection- Nested classes and inner classes - String class

UNIT II INHERITANCE, PACKAGES AND INTERFACES   (9 Hrs)

Inheritance: Basic concepts - forms of inheritance - super key word – method overriding, abstract classes, dynamic method dispatch - the Object class. Packages: Defining, Creating and Accessing, importing packages. Interfaces: Defining, implementing, applying, variables and extending interfaces

UNIT III EXCEPTION HANDLING, MULTITHREADING   (9 Hrs)

Concepts of Exception handling, types of exceptions, creating own exception, Concepts of Multithreading, creating multiple threads, Synchronization, inter thread communication. Enumeration - Autoboxing - Generics.

UNIT IV COLLECTIONS, I/O STREAMS   (9 Hrs)

Collections: List –Vector – Stack - Queue – Dequeue –Set - SortedSet. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.

UNIT V EVENT DRIVEN PROGRAMMING AND JDBC   (9 Hrs)

Events - Delegation event model - Event handling - Adapter classes. AWT: Concepts of components - Font class, Color class and Graphics. - Introduction to Swing – layout management - Swing Components. Java Database Connectivity- Develop real time applications.

Text Books

1. Herbert Schildt, "Java: The Complete Reference", TMH Publishing Company Ltd, Eleventh Edition, 2018.
2. Sagayaraj, Denis, Karthik, Gajalakshmi , "JAVA Programming for core and advanced learners" , Universities Press Private Limited, 2018
3. Herbert Schildt, "The Complete Reference JAVA 2", TMH, Seventh Edition, 2006.

Reference Books

1. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9thEdition, Prentice Hall, 2013.
2. H.M.Dietel and P.J.Dietel, "Java How to Program", Pearson Education/PHI , 11thEdition, , 2017.
3. Cay.S.Horstmann and Gary Cornell, "Core Java, Vol 2, Advanced Features", Pearson Education, 8th Edition, 2008.
4. "Java for Programmers", P.J. Dietel and H.M Dietel,Pearson Education (OR) JAVA:
5. "Programming in Java", S. Malhotra and S. Choudary, Oxford Univ. Press.

Web References

1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM's tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog
5. https://www.geeksforgeeks.org

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	3	-	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

	L	**T**	**P**	**C**	**Hrs**
U19BMT43 **BIOSIGNAL PROCESSING**	2	2	0	3	60

Course Objectives
- To understand the characteristics of digital filters, design digital IIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the characteristics of digital filters, design digital FIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the effects of finite precision representation on digital filters
- To gain knowledge on the signal processing techniques used for ECG in cardiology
- To gain knowledge on the signal processing techniques used for EEG in neurology

Course Outcomes
After completion of the course, the students will be able to
CO1 - Design and implement IIR digital filters **(K4)**
CO2 - Design and implement FIR digital filters **(K4)**
CO3 - Characterise the effects of finite precision representation on digital filters **(K3)**
CO4 - Know the process of analysing ECG Signals **(K4)**
CO5 - Know the process of analysing EEG Signals **(K4)**

UNIT I INFINITE IMPULSE RESPONSE FILTERS   (12 Hrs)
Characteristics of practical frequency selective filters. Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analogdomain.Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT II FINITE IMPULSE RESPONSE FILTERS   (12 Hrs)
Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

UNIT III FINITE WORD LENGTH EFFECTS   (12 Hrs)
Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.

UNIT IV CARDIOLOGICAL SIGNAL PROCESSING   (12 Hrs)
Pre-processing of ECG signal, QRS detection Methods-Differentiation-based and template-based. Rhythm analysis and Arrhythmia detection algorithms. Automated ECG analysis. Data compression techniques: Turning Point algorithm, AZTEC, CORTES, and the KL transform. Adaptive filters, Weiner filter principles, LMS and RLS, medical Applications of Adaptive Noise Cancellation.

UNIT V NEUROLOGICAL SIGNAL PROCESSING   (12 Hrs)

Stochastic process. Linear prediction. Yule-Walker equations. Auto Regressive Modelling of EEG signal. Detection of EEG Rhythms, Template matching for EEG spike-and-wave detection, Detection of EEG spike-and-wave complexes, Coherence analysis of EEG channels, Adaptive segmentation of EEG signals. Sleep stage analysis using Markov model. Analysis of evoked potential using Prony's method.

Text Books

1. John L. Semmlow, Benjamin Griffel , "Biosignal and Medical Image Processing", CRC Press,2014
2. Willis J. Tompkins , "Biomedical Digital Signal Processing", Prentice-Hall of India Pvt. Ltd., 2012
3. Christoph Hintermuller , "Advanced Biosignal Processing and Diagnostic Methods", In Tech Open, 2016

Reference Books

1. Jonathan Wolpaw and Elizabeth Winter Wolpaw, "Brain-Computer Interfaces: Principles and Practice", Oxford University Press, 2012.
2. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling", Wiley-India, 2010.
3. StephaneMallat, "Wavelet Tour of Signal Processing: The Sparse Way", Third edition. Academic Press, 2011.
4. Kayvan Najarian Robert Splinter "Biomedical Signal and Image Processing" by Taylor & Francis Group, LLC, Second edition. 2012
5. Li Tan , Jean Jiang "Digital Signal Processing fundamentals and Applications", Second edition, Academic Press, 2013

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1. https://www.youtube.com/watch?v=S_U-s27nPLE
2. https://www.youtube.com/watch?v=bFeYjFtSsrg
3. https://www.journals.elsevier.com/biomedical-signal-processing-and-control/recent-articles
4. https://www.classcentral.com/course/swayam-biomedical-signal-processing-10069
5. https://nptel.ac.in/content/syllabus_pdf/108105101.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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3	2	2	3	3	3	2	-	-	-	-	-	1	3	3	-
4	3	3	3	3	3	2	-	-	-	-	-	1	3	3	-
5	3	3	3	3	3	2	-	-	-	-	-	1	3	3	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

	L	T	P	C	Hrs
U19BMT44 ANALOG AND DIGITAL INTEGRATED CIRCUITS	3	0	0	3	45

Course Objectives
- To study the basics of digital circuits and combinational circuits.
- To understand flip flop and counters.
- To learn the linear and non-linear applications of operational amplifiers.
- To introduce the concepts of active filters and waveform generators
- To introduce the theory and applications of timer, PLL and data converters.

Course Outcomes
After completion of the course, the students will be able to
CO1 - Realize Number systems and construction of combinational circuits **(K3)**
CO2 - Construct and study the function of sequential circuits **(K3)**
CO3 - Categorize the linear a**n**d non-linear applications of operational amplifiers **(K3)**
CO4 - Explain the function of active filters and waveform generation **(K3)**
CO5 - Describe the operation and applications of Timer, PLL and data converters **(K3)**

UNIT I NUMBER SYSTEM AND COMINATIONAL LOGIC CIRCUITS   (9 Hrs)
Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization-Design of Half and Full Adders-Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder.

UNIT II REGISTERS AND COUNTERS   (9 Hrs)
Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF-Design of Counters- Ripple Counters, MOD N Counter- Ring Counters, Shift registers, Universal Shift Register.

UNIT III OPERATIONAL AMPLIFIERS   (9 Hrs)
Characteristics of Ideal Operational Amplifier-DC and AC performance characteristics, slew rate, Open and closed loop configurations –Linear application of op amp-Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier.

UNIT IV ACTIVE FILTERS AND SIGNAL GENERATOR   (9 Hrs)
Active filters-Low-pass, high-pass, Band reject and band-pass Butterworth filters. Oscillators-RC phase shift and Wein bridge type-Waveform generators -Sine-wave generator and Triangular wave generator, Multivibrators,

UNIT V TIMER PLL AND DATA CONVERTERS   (9 Hrs)
555 timers and its applications- mono stable and Astable multivibrator-phase locked loop (IC 565) and its applications. IC 723 general purpose regulator –Digital to Analog converter (DAC)-Weighted resistor DAC, R-2R ladder DAC, Analog to digital converter (ADC) - Flash type ADC, successive approximation ADC and dual slope ADC.

Text Books

1. D. Roy Choudhry, Shail Jain, "Linear Integrated Circuits", Fifth Edition, New Age International Pvt. Ltd., 2018,
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Fourth Edition, Tata Mc Graw-Hill, 2016.
3. M. Morris Mano and Michael D. Ciletti, "Digital Design", Fifth Edition, Pearson, 2014

Reference Books

1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", Fourth Edition, Prentice Hall / Pearson Education, 2015
2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2010.
3. S.Salivahanan& V.S. KanchanaBhaskaran, "Linear Integrated Circuits", Second Edition, TMH, 4th Reprint, 2016.
4. S.Salivahanan and S.Arivazhagan. "Digital Electronics", First Edition, Vikas Publishing House pvt Ltd, 2012
5. A.Anand Kumar, "Fundamentals of Digital Circuits", Fourth Edition, PHI Learning Private Limited, 2016.

Web References

1. https://www.tutorialspoint.com/digital_circuits/index.htm
2. https://www.tutorialspoint.com/digital_circuits/index.htm
3. https://e-box.co.in/linear-integrated-circuits.shtml
4. https://www.tutorialspoint.com/linear_integrated_circuits_applications/index.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	1	-	-	1	-	1	1	3	3	-
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3	3	3	1	3	2	1	-	-	1	-	1	1	3	3	2
4	3	3	2	3	2	1	-	-	1	-	1	1	3	3	-
5	3	3	3	3	2	1	-	-	1	-	1	1	3	3	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

	PROGRAMMING IN JAVA LABORATORY	**L**	**T**	**P**	**C**	**Hrs**
U19BMP41	(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS)	**0**	**0**	**2**	**1**	**30**

Course Objectives

□ To acquire programming skill in core java.
□ To learn how to design java program and applications.
□ To acquire object-oriented skills in java.
□ To develop the skill of designing applications.
□ To explore database connectivity.

Course Outcomes

After completion of the course, students will be able to

CO1 - Apply and practice logical formulations to solve simple problems leading to specific applications. **(K3)**
CO2 - Demonstrate the use of inheritance, interface and package in relevant applications. **(K3)**
CO3 - Create java applications using exception handling, multithread. **(K3)**
CO4 - Build java distributed applications using Collections and IO streams. **(K3)**
CO5 - Develop simple database programs. **(K3)**

List of Experiments

1. Develop simple programs using java technologies and testing tools.
2. Develop a java program that implements class and object.
3. Write a java program to demonstrate inheritance.
4. Develop a simple real life application program to illustrate the use of Multi Threads.
5. Implement simple applications using Collections.
6. Develop a simple application and use JDBC to connect to a back-end database.
7. Create a student application with Add, Edit, Delete, Show functions using JDBC.
8. Create a Bill Application to store sales details using JDBC.
9. Create java applications using Exception Handling for error handling.
10. Develop a java program that implements the Packages.

Reference Books

1. E. Balaguruswamy, "Programming with Java", TMH Publ, 2nd Edition, 2005.
2. JAVA How to programming by DIETEL & DIETEL.
3. Herbert Schil dt, "The Complete Reference JAVA 2", TMH, Seventh Edition, 2006.
4. Cay.S.Horstmann and Gary Cornell, "Core Java 2", Vol 2, Advanced Features, Pearson Education, Seventh Edition, 2010.

Web References

1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM's tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog
5. ttps://www.geeksforgeeks.org

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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2	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19BMP42	**BIOSIGNAL PROCESSING USING MATLAB**	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To familiarize the students with various computation techniques involved in signal processing.
- To introduce the theory and application of IIR and FIR filters along with its implementation.
- To impart knowledge on the various types of errors that affect signals during digital signal processing.
- To learn the characteristics of various bio signals.
- To learn the properties of Fourier Transform.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the computation of convolution and analysis of various systems **(K2)**
CO2 - Implement the FIR and IIR filters in various applications **(K3)**
CO3 - Analyse the spectrum and noise removal of biomedical signals **(K3)**
CO4 - Simulate and analyse Bio signals **(K3)**
CO5 - Analyses various Fourier transform properties **(K4)**

List of Experiments

1. Generation of Discrete and Continuous time signals
2. Linear and Circular Convolution
3. Auto Correlation and Cross Correlation
4. Frequency analysis using DFT
5. ECG and Arrhythmia signal generation
6. Spectrum analysis and noise removal of biomedical signals
7. ECG Data reduction algorithms
8. Detection of QRS Component from ECG signal.
9. Down sampling and up-sampling of ECG signals
10. IIR Filter Design
11. FIR Filter Design
12. Design of Notch filter for elimination of 50Hz from ECG Signal
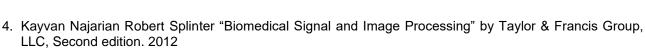13. Measurement of respiration rate using thermistor

Text Books

1. John L. Semmlow, Benjamin Griffel , "Biosignal and Medical Image Processing", CRC Press,2014
2. Willis J. Tompkins , "Biomedical Digital Signal Processing", Prentice-Hall of India Pvt. Ltd., 2012
3. Christoph Hintermuller , "Advanced Biosignal Processing and Diagnostic Methods", InTechOpen, 2016

Reference Books

1. Jonathan Wolpaw and Elizabeth Winter Wolpaw, "Brain-Computer Interfaces: Principles and Practice", Oxford University Press, 2012.
2. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling", Wiley-India, 2009.
3. Stephane Mallat, "Wavelet Tour of Signal Processing: The Sparse Way", Third edition. Academic Press, 2011.

4. Kayvan Najarian Robert Splinter "Biomedical Signal and Image Processing" by Taylor & Francis Group, LLC, Second edition. 2012
5. Li Tan , Jean Jiang   "Digital Signal Processing fundamentals and Applications", Second edition, Academic Press, 2013

Web References
1. https://www.youtube.com/watch?v=S_U-s27nPLE
2. https://www.youtube.com/watch?v=bFeYjFtSsrg
3. https://www.journals.elsevier.com/biomedical-signal-processing-and-control/recent-articles
4. https://www.classcentral.com/course/swayam-biomedical-signal-processing-10069
5. https://nptel.ac.in/content/syllabus_pdf/108105101.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	3	2	1	-	1	-	-	1	3	2	-
2	3	2	2	1	3	2	1	-	1	-	-	1	3	2	-
3	3	2	-	-	3	2	1	-	1	-	-	1	3	2	-
4	3	2	3	3	3	2	1	-	1	-	-	1	3	2	-
5	3	2	3	3	3	2	1	-	1	-	-	1	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

		L	**T**	**P**	**C**	**Hrs**
U19BMP43	**INTEGRATED CIRCUITS LABORATORY**	0	0	2	1	30

Course Objectives
- To examine combinational logic circuits
- To realize flip flop and counters
- To design the op-amp for various applications
- To analyse active filters and its response
- To understand the working of data converters and multivibrators

Course Outcomes
After completion of the course, students will be able to
CO1 - Investigate the functions of logic gates **(K3)**
CO2 - Realize Combinational and sequential circuits **(K3)**
CO3 - Demonstrate the applications of Operational Amplifier **(K4)**
CO4 - Evaluates the performance of Active filters **(K4)**
CO5 - Analyse the working of Data converters and Multivibrator **(K4)**

COURSE CONTENTS
1. Realization of different gates like AND, OR, NOT, NAND, NOR, EX-OR and EX-NOR.
2. Construction of simple arithmetic circuits-Adder, Subtractor.
3. Construction of simple Decoder and Multiplexer circuits using logic gates.
4. Realization of RS, JK and D flip-flops using Universal logic gates.
5. Realization of Shift Register using flip-flops and logic gates.
6. Realization of Universal Register using multiplexer and flip-flops.
7. Realization of Asynchronous Up/Down counters
8. Design of Summer, Subtractor, differentiator and integrator using op-amp
9. Design of instrumentation amplifier for bio-signal acquisition
10. Design of half wave and full wave rectifier using op-amp
11. Design of RC phase shift oscillator and Wien bridge oscillator using op-amp
12. Design of first and second order active low pass filter
13. Design of weighted resistor DAC and R-2R ladder DAC using op-amp
14. Design of Multivibrator using IC 555

Text Books
1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", Fifth Edition, New Age International Pvt. Ltd., 2018,
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Fourth Edition, Tata Mc Graw-Hill, 2016.
3. M. Morris Mano and Michael D. Ciletti, "Digital Design", Fifth Edition, Pearson, 2014

Reference Books

1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", Fourth Edition, Prentice Hall / Pearson Education, 2015
2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2010.
3. S.Salivahanan& V.S. KanchanaBhaskaran, "Linear Integrated Circuits", Second Edition, TMH, 4th Reprint, 2016.
4. S.Salivahanan and S.Arivazhagan. "Digital Electronics", First Edition, Vikas Publishing House pvt Ltd, 2012
5. A.Anand Kumar, "Fundamentals of Digital Circuits", Fourth Edition, PHI Learning Private Limited, 2016.

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2. https://www.tutorialspoint.com/digital_circuits/index.htm
3. https://e-box.co.in/linear-integrated-circuits.shtml
4. https://www.tutorialspoint.com/linear_integrated_circuits_applications/index.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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4	3	3	2	3	2	1	-	-	1	-	1	1	3	3	-
5	3	3	3	3	2	1	-	-	1	-	1	1	3	3	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

		L	T	P	C	Hrs
U19BMC4X	**CERTIFICATION COURSES**	0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

U19BMS41	GENERAL PROFICIENCY–II	L	T	P	C	Hrs
		0	0	2	-	30

Course Objectives
- To examine various standardized test in English language
- To recognize the key features of various technical writing
- To integrate LSRW skills to endorse multifarious skill set in practical situation
- To understand the factors that influence the usage of grammar
- To understand the basic concepts of logical reasoning skills

Course Outcomes
After completion of the course, the students will be able to

CO1 - Infer ideas to attend international standardized test by broadening receptive and productive skills **(K2)**

CO2 - Interpret the types of writing in different state of affairs **(K2)**

CO3 - Develop language skills professionally to groom the overall personality through sensitizing various etiquettes in real time situation **(K3)**

CO4 - Identify the rules of grammar in academic discourse settings **(K3)**

CO5 - Extend the skills to compete in various competitive exams like GATE, GRE, CAT, UPSC, etc**. (K2)**

UNIT I - CAREER SKILLS   (6 Hrs)
Listening: Listening at specific contexts **Speaking:** Mock interview (Personal & Telephonic)-**Reading**: Read and Review -Newspaper, Advertisement, Company Handbooks, and Guidelines (IELTS based) **Writing:** Essay Writing (TOEFL) **Vocabulary:** Words at specified context (IELTS)

UNIT II - CORPORATE SKILLS   (6 Hrs)
Listening: Listening and replicating **Speaking**: Team Presentation (Work Place Etiquettes) **Reading:** Short texts (signs, emoticons, messages) **Writing:** E-mail writing- Hard skills -Resume' Writing, Job Application Letter, Formal Letter **Vocabulary:** Glossary (IELTS)

UNIT III - FUNCTIONAL SKILLS   (6 Hrs)
Listening: Listening TED Talks – **Speaking:** Brainstorming &Individual Presentation, Persuasive Communication –- **Reading:** Text Completion (GRE Based) **Writing:** Expansion of Compound Words **Vocabulary:** Expansion of vocabulary (IELTS)

UNIT IV - TRANSFERABLE SKILLS   (6 Hrs)
Listening: Listening Documentaries and making notes –**Speaking:** Conversation practice at formal & informal context   **Reading:** Read and transform- report, memo, notice and advertisement, **Writing:** Euphemism, Redundancy, and Intensifiers **Vocabulary:** Refinement of vocabulary (IELTS)

UNIT V - APTITUDE   (6 Hrs)
Transformational Grammar: Phrases & Clauses, Concord, Conditional Clauses, Voice, Modals
Verbal Ability Enhancement: Letter Series, Coding &Decoding**,** Sentence Completion (GATE), Critical Reasoning & Verbal Deduction (GATE), Syllogism

Reference Books

1. Lougheed, Lin. "Barron's Writing for the TOEFL IBT: With Audio CD". Barron's Educational series, 2008.
2. Tulgan, Bruce**. "Bridging the soft skills gap: How to teach the missing basics to today's young talent". John Wiley & Sons, 2015.
3. Sherfield, Robert M. "Cornerstone: Developing Soft Skills". Pearson Education India, 2009.
4. Cullen, Pauline, Amanda French, and Vanessa Jakeman**. "The official Cambridge guide to IELTS for academic & general training".Cambridge, 2014.
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1. https://www.englishclub.com/grammar/nouns-compound.htm
2. https://lofoya.com/Verbal-Test-Questions-and-Answers/Sentence-Completion/l3p1
3. https://www.grammarwiz.com/phrases-and-clauses-quiz.html
4. https://www.clarkandmiller.com/25-english-euphemisms-for-delicate-situations/
5. http://www.englishvocabularyexercises.com/general-vocabulary/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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3	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
4	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
5	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

		L	**T**	**P**	**C**	**Hrs**
U19BMS42	**SKILL DEVELOPMENT COURSE 4**	0	0	2	-	30

1. TROUBLE SHOOTIING OF MEDICAL EQUIPMENTS

Course Content:

1. Rules of Engagements
2. Blood Pressure Monitor Equipment (Manual)
   a. Preventive Maintenance
   b. Dissembling a Mercury Manometer
   c. Mercury handling protocol
3. Cell Counter Equipment
   a. Preventive maintenance
   b. Run a test cycle
   c. Adjustments of Probe and unclogging aperture
   d. Checking Motor Functions
   e. Lamp Functions and Allignments
4. Centrifuge Equipment
   a. Preventive Maintenance
   b. Checking Motor Functions
   c. RPM Measurements
   d. Bypassing Interlock
5. Microscope
   a. Preventive Maintenance
   b. Checking Light Source
   c. Adjustments of Knobs
   d. Ensuring the amount of Lubricants

Reference Books

1. Justin Cooper and Alex Dahinten, "Medical Equipment Troubleshooting Flowchart Handbook" Published by: Engineering world health, Vesion- 6, 2013

Web References

1. https://www.youtube.com/watch?v=whp2pnCBs6s
2. https://www.youtube.com/watch?v=EJJVrCm3YT4
3. https://www.youtube.com/watch?v=T0QmUe0bwL8
4. https://www.youtube.com/watch?v=3kXnL0AQhYA
5. https://www.usms.biz/preventive-maintenance-for-medical-devices/

2. PCB BOARD DESIGNING
Course Content:

MODULE 1: INTRODUCTION TO PCB DESIGNING CONCEPTS   (6 Hrs)
Introduction & Brief History - What is PCB, Difference between PWB and PCB, Types of PCBs: Single Sided (Single Layer), Multi-Layer (Double Layer), PCB Materials? Introduction to Electronic design Automation

(EDA) - Brief History of EDA, Latest Trends in Market, How it helps and why it requires, Different EDA tools, Introduction to SPICE and PSPICE Environment, Introduction and Working of PROTEUS.

MODULE 2: COMPONENT INTRODUCTION AND THEIR CATEGORIES   (6 Hrs)
Types of Components - Active Components, Passive Components, Component Package Types - Through Hole Packages: Axial lead o Radial Lead, Single Inline Package(SIP), Dual Inline Package(DIP), Transistor Outline(TO), Pin Grid Array(PGA), Through Hole Packages: Metal Electrode Face(MELF), Leadless Chip Carrier(LCC), Small Outline Integrated Circuit(SOIC), Quad Flat Pack(QPF) and Thin QFP (TQFP), Ball Grid Array(BGA), Plastic Leaded Chip Carrier(PLCC)

MODULE 3: INTRODUCTION TO DEVELOPMENT TOOLS   (6 Hrs)
Introduction to PCB Design using OrCAD tool, Introduction to PCB Design using PROTEUS tool

MODULE 4: DETAILED DESCRIPTION AND PRACTICAL OF PCB DESIGNING   (6 Hrs)
PCB Designing Flow Chart - Schematic Entry, Net listing, PCB Layout Designing, Prototype Designing - Design Rule Check(DRC), Design For Manufacturing(DFM), PCB Making - Printing, Etching, Drilling, Assembly of components. Description of PCB Layers - Electrical Layers, Mechanical Layers, Documentation Layers, PCB Materials, Rules for Track, Study of IPC Standards

MODULE 5: DESIGNING AND FABRICATION PROCESS   (6 Hrs)
Starting the PCB designing, Understanding the schematic Entry, Creating Library & Components, Drawing a Schematic, Flat Design / hierarchical Design, Setting up Environment for PCB, Design a Board Auto routing - Introduction to Auto routing, Setting up Rules, Defining Constraints, Auto router Setup, PCB Designing Practice, Post Designing & PCB Fabrication Process.

Reference Books
1. Christopher T Robertson, Printed Circuit Board Designer's Reference; Basics, Prentice Hall Modern Semiconductor Design, 2003
2. Bosshart, Printed Circuit Boards: Design and Technology, Tata McGraw-Hill Education, 1983
3. R. S. Khandpur, Printed Circuit Boards, McGraw-Hills, 2005.
4. Charles A. Harper, High Performance Printed Circuit Boards, McGraw Hill Professional, 2000
5. Jon Varteresian, Fabricating Printed Circuit Boards, Newnes, 2002

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1. https://www.electronics-notes.com/articles/analogue_circuits/pcb-design/how-to-design-pcb-board-basics.php
2. https://www.circuitbasics.com/make-custom-pcb/
3. https://learn.sparkfun.com/tutorials/pcb-basics/all
4. https://www.pcbpower.com/
5. https://www.build-electronic-circuits.com/pcb-design/

3. TESTING OF ELECTRONIC MEDICAL DEVICES
Course Content:

MODULE 1: TESTING OF ELECTRICAL EQUIPMENTS **(6 Hrs)**

AC, DC power supply, Grounding, shielding, Guarding, insulation testing, insulation resistance measurement, Types of Circuit Breakers, Rating – Testing of circuit breakers –Transformer testing- Earthing –Earth wires - Earthing of appliances –contactor, relay testing–CT and PT, Panel wiring- Megger-Testing equipment and instruments

MODULE 2: TESTING OF ELECTRONIC COMPONENTS **(6 Hrs)**

Troubleshooting of PCB boards, Calibration of analog and digital sensor probe, Display interface, DC Power supply design, testing, Safe electrical practice, Cables and standard, Fuse

MODULE 3: TESTING OF SURGICAL EQUIPMENT **(6 Hrs)**

Functions and operating procedure-Testing and maintenance of Heart lung machine, surgical lights, ventilator, patient monitor, anesthesia machine, dialyzer, surgical tools.

MODULE 4: TESTING OF ICU EQUIPMENTS **(6 Hrs)**

X-ray machines, Testing of ECG recorders, incubator, baby warmer, infusion pumps, annual maintenance, contract requirements, vendor services, quality and safety standards.

MODULE 5: LIFE CYCLE MANAGEMENT OF MEDICAL EQUIPMENT **(6 Hrs)**

Cost of the medical equipment, maintenance cost, replacement analysis, managing equipment service, decision making, extracting optimal benefit from medical equipment over its life cycle, Case study.

Reference Books

1. Joseph. J Carr, John M Brown, Introduction to Biomedical Equipment Technology, John Wiley& Sons, New York, 4th edition, 2008.
2. Keith Willson, Keith Ison, Slavik Tabakov, "Medical equipment management", CRC Press, UK, 2014.
3. Jenny Dooley,John Lehnert Virginia Evans, "Career Paths: Medical Equipment Repair", Express Publishing, UK,2018
4. Shakti Chatterjee, Aubert Miller, "Biomedical Instrumentation systems", Cengage Learning Technology & Engineering, 2010.
5. David Herres, "Troubleshooting and Repairing Commercial Electrical Equipment", McGraw Hill Professional edition, 2013.

Web References

1. https://www.element.com/connected-technologies/electronics-test-methods
2. https://www.electronics-notes.com/articles/test-method
3. https://www.element.com/more-sectors/medical-device
4. https://www.metlabs.com/industries/medical-device-testing/
5. https://www.intertek.com/medical/

		L	T	P	C	Hrs
U19BMM41	**INDIAN CONSTITUTION**	2	0	0	-	30

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21.

	L	T	P	C	Hrs
U19BMT51 **BIO STATISTICS**	2	2	0	3	60

Course Objectives

- To familiarize the concept Mean, median, mode and Standard deviation.
- To understand the concept of Correlation and Regression analysis
- To learn Analysis of variance.
- To learn the concept of testing of hypothesis using statistical analysis.
- To learn the concept of Small sampling.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Solve problems related to Bar diagrams and Pie diagrams. **(K3)**

CO2 - Find the nature of correlation and regression. **(K3)**

CO3 - Analyse the applications of variance. **(K3)**

CO4 - Understand the applications of large samples. **(K2)**

CO5 - Solve the problems related to testing of hypothesis in small samples **(K3)**

UNIT I MEASURE OF DISPERSION (12 Hrs)

Collection - Classification and Tabulation of data, Bar diagrams and Pie diagrams, Histogram-Frequency curve and frequency polygon, Ogive, Mean, median, mode, Standard deviation.

UNIT II CORRELATION AND REGRESSION ANALYSIS (12 Hrs)

Correlation and Regression analysis: Relation between two variables- scatter diagram- definition of correlations - Two regression lines- Karl Pearson's coefficient of correlation, Rank correlation, Tied ranks.

UNIT III DESIGN OF EXPERIMENTS (12 Hrs)

Analysis of variance – One way and two-way classifications – Completely randomized design – Randomized block design – Latin square design - 22 Factorial design.

UNIT IV LARGE SAMPLES (12 Hrs)

Curve fitting by the method of least squares – fitting of straight lines – second degree parabolas and more general curves – Test of significance: Large samples test for single proportions, differences of proportions, single mean, difference of means and standard deviations.

UNIT V SMALL SAMPLES (12 Hrs)

Test for single mean – Difference of means and correlations of coefficients – Test for ratio of variances – Chi-square test for goodness of fit and independence of attributes. Case study under t-test and Chi square test

Text Books

B.Tech. Biomedical Engineering

1. Irfan A Khan,"Fundamentals of Biostatistics",Ukaaz Publication 5th edition, 2016.
2. PSS Sunder Rao,"An introduction to Biostatistics",PHI Learning Pvt Ltd ,2012
3. Moore and McCabe, "Introduction to the Practice of Statistics",WH Freeman, 9th Edition ,2009.

Reference Books

1. Marcello Pagano, "Principles of Biostatistics", 7th edition, 2015.
2. Course Manuals: S-PLUS Command Line Essentials, the Analysis of Microarrays
3. Richard.A. Johnson, Irwin Miller and John E.Freund ," Probability and Statistics for Engineers", 9th Edition ,Pearson Education, 2018
4. P. Kandasamy K. Thilagavathy and K. Gunavathi.,"Probability and Queuing Theory",S.Chand & Co, Pvt.Ltd.2015
5.Dr.G. Balaji," Probability and Statistics",G.Balaji Publishers,2017

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1.   https://www.youtube.com/watch?v=_e4mwlqCQrc
2.   https://www.youtube.com/watch?v=lQW_sWL_sfQ
3.   https://www.youtube.com/watch?v=75pQPB1RF50
4.   https://www.digimat.in/nptel/courses/video/102101056/L01.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-
2	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-
3	2	1	-	-	-	1	-	-	-	-	-	1	2	2	-
4	2	1	-	-	-	1	-	-	-	-	-	1	2	2	-
5	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-

Correlation Level: 1-Low, 2-Medium, 3- High

B.Tech. Biomedical Engineering

U19BMT52	BIOMECHANICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basics of biomechanics
- To describe the properties of blood, bone and soft tissues
- To gain knowledge about the mechanics of moving systems
- To understand Cardiac mechanisms
- To study respiratory Biomechanics

Course Outcomes

After completion of the course, the students will able to

CO1 - Describe the fundamentals of biomechanics. **(K2)**
CO2 - Analyse the properties, functions of hard and flexible tissues **(K3)**
CO3 - Describe the types and mechanics of skeletal joints and movement mechanics **(K2)**
CO4 - Explain the mechanical properties of Cardiac system. **(K2)**
CO5 - Understand the respiratory mechanisms **(K2)**

UNIT I INTRODUCTION TO BIOMECHANICS (9 Hrs)

Review of the principles of mechanics, Vector mechanics- Resultant forces of Coplanar and Non coplanar, Concurrent and non-concurrent forces, parallel force in space, Equilibrium of coplanar forces, Newton's laws of motion, Work and energy, Moment of inertia.

UNIT II TISSUE BIOMECHANICS (9 Hrs)

Hard Tissues: Bone structure and properties of bones, cortical and cancellous bones, type of fractures, biomechanics of fracture healing. **Soft Tissues:** Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle; Material Properties: Cartilage, Tendon, Ligament, and Muscle.

UNIT III JOINTS AND MOVEMENT BIOMECHANICS (9 Hrs)

Joints - forces and stresses in human joints, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, hip, knee and ankle. Body and limbs- mass and motion characteristics actions, forces transmitted by joints. Biomechanics of push - like motions, Biomechanics of throw - like motions.

UNIT IV CARDIAC BIOMECHANICS (9 Hrs)

Cardiovascular system, Mechanical properties of blood vessels: arteries, arterioles, capillaries, and veins. artificial heart valves, biological and mechanical valves development, testing of valves.

UNIT V RESPIRATORY BIOMECHANICS (9 Hrs)

Alveoli mechanics, Interaction of blood and lung, P-V curve of lung, breathing mechanism, Airway resistance, lung diseases.

Text Books

1. Gerhard A. Holzapfel, Ray W. Ogden, "Mechanics of Biological Tissue", Springer, 2010.

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2. Sean P. Flanagan and Flanagan, "Biomechanics: A case based Approach", Jones and Bartlett Publishers, 2018.
3. Carol A. Oatis, "The Mechanics and Pathomechanics of Human Movement", Lippincott Williams and Wilkins, 2010.

Reference Books

1. Ozkaya, N, Leger, D, Goldsheyder, D, Nordin, M, "Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation", 4th edition. Springer International Publishing, 2017.
2. Donald R. Peterson and Joseph D. Bronzino," Biomechanics: principles and applications", third edition. CRC Press, 2011.
3. Ray W. Ogden, "Biomechanics of Soft Tissue in Cardiovascular Systems", Springer Vienna, 2014.
4. Subrata Pal, "Text book of Biomechanics", Viva education Private limited, New Delhi. 2009
5. Susan J.Hall, "Basics Bio Mechanics" 5th Edition, McGraw-Hill Publishing Co, Newyork, 2007.

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2. https://tinyurl.com/y8osnq6d
3. https://tinyurl.com/y78y4cvy

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
2	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
3	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
4	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
5	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2

Correlation Level: 1-Low, 2-Medium, 3- High

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	L	T	P	C	Hrs
U19BMT53 **BIOMEDICAL INSTRUMENTATION**	3	0	0	3	45

Course Objectives
- To acquire knowledge in the basics of bio potential electrodes
- To understand the different types of electrodes and its placement for various recordings
- To design bio amplifier for various physiological recording
- To learn the different measurement techniques for non-physiological parameters.
- Understand the design aspects of various assist and therapeutic devices

Course Outcomes
After completion of the course, students will be able to
CO1 - Gain knowledge in electrodes and its functions. **(K2)**
CO2 - Illustrate different electrode placement for various physiological recordings. **(K3)**
CO3 - Analyse bio amplifier for various physiological recordings. **(K4)**
CO4 - Explain various techniques for non-electrical physiological measurements. **(K3)**
CO5 - Investigate various assist and therapeutic devices. **(K3)**

UNIT I BIOPOTENTIAL ELECTRODES (9 Hrs)
Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes – Electrode-tissue interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes, Needle electrodes

UNITII BIOPOTENTIAL MEASUREMENTS (9 Hrs)
Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven 's triangle, standard 12 lead system, Principles of vector cardiography.EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of ERG, EOG and EGG

UNIT III SIGNAL CONDITIONING CIRCUITS (9 Hrs)
Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS (9 Hrs)
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods -Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT V ASSIST DEVICES AND RESPIRATORY DEVICES (9 Hrs)
Pacemakers - Defibrillators – Audiometry – Hearing aid, Ventilators, Spirometer, Lung Volume and capacities, Pneumo tachometers: different types

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Text Books

1. R. S. Khandpur, "Biomedical Instrumentation Technology and Applications", McGraw-Hill Professional, 2014.
2. Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd edition. PHI, 2008.
3. Raja Rao, C and Guha S.K, "Principles of Medical Electronics and Biomedical Instrumentation", Orient Longman Publishers, 2001

Reference Books

1. R. Anandanatarajan, "Biomedical Instrumentation", 2nd edition, PHI Learning, 2016.
2. Andrew G. Webb, "Principles of Biomedical Instrumentation", Cambridge University Press, 2018.
3. John G. Webster, "Medical Instrumentation: Application and Design", 4th edition. John Wiley and Sons, New York, 2010.
4. A.K. Sawhney, "A Course in Electrical and Electronic measurements and Instruments", DhanpatRai and Sons, 2015
5. M. Arumugam, "Biomedical Instrumentation",Anuradha Agencies Publishers, 2002.

Web References

1. https://apm.iitm.ac.in/biomedical/sai/
2. https://www.youtube.com/watch?v=iK-6q4nnmtA
3. https://www.youtube.com/watch?v=8m8yNSaCMpg

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	2	-	-	-	-	-	2	2	1	2
2	3	3	2	2	2	2	-	-	-	-	-	2	2	1	2
3	3	3	2	2	2	2	-	-	-	-	-	2	2	1	2
4	3	3	2	2	2	2	-	-	-	-	-	2	2	1	2
5	3	3	2	2	2	2	-	-	-	-	-	2	2	1	2

Correlation Level: 1-Low, 2-Medium, 3- High

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	L	T	P	C	Hrs
U19BMT54 **BIOCONTROL SYSTEMS**	2	2	0	3	60

Course Objectives

- To explain the system concepts and the different mathematical modelling techniques
- To analyse the given system in time domain
- To estimate the stability of the system using various techniques
- To estimate the frequency response of any system by using various plots
- To examine the state space analysis

Course Outcomes

After completion of the course, the students will able to

CO1 - Explain the concepts of different modelling systems. **(K3)**
CO2 - Analyse the time response analysis of different order systems and steady state error **(K4)**
CO3 - Determine the stability and root locus concepts. **(K4)**
CO4 - Analyse the frequency response using various plots. **(K4)**
CO 5- Investigate the state space analysis and biomedical applications. **(K4)**

UNIT I MODELLING OF SYSTEMS (12 Hrs)

Control system terminology - classification of control systems, feedback and its effects on overall gain, stability, noise and sensitivity , Open loop and closed loop control systems with physiological system examples- advantages and disadvantages ,Transfer function, modelling of electrical systems, Modelling of translational and rotational mechanical systems and electromechanical systems, analogous systems, Block diagram reduction technique ,Signal flow graph, conversion of block diagram to signal flow graph.

UNIT II TIME RESPONSE ANALYSIS (12 Hrs)

Standard test signals - step, ramp, parabolic and impulse type and order of a system, Time response of first order systems, Time response of second order systems, Transfer function-Time constant form and pole zero form, time domain specifications, Evaluation of time domain specifications, Steady state error and error constants and its computation.

UNIT III STABILITY ANALYSIS (12 Hrs)

Stability criterion- necessary conditions for stability, Determining the stability by Routh and Hurwitz criterion ,Root locus concepts ,Rules for the construction of root locus ,Sketching of root locus for various systems , Effect of adding poles and zeros to a system.

UNIT 1V FREQUENCY RESPONSE ANALYSIS (12 Hrs)

Frequency response - Frequency domain specifications, Polar plot, Bode plot, Nyquist Plot, Nyquist Stability criterion, Closed loop Stability, Constant M&N Circuits, Nicholas Chart.

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UNIT V STATE SPACE ANALYSIS AND BIOMEDICAL APPLICATIONS   (12 Hrs)

Introduction-general state space representation, Applying the state space representation, Converting a transfer function to state space, Converting from state space to a transfer function, Controllers-P, PI and PID controllers, Lung mechanics model with proportional control.

Text Books

1. Nagrath J and Gopal M, "Control system engineering", 5th edition, New Age International Publishers, 2011.
2. Rajeev Gupta, "Control systems engineering", 1st edition. Wiley India Pvt Ltd, 2011.
3. Michael C K Khoo, Physiological control systems-Analysis, simulation and estimation", Second edition, Prentice Hall of India, 2018.

Reference Books

1. Norman S Nice, "Control system engineering", 7th edition, Wiley India Pvt Ltd, 2015.
2. K R Varmah, "Control systems", 1st edition. Tata McGraw Hill, 2010.
3. Salivahanan," Control systems Engineering", Pearson Education India, 2015
4. K. Padmanabhan,"Control systems", Wiley India Pvt Ltd, 2020
5. A. Anand Kumar, Control systems, 2nd edition. PHI Learning Pvt Ltd, 2015.

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2. https://www.youtube.com/watch?v=QY9NTVh-Awo&list=PLDK4cGT3XCf3GovuGIqmp-mgfm8pXIPH6
3. https://www.youtube.com/watch?v=RJleGwXorUk

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	1	3	-	-	-	3	3	2	-
2	3	3	2	2	2	2	1	3	-	-	-	3	3	2	-
3	3	3	2	2	2	2	1	3	-	-	-	3	3	2	-
4	3	3	2	2	2	2	1	3	-	-	-	3	3	2	-
5	3	3	2	2	2	2	1	3	-	-	-	3	3	2	-

Correlation Level: 1-Low, 2-Medium, 3- High

B.Tech. Biomedical Engineering

U19BMP51	**STATISTICAL LABORATORY** (USING MAT LAB / ANOVA TABLE)	**L** 0	**T** 0	**P** 3	**C** 1	**Hrs** 30

Course Objectives
- To familiarize the concept of Uni-variate, bi-variate frequency distributions.
- To understand the concept of Measures of location and dispersion.
- To learn Rank correlation.
- To understand the concept of Regression Equations.
- To introduce the concepts of curve fitting.

Course Outcomes
After completion of the course, the students will be able to
CO1 - Draw the different types of curves. **(K3)**
CO2 - Understand the concept of Skewness and Kurtosis. **(K2)**
CO3 - Compute Correlation coefficient. **(K3)**
CO4 - Compute regression lines. **(K3)**
CO5 - Find the straight line and parabola.**(K3)**

List of Experiments
1. Construction of bar diagram
2. Construction of pie diagram
3. Construction of Mean,Median,Mode
4. Construction of standard deviation
5. Measures of Skewness and Kurtosis for both grouped and ungrouped data.
6. Computation of Correlation co-efficient.
7. Computation Rank correlation.
8. Regression Equations.
9. Fit a straight line
10. Fit a parabola

Text Books
1.Irfan A Khan,"Fundamentals of Biostatistics",Ukaaz Publication 5th edition, 2016.
2. PSS Sunder Rao,"An introduction to Biostatistics",PHI Learning Pvt Ltd ,2012
3. Moore and McCabe, "Introduction to the Practice of Statistics",WH Freeman,9th Edition ,2009.

Reference Books
1. Marcello Pagano, "Principles of Biostatistics", 7th edition, 2015.
2. Course Manuals: S-PLUS Command Line Essentials, the Analysis of Microarrays
3. Richard A. Johnson, Irwin Miller and John E. Freund," Probability and Statistics for Engineers",
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4. https://youtu.be/6MEdP4zMLuQ
5. https://www.youtube.com/watch?v=LMSyiAJm99g

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-
2	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-
3	2	1	-	-	-	1	-	-	-	-	-	1	2	2	-
4	2	1	-	-	-	1	-	-	-	-	-	1	2	2	-
5	3	2	1	1	-	1	-	-	-	-	-	1	2	2	-

Correlation Level: 1-Low, 2-Medium, 3- High

B.Tech. Biomedical Engineering

U19BMP32	**BIOMEDICAL INSTRUMENTATION LABORATORY**	L	T	P	C	Hrs
		0	0	3	1	30

Course Objectives

- To provide hands-on training on designing of bio signal acquisition system and measurement of physiological parameters.
- To acquire an adequate knowledge about measurement of various physiological parameters
- To understand the working of the biomedical instruments.
- To know about the stimulation of eye and its effects
- To understand the Artificial respiration and Cardio Pulmonary Resuscitation

Course Outcomes

After completion of the course, the students will be able to
 CO1 - Determine the heart axis in different leads and analyse the heart rate **(K4)**
 CO2 - Examine the blood pressure using sphygmomanometer **(K4)**
 CO3 - Investigate cardiac efficiency test, tuning fork tests for hearing **(K4)**
 CO4 - Explain the stimulation of eye, near point and near response **(K3)**
 CO5 - Demonstrate Artificial respiration and Cardio Pulmonary Resuscitation **(K4)**

List of Experiments

1. Determination of Heart Axis by measuring QRS amplitude in the different leads (Lead I, Lead II and Lead III) and Plotting Einthoven Triangle
2. Recording of blood pressure using sphygmomanometer and stethoscope
3. Measurements of various time intervals between each segment of ECG, Measurement of R-R interval and calculation of Heart Rate
4. Cardiac Efficiency Test
5. Measurement of Visually Evoked Potential
6. Galvanic Skin Resistance (GSR) Measurement
7. Peripheral pulse signal in different physical posture
8. EMG Signal for different stress on the muscle
9. Recording and interpretation of Heart sounds
10. Demonstration of Artificial respiration and Cardio Pulmonary Resuscitation
11. Determination of Nerve conduction velocity

Text Books

1. A.K.Sawhney ,"A Course in Electrical and Electronic measurements and Instruments" Dhanpat Rai and Sons, 2000.
2. Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd edition. PHI, 2018.

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3. Raja Rao, C and Guha S.K, "Principles of Medical Electronics and Biomedical Instrumentation", Orient Longman Publishers, 2001

Reference Books

1. R. Anandanatarajan, Biomedical Instrumentation. PHI Learning, 2009.
2. Andrew G. Webb, Principles of Biomedical Instrumentation. Cambridge University Press, 2018.
3. John G. Webster, "Medical Instrumentation: Application and Design", 4th edition. John Wiley and Sons, New York, 2010.
4. A.K. Sawhney, "A Course in Electrical and Electronic measurements and Instruments", Dhanpat Rai and Sons, 2015
5. M. Arumugam, "Biomedical Instrumentation", Anuradha Agencies Publishers, 2002.

Web References

1. https://www.uvpce.ac.in/content/biomedical-transducers-and-biosensors-laboratory
2. https://apm.iitm.ac.in/biomedical/sai/
3. https://www.electrical4u.com/introduction-to-biomedical-instrumentation/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	1	-	-	-	-	-	2	2	-	-
2	3	3	2	2	2	1	-	-	-	-	-	2	2	-	-
3	3	3	2	2	2	-	-	-	-	-	-	2	1	-	-
4	3	3	2	2	2	-	-	-	-	-	-	2	1	-	-
5	3	3	2	2	2	-	-	-	-	-	-	2	1	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

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	L	T	P	C	Hrs
U19BMP53 **COMPUTATION LAB**	0	0	3	1	30

Course Objectives

- To perform different operations on signal using MATLAB.
- To familiarize with the generation of different signals using MATLAB
- To simulate Transient analysis of signals
- To simulate frequency response and stability analysis
- To simulate state space model

Course Outcomes

After completion of the course, the students will be able to

CO1 - Perform different operations on signal using MATLAB**. (K4)**

CO2 - Familiarize with the generation of different signals **(K4)**

CO3 – Demonstrate Transient analysis of signals **(K4)**

CO4 -. Analyse frequency response and stability of systems **(K4)**

CO5 – Simulate state space model and Lung mechanics using transfer function. **(K4)**

List of Experiments

Simulation of experiments using MATLAB/SIMULINK

1. Generation of sequence and perform operation like shifting, folding, time scaling and multiplication.
2. Generation of Periodic, Exponential, Sinusoidal, Step, Impulse, Ramp signals
3. Transient Analysis of Impulse Response
4. Transient Analysis of Step Response
5. Determine the Time response of Second Order system
6. Frequency Domain Analysis of signals
7. Effect of P, PI, PID Controller on second order systems
8. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system.
9. State space model for classical transfer function
10. Simple Lung Mechanics using Transfer Function

Text Books

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, Signals and Systems. Pearson, 2007.
2. A Michael C K Khoo, Physiological control systems-Analysis, simulation and estimation", Second edition, Prentice Hall of India, 2018.
3 Shailendra Jai**n** , **"**Modeling and Simulation using MATLAB – Simulink", 2nd edition, Wiley 2015.

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Reference Books

1. B. P. Lathi, Principles of Linear Systems and Signals, 2nd ed. Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, Signals and Systems Continuous and Discrete. Pearson, 2007.
3. Nagrath J and Gopal M, "Control system engineering", 5th edition, New Age International Publishers, 2011.
4. Rajeev Gupta, "Control systems engineering", 1st edition. Wiley India Pvt Ltd, 2011.
5. Salivahanan," Control systems Engineering", Pearson Education India, 2015

Web References

1. https://www.sciencedirect.com/
2. http://www.springer.com
3. http://www.researchgate.net

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	1	2	1	3	2	1	1	3	3	1	-
2	3	3	3	2	1	2	1	3	2	1	1	3	3	1	-
3	3	3	3	2	1	2	1	3	2	1	1	3	3	1	-
4	3	3	3	2	1	2	1	3	2	1	1	3	3	1	-
5	3	3	3	2	1	2	1	3	2	1	1	3	3	3	-

Correlation Level: 1-Low, 2-Medium, 3- High

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	L	T	P	C	Hours
U19BMP54 **HOSPITAL TRAINING**	0	0	3	1	30

Course Objectives

- Give you the opportunity to observe medical professionals at work in the wards and the roles of Allied Health Professionals.
- Provide access to healthcare Professionals to get a better understanding of their work.
- Demonstrate patient-care in a hospital setting.

Course Outcome

After completion of the course, the students will able to

CO1 - Learn a patient-centered approach in healthcare.

CO2 - Communicate with other health professionals in a respectful and responsible manner.

CO3 - Recognize the importance of inter-professional collaboration in healthcare.

CO4 - Propose a patient-centered inter-professional health improvement plan based upon the patient's perceived needs.

CO5 - Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served.

Department Visit

1. Cardiology
2. Ophthalmology
3. ENT
4. Orthopaedic and Physiotherapy
5. ICU/CCU
6. Operation Theatre
7. Neurology
8. Nephrology
9. Radiology
10. Nuclear Medicine
11. Pulmonology
12. Urology
13. Obstetrics and Gynaecology
14. Emergency Medicine
15. Biomedical Engineering Department
16. Histo Pathology
17. Biochemistry
18. Pediatric and Neonatal
19. Dental
20. Oncology
21. PAC's

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22. Medical records/Telemetry

Text Books
1. Girdhar J Gyani and Alexander Thomas, "Handbook of Healthcare quality and patient safety", 2nd edition, Jaypee brothers medical publisher, 2019.
2. Shakti Kumar Gupta,Sunil Kant, R Chandrashekhar and Sidharth Satpathy,"Modern Trends in Planning & Designing of Hospitals: Principles and Practice", Jaypee, 2007.
3. Dr Malhotra's series, "Step by Step Hospital designing & planning", Jaypee, 2007.

Reference Books
1. Sonu Dr. Goel, "Textbook of Hospital Administration", Elsevier, 2014.
2. William Charney," Handbook of Modern Hospital Safety", 2nd edition, CRC press, 2010.
3. Cindy Taylor, "The Hospital Safety Professional's Handbook", 5th edition. HCPro, BLR, 2015.

Web References
1. https://en.wikipedia.org/wiki/Medical_equipment_management
2. http://www.who.int/hac/techguidance/preparedness/hospital_safety_index_forms.pdf
3. https://www.who.int/news-room/fact-sheets/detail/patient-safety
4. https://www.coursera.org/browse/health/healthcare-management
5. https://www.who.int/management/newitems/en/index1.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	3	2	-	-	-	-	-	2	2	3	3
2	3	3	3	2	3	2	-	-	-	-	-	2	2	3	3
3	3	3	3	2	3	2	-	-	-	-	-	2	1	3	3
4	3	3	3	2	3	2	-	-	-	-	-	2	1	3	3
5	3	3	3	2	3	2	-	-	-	-	-	2	1	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

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U19BMC5X	**CERTIFICATION COURSE – III**	**L**	**T**	**P**	**C**	**Hrs**
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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	SKILL DEVELOPMENT COURSE 5	L	T	P	C	Hrs
U19BMS51	(Foreign Language / IELTS – I)	0	0	2	-	30

Student should choose the Foreign Language/IELTS course like Japanese/French/ Germany/IELTS, etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and language Experts. The courses are to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation.

	SKILL DEVELOPMENT COURSE 6	L	T	P	C	Hrs
U19BMS52	(Presentation Skills using ICT)	0	0	2	-	30

The methodology used is "learning by doing", a hands-on approach, enabling the students to follow their own pace. The teacher, after explaining the project, became a tutor, answering questions and helping students on their learning experience.

CT skills

- Understand ICT workflow in cloud computing.
- Manage multitasking.
- Deal with main issues using technology in class.
- Record, edit and deliver audio and video.
- Automate assessments and results.

Teaching tools

- Different ways to create audiovisual activities.
- Handle audiovisual editors.
- Collaborative working.
- Individualize learning experience.
- Get instant feedback from students.

Each one of the students will be assigned an ICT Topic and the student has to conduct a detailed study and have to prepare a report, running to 15 or 20 pages for which a demo to be performed followed by a brief question and answer session. The demo will be evaluated by the internal assessment committee for a total of 100 marks. The marks attained for this course is not considered for CGPA calculation.

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U19BMM51	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C	Hrs
		2	0	0	-	30

Course Objectives

The course will introduce the students to
- To get a knowledge in Indian Culture
- To Know Indian Languages and Literature and the fine arts in India
- To explore the Science and Scientists of Medieval and Modern India

Course Outcomes

After completion of the course, the students will be able to
CO1- Understand philosophy of Indian culture.
CO2 -Distinguish the Indian languages and literature.
CO3 -Learn the philosophy of ancient, medieval and modern India.
CO4 - Acquire the information about the fine arts in India.
CO5 - Know the contribution of scientists of different eras.

UNIT - I Introduction to Culture

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India

UNIT - II Indian Languages, Culture and Literature:

Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages and literature

UNIT - III Religion and Philosophy

Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only)

UNIT – IV Fine Arts in India (Art, Technology& Engineering)

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT – V Education System in India

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

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Reference Books

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. S. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers,ISBN 13: 978-8120810990,2014

		L	T	P	C	Hr:
U19BMT61	**DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS**	3	0	0	3	45

Course Objectives

- To impart knowledge on Ultrasonic Techniques.
- To describe patient monitoring and Biotelemetry equipment's
- To understand the classification of Diathermy
- To introduce special diagnostic techniques.
- To study patient safety

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand Ultrasonic Techniques. **(K2)**
CO2 - Describe the patient monitoring and Biotelemetry. **(K3)**
CO3 - Understand the classification of Diathermy. **(K3)**
CO4 - Interpret special diagnostic techniques. **(K4)**
CO5 - Acquire knowledge in patient's safety. **(K3)**

UNIT I ULTRASONIC TECHNIQUES (9 Hrs)

Diagnosis-Basic principles of Echo technique - display techniques A, B and M mode - Application of ultrasound as diagnostic tool - Echocardiogram, abdomen - obstetrics and gynaecology.

UNIT II PATIENT MONITORING AND BIOTELEMETRY (9 Hrs)

ICU/CCU Equipment's - Infusion pumps - bed side monitors - Central consoling controls - Radio Telemetry (single, multi) - Portable and Landline Telemetry unit - Applications in ECG and EEG Transmission.

UNIT III DIATHERMY (9 Hrs)

IR and UV lamp and its application - Thermography - Recording and clinical application - Short wave diathermy - ultrasonic diathermy - Microwave diathermy - Electro surgery machine - Current waveforms, Tissue Responses - Electro surgical current level.

UNIT IV SPECIAL DIAGNOSTIC TECHNIQUES (9 Hrs)

Need for heart lung machine - functioning of bubble - disc type and membrane type oxygenators - finger pump - roller pump - electronic monitoring of functional parameter – Haemo Dialyzer unit – Lithotripsy- Principles of Cryogenic technique and application - Endoscopy, Laparoscopy.

UNIT V PATIENT SAFETY (9 Hrs)

Physiological effects of electricity - important susceptibility parameters – Macro shock – Micro shock hazards – Patient's electrical environment – Isolated Power system – Conductive surfaces – Electrical safety codes and standards – Basic Approaches to protection against shock - Protection equipment design - Electrical safety analyser

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– Testing the Electric system

Text Books

1. Leslie Cromwell," Biomedical Instrumentation and Measurement", Second edition. Prentice Hall, 2015.
2. John G. Webster, "Medical Instrumentation Application and Design", Fifth edition, John Willey and sons, 2020.
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Third edition, John Willey and sons, New York, 2003.

Reference Books

1.Khandpur,R.S,"Handbook of Biomedical Instrumentation ",Second Edition. Tata Mc Graw Hill, 2003

2.Rick Krohn, David Metcalf, Patricia Salber, "Health-e Everything: Wearables and The Internet of Things for Health, 2013.

3. Principles of Applied Biomedical Instrumentation L.A Geddas and L.E.Baker – 2004.

4.John G. Webster, "Medical Instrumentation: Application and Design", 4th edition. John Wiley and Sons, New York, 2010.

5.Samuel A. Fricker, Christoph Thümmler , Anastasius Gavras, "Requirements Engineering For Digital Health", Springer, 2015

Web References

1. https://www.nap.edu/read/21794/chapter/7
2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapeutic-systems.
3. https://www.wsh.nhs.uk/CMS-Documents/Trust-policies/201-250/PP19206 DiagnosticandTherapeuticEquipmentTraining.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	1	2	-	-	-	-	-	1	2	2	2
2	3	3	2	2	1	2	-	-	-	-	-	1	2	2	2
3	3	3	2	2	2	2	-	-	-	-	-	1	1	2	2
4	3	3	2	2	2	2	-	-	-	-	-	1	1	2	2
5	3	3	2	2	2	2	-	-	-	-	-	1	1	2	2

Correlation level: 1 - Low 2 - Medium 3 - High

	L	**T**	**P**	**C**	**Hrs**
U19BMT62　　**MEDICAL INTERNET OF THINGS**	3	0	0	3	45

Course Objectives
- To understand the architecture of IOT and its associated protocols
- To gain knowledge on interfacing IOT and cloud
- To understand Application layer of IOT architecture
- To get trained with m-IOT components and equipment's
- To understand wearable technologies and applications of m-IOT

Course Outcomes
After completion of the course, the students will be able to
CO1 - understand the architecture of IOT and its associated protocols **(K2)**
CO2 - Explain interfacing IOT and cloud **(K2)**
CO3 - Gain knowledge on Application layer of IOT **(K2)**
CO4 - Explain m-IOT components and its role in surgery **(K3)**
CO5 - Describe wearable technologies and applications of m-IOT **(K3)**

UNIT I INTRODUCTION TO IOT (9 Hrs)
Brief History of IOT – Architectural Layers of IOT – Bluetooth – Zigbee - Wi-Fi - IP-Based Protocols – UPnP – CoAP – MQTT – XMPP – SCADA - Authentication protocols - IEEE 802.15.4.60

UNIT II IOT IN THE CLOUD (9 Hrs)
Network layer – Cloud - Network Technologies - Types of Networks – BAN - Cloud and Virtualization - Cloud terminologies - Types of Cloud - Service Models - Fog and edge customization

UNIT III APPLICATION LAYER (9 Hrs)
Data – Databases - Database Management systems - Real time Databases - Diagnosis and therapeutics - Big Data - Medical Data Mining and processing.

UNIT IV M-IOT IN SURGERY (9 Hrs)
Perception Layer – RFIDs – cameras – Sensors - Introduction to ASICs - pulse oximeters, instrumentation amplifiers - Surgical equipment and dependencies - Surgery and its types - role of IOT in surgery.

UNIT V APPLICATIONS OF IOT (9 Hrs)
Ventilators - Wearable Technologies - smart watches - Computer Assisted Anthropology - Smart Health Organizations

Text Books
1. Aboul Ella Hassanien, Nilanjan Dey, Surekha Borra "Medical Big Data and Internet of Medical Things", CRC Press, 1st edition, 2018

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2. P. B. Pankajavalli, G. S. Karthick "Incorporating the Internet of Things in Healthcare Applications and Wearable Devices,Advances in Medical Technologies and Clinical Practice(AMTCP)", IGI Global, 1st edition, 2019
3. Peter Waher, "Learning Internet of Things", Packt Publishing, 2015

Reference Books

1. Valentia E.Balas, Le Hoang Son, Sudan Jha, Manju Khari, Raghvendra Kumar "Internet of Things in Biomedical Engineering", , Academic Press, 2019
2. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights ,2014
3. Vijender Kumar Solanki, Raghvendra Kumar, Md. Atiqur Rahman Ahad "A Handbook of Internet of Things in Biomedical and Cyber Physical System" Springer International Publishing,2019
4. Amit Banerjee, Lalit Garg, Joel J. P. C. Rodrigues "Internet of Medical Things for Smart Healthcare" Springer Singapore,2019
5. Subhas Chandra Mukhopadhyay "Intelligent IoT Systems in Personalized Health Care" Elsevier Science,2020

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1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/
2. https://www.digimat.in/nptel/courses/video/108105091/L01.html
3. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7113786

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	2	2	-	-	-	-	-	1	3	1	1
2	3	3	2	2	2	2	-	-	-	-	-	1	3	2	1
3	3	3	2	2	2	2	-	-	-	-	-	1	3	2	1
4	3	3	2	2	2	2	-	-	-	-	-	1	3	2	1
5	3	3	2	2	2	2	-	-	-	-	-	1	3	2	1

Correlation level: 1 - Low 2 - Medium 3 - High

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	MICROCONTROLLER AND EMBEDDED SYSTEMS	L	T	P	C	Hrs
U19BMT63		3	0	0	3	45

Course Objectives
- To study the Architecture of 8051 microcontroller.
- To design a microcontroller based system
- To introduce the Building Blocks of Embedded System
- To Educate in Various Embedded Development Strategies.
- To Introduce Bus Communication in processors, Input/output interfacing.

Course Outcomes
After completion of the course, the students will be able to
CO1 - Explain the Architecture of 8051 microcontroller **(K2)**
CO2 - Design the microcontroller-based systems**(K3)**
CO3 - Identify the Building Blocks of Embedded System **(K2)**
CO4 – Familiarize with various Embedded networking protocols **(K2)**
CO5 - Learn Bus Communication in processors, Input/output interfacing **(K2)**

UNIT I MICROCONTROLLER (**9 Hrs)**
Architecture of 8051 – Special Function Registers (SFRs) – I/O Pins Ports and Circuits – Instruction set – Addressing modes – Assembly language programming.

UNIT II INTERFACING MICROCONTROLLER (9 Hrs)
Programming 8051 Timers – Serial Port Programming – Interrupts Programming – LCD and Keyboard Interfacing – ADC, DAC and Sensor Interfacing – External Memory Interface- Stepper Motor and Waveform generation – Comparison of Microprocessor - Microcontroller - PIC and ARM processors.

UNIT III INTRODUCTION TO EMBEDDED SYSTEMS (9 Hrs)
Introduction to Embedded Systems – The build process for embedded systems- Structural units in Embedded processor - selection of processor and memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer - Real Time Clock - In circuit emulator -Target Hardware Debugging.

UNIT IV EMBEDDED NETWORKING (9 Hrs)
Embedded Networking: Introduction, I/O Device Ports and Buses– Serial Bus communication protocols – RS232 standard – RS422 – RS485 – CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –need for device drivers.

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UNIT V EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT   (9 Hrs)

Embedded Product Development Life Cycle- objectives - different phases of EDLC - Modelling of EDLC - issues in Hardware-software Co-design - Data Flow Graph - state machine model - Sequential Program Model - concurrent Model - object oriented Model.

Text Books

1. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011
2. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Third Edition —Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
3. A.K. Singh "Microcontroller and Embedded System", New Age International (P) Limited ,2008

Reference Books

1. Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH,2012.
2. Lyla B.Das, "Embedded Systems : An Integrated Approach", Pearson Education, 2013.
3. David. E. Simon, "An Embedded Software Primer ", First Edition, Fifth Impression, Addison Wesley Professional, 2007.
4. Gul N. Khan "Embedded and Networking Systems Design, Software, and Implementation", CRC Press, 2012.
5. Vincent Zimmer, Jiming Sun, Marc Jones, Stefan Reinauer,"Embedded Firmware Solutions Development Best Practices for the Internet of Things", Apress, 2015

Web References

1. https://www.tutorialspoint.com/embedded_systems/es_microcontroller.htm
2. https://www.elprocus.com/embedded-systems-real-time-applications/
3. https://onlinecourses.nptel.ac.in/noc20_ee98/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	P1SO2	PSO3
1	2	2	3	2	2	2	-	-	-	-	-	2	1	1	1
2	2	2	3	2	2	2	-	-	-	-	-	2	1	1	1
3	2	1	3	2	1	1	-	-	-	-	-	2	1	1	-
4	2	1	3	2	1	1	-	-	-	-	-	2	1	1	-
5	2	1	3	2	1	1	-	-	-	-	-	2	1	1	-

Correlation level: 1 - Low 2 - Medium 3 - High

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		L	T	P	C	Hrs
U19BMT64	**ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN MEDICINES**	2	2	0	3	60

Course Objectives

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI.
- To acquire knowledge in solving AI problems.
- To understand the different machine learning techniques.
- To learn the planning for Machine learning.

Course Outcomes

After completion of the course, the students will be able to
CO1 - Define the various characteristics of intelligent agents **(K2)**
CO2 - Describe the different search strategies in AI **(K2)**
CO3 - Apply the particular agent strategy to solve a given problem **(K3)**
CO4 - Classify the different machine learning techniques **(K2)**
CO5 - Understand the planning for Machine learning **(K2)**

UNIT I INTRODUCTION (**12 Hrs)**

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents–Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

UNIT II PROBLEM SOLVING METHODS (12 Hrs)

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games.

UNIT III KNOWLEDGE REPRESENTATION (12 Hrs)

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information.

UNIT IV MACHINE LEARNING BASICS (12 Hrs)

Introduction - History of machine learning - Algorithm types for machine learning - the human touch, Uses for machine learning and Languages for machine learning.

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UNIT V PLANNING FOR MACHINE LEARNING   **(12 Hrs)**

Machine learning cycle - defining the process - building a data team - Data processing - data storage - Data privacy - data quality and cleaning.

Text Books

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Third Edition,Prentice Hall, 2009,
2. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth edition, 2011, Addison-Wesley Educational Publishers Inc.
3. Richard Szeliski, "Computer Vision: Algorithms and Applications", First Edition, 2010, Springer.

Reference Books

1. Gerhard Weiss, "Multi Agent Systems", Second Edition, 2013, MIT Press.
2. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agentsǁ", Fourth Edition, Cambridge University Press, 2010
3. Simon J.D. Prince, "Computer vision: models, learning and inference" ,First edition, Cambridge University Press,2012
4. E R Davies, "Computer and Machine Vision: Theory, Algorithms and Practicalities", Fourth Edition, Elsevier, 2012
5. Lei Xing, Maryellen L. Giger, James K. Min "Artificial Intelligence in Medicine Technical Basis and Clinical Applications" Elsevier Science 2020

Web References

1. https://www.nap.edu/read/21794/chapter/7
2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapeutic-systems.
3. https://nptel.ac.in/courses/106/106/106106139/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	1	-	-	-	-	-	-	2	1	1	1
2	3	3	2	3	1	-	-	-	-	-	-	2	1	1	1
3	2	3	2	3	-	1	-	-	-	-	-	2	1	1	1
4	2	3	2	2	-	1	-	-	-	-	-	2	1	1	1
5	2	2	1	1	-	1	-	-	-	-	-	2	1	1	1

Correlation level: 1 - Low 2 - Medium 3 - High

U19BMP61	DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS LABORATORY	L	T	P	C	Hours
		0	0	3	1	30

Course Objectives
- To familiarize students with ECG, EEG and EMG signal.
- To illustrate students with the simulation of ECG signals.
- To impart knowledge on Pace maker simulator.
- To describe the working of Defibrillator simulator.
- To analyse the protection equipments for electrical safety measures.

Course Outcomes
After completion of the course, the students will be able to
CO1 - Experiment the analysis of ECG, EEG and EMG signals**. (K3)**
CO2 - Simulate ECG signals and Pacemaker**. (K4)**
CO3 - Conduct investigation using Defibrillator simulator **(K3)**
CO4 – Describe shortwave and ultrasonic diathermy **(K3)**
CO5 - Demonstrate the protection equipment's for electrical safety measures.**(K3)**

List of Experiments

1. Recording and analysis of ECG signals
2. Recording and analysis of EEG signals
3. Recording - Fatigue test of EMG signals
4. Simulation of ECG – detection of QRS complex and heart rate
5. Study of Pacemaker simulator
6. Study of Defibrillator simulator
7. Study of shortwave and ultrasonic diathermy
8. Study of biotelemetry
9. Study of Endoscopy and Laparoscopy equipment's
10. Electrical safety measurements
11. Recording of Audiogram

Text Books
1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Second edition. Prentice Hall, 2015.
2. John G. Webster "Medical Instrumentation Application and Design", John Willey and sons, Fifth Edition 2020.
3. Joseph J. Carr and John M. Brown "Introduction to Biomedical equipment technology", John Wiley and sons, New York, 2001.

B.Tech. Biomedical Engineering

Reference Books

1. Richard Aston, "Principles of Biomedical Instrumentation and Measurement", Merril Publishing Company, 2007.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, Third edition, New Delhi, 2003.
3. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", Mc Graw Hill, 2003.
4. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", Third edition, 2008.
5. Antony Y.K.Chan, "Biomedical Device Technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.

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1. https://www.nap.edu/read/21794/chapter/7
2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapeutic-systems.
3. https://www.wsh.nhs.uk/CMS-Documents/Trust-policies/201-250/PP19206

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	1	-	-	3	3	-	2	2	2	1
2	3	3	2	2	2	1	-	-	3	3	-	2	2	2	1
3	3	3	2	2	2	-	-	-	3	3	-	2	1	2	1
4	3	3	2	2	2	-	-	-	3	3	-	2	1	2	1
5	3	3	2	2	2	-	-	-	3	3	-	2	1	2	1

Correlation level: 1 - Low 2 - Medium 3 - High

		L	**T**	**P**	**C**	**Hrs**
U19BMP62	**MEDICAL INTERNET OF THINGS LABORATORY**	0	0	2	1	30

Course Objectives

- To study Embedded programming, REST API and its commands.
- To develop systems like human fall detection, ECG system, surgical automation system.
- To understand Thingspeak cloud.
- To integrate Raspberry pi and Thingspeak.
- To develop smart automated systems.

Course Outcomes

After completion of the course, the students will be able to
CO1 - Gain knowledge in Programming for embedded applications**. (K3)**
CO2 - Develop human fall detection, ECG system, and surgical automation system. **(K4)**
CO3 - Familiarize with Thing speak cloud**. (K3)**
CO4 - Integrate Raspberry pi and Thing speak**. (K3)**
CO5 - Develop smart automated systems **(K4)**

List of Experiments

Conduct the Experiments using Arduino / Raspberry pi

1. Study of Raspberry pi, UART Communication
2. Study of REST and HTTP protocols, PUSH, PUT and GET commands, Linux CLI, Raspbian OS
3. Human Fall detection system using an Accelerometer sensor
4. Study of ECG system, which gets Heart beat sensor reading from different modes
5. Surgical automation system, which runs 2 motor using a Servo Motor based inputs given on console in pc and operates the motor operation.
6. Baby Monitoring system, to prevent Sudden Infant Death Syndrome
7. Clinical Management system consisting of RFIDs tags and cards which constantly uploads inpatient and outpatient details to Thinkspeak server
8. Smart Ventilator system to control through various modes of ventilator connected to Thinkspeak server, and remotely operated.
9. Waste Management system consisting of moisture and Gas sensor connected to server and remotely indicating the recycle process of medical waste
10. Smart watch system, to indicate and alert users of their routine works and also monitor the pulse and temperature readings.

B.Tech. Biomedical Engineering

Text Books

1. Hands-on Artificial Intelligence for IoT, Packet Publishing, 2019.
2. Smart Medical Data Sensing and IoT Systems Design in Healthcare, Business Science Reference, 1st edition, 2020.
3. Joseph D. Bronzino, "The biomedical engineering handbook", Volume 2, CRC Press,USA, 2000.

Reference Books

1. Medical Big Data and Internet of Medical Things, CRC Press, 1st edition, 2018.
2. P. Venkata Krishna, Sasikumar Gurumorthy, Mohammad S.Obaidat, Internet of Things and Personalized Healthcare systems, Springer, 1st edition, 2019.

Web References

1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/
2. https://www.digimat.in/nptel/courses/video/108105091/L01.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	2	-	-	2	2	-	3	3	1	1
2	3	3	3	3	3	2	-	-	2	2	-	3	3	1	1
3	3	3	3	3	3	2	-	-	2	2	-	3	3	1	1
4	3	3	3	3	3	2	-	-	2	2	-	3	3	1	1
5	3	3	3	3	3	2	-	-	2	2	-	3	3	3	3

Correlation level: 1 - Low 2 - Medium 3 - High

U19BMP63	MICROCONTROLLER AND EMBEDDED SYSTEMS LABORATORY	L	T	P	C	Hours
		0	0	3	1	30

Course Objectives

- To learn about the various modules of microcontroller kit.
- To provide training on Basic programs using microcontroller
- To acquire knowledge on interfacing with ADC /DAC converters.
- To learn the working of ARM processor.
- To write programs to interface memory, I/Os with processor

Course Outcomes

After completion of the course, the students will be able to
CO1-Understand about the various modules of microcontroller kit**.(K2)**
CO2-Analyse the performance of interrupt**. (K3)**
CO3-Gain knowledge in ARM for a specific Application**. (K3)**
CO4-Interface A/D and D/A convertors with ARM system**(K3)**
CO5-Interface memory, I/Os with processor**.(K3)**

List of Experiments

Part A: Conduct the following experiments using 8051 microcontroller kit**.**

1. Study of 8051 Microcontroller trainer kit.
2. Assembly Language Program for addition of 8-bit numbers stored in an array.
3. Assembly Language Program for Multiplication by successive addition of two 8-bit numbers.
4. Assembly Language Program for finding largest no. from a given array of 8-bit numbers.
5. Assembly Language program to arrange 8-bit numbers stored in an array in ascending order.
6. Stepper motor control by 8051 Microcontroller.
7. Interfacing of 8-bit ADC 0809 with 8051 Microcontroller.
8. Interfacing of 8-bit DAC 0800 with 8051 Microcontroller and Waveform generation using DAC.

Part B: Conduct the following experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' and Keil µvision-4 tool/compiler.

9. Display "Hello World" message using Internal UART.
10. Interface and Control a DC Motor.
11. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
12. Determine Digital output for a given Analog input using Internal ADC of ARM controller.
13. Interface a DAC and generate Triangular and Square waveforms.
14. Interface a 4x4 keyboard and display the key code on an LCD.

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Text Books

1. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011
2. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Third Edition —Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
3. A.K. Singh "Microcontroller and Embedded System", New Age International (P) Limited ,2008

Reference Books

1. Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH,2012.
2. Lyla B.Das, "Embedded Systems : An Integrated Approach", Pearson Education, 2013.
3. David. E. Simon, "An Embedded Software Primer ", First Edition, Fifth Impression, Addison Wesley Professional, 2007.
4. Gul N. Khan "Embedded and Networking Systems Design, Software, and Implementation", CRC Press, 2012.
5. Vincent Zimmer, Jiming Sun, Marc Jones, Stefan Reinauer ",Embedded Firmware Solutions Development Best Practices for the Internet of Things", Apress, 2015

Web References

1. https://www.tutorialspoint.com/embedded_systems/es_microcontroller.htm
2. https://www.elprocus.com/embedded-systems-real-time-applications/
3. https://onlinecourses.nptel.ac.in/noc20_ee98/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	1	1	-	-	2	2	-	-	2	2	1
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3	3	3	2	2	1	1	-	-	2	2	-	-	1	2	1
4	3	3	2	2	1	1	-	-	2	2	-	-	1	2	1
5	3	3	2	2	1	1	-	-	2	2	-	-	1	2	1

Correlation level: 1 - Low 2 - Medium 3 - High

B.Tech. Biomedical Engineering

U19BMC6X	CERTIFICATION COURSE - IV	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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U19BMS61	**SKILL DEVELOPMENT COURSE 7**	L	T	P	C	Hrs
	(Foreign Language / IELTS – II)	0	0	2	-	30

Student should choose the Foreign Language/IELTS course like Japanese/French/ Germany/IELTS, etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and language Experts. The courses are to be approved by Academic Council on the recommendation of HoD at the beginning of the semester, if necessary, subject to ratification in the next Academic council meeting. Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation

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	SKILL DEVELOPMENT COURSE 8	L	T	P	C	Hrs
U19BMS62	(Technical Seminar)	0	0	2	-	30

Course Objectives

- To encourage the students to study advanced engineering developments
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as over head projectors, power pointpresentation and demonstrative models.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Review, prepare and present technological developments.

CO2 - Face the placement interviews.

Method of Evaluation:

- During the seminar session each student is expected to prepare and present a topic on engineering/technology, for duration of about 20 minutes.
- In a session of three periods per week, 8 to 10 students are expected to present the seminar.
- Each student is expected to present atleast twice during the semester and the student is evaluated based on that.
- At the end of the semester, he / she can submit a report on his / her topic of seminar and marks aregiven based on the report.
- A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student andmaintain attendance also.
- Evaluation is 100% internal. The marks attained for this course is not considered for CGPA calculation.

B.Tech. Biomedical Engineering

	SKILL DEVELOPMENT COURSE 9	L	T	P	C	Hrs
U19BMS63	(NPTEL / MOOC - I)	0	0	2	-	30

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and Subject Experts. Students have to complete the relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester, if necessary, subject to ratification in the next Academic council meeting. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course / marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation.

B.Tech. Biomedical Engineering

U19BMM61	**PROFESSIONAL ETHICS**	L	T	P	C	Hrs
		2	0	0	-	30

Course Objectives

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

Course Outcomes

After completion of the course, the students will be able to

- Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

UNIT I HUMAN VALUES (6 Hrs)

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS (6 Hrs)

Senses of „Engineering Ethics" – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg"s theory – Gilligan"s theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION (6 Hrs)

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS (6 Hrs)

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES (6 Hrs)

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development– Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility

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Reference Books

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi,2004.
3. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
4. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics –Concepts and Cases",Cengage Learning, 2009
5. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
6. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", OxfordUniversity Press, Oxford, 2001
7. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.

Web References

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

PROFESSIONAL ELECTIVE – I

U19BME41	**PATHOLOGY AND MICROBIOLOGY**	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives
- To Gain knowledge on the structural and functional aspects of living organisms.
- To know the etiology and remedy in treating the pathological diseases.
- To study the structure of Bacteria and virus
- To know the functions of microscope
- To study about immune system and disorders

Course Outcomes
After completion of the course, the students will be able to
CO1 - Understand the structural and functional aspects of living organisms **(K2)**
CO2 - Understand the importance of Fluid related disorders **(K2)**
CO3 - Describe the structure of Bacteria and virus **(K3)**
CO4 - Knowledge about the function of microscope. **(K3)**
CO5 - Define methods involved in easing the pathological diseases. **(K3)**

UNIT I CELL DEGENERATION, REPAIR AND NEOPLASIA (9 Hrs)
Cell injury – Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification – Dystrophic and Metastatic.Cellular adaptions of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours Autopsy and biopsy.

UNIT II FLUID AND HEMODYNAMIC DERANGEMENTS (9 Hrs)
Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, chronic venous congestion. Hematologica disorders-Bleeding disorders, Leukaemia's, Lymphomas Haemorrhage.

UNIT III MICROBIOLOGY (9 Hrs)
Structure of Bacteria and Virus: Routes of infection and spread; endogenous and exogenous infections, Morphological features and structural organization of bacteria and virus, growth curve, identification of bacteria, culture media and its types, culture techniques and observation of culture. Disease caused by bacteria, fungi, protozal, virus and helminthes.

UNIT IV MICROSCOPES (9 Hrs)
Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM and SEM). Preparation of samples for electron microscope. Staining methods – simple, gram staining and AFB staining

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UNIT V IMMUNOPATHOLOGY (9 Hrs)

Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury; opsonization, phagocytosis, inflammation, Secondary immunodeficiency including HIV infection. Auto – immune disorders: Basic concepts and classification, SLE. Antibodies and its types, antigen and antibody reactions, immunological techniques; immune diffusion, immune electrophoresis, RIA and ELISA, monoclonal antibodies.

Text Books

1. Robbins and Cotran, "Pathologic Basis of Disease", Ninth edition Saunders, 2014
2. Ananthanarayan and Paniker's, "Textbook of Microbiology", Tenth Revised edition, The Orient Blackswan, 2017.
3. Harsh Mohan, "Text book of Pathology", Seventh Edition, Jaypee Brothers Medical publishers private Limited, 2014.

Reference Books

1. James Underwood Simon Cross," General and Systematic Pathology", Churchill Livingstone, 2009
2. R C Dubey and D K Maheshwari , "A Textbook of Microbiology", Third edition, S.Chand Publishing, 2013.
3. Prescott, Harley and Klein, Microbiology, Tenth edition, McGraw Hill, 2017.
4. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", Seventh edition, WB Saunders Co. 2010
5. Kanika Sharma Ane's student edition, "Manual of Microbiology tools and techniques", 2010.

Web References

1. https://tinyurl.com/ydcze6yx
2. http://www.rkmyat.in/up1/34/1629.pdf
3. http://moscmm.org/pdf/Ananthanarayan%20microbio.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	-	-	1	1	-	-	-	1	2	-	-
2	3	3	3	1	-	-	1	1	-	-	-	1	2	-	-
3	3	3	3	1	-	-	1	1	-	-	-	1	2	-	-
4	3	3	3	3	3	-	1	1	-	-	2	1	2	1	1
5	3	2	2	1	3	-	1	1	-	-	-	1	2	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19BME42	**HOSPITAL EQUIPMENT SAFETY AND MANAGEMENT**	**L**	**T**	**P**	**C**	**Hrs**
	3	0	0	3	45

Course Objectives
- To provide a safe, functional, supportive, and effective environment
- To preserve the quality of the service by providing training and appraisal
- To effectively manage the accreditations of the hospitals
- To effectively manage the hospitals and its functions using Strategic tools
- To control known and potential safety hazards to patients, personnel and visitors

Course Outcomes
After completion of the course, the students will be able to
CO1 - Assess practice-based learning and improvement in quality and health policies for patients **(K2)**
CO2 - Increase the trend for developing educational interventions in patient safety **(K2)**
CO3 - Know the necessity of improving standard and quality of the hospital **(K2)**
CO4 - Gain the roles and responsibilities of hospital staffs in various functions of hospital **(K3)**
CO5 - Able to reach the hospital management standard for the patient safety **(K4)**

UNIT I CLINICAL ENGINEERING (9 Hrs)
Clinical engineering program, educational responsibilities, role to be performed by them in hospital, staff structure in hospital – HIS. Need for evolving health policy, health organization in state, health financing system, health education, health insurance, health legislation

UNIT II HOSPITAL AND INDUSTRIAL ORGANIZATION (9 Hrs)
Difference between hospital and industrial organization, levels of training, steps of training, developing training program, evaluation of training, wages and salary, employee appraisal method.

UNIT III STANDARDIZATION (9 Hrs)
Necessity for standardization, FDA, AERB, Joint Commission of Accreditation of hospitals, ICRP and other standard organization, methods to monitor the standards.

UNIT IV STRATEGIC MANAGEMENT IN HOSPITALS (9 Hrs)
Nature and value of strategic management in hospitals - Awareness on the application of IT in Various functions of Hospital. Application of statistical tools in the areas of Health services. Introduction to support services – Disaster management, Ambulance services, Laundry services, Civil Assets.

UNIT V SAFETY MEASURES (9 Hrs)
Elements of Safety - Safety Publications and Standards Organizations - Orientation to Laboratory Safety - Types of risks in the hospitals - factors of environment - Safety showers and Eye Washes – Radiation hazards – radiation detection – safety measures – standards. Ergonomics - Flammables and Explosives – Formaldehydes - PEL Standards and Calculations - Material Safety - Organization of Safety in the hospitals.

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Text Books

1. Joydeep Das Gupta, "Hospital Administration and Management: A Comprehensive Guide", Jaypee Brothers Medical Publishers, 2015.
2. Saxena.M, "Hospital Management", CBS Publishing, First edition, 2016.
3. Girdhar J Gyani and Alexander Thomas, "Handbook of Healthcare quality and patient safety" Second edition, Jaypee brothers medical publisher, 2019.

Reference Books

1. Sonu Dr. Goel, "Textbook of Hospital Administration", Elsevier, 2014.
2. William Charney,"Handbook of Modern Hospital Safety", CRC press, Second edition, 2010.
3. Ramani. K. V, "Hospital Management", Pearson, 2011.
4. Arnold D. Kalcizony & Stephen M. Shortell, "Health Care Managementll", Sixth Edition, Cengage Learning, 2011.
5. Cindy Taylor, "The Hospital Safety Professional's Handbook", Fifth Edition, 2015.

Web References

1. https://en.wikipedia.org/wiki/Medical_equipment_management
2. http://www.who.int/hac/techguidance/preparedness/hospital_safety_index_forms.pdf
3. https://www.who.int/news-room/fact-sheets/detail/patient-safety
4. https://www.coursera.org/browse/health/healthcare-management
5. https://www.who.int/management/newitems/en/index1.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	-	-	3	-	-	-	-	3	-	-
2	3	3	2	2	-	-	-	3	-	-	-	-	3	-	-
3	3	3	2	2	-	-	-	3	-	-	-	-	3	-	-
4	3	3	2	2	-	-	-	3	-	-	-	-	3	-	-
5	3	3	3	3	3		3	3	-	-	-	-	3	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19BME43	**MEDICAL PHYSICS**	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives

- To study effects of sound and light in human body
- To understand the effects of radiation in matter and how isotopes are produced
- To explore the interaction of the radiation particles with matter
- To understand the various detectors of detecting the presence of ionizing radiation
- To study the effects of radiation to the human body

Course Outcomes

After completion of the course, the students will be able to

CO1 - Comprehend the significance and role of non-ionizing radiation in Medical Applications **(K2)**
CO2 - Understand radioactive decay and production of radio nuclides **(K2)**
CO3 - Understand the concepts of different interaction of radiation with matter **(K2)**
CO4 - Discuss the measurement of ionizing radiation **(K3)**
CO5 - Enumerate the effect of ionizing radiation in human body **(K3)**

UNIT I NON IONIZING RADIATION AND ITS MEDICAL APPLICATION (9 Hrs)

Light- Physics of light, Intensity of light color vision and limits of vision sound - Normal sound levels – Ultrasound fundamentals- Generation of ultrasound (Ultrasound Transducer) Interaction of Ultrasound with Materials-Reflection and Refraction – Absorption and Scattering Non ionizing Electromagnetic Radiation, Tissue as a leaky dielectric – Relaxation process- overview of non-ionizing radiation effects-low frequency effect- high frequency effect

UNIT II PRINCIPLES OF RADIOACTIVE NUCLIDES (9 Hrs)

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology ,Decay series, Production of radionuclides – Cyclotron produced Radionuclide- Reactor produced Radionuclide-fission and electron Capture reaction, radionuclide Generator-Milking process – Linear accelerator, Radionuclide used in medicine and Technology.

UNIT III INTERACTION OF RADIATION WITH MATTER (9 Hrs)

Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of Gamma radiation with matter- Photoelectric effect, Compton Scattering , Pair production, Attenuation of Gamma Radiation ,Interaction of neutron with matter and their clinical significance.

UNIT IV PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS (9 Hrs)

Principles of radiation detection, Properties of dosimeters, Theory of gas filled detectors, Ionization Chamber, Proportional chamber, G.M. Counter, Film dosimetry, luminescence dosimetry, scintillation detectors, Radiation detection instruments, Area survey meters, Personal Radiation monitoring device, Film badge.

UNIT V RADIATION EFFECTS   (9 Hrs)

Acute Radiation Effects - The concept of LD 50 – Radiation syndromes- Central nervous systemsyndrome - Gastro-intestinal syndrome –Bone Marrow syndrome Delayed Effects of Radiation - Stochastic and Deterministic effects – Late Deterministic effect in different organs and tissues.

Text Books

1. Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine", Fourth Edition, Springer, 2013.
2. Thayalan Kuppusamy, "Basic Radiological Physics" Second Edition, Jaypee Brothers Medical Publishers, 2017.
3. Kwan Hoong Ng, "Problem and solutions in Medical Physics: Diagnostic imaging Physics", Third volume, CRC press, 2011.

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1. Muhammad Maqbool," An Introduction to Medical Physics", Springer, 2018.
2. Slavik Tabakov, "Encyclopedia of Medical Physics", volume 1, CRC press, 2012.
3. Andrew Webb, Nadrine Barrie Smith, "Introduction to Medical Imaging:Physics, Engineering and Clinical Applications, Cambridge University press, 2010.
4. Faiz M Khan,"Khan's Lecture: Handbook of the Physics of Radiation Therapy", 2011.
5. Faiz M Khan, John P Gibbons, "Khan's the physics of Radiation Therapy" Fifth Edition, 2014.

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2. https://en.m.wikipedia.org/wiki/Medical_physics
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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	-	-	2	1	-	-	-	-	3	-	-
2	3	3	-	-	-	-	2	1	-	-	-	-	3	-	-
3	3	3	2	-	-	-	2	1	-	-	-	-	3	-	-
4	3	3	2	3	3	-	2	1	-	-	-	-	3	-	2
5	3	3	2	3	3	-	2	1	-	-	-	-	3	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

	L	**T**	**P**	**C**	**Hrs**
U19BME44 **COMMUNICATION SYSTEMS**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the various Analog modulation techniques
- To learn the concepts of various Digital modulation techniques.
- To study fiber optic and satellite communication systems.
- To understand the Spread spectrum and multiple access techniques.
- To Gain knowledge on radio communication.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the various Analog modulation techniques **(K1)**
CO2 - Gain knowledge in Digital modulation techniques **(K2)**
CO3 - Knowledge about fiber optic and satellite communication systems **(K2)**
CO4 - Analyze spread spectrum and multiple access techniques **(K3)**
CO5 - Asses the importance of radio communication system **(K3)**

UNIT I ANALOG MODULATION   (9 Hrs)

Need for modulation - Amplitude modulation – Frequency spectrum of AM wave – Representation of AM – Power relation – Frequency modulation – Frequency spectrum of FM wave –AM transmitter – FM transmitter – Super heterodyne AM receiver –FM receivers.

UNIT II DIGITAL MODULATION   (9 Hrs)

Principles of pulse modulation – sampling theorem, PAM, PWM, PPM, Conversion of PWM wave to PPM wave – Generation of PAM, PPM and PWM waves – Demodulation of PAM, PWM, PPM – An introduction to digital modulation systems – PCM, DPCM, Delta Modulation, ADM, ASK, FSK and PSK.

UNIT III FIBER OPTIC AND SATELLITE COMMUNICATION   (9 Hrs)

Need for fiber optics- principle of light transmission through a fiber- fiber classification-fiber losses- Light sources and photo detectors- Block diagram of a fiber optic system - Power budget analysis for an optical link-Recent medical application of fiber optics.
Block diagram of a satellite communication system, Satellite Orbits, satellite parameters, satellite link model, GPS services.

UNIT IV SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES   (9 Hrs)

Pseudo-noise sequence, DS spread spectrum, FH spread spectrum, multiple access techniques –TDMA and FDMA, source coding of speech for wireless communication.

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UNIT V RADIO COMMUNICATION (9 Hrs)

Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Hand off.

Text Books

1. Wayne Tomasi, "Advanced Electronic Communication Systems", Sixth Edition, Pearson Education, 2010.
2. Kennedy Davis, "Electronic Communication Systems", Fifth Edition,Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.
3. William C.Y. Lee, "Mobile Cellular Telecommunication Systems", McGraw Hill International Edition, Third edition, 2008.

Reference Books

1. Simon Haykin, "Communication Systems", Fourth Edition, John Wiley and Sons, 2009.
2. Rappaport T.S, "Wireless Communications: Principles and Practice", Second Edition, Pearson Education, 2010
3. H.Taub, D L Schilling and G Saha, "Principles of Communication", Third Edition, Pearson Education, 2010
4. B. P.Lathi, "Modern Analog and Digital Communication Systems", Third Edition, Oxford University Press, 2009
5. Martin S.Roden, "Analog and Digital Communication System", Fifth Edition, Prentice Hall of India, 2012.

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1. https://nptel.ac.in/courses/108104091/
2. https://www.docsity.com/en/lecture-notes-of-intro-to-communication-systems/4580827/
3. https://nptel.ac.in/courses/117/101/117101051/
4. https://nptel.ac.in/courses/117/105/117105143/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	1	2	-	-	-	-	3	1	1	3	2	-
2	3	2	2	1	2	-	-	-	-	3	1	1	3	2	-
3	3	3	-	1	1	-	-	-	-	3	1	1	3	2	-
4	3	2	-	1	1	-	-	-	-	3	1	1	3	2	-
5	3	3	2	1	2	-	-	-	-	3	1	1	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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		L	**T**	**P**	**C**	**Hrs**
U19BME45	**VLSI DESIGN**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To Study the fundamentals of CMOS circuits and its characteristics
- To Learn the design and realization of combinational & sequential digital circuits
- To perform tradeoffs involved in designing and realizing the circuits in CMOS technology
- To create different FPGA architectures and testability of VLSI circuits.
- To provide designing environment for the FPGA architecture

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the analysis of CMOS digital electronics circuits **(K1)**
CO2 - Knowledge about moderately sized CMOS circuits that realize specified digital functions **(K2)**
CO3 - Apply CMOS technology in sequential circuit design **(K3)**
CO4 - Apply the concepts of CMOS in designing Memory structures **(K3)**
CO5 - Implement different testing methods for CMOS Circuits (**K4**)

UNIT I INTRODUCTION TO MOS TRANSISTOR (9 Hrs)

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS (9 Hrs)

Circuit Families: Static CMOS, Ratioed Circuits, Cascade Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls. Power: Dynamic Power, Static Power, Low Power Architecture

UNIT III SEQUENTIAL CIRCUIT DESIGN (9 Hrs)

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues : Timing Classification Of Digital System, Synchronous Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM (9 Hrs)

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING (9 Hrs)

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

Text Books

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Pearson, 2016.
2. Wayne wolf, "Modern VLSI Design: System on Chip Design", Prentice Hall of India, 2012.
3. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", A system Perspective, Addision Wesley, Second Edition, 2004.

Reference Books

1. Neil H. E. Weste, Kamran Eshraghian, "CMOS Digital Integrated Circuits Analysis and Design", Fourth Edition, 2011, McGraw-Hill.
2. E.Eshranghian, D.A.Pucknelland S.Eshraghian, "Essentials of VLSI circuits and systems", PHI, 2005.
3. A.Pucknell, Kamran Eshraghian, "BASIC VLSI DESIGN", Prentice Hall of India, Third Edition, 2007.
4. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India, 2005.
5. Deba Prasad Das, "VLSI Design", Oxford University Press, 2012

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3. www.creativeworld9.com/2011/12/learning-videos-of-vlsi-design-1
4. www.btechbunks.com/2011/03/vlsi-design-study-material

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	1	2	-	-	1	-	-	-	-	3	-	-
2	3	2	-	1	2	-	-	1	-	-	-	-	3	-	-
3	3	2	-	1	2	-	-	1	-	-	-	-	3	-	-
4	3	2	3	2	2	-	-	1	-	-	-	-	3	-	-
5	3	2	3	1	2	-	-	1	-	-	-	-	3	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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PROFESSIONAL ELECTIVE – II

U19BME51   **BIOTEMETRY AND TELEMEDICINE**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives:
- To understand the classification of Telemetry systems.
- To gain knowledge about telemetry in comparison with telemedicine
- To know about the applications of telemetry in various fields
- To provide the idea about the value of telemedicine
- To know the various applications in telemedicine area

Course Outcomes:
After completion of the course, the students will be able to
CO1 -Understand telemetry basics and its classification **(K2)**
CO2- Gain knowledge about telemetry and telemedicine applications **(K2)**
CO3- Describe the applications of Biotelemetry **K3)**
CO4- Acquire clear idea about the fundamentals of telemedicine **(K2)**
CO5- Explain the Applications of telemedicine in various fields **(K3)**

UNIT - I INTRODUCTION TO TELEMETRY (9 Hrs)
Basic system - Classification - Non electrical telemetry systems - Mechanical and Pneumatic type, Voltage and Current telemetry systems - Local transmitters and Converters - Frequency telemetry system - Power Line carrier communication (PLCC) .

UNIT - II BIOTELEMETRY (9 Hrs)
Radio Telemetry principles, FM, AM, PCM. Transmission of biological data through radio telemetry.

UNIT - III APPLICATION OF BIOTELEMETRY (9 Hrs)
Wireless Telemetry - Single Channel and Multi-channel Telemetry systems - Multi Patient Telemetry - Implantable Telemetry Systems - Ambulatory patient monitoring.

UNIT - IV FUNDAMENTALS OF TELEMEDICINE (9 Hrs)
History and advancements in telemedicine - Benefits of telemedicine – Functional Block of a telemedicine system - Use of computers in distance mode of healthcare delivery - Familiarizing with technology of telemedicine – scanner, electro stethoscope - data reception equipment - Scope for telemedicine - Limitations of telemedicine.

UNIT - V APPLICATIONS OF TELEMEDICINE (9 Hrs)
Telemedicine in Neuroscience - Telecardiology –Telepathology –- Telepediatrics – Telepharmacy – Telepsychiatry and mental health – Veterinary.

Text Books
1. Olga (EDT), Ferre Roca, M. Sosa (EDT, "Handbook of Telemedicine", 3rd Edition, 1998, IOS press.
2. Marilyn J. Field, "A Guide to Assessing Telecommunications in Health Care", 4th Edition, 1996, Academy Press.
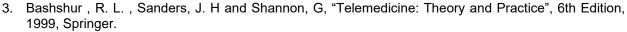
3. Bashshur , R. L. , Sanders, J. H and Shannon, G, "Telemedicine: Theory and Practice", 6th Edition, 1999, Springer.
4. Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine", 5th Edition, 2006, Royal Society of Medicine Press Ltd.

Reference Books
1. Bemmel, J.H. van, Musen, M.A. (Eds.), "Handbook of Medical Informatics", 2nd Edition, 2002, Springer.
2. Simpson, W, "Video over IP. A practical guide to technology and applications'", 9th Edition, 2006, Focal Press, Elsevier.
3. Ferrer-Roca, O., Sosa-Iudicissa, , "Handbook of Telemedicine", 12th Edition, 2002, IOS Press
4. Norris, A.C, "Essentials of Telemedicine and Telecare", 8th Edition, 2002, Wiley.

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1. https://en.wikipedia.org/wiki/Biotelemetry
2. https://www.who.int/goe/publications/goe_telemedicine_2010.pdf
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5927731/

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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2	3	2	1	-	1	2	-	2	1	2	1	1	2	-	-
3	3	2	2	-	2	2	-	2	1	2	2	1	3	1	-
4	3	1	-	-	1	1	-	1	1	2	1	1	3	-	-
5	3	1	1	-	1	2	-	1	1	2	1	1	3	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

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	L	T	P	C	Hrs
U19BME52 EVIRONMENTAL BIOTECHNOLOGY	3	0	0	3	45

Course Objectives

- To learn about the basic concepts of environmental biotechnology
- To understand about the biodegradation and bioremediation
- To gain knowledge on microbiological treatment technologies
- To replace conventional treatment methodologies by using biocatalyst and bioreactors
- To understand bioproducts production and composting technology

Course Outcomes

After completion of the course, the students will be able to

CO1 - Gain knowledge in the basic concepts of environmental biotechnology **(K2)**
CO2 - Familiarize with the biodegrading and bioremediation modules and its functions **(K2)**
CO3 - Describe the principles of microbiological treatment technologies to clean up contaminated environments. **(K3)**
CO4 - Explain the replacement of conventional treatment methodologies using biocatalyst and bioreactors **(K3)**
CO5 - Understand bioproducts production and composting technology **(K2)**

UNIT I INTRODUCTION   (9 Hrs)

Biotechnology in the reduction of carbon dioxide emission- Microbial flora of soil - Microbial treatment of heavy Metal – bioleaching, bioaccumulation, biosorption and bioprecipitation Understand the various bioproducts production and composting technology of heavy metals - Soil, water and air - sources and effects - Removal of Pollutants.

UNIT II BIODEGRADATION AND BIOREMEDIATION   (9 Hrs)

Aerobic degradation of aliphatic and aromatics compounds - Anaerobic degradation of aromatic compounds - Biodegradation of herbicides and pesticides - Remediation Technologies - Bioventing, biosparging and bioslurping, phytoremediation - Biodesulphurization of coal and oil - microbial treatment of oil pollution.

UNIT III MICROBIAL TREATMENT OF WASTE AND WASTE WATER   (9 Hrs)

Biological treatment of anaerobic and aerobic- methanogenesis, methanogenic, acetogenic- Use of genetically engineered organisms - Biotechnological Processes in waste - water treatment; Applications include treatment of municipal and industrial wastewaters.

UNIT IV BIOCATALYSTS AND BIOREACTORS   (9 Hrs)

Enzymes isolation, whole cell systems - Biocatalytic Application - Advantages & Disadvantages- Design of activated sludge process and anaerobic digestion system - Trickling Filter - Rotating biological contactors - Fluidized bed reactor - Up-flow anaerobic sludge blanket reactor (UASB) - High-rate anaerobic wastewater treatment.

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UNIT V BIOPRODUCTS AND RENEWABLE SOURCES (9 Hrs)

Biofertilizers – Biopesticides - Biofuel production – Bioethanol – Biohydrogen – Biodiesel - Bioplastics and biopolymers - Composting technologies, composting systems, compost quality.

Text Books

1. Bhattacharya B. C. and Banerjee R, " Environmental Biotechnology", Oxford University Press, 2017.
2. Jordening H. J. and Winter J., "Environmental Biotechnology: Concepts and Application", Wiley , 2015.
3. Bruce Rittmann and Perry McCarty," Environmental Biotechnology", McGraw-Hill, 2011.

Reference Books

1. W.D. Grant & P.E. Long, Blakie, Environmental Microbiology, Springer, 2019.
2. H. Polasa,Microbial Gene Technology, South Asian Publishers, 2011.
3. D. L. Wise, Biotreatment Systems.CRC Press, 2010.
4. A.K. Chatterji," Introduction to Environmental Biotechnology", Prentice Hall of India Pvt. Ltd.,2003
5.Pramod Kumar, Vipin Kumar**,** Pravin Kumar Sacha**, "**Textbook of Environmental Biotechnology **",** Woodhead Publishing India**,** 2019.

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2. http://dbtindia.gov.in/schemes-programmes/research-development/energy-environment-and-bio-resource-based-applications-0
3. https://www.hindawi.com/journals/scientifica/si/269412/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	-	-	2	-	-	-	-	-	2	2	-	-
2	2	2	2	-	-	2	-	-	-	-	-	2	2	-	-
3	2	2	3	2	-	2	-	-	-	-	-	2	2	-	-
4	2	2	2	2	2	2	-	-	-	-	-	2	2	-	-
5	2	2	2	2	2	2	-	-	-	-	-	2	2	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19BME53	LASER AND FIBER OPTICS IN MEDICINE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives:
- To expose the basic concepts of optical fibers
- To provide basic concepts of lasers.
- To understand how Lasers used in medical practice
- To provide adequate knowledge about application of optical fibers.
- To gain knowledge in the applications of laser in medicine

Course Outcomes:
After completion of the course, the students will be able to
CO1 -Understand the basic principles of optical fibers **(K2)**
CO2- Acquire knowledge on various types of lasers **(K2)**
CO3- Familiarize with the use of laser systems in medicine **(K2)**
CO4- Apply optical fiber technology for different applications **(K3)**
CO5 - Analyse the applications of laser in medicine **(K3)**

UNIT I OPTICAL FIBERS AND THEIR PROPERTIES **(9 Hrs)**
Introduction to optical fiber - fiber characteristics - principles of light propagation through a fiber - Different types of fibers and their properties - Losses in the optical fiber - Dispersion - advantages and disadvantages of optical fibers

UNIT II LASER FUNDAMENTALS **(9 Hrs)**
Laser Fundamentals: Introduction to lasers - Laser characteristics – Laser configuration – Three level and four level lasers – Q-switching – Mode locking – Types of lasers: Gas lasers, Solid lasers, Liquid lasers and Semiconductor lasers.

UNIT III LASER SYSTEMS
Lasers used in medical practice: Ruby laser, CO_2 laser, Nd-Y AG laser and related solid-state laser. Laser -Tissue Interaction: Terminology, spectral band designations, energy & power, irradiant & radiant exposure.

UNIT IV APPLICATIONS OF OPTICAL FIBERS **(9 Hrs)**
Interferometer method of measurement of length – Moire fringes – Measurement of pressure, Temperature, Current, Voltage, Liquid level and strain - fiber optic Gyroscope – Polarization maintaining fibers - Applications.

UNIT V LASER APPLICATIONS IN MEDICINE **(9 Hrs)**
Application in general surgery-Dermatology, Ophthalmology, Cardiovascular &chest surgery, Dentistry, Neuro surgery, Otolaryngology & head and neck surgery, Tumor surgery, Gynecologic laser, Endoscopy, Laparoscopy.

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Text Books
1. Abraham Katzir, "Lasers and Optical Fibers in Medicine", Academic press Inc, 2012.
2. Helena Jelinkova, "Lasers for medical Applications", Woodhead Publishing, 2013.
3. David A Boas, "Handbook of Biomedical Optics", CRC Press, 2011.

Reference Books
1. Jeff Hecht, "Understanding Fiber Optics", fourth edition, Prentice Hall publishers, 2015.
2. Tuan Vo-Dinh, "Biomedical Photonics Handbook", 3 volume set, 2018.
3. Tosi Daniele, "Fiber optics Sensor for Biomedical Applications", 2010.
4. KeyvanNouri, "Laser in Dermatology and Medicine", Springer, 2011.
5. Nagabhushana, "Laser and Optical Instrumentation", I.K International House Pvt Ltd. 2010.

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2. https://en.wikipedia.org/wiki/Optical_fiber
3. https://ethw.org/Fiber_Optics
4. https://www.classcentral.com/course/swayam-fiber-optics-7913
5. https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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1	3	-	1	-	-	1	-	-	-	-	-	1	2	-	1
2	3	1	2	-	1	1	-	-	-	-	-	1	2	1	1
3	3	2	2	-	1	1	-	-	-	-	-	1	2	2	1
4	3	2	2	2	2	1	-	-	-	-	-	1	2	2	1
5	3	2	2	2	2	1	-	-	-	-	-	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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		L	**T**	**P**	**C**	**Hrs**
U19BME54	**MEDICAL INFORMATICS**	3	0	0	3	45

Course Objectives
- To understand the functional capabilities of hospital information systems
- To give a deep insight of the medical standards and ethics to be followed
- To enable the understanding of the theories and practices adopted in Hospital Information Systems standards
- To gain knowledge on various domains of informatics
- To understand medical data formats and recent trends in Hospital Information Systems

Course Outcomes
After completion of the course, the students will be able to
CO1 - Discuss about health informatics and the function of Hospital Information Systems **(K2)**
CO2 - Analyze medical standards (**K4**)
CO3 - Explain about storage of medical data **(K2)**
CO4 - Understand the basic concepts of bioinformatics **(K2)**
CO5 - Discuss about the application of medical informatics **(K4)**

UNIT I MEDICAL INFORMATICS (9 Hrs)
Introduction, Medical Informatics, Bioinformatics, Health Informatics, Structure of Medical Informatics, Functional capabilities of Hospital Information System, On-line services and off-line services, History taking by computer, Dialogue with the computer

UNIT II MEDICAL STANDARDS (9 Hrs)
Evolution of Medical Standards, IEEE 11073, HL7, DICOM, IRMA, LOINC, HIPPA, Electronics Patient Records, Healthcare Standard Organizations, JCAHO (Join Commission on Accreditation of Healthcare Organization), JCIA (Joint Commission International Accreditation), Evidence Based Medicine, Bioethics.

UNIT-III MEDICAL DATA STORAGE AND AUTOMATION (9 Hrs)
Plug in Data Acquisition and Control Boards, Data Acquisition using Serial Interface, Medical Data formats, Signal, Image and Video Formats, Medical Databases, Automation in clinical laboratories, Intelligent Laboratory Information System, PACS, Data mining.

UNIT IV HEALTH INFORMATICS (9 Hrs)
Bioinformatics Databases, Bio, information technologies, Semantic web and Bioinformatics, Genome projects, Clinical informatics, Nursing informatics, Public health informatics, Education and Training

UNIT V RECENT TRENDS IN MEDICAL INFORMATICS (9 Hrs)
Medical Expert Systems, Virtual reality applications in medicine, Virtual Environment, Surgical simulation, Radiation therapy and planning , Telemedicine , virtual Hospitals , Smart Medical Homes , Personalized ehealth services , Biometrics , GRID and Cloud Computing in Medicine

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Text Books

1. R.D.Lele, ―Computers in medicine progress in medical informatics, Tata McGraw Hill Publishing computers Ltd, 2005, New Delhi
2. H. K. Huang , "PACS and Imaging Informatics: Basic Principles and Applications", 2010
3. Oleg S. Pianykh, "Digital Image Quality in Medicine", Springer. 2014

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1. Mohan Bansal, ―Medical informatics, Tata McGraw Hill Publishing Computers Ltd, 2003 New Delhi
2. N.Mathivanan, ―PC-Based Instrumentation, Prentice Hall of India Pvt Ltd , New Delhi , 2007
3. Orpita Bosu and Simminder KaurThukral, ―Bioinformatics Databases, Tools and Algorithms, Oxford University press, 2007, New Delhi
4. Yi , Ping Phoebe Chen, ―Bioinformatics Technologies, Springer International Edition, 2007, New Delhi
5. Wager, K. A., Lee, F. W., & Glaser, J. P, "Health care information systems: A practical approach for health care management",4th Edition, 2017

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	-	-	-	1	1	-	-	-	-	3	1	1
2	3	1	-	-	-	-	1	1	-	-	-	-	3	1	1
3	3	1	-	-	2	-	2	3	-	-	-	1	3	1	1
4	3	1	1	-	2	-	2	2	-	-	-	2	3	2	2
5	3	1	1	-	2	-	2	2	-	-	-	2	3	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

	L	**T**	**P**	**C**	**Hrs**
U19BME55 **COMPUTERS IN MEDICINE**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To study the 8086 architectures, instruction sets and various units of PC-AT.
- Study the technique of data acquisition, storage, retrieval and transmission of bioinformation.
- To understand the application of computers in patient monitoring.
- To understand the application of computers in system modelling and pattern recognition, medical imaging and development of expert systems.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Able to have a clear understanding about computer hardware's **(K2)**
CO2 - Acquire the knowledge about computers in data acquisition, monitoring, system modeling. **(K2)**
CO3 - Gain the knowledge about patient monitoring using computers **(K3)**
CO4 - Design computers in medical systems **(K3)**
CO5 - Apply computers in research area in medicine **(K3)**

Unit - I OVERVIEW OF COMPUTER HARDWARE PC-AT   (9 Hrs)

8086 architecture, system connections, Instruction set & programming, Microcontrollers, Motherboard and its logic, RS232-C and IEEE bus standards, CRT controllers, FDC, HDC and Post sequence, PC based video card, modems and networking.

Unit - II SYSTEM DESIGN   (9Hrs)

Multichannel computerized ECG, EMG and EEG data acquisition, storage and retrieval, transmission of signal and images.

Unit - III COMPUTERS IN PATIENT MONITORING   (9Hrs)

Physiological monitoring, automated ICU, computerized arrhythmia monitoring, information flow in a clinical lab, computerized concepts, interfacing to HIS.

Unit - IV COMPUTERS IN MEDICAL SYSTEMS MODELLING   (9Hrs)

Radiotherapy, drug design, drug delivery system, physiological system modeling and simulation.

Unit - V COMPUTERS IN MEDICAL RESEARCH   (9Hrs)

Role of expert systems, pattern recognition techniques in medical image classification, ANN concepts.

Text Books

1. R.D.Lee, "Computers in Medicine", Tata McGraw-Hill, New Delhi, 2010
2. Lele , "Computers In Medicine", McGraw Hill Education; 1st edition, 2006.
3. Eve Stwertka and Albet Swetka," Computer in Medicine", Franklin Watts, 1984.
4. Dhiya Al-Jumeily Abir Hussain Conor Mallucci Carol Oliver, " Applied computing in medicine and health", 1st edition, 2015.

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Reference Books

1. Douglas V.Hall, "Microprocessors and Interfacing: Programming and hardware", McGraw-Hill, Singapore, 2011.
2. Susan Sandeson, "Computer in the medical office", McGrawHill, 9 th edition, 2016.
3. Jonathan Javitt MD, "Computer in Medicine: Applications and Possibilities", Saunders, 1986.
4. Naval Kishore, " Computer in medicine", S.Chand (G/L) & Company Ltd, 2003.

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1. https://www.techwalla.com/articles/10-ways-computers-are-used-in-medicine
2. https://www.techwalla.com/articles/10-ways-computers-are-used-in-medicine
3. https://www.online-sciences.com/computer/computers-in-medicine-uses-advantages-and-disadvantages/

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	-	-	-	1	-	1	-	-	3	1	1
2	3	1	1	--	-	-	-	1	-	1	-	-	3	1	1
3	3	1	1	-	-	-	-	2	-	1	-	-	3	1	2
4	3	1	1	-	-	-	-	2	-	2	-	-	3	1	2
5	3	1	1	-	-	-	-	2	-	2	-	-	3	1	2

Correlation Level: 1-Low, 2-Medium, 3- High

PROFESSIONAL ELECTIVE -III

U19BME61	**HOSPITAL ENGINEERING AND INFORMATION SYSTEMS**	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives
- To enhance Medical Outcomes, Quality of Life, Quality of Care
- To reduce Operations, Morbidity, Medical Errors and Cost
- To view a broad picture of hospital growth
- To maintain the clinical component for patient records, lab system, financial system
- To support high-quality, efficient, patient-centered care physicians

COURSE OUTCOMES
After completion of the course, the students will be able to
CO1 - Providing good academic ambience by adopting best information system **(K2)**
CO2 - Achieve the best possible support from patient and administration **(K4)**
CO3 - Deliver efficient delivery of high quality health services **(K3)**
CO4 - Develop decision support systems, health information standards and information systems acquisitions **(K3)**
CO5 - Identify problems and alternate solutions related to records management in the healthcare environment **(K4)**

UNIT - I HEALTH SYSTEM   (9 Hrs)
Concept of Hospital Management **-** Roles and Responsibilities of Administrator **-** Hospital Design **-** Health organization of the country, state, and cities, Health Financing System.

UNIT - II HOSPITAL ORGANISATION   (9 Hrs)
Organization of Out-Patient Services **-** Problems encountered in functioning of O.P Department **–** Organization of In- Patient Services **-** Casualty & Emergency Services - Organization and management of Operation theatres

UNIT - III SUPPORTIVE SERVICES IN HOSPITAL   (9 Hrs)
Organization and management of Nursing services and Dietary Services in hospital **-** House-keeping and maintenance **-**Medical Records - Human resources management in hospital – Management Assisted by Computers: Reservation, Admission, Registration & Discharge Module

UNIT - IV HOSPITAL ORGANIZATION   (9 Hrs)
Organization of Out-Patient Services **-** Problems encountered in functioning of O.P Department **–** Organization of In- Patient Services **-** Casualty & Emergency services - Organization and management of Operation theatres

UNIT - V INTEGRATED MEDICAL INFORMATION SYSTEM   (9 Hrs)
Integration of inter and intra hospital information system. Role of expert systems-web based Multimedia information system- introduction of a computerized HIS Automation of medical record-cost and Benefits of

B.Tech. Biomedical Engineering

HIS-Modems and Networking in Hospitals.

Text Books
1. Dr. L.L. Rao, "Hospital Management", Annamalai University Press, 2nd edition, 2013
2. R. D. Lele, "Computers in Medicine", Tata McGraw Hill, 3rd edition, 2005
3. Mohan Bansal, "Medical informatics", Tata McGraw Hill. 2nd Edition, 2005.
4. Harold E. Smalley, "Hospital Management Engineering – A guide to the improvement of hospital management system ", PHI, 1st Edition, 1982.

Reference Books
1. Gupta, Kant, Chandrashekhar, Satpathy,"Modern Trends in Planning and Designing of Hospitals Principles and Practice with CD-ROM", JaySpee Medical publishers, 1st edition, 2007.
2. Sharma, "Essentials for Hospital Support Services and Physical Infrastructure", Jaypee Medical Publishers, 1st edition, 2003
3. Sakharkar, "Principles of Hospital Administration and Planning", Jaypee Medical, 1st edition, 2004.

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1. https://en.wikipedia.org/wiki/Hospital_information_system
2. https://www.ncbi.nlm.nih.gov/books/NBK22862/
3. https://en.wikipedia.org/wiki/Healthcare_engineering

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	1	1	2	2	2	1	1	3	1	2
2	3	1	1	-	1	1	1	2	2	2	1	1	3	1	2
3	3	1	1	-	1	1	1	2	2	2	1	1	3	2	3
4	3	1	1	-	1	1	1	2	2	2	1	1	3	2	3
5	3	1	1	-	1	1	1	2	2	2	1	1	3	3	3

Correlation Level: 1-Low, 2-Medium, 3- High

U19BME62	**TRANSPORTATION IN LIVING SYSTEMS**	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives

- To understand the ways of living organisms for transporting materials like food, water and oxygen to various organs.
- To provide the knowledge about the basics of human membrane system
- To acquire knowledge about the process of osmosis
- To study about the transportation of lymph through internal organs
- To have a clear idea about blood constituents of artificial organs

Course Outcomes

After completion of the course, the students are able to

CO1 - Develop and solve models of living system as a microvascular networks **(K2)**
CO2 - Analyse how the living system characteristics depend on the underlying network structure **(K4)**
CO3 - Gives information about system of osmosis **(K2)**
CO4 - Gain knowledge about transportation of lymph **(K2)**
CO5 - Provides clear idea about human system along with artificial organ **(K2)**

UNIT - I Introduction (9 Hrs)

Organization of the human body, cells, tissues, different organs, natural membrane system

UNIT - II Heat Transport (9 Hrs)

Body temperature regulation based on thermostate principle and its operation, transportation in tissues, muscle, skin and other organs in different environmental temperature.

UNIT - III Transportation of Fluids (9 Hrs)

Blood transport trough internal organs, urogenitary system, cardio pulmonary system, central nervous system, gastro intestine system, diffusion, osmosis, electroosmosis, ultrafiltration, reverse osmosis through natural membrane systems, reverse osmosis through artificial synthetic membranes.

UNIT - IV Transportation of Lymph (9 Hrs)

Transportation of lymph through internal organs, urogenitary system, cardio pulmonary system, central nervous system, gastro intestine system, problems on lymph transfer in human body.

UNIT - V Mass Transfer (9 Hrs)

Constituents of blood, urine, mass transfer in kidney, skeletal, nervous, gastro intestine system, cardio pulmonary system, comparison with artificial organs.

Text Books

1. David O.Cooney, "An introduction to fluid, heat & mass transport process-Principles", Marcel Dekker Inc., Vol.1, 2nd edition, 2007.

2. Richard P. Menninger, "Best and Taylor's Physiological Basis of Medical Practice", LippinCott Williams and Wilkins, 2008
3. RB Bird, WE Stewart and EN Lightfoot," Transport Phenomena", Second Edition, John Wiley and Sons, 2007.
4. Truskey and Yuan and Katz, "Transport Phenomena in Biological Systems", Pearson Prentice Hall 2009.

Reference Books
1. Kim Barrett, Susan Barman, Jason Yuan, Heddwen Brooks, "Ganong's Review of Medical Physiology", McGraw-Hill Education, 2019.
2. SujitK.Chaudhuri, "Concise Medical Physilogy" New Central Book agency, 6th edition, 2011.
3. Patrick Tabeling, "Introduction to Microfluidics", Oxford University Press, 2005.
4. Edwin N Lightfoot, "Transport phenomena and living systems; Biomedical aspects of momentum and mass transport", Wiley; First Edition,1974.

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1. https://www.toppr.com/ask/question/transportation-in-the-living-organisms-is-necessary-because-of-the-following-reasons/
2. https://link.springer.com/content/pdf/10.1007/978-1-349-14068-8_6.pdf
3. https://secondarytwojyssscience.weebly.com/transport-system-in-living-things.html

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	-	-	1			-	-	-	1	2	1	1
2	3	2	1	-	-	1			-	-	-	1	2	1	1
3	3	2	1	-	-	1			-	-	-	1	2	1	1
4	3	2	1	-	-	1			-	-	-	1	2	1	1
5	3	2	1	-	-	1			-	-	-	1	2	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

		L	T	P	C	Hrs
U19BME63	**SOFT COMPUTING TECHNIQUES**	3	0	0	3	45

Course Objectives
- To classify the various soft computing frame works and fuzzy set.
- To learn mathematical background for optimized genetic programming
- To familiar with the design of neural networks.
- To understand with the design of fuzzy logic and fuzzy systems.
- To be exposed to neuro-fuzzy hybrid systems and its applications

Course Outcomes
After completion of the course, the students are able to

CO1 - Classify the various soft computing frame works. **(K2)**
CO2 - Understand the concept of optimized genetic programming **(K2)**
CO2 - Understand the design of neural networks. **(K3)**
CO4 - Understand with the design of fuzzy logic and fuzzy systems **(K2)**
CO5 - Understand the neuro-fuzzy hybrid systems and its applications **(K3)**

UNIT - I Introduction to Fuzzy Set (9 Hrs)
Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

UNIT - II Optimization (9 Hrs)
Optimization - Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search.

UNIT - III Neural Networks (9 Hrs)
Introduction to Neural Networks - Supervised Learning Neural Networks – Perceptrons - Adaline – BackpropagationMutilayerPerceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning.

UNIT - IV Fuzzy Interface Systems (9 Hrs)
Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation.

UNIT - V Applications (9 Hrs)
Pattern Recognitions, Image Processing, Biological Sequence Alignment and Drug Design, Robotics and Sensors, Information Retrieval Systems, Natural Language Processing

Text Books

1. S.Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989
3. Kumar S., "Neural Networks - A Classroom Approach", Tata McGraw Hill, 2004.
4. Ross T. J., "Fuzzy Logic with Engineering Applications", McGraw Hill, 2016.
5. Eiben A. E. and Smith J. E., "Introduction to Evolutionary Computing", Second Edition, Springer, Natural Computing Series, 2007.

Reference Books

1. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004
2. R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence – PC Tools", AP Professional, Boston, 2007.
3. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw- Hill, 2011.
4. Engelbrecht A. P., "Fundamentals of Computational Swarm Intelligence", John Wiley & Sons, 2006.
5. Konar. A, "Computational Intelligence: Principles, Techniques and Applications", Springer Verlag, 2005.

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1. https://www.sciencedirect.com/science/article/pii/S1877050916325467
2. https://www.elprocus.com/soft-computing/
3. http://airccj.org/CSCP/vol3/csit3206.pdf

Cos	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	1	1	1	-	-	-	-	-	1	3	1	1
2	3	1	1	1	1	1	-	-	-	-	-	1	2	1	1
3	3	1	1	1	1	1	-	-	-	-	-	1	3	1	1
4	3	2	1	2	2	1	-	-	-	-	-	1	3	1	2
5	3	2	1	2	2	1	-	-	-	-	-	2	3	1	2

Correlation Level: 1-Low, 2-Medium, 3- High

		L	T	P	C	Hrs
U19BME64	**MEDICAL IMAGE ACQUISITION TECHNIQUES**	3	0	0	3	45

Course Objectives

- To learn the physics behind x-ray imaging
- To understand the hardware and techniques involved in CT imaging.
- To learn the properties and techniques in ultrasound imaging.
- To understand the physics behind magnetic resonance and the techniques in resonance imaging.
- To understand the different parts of medical imaging systems and its working principle.

Course Outcomes

After completion of the course, the students are able to

CO1 - Understand the physics behind x-ray imaging **(K2)**
CO2 - Understand the hardware and techniques involved in CT imaging **(K2)**
CO3 - Describe the properties and techniques in ultrasound imaging **(K2)**
CO4 - Understand the physics behind magnetic resonance and the techniques in resonance-imaging **(K2)**
CO5 - Understand the different parts of medical imaging systems and its working principle **(K2)**

UNIT - I X-RAY   (9 Hrs)

Basic imaging principle image modalities, Image properties Projection radiography, interaction between X – Rays and matter, Intensity of an X – Ray, Attenuation, X – Ray Generation and Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and image intensifiers, X – Ray, detectors, Conventional X – Ray radiography, Fluoroscopy, Angiography, Digital radiography.

UNIT - II COMPUTED TOMOGRAPHY   (9 Hrs)

Basic Principle, Generation of CT machines, Detectors & Detector arrays, Details of Acquisition,Digital image display Radiation Dose, Image quality.

UNIT - III ULTRASOUND   (9 Hrs)

Acoustic propagation, Attenuation, Absorption and Scattering, Ultrasonic transducers, TransducerArrays, A mode, B mode, M mode scanners, Tissue characterization, Color Doppler flowimaging, Echocardiography.

UNIT - IV MRI   (9 Hrs)

Angular momentum, Magnetic dipole moment, Magnetization, Larmor frequency Rotating frameof reference, free induction decay, Relaxation times, Pulse sequences, Generation and Detectionof NMR Imager, Slice selection, Frequency encoding, Phase encoding, Spin – Echo imaging,Gradient – Echo imaging, Imaging safety, Biological effects of magnetic field, Introduction toFMRI,EMRI.

UNIT - V OTHER IMAGING TECHNIQUES   (9 Hrs)

Spectroscopy techniques: light source, optical fibers, monochromator, filters and polarizer- Real time spectroscopy techniques, fractional flow reserve measurement techniques-Magneto encephalography, optical coherence tomography-Infrared imaging: Thermal radiation, single photon detectors,

Thermographic scanning systems, clinical thermography and its applications

Text Books

1. Mathematics and Physics of Emerging Biomedical Imaging , National Academies Press, 1996
2. Rongguang Liang, "Biomedical optical imaging technologies: Design and applications", Springer Science & Business Media, 1st edition, 2012.
3. Steve Webb, "The physics of medical imaging", Adam Hilger, Bristol, England, Philadelphia, USA, 1988
4. John C Russ, "The image processing handbook", CRC and IEEE press 2016.
5. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image processing, analysis and machine vision", 2nd Edition, Brooks Cole publishing Co.,2007.

Reference Books

1. K Kirk Shung, Michael B smith &Benjamim M W Tsui, "Principles of Medical Imaging", Academic press inc, 1992.
2. Jerry L Prince & Jonathan M Links, "Medical Imaging Signals and Systems", Pearson Prentice Hall, 2006.
3. Jerrold T. Bushberg "The essential Physics of Medical Imaging", Lippincott Williams and Wilkins, 2002.
4. R S Khandpur, "Hand Book of Biomedical Instrumentation", Tata McGraw Hill Publication, Second Edition. 2003.
5. Ray H. Hashemi , William G. Bradley, Christopher, J. Lisanti, MRI: The Basics, 2004.
6. Frederick W Kremkau "Diagnostic Ultrasound Principles & Instruments", Saunders Elsevier, 2005.

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1. https://en.wikipedia.org/wiki/Medical_imaging
2. https://www.acvr.org/page/types-imaging-therapy
3. https://study.com/academy/lesson/medical-imaging-techniques-types-uses.html

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	1	1	2	2	1	2	1	1	3	2	2
2	3	2	1	1	1	1	2	2	1	2	1	1	3	2	2
3	3	2	1	1	2	1	2	2	1	2	1	1	3	2	3
4	3	2	1	1	2	1	2	2	1	2	1	1	3	2	3
5	3	2	1	1	2	1	2	2	1	2	2	1	3	2	3

Correlation Level: 1-Low, 2-Medium, 3- High

19BME65	**TROUBLE SHOOTING AND QUALITY CONTROL IN MEDICAL EQUIPMENTS**	L	T	P	C	Hrs
		3	0	0	3	45

COURSE OBJECTIVES

- To understand the troubleshooting procedures in electronic equipment.
- To learn the testing procedures of active and passive components.
- To analyze the fault diagnosis in analog circuits and digital ICs.
- To understand the problems in common biomedical equipment in hospitals when it is not working and provide a suitable solution.
- To learn the various quality measures & standards adapted for medical systems
-

COURSE OUTCOMES

After completion of the course, the students are able to

CO1 - Understand the troubleshooting procedures in electronic equipment **(K2)**
CO2 - Describe the testing procedures of active and passive components.**(K3)**
CO3 - Analyze the fault diagnosis in analog circuits and digital ICs. **(K4)**
CO4 - Identify the problems in common biomedical equipment in hospitals when it is not working and provide a suitable solution. **(K4)**
CO5 - Describe the various quality measures & standards adapted for medical systems **(K2)**

UNIT - I FUNDAMENTAL TROUBLESHOOTING TESTING PROCEDURES   (9 Hrs)

Equipment failure and its cause-Functional block diagram of a troubleshooting system-Troubleshooting process & fault finding aids-Troubleshooting techniques and their correction action-Testing of active and passive components: resistor, capacitor, inductor, BJT, JFET, & MOSFET-

UNIT - II FAULT DIAGNOSIS IN ANALOG & DIGITAL INTEGRATED CIRCUITS   (9Hrs)

Characteristics of ideal op-amps, typical op-amp based medical circuits-Fault diagnosis in op-amp circuits-Digital troubleshooting methods-Digital IC Troubleshooters, logic clip, logic probe, logic pulser, logic current tracer, logic comparator-Circuit board Troubleshooting.

UNIT - III BIOMEDICAL EQUIPMENT TROUBLESHOOTING   (9 Hrs)

Troubleshooting- ECG Machine, EEG Machine-Troubleshooting- defibrillator, electrosurgical unit-Troubleshooting- anesthesia machine, autoclaves & sterilizers-Troubleshooting- endoscope, incubators, nebulizer-Troubleshooting- oxygen concentrators, sphygmomanometers, suction machine-Troubleshooting- X-ray machine.

UNIT - IV MEDICAL DEVICE DESIGN QUALITY   (9 Hrs)

Definition of quality, essence of quality-Quality operating system and the device life cycle-Evolution of quality-Business excellence: a value proposition-Health care quality.

UNIT - V DESIGN FOR SIX SIGMA AND MEDICAL DEVICE REGULATION   (9 Hrs)

Global Perspective on medical device regulations, medical device classification (USA, Europe & GHTF-Medical device safety, medical device quality management systems requirements-Medical device regulation throughout the product development life cycle-Purpose of ISO 9001:2001&ISO 13485.

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Text Books

1. Khandpur R S, "Troubleshooting Electronic Equipment- Includes Repair & Maintenance", 2nd edition, Tata McGrawHill, 2009.
2. Basem S EL-Haik& Khalid S Mekki, "Medical Device Design for Six Sigma: A Road Map for Safety and Effectiveness", 1st edition, John Wiley & Sons 2008.
3. Gopalakrishna, P. Purchasing and Materials Management, Tata MC.Graw Hill, New Delhi, 2017.

Reference Books

1. Nicholas Cram & Selby Holder, "Basic Electronic Troubleshooting for Biomedical Technicians", 2nd edition, 2010, TSTC Publishing.
2. Dan Tomal& Neal Widmer, "Electronic Troubleshooting", 3rd edition, McGraw Hill ,2004,.
3. Richard Fries, "Reliable Design of Medical Devices", 2nd edition, CRC Press., 2006
4. Joseph J Panichello, "X-Ray Repair: A Comprehensive Guide to the Installation & Servicing of Radiographic Equipment", 2nd edition,Charles C Thomas Publisher Ltd. , 2005
5. Gopalakrishna, P., Materials Management, Prentice Hall, New Delhi, 2015.

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1. https://www.who.int/medical_devices/publications/en/MD_Regulations.pdf
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2924127/
3. https://www.ncbi.nlm.nih.gov/pubmed/7613571

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	1	2	1	3	2	2	3	2	2
2	3	2	1	1	2	1	1	2	1	3	2	2	3	2	2
3	3	3	2	1	2	1	1	2	1	2	2	2	3	2	2
4	3	3	2	1	2	1	1	2	1	2	2	2	3	2	2
5	3	3	2	1	2	1	1	2	1	2	2	2	3	2	2

Correlation Level: 1-Low, 2-Medium, 3- High

OPEN ELECTIVE – I

	ELECTRICAL SAFETY	L	T	P	C	Hrs
U19EEO42	(Common to ECE, ICE, MECH, CIVIL, Mechatronics, CCE, BME, IT, CSE)	3	0	0	3	45

Course Objectives
- To familiarize the Indian Electricity Rules and Act related with electrical safety.
- To provide a knowledge about electrical shocks and safety precautions.
- To create awareness of the electrical safety associated with installation of electrical equipment.
- To analyze different Hazardous areas for electrical safety.
- To expose knowledge about necessity of safety policy and safety management.

Course Outcomes
After completion of the course, the students will be able to

CO1 - Describe the Indian Electricity (IE) acts and various rules for electrical safety.**(K2)**
CO2 - Expose safety measures to prevent electrical shock in handling of domestic electrical appliances. **(K3)**
CO3 - Evaluate the safety aspects during installation of plant and equipment. **(K3)**
CO4 - Describe the various hazardous area and application of electrical safety in various places. **(K3)**
CO5 - Acquire knowledge about importance of electrical safety training to improve quality management in electrical systems. **(K3)**

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS (9 Hrs)

Objective and scope of electrical safety - National electrical Safety code - Statutory requirements – Indian Electricity acts related to electrical Safety - Safety electrical one line diagram - International standards on electrical safety safe limits of current and voltage - Grounding of electrical equipment of low voltage and high voltage systems - Safety policy - Electrical safety certificate requirement

UNIT II ELECTRICAL SHOCKS AND THEIR PREVENTION (9 Hrs)

Primary and secondary electrical shocks - Possibilities of getting electrical shock and its severity - Effect of electrical shock of human being - Shocks due to flash/ Spark over's - Firing shock - Multi storied building - Prevention of shocks - Safety precautions - Safe guards for operators - Do's and Don'ts for safety in the use of domestic electrical appliances - Case studies on electrical causes of fire and explosion

UNIT III SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE (9 Hrs)

Need for inspection and maintenance - Preliminary preparations - Field quality and safety - Personal protective equipment - Safe guards for operators - Safety equipment - Risks during installation of electrical plant and equipment - Effect of lightning current on installation and buildings - Safety aspects during installation -Safety during installation of electrical rotating machines - Importance of earthing in installation– Agricultural pump installation

UNIT IV HAZARDOUS ZONES (9 Hrs)

Primary and secondary hazards - Hazardous area classification and of electrical equipments (IS, NFPA, API and OSHA standards) - Explosive gas area classifications: Class I(Division 1) - Zone 0, Zone 1, zone 2 classified locations, Design Philosophy for Equipment and installations-Classification of equipment enclosure for various hazardous gases and vapors - flash hazard calculation and approach distances- calculating the required level of arc protection

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UNIT V SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS   (9 Hrs)

Principles of Safety Management - Occupational safety and health administration standards - Safety organization - Safety auditing - Employee electrical safety teams - Electrical safety training to improve Quality management - Total quality control and management – Importance of high load factor - Causes of low power factor - Disadvantages of low power factor - Power factor improvement - Importance of P.F. improvement - Case studies of electrical workplace safety practices.

Text books

1. John Cadick, Mary Capelli Schellpfeffer, Dennis Neitzel, Al Winfield, "Electrical Safety Handbook", McGraw-Hill Education, 4th Edition, 2012.
2. Madden, M. John, "Electrical Safety and the Law: A Guide to Compliance", Wiley publications, 4th Edition, 2002.
3. Mohamed A. El-Sharkawi, "Electric Safety: Practice and Standards", CRC Press; 1st Edition, 2013.

Reference books

1. Rob Zachariason, "Electrical Safety", Delmar Cengage Learning, 1st Edition, 2011.
2. Peter E. Sutherland, "Principles of Electrical Safety", Wiley-IEEE Press; 1st Edition, 2014.

Web References

1. https://www.apeasternpower.com/downloads/elecact2003.pdf
2. https://safetyculture.com/topics/electrical-hazards/
3. https://www.jove.com/science-education/10114/electrical-safety-precautions-and-basic-equipment
4. https://electrical-engineering-portal.com/21-safety-rules-for-working-with-electrical-equipment
5. https://www.electrical4u.com/safety-precautions-for-electrical-system/
6. https://www.constellation.com/energy-101/electrical-safety-tips.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	-	2	-	-	-	-	-	-	1	-	2
2	3	3	3	2	-	2	-	-	-	-	-	-	1	-	2
3	3	3	3	2	-	2	-	-	-	-	-	-	1	-	2
4	3	3	3	2	-	2	-	-	-	-	-	-	1	-	2
5	3	3	3	2	-	2	-	-	-	-	-	-	1	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19ECO41	**ENGINEERING COMPUTATION WITH MATLAB** (Common to EEE, ICE, MECH, CIVIL, BME, Mechatronics)	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives

- To understand basic representation of Matrices and vectors in MATLAB
- To learn various programming structures in MATLAB
- To study built in and user defined functions in MATLAB.
- To become conversant with 2D as well as 3D graphics in MATLAB
- To make a Graphical User Interface (GUI) in MATLAB in order to achieve interactivity

Course Outcomes

After completion of the course, students will be able to

CO1 - State the basics of MATLAB (K1)

CO2 - Explain how to work with matrices, and their operations (K2)

CO3 - Use the MATLAB functions relevant to communication engineering, (K3)

CO4 - Demonstrates various file operations in MATLAB (K3)

CO5 - Applying the plotting capabilities of MATLAB effectively to various systems. (K3)

UNIT I INTRODUCTION TO MATLAB   (9 Hrs)

Menus & Tool bars, Variables - Matrices and Vectors - initializing vectors - Data types- Functions – User defined functions - passing arguments - writing data to a file-reading data from a file - using functions with vectors and matrices- cell arrays & structures - Strings - 2D strings-String comparing - Concatenation - Input and Output statements - Script files .

UNIT II LOOPS& CONTROL STATEMENTS   (9 Hrs)

Introduction; Relational & Logical operations - Example programs - Operator precedence - Control & Decision statements- IF - IF ELSE - NESTED IF ELSE - SWITCH - TRY & CATCH - FOR -WHILE - NESTED FOR - FOR with IF statements, MATLAB program organization, Debugging methods - Error trapping using eval&lastern commands.

UNIT III PLOTS IN MATLAB & GUI   (9 Hrs)

Basic 2D plots, Labels, Line style, Markers, plot, subplot, LOG, LOG-LOG, SEMILOG-POLARCOMET, Grid axis, labeling, fplot, ezplot, ezpolar, polyval, exporting figures, HOLD, STEM, BAR, HIST, Interactive plotting, Basic Fitting Interface – Polyfit - 3D plots – Mesh - Contour - Example programs. GUI - Creation Fundamentals – Capturing mouse actions

UNIT IV MISCELLANEOUS TOPICS   (9 Hrs)

File & Directory management - Native Data Files - Data import & Export - Low Level File I/O – Directory management - FTP File Operations - Time Computations -Date & Time – Format Conversions - Date & Time, Functions - Plot labels - Optimization - zero Finding - Minimization in one Dimension - Minimization

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in Higher Dimensions- Practical Issues. Differentiation & Integration using MATLAB, 1D & 2D Data Interpolation

UNIT V SIMULINK & APPLICATIONS (9 Hrs)

How to create & run Simulink, Simulink Designing - Using SIMULINK Generating an AM signal & 2nd order systems - Designing of FWR & HWR using Simulink - Creating a subsystem in Simulink. Applications Programs -Frequency response of filters. Open Loop gain of OPAMP, I/P characteristics of BJT, Plotting the graph between Breakdown voltage & Doping Concentration.

Text Books

1. RudraPratap, Getting Started with MATLAB 6.0 ,1st Edition, Oxford University Press-2004.
2. Duane Hanselman ,Bruce LittleField, "Mastering MATLAB 7", Pearson Education Inc, 2005
3. William J.Palm, "Introduction to MATLAB 6.0 for Engineers", McGraw Hill & Co, 2001.

Reference Books

1. M.Herniter, "Programming in MATLAB", Thomson Learning, 2001
2. John OkyereAltla, "Electronics and circuit analysis using MATLAB", CRC press, 1999
3. K.K.Sharma, "MATLAB Demustifyied", Vikas Publishing House Pvt Ltd. 2004

Web References

1. https://www.mathworks.com/products/matlab.html
2. https://www.tutorialspoint.com/matlab/index.htm
3. https://www.cmu.edu/computing/software/all/matlab/
4. https://ctms.engin.umich.edu/CTMS/index.php?aux=Home

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	-	2	3	-	-	-	-	-	-	-	1	3	-
2	2	2	-	2	3	-	-	-	-	-	-	-	1	3	-
3	2	2	-	2	3	-	-	-	-	-	-	-	-	3	-
4	2	2	-	2	3	-	-	-	-	-	-	-	-	3	-
5	2	2	-	2	3	-	-	-	-	-	-	-	-	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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	CONSUMER ELECTRONICS	**L**	**T**	**P**	**C**	**Hrs**
U19ECO42	(Common to EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives
- To enable thetroubleshoot of different types of microphones and loudspeakers
- To make the students to analyse the working of digital console, digital FM tuner and troubleshoot audio systems
- To train to test the working of various colour TV
- To empower them to troubleshoot colour TV receivers
- To equip them to maintain various electronic home and office appliances

Course Outcomes
After completion of the course, students will be able to

CO1 - Describe the fundamental audio characteristics and measurements, operating principles of microphone and loudspeaker **(K1)**

CO2 - Explain the working of digital console, digital FM tuner and troubleshoot the audio systems **(K2)**

CO3 - Distinguish the salient features of colour TV and Monochrome and troubleshoot TV camera **(K2**)

CO4 - Demonstrate various interfaces in digital TV, the working of DTH receiver, CD/DVD players **(K3)**

CO5 - Explain the working of FAX, Microwave oven, Washing machine, Air conditioner, Refrigerators and camera **(K2)**

UNIT I AUDIO FUNDAMENTALS AND DEVICES   (9 Hrs)
Basic characteristics of sound signal, Microphone- working principle, sensitivity, nature of response. Types of Microphone, Loud speaker- working principle, Woofers and Tweeters, characteristics.Types of Loudspeaker. Sound recording

UNIT II AUDIO SYSTEMS   (9 Hrs)
Introduction to audio system, Digital Console- Block diagram, working principle,applications, FM tuner- concepts of digital tuning, ICs used in FM tuner TD702IT, PA address system- Planning, speaker impedance matching, characteristics, Power amplifier specification

UNIT III TELEVISION SYSTEMS   (9 Hrs)
Monochrome TV standards, Components of TV system, scanning process, aspect ratio, persistence of vision and flicker, interlace scanning, picture resolution. Composite video signal,Colour TV standards, colour theory, hue, brightness, saturation, luminance and chrominance. Different types of TV camera.

UNIT IV TELEVISION RECEIVERS AND VIDEO STANDARDS   (9 Hrs)
Colour TV receiver- block diagram, Digital TVs- LCD, LED , PLASMA, HDTV, 3-D TV, projection TV, DTH receiver, Video interface: Composite, Component, Separate Video, Digital Video, SDI, HDMI, Digital Video Interface, CD and DVD player: working principles, interfaces

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UNIT V HOME AND OFFICE APPLIANCES   (9 Hrs)

Microwave Oven: Types, technical specifications. Washing Machine: hardware and software. Air conditioner and Refrigerators: Components features, applications, and technical specification. Digital camera and cam coder: - pick up devices, picture processing, picture storage

Text Books

1 Bali S.P. , 'Consumer Electronics', **copyright 2008**,Pearson Education India
2 Bali R and Bali S.P. 'Audio video systems : principle practices & troubleshooting', Khanna Book Publishing Co. (P) Ltd
3 Gulati R.R., 'Modern Television practices', 5th edition, 2015, New Age International Publication (P) Ltd

Reference Books

1 Gupta R.G., 'Audio video systems', 2nd edition,2017, Tata Mcgraw Hill, New Delhi, India
2 Whitaker Jerry & Benson Blair, 'Mastering Digital Television', McGraw-Hill Professional, 2006
3 Whitaker Jerry & Benson Blair, 'Standard handbook of Audio engineering', 2nd edition,2002, McGraw-Hill Professional

Web References

1 http://www.scientificamerican.com/article.cfm?id = expertsbluetooth-work
2 http://www.cosc.brocku.ca/Offerings/3P92/seminars/HDTV.ppt
3 http://www.circuitstoday.com/blu-ray-technology-working
4 http://www.freevideolectures.com

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	2	1	-	1	-	-	-	-	-	-	-	1	-
2	2	-	2	1	-	1	-	-	-	-	-	-	-	1	-
3	2	-	2	1	-	1	-	-	-	-	-	-	-	1	-
4	2	-	2	1	-	1	-	-	-	-	-	-	-	1	-
5	2	-	2	1	-	1	-	-	-	-	-	-	-	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

		L	**T**	**P**	**C**

U19CSO41   **WEB DEVELOPMENT**

(Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)   **3**   **0**   **0**   **3**

Course Objectives
- To study the fundamentals of web application development
- To understand the design components and tools using CSS
- To learn the concepts JavaScript and programming fundamentals.
- To study about advance scripting and Ajax applications.
- To understand the working procedure of XML

Course Outcomes
After the completion of the course, the students will be able to

CO1 - Develop basic web applications. **(K5)**
CO2 - Design the web applications using CSS. **(K5)**
CO3 - Validate the web pages using javascripts functions. **(K5)**
CO4 - Demonstrate the web 2.0 application to advance scripts. **(K3)**
CO5 - Update the knowledge of XML Data. **(K4)**

UNIT I INTRODUCTION TO WWW & HTML   (9 Hrs)
Protocols, secure connections, application and development tools, the web browser, What is server, dynamic IP, Web Design: Web site design principles, planning the site and navigation. HTML: The development process, Html tags and simple HTML forms, web site structure.

UNIT II STYLE SHEETS   (9 Hrs)
Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2.

UNIT III JAVASCRIPTS   (9 Hrs)
Client side scripting, What is JavaScript, How to develop JavaScript, simple Javascript, variables, functions, conditions, loops and repetition.

UNIT IV ADVANCE SCRIPT   (9 Hrs)
JavaScript and objects, JavaScript own objects, the DOM and web browser environments, forms and validations DHTML: Combining HTML, CSS and Javascript, events and buttons, controlling your browser, Ajax: Introduction, advantages & disadvantages, ajax based web application, alternatives of ajax.

UNIT V XML   (9 Hrs)
Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application.XML, XSL and XSLT. Introduction toXSL, XML transformed simple example, XSL elements, transforming with XSLT.

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Text Books

1. P.J. Deitel AND H.M. Deitel," Internet and World Wide Web - How to Program", Pearson Education, 2009.
2. Keith Wald, Jason Lengstorf," Pro PHP and jQuery", Paperback, 2016.
3. Semmy Purewal, "Learning Web App Development", O'Reilly Media, Inc.

Reference Books

1. UttamK.Roy, "Web Technologies", Oxford University Press, 2010.
2. Rajkamal, "Web Technology", Tata McGraw-Hill, 2009.
3. Steven Suehring, Janet Valade, "PHP, MySQL, JavaScript & HTML5 All-in-One", John Wiley & Sons, Inc, 2013.
4. Yakov Fain, Victor Rasputnis, Anatole Tartakovsky and Viktor Gamov, "Enterprise Web Development ", O'Reilly Media, 2014.
5. Shklar, Leon, Rosen, Rich, "Web Application Architecture: Principles, Protocols and Practices", Wiley Publication, 2009.

Web References

1. https://www.w3schools.com
2. https://www.geeksforgeeks.org/web-technology/
3. https://www.guru99.com/cakephp-tutorial.html
4. https://www.ithands.com/blog/cms-or-php-framework-which-technology-is-better-for-my-business
5. http://Oriel.ly/learning-web-app

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3	-	-	3	-	3	2	-
2	2	2	2	2	-	2	-	2	-	2	-	2	3	2	-
3	3	3	3	3	3	3	3	3	-	-	3	-	3	2	-
4	2	2	2	2	-	2	-	2	-	2	-	2	3	2	-
5	2	2	2	2	-	2	-	2	-	2	-	2	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19CSO42	**ANALYSIS OF ALGORITHMS** (Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives

- To analyze the performance of algorithms in terms of time and space complexity
- To understand how the choice of algorithm design methods such as divide and conquer, greedy method impacts the performance of programs.
- To solve problems using Dynamic Programming and derive the time complexity
- To solve problems using Backtracking technique and derive the time complexity
- To solve problems using Branch and Bound technique and derive the time complexity

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 - Choose the appropriate data structure and algorithm design method for a specified application.**(K2)**

CO2 - Ability to understand the design technique such as divide and conquer, greedy method applied to realistic problems and analyse them. **(K3)**

CO3 - Ability to understand the dynamic programming design technique and how it is applied to realistic problems and analyze them. **(K3)**

CO4 - Ability to understand the backtracking design technique and how it is applied to realistic problems and analyze them. **(K3)**

CO5 - Ability to understand Branch and Bound design technique and how it is applied to realistic problems and analyze them. **(K2)**

UNIT I INTRODUCTION   (9 Hrs)

Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Time complexity, Space complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation.

UNIT II DIVIDE AND CONQUER METHOD AND GREEDY METHOD   (9 Hrs)

Divide and Conquer method:, Applications- Binary search, Merge sort, Quick sort.

Greedy method: General method, applications -, Knapsack problem, Minimum cost spanning trees, Single source shortest path problem.

UNIT III DYNAMIC PROGRAMMING   (9 Hrs)

Dynamic Programming: Applications - Multistage graphs, 0/1 knapsack problem, All pairs shortest path problem, Traveling salesperson problem, Reliability design.

UNIT IV BACKTRACKING   (9 Hrs)

Backtracking: General method, Applications-N-queen problem, Sum of subsets problem, Graph coloring- Hamiltonian Cycles.

UNIT V BRANCH AND BOUND (9 Hrs)

Branch and Bound: General method, Applications - Traveling sales person problem, 0/1 knapsack problem- LC Branch and Bound solution, FIFO Branch and Bound solution.

Text Books

1. E. Horowitz and S.Sahni, "Fundamentals of Algorithms", 2nd Edition, Galgotia Publications, 2010.
2. T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, "Introduction to Algorithms", 3rdEdition, PHI/Pearson Education, 2009.
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.

Reference Books

1. Michael T. Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", Wiley India, 2006.
2. Sara Baase and Allen Van Gelder, "Computer Algorithms Introduction to Design and Analysis", 3rd Edition, Pearson Education Asia, 2010.
3. Donald E Knuth, "The Art of Computer Programming, Volume I & II", Revised Re-Third Edition, Addison Wessely, 2011.
4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.
5. Harsh Bhasin, "Algorithms Design and Analysis", Oxford university press, 2016.

Web References

1. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/
2. https://www.javatpoint.com/daa-tutorial
3. https://www.guru99.com/design-analysis-algorithms-tutorial.html
4. https://www.geeksforgeeks.org/fundamentals-of-algorithms/
5. https://swayam.gov.in/nd1_noc20_cs71/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PS
1	3	3	2	3	2	2	1	-	-	-	-	-	3	2	
2	3	2	3	3	2	2	1	-	-	-	-	-	3	2	
3	3	3	3	3	2	2	2	-	2	-	-	-	3	2	
4	3	2	3	3	3	2	2	-	-	-	3	-	3	2	
5	3	3	3	3	2	2	2	-	-	-	3	2	3	2	

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19ITO41	**DATABASE SYSTEM: DESIGN & DEVELOPMENT**	L	T	P	C	Hrs
	(Common to EEE, ECE, ICE, BME)	3	0	0	3	45

Course Objectives
- Understand the various data models, conceptualize E-R diagram and depict using relational model
- Gain knowledge about database languages and frame query using Relational Algebra and SQL
- Understand and design an efficient database schema using the various normal forms
- Impart knowledge on data storage and transaction processing, concurrency control techniques and recovery procedures
- Explore knowledge on tools and practice case studies

Course Outcomes
After completion of the course the students will be able to:
CO1 - Explain the concepts of Database Management System and develop Entity Relationship model and Relational Models for a given application **(K2)**
CO2 - Manipulate and build database queries using Structured Query Language and relational algebra **(K2)**
CO3 - Apply data normalization principles to develop a normalized database for a given application.**(K3)**
CO4 - Explain various storage & indexing techniques, transactions and recovery techniques **(K2)**
CO5 - Apply tools like NoSQL, MongoDB, Cassandra on real time applications **(K3)**

UNIT I INTRODUCTION   (9 Hrs)
Database Systems– Data Models – Database System Architecture - Entity-Relationship Model - ER Diagram-Extended ER Model –ER into Relational Model - **Relational Model**: Structure of Relational Databases, Database Schema, Keys, Tables

UNIT II DATABASE LANGUAGES   (9 Hrs)
Relational Algebra – Extended-Relational Algebra Operations –**SQL**: Introduction – DDL – DML –Integrity Constraints-Set Operations-Joins – Nested Queries -View- Trigger - Stored Procedures

UNIT III RELATIONAL-DATABASE DESIGN   (9 Hrs)
Introduction to Schema Refinement – Decomposition – Lossless Decomposition – Functional Dependencies – Normal Forms - First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Fourth Normal Form.

UNIT IV DATA STORAGE   (9 Hrs)
RAID - File Organization - Indexing, Ordered Index, Index files, Hashing - Static and dynamic hashing. **Transactions**: Transaction concepts and states– Concurrent Execution-Serializability-Concurrency Control: Lock based Protocol - Timestamp based Protocol - **Recovery System**: – Log-Based Recovery – Shadow Paging

UNIT V CASE STUDY   (9 Hrs)
NoSQL – Document Database : MongoDB - Multi-dimensional: Cassandra

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Text Books
1. Silberschatz, Korth, Sudarshan, *Database System Concepts*, 7thEdition – McGraw-Hill Higher Education, International Edition, 2019.
2. Ramez Elmasri, and Shamkant B. Navathe, Fundamentals of Database Systems (7th edition), Publisher: Pearson,2016

Reference Books
1. Raghu Ramakrishnan, —Database Management Systems, Fourth Edition, McGraw-Hill College Publications, 2015.
2. Date C J, Kannan A and Swamynathan S, —An Introduction to Database Systemsǁ, 8th Edition, Pearson Education, New Delhi, 2006.
3. Alan Beaulieu, Mastering SQL Fundamentals, Second Edition, O'Reilly,2009
4. Kristina Chodorow; Shannon Bradshaw MongoDB: The Definitive Guide, 3rd Edition, O'Reilly Media, Inc., 2018.
5. Pramod J. Sadalage (Author), Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1stEdition, Kindle Edition

Web References
1. http://www.database.com/
2. http://cassandra.apache.org/
3. https://www.mongodb.com/

CO-POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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2	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19ITO42	**R PROGRAMMING**	**L**	**T**	**P**	**C**	**Hrs**
	(Common to EEE, ECE, ICE, BME, MECH, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the basics in R programming in terms of constructs, control statements, string functions
- To learn to apply R programming for Text processing
- To understand the use of data frames and tables
- To able to appreciate and apply the R programming from a statistical perspective
- To understand the interface model

Course Outcomes

After completion of the course the students will be able to:

CO1 - Create artful graphs to visualize complex data sets and functions.**(K3)**
CO2 - Write more efficient code using parallel R and vectorization.**(K3)**
CO3 - Create data frames and working with tables.**(K3)**
CO4 - Interface R with C/C++ and Python for increased speed or functionality.**(K2)**
CO5 - Find new packages for text analysis, image manipulation & perform statistical analysis.**(K4)**

UNIT I INTRODUCTION   (9 Hrs)

Introducing to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names

UNIT II MATRICES AND ARRAYS   (9 Hrs)

Matrices, Arrays And Lists Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists.

UNIT III DATA FRAMES   (9 Hrs)

Data Frames Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions

UNIT IV FUNCTIONS AND ARGUMENTS   (9 Hrs)

Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Environment and Scope issues – Writing Upstairs - Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots

UNIT V INTERFACING   (9 Hrs)

Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear

models – Non-linear models – Time Series and Auto-correlation – Clustering.

Text Books
1. Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011.
2. Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Data & Analytics Series, 2013.

Reference books
1. Mark Gardener, " Beginning R – The Statistical Programming Language", Wiley, 2013
2. Robert Knell, "Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R", Amazon Digital South Asia Services Inc, 2013.

Web References
1. https://www.coursera.org/learn/r-programming
2. https://www.r-project.org/

CO-POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

U19MEO41	**RAPID PROTOYPING**	**L**	**T**	**P**	**C**	**Hrs**
	(Common to EEE, ECE, ICE, CIVIL, BME)	**3**	**0**	**0**	**3**	**45**

Course Objectives
- To understand the development of RP systems
- To learn the classification of liquid based and solid based rapid prototyping systems
- To understand the powder based rapid prototyping systems
- To learn about the materials for rapid prototyping systems
- To discuss about the reverse engineering and new technologies

Course Outcomes
On successful completion of the course, students will be able to

CO1 - Acquire knowledge about the product development**(K1)**
CO2 -Analyse the classification of liquid based and solid based rapid prototyping systems**(K4)**
CO3 - Analyse the powder based rapid prototyping systems**(K4)**
CO4 -Acquire knowledge about the materials for rapid prototyping systems**(K1)**
CO5 - Acquire knowledge about reverse engineering and new technologies**(K1)**

UNIT I INTRODUCTION   (9 Hrs)
History – Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle – Fundamental – File format– Other translators – medical applications of RP - On demand manufacturing – Directmaterial deposition - Shape Deposition Manufacturing.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS   (9 Hrs)
Classification – Liquid based system - Stereolithography Apparatus (SLA), details of SLprocess, products, Advantages, Limitations, Applications and Uses. Solid based system- Fused Deposition Modeling, principle, process, products, advantages, applications anduses - Laminated Object Manufacturing.

UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS   (9 Hrs)
Selective Laser Sintering – principles of SLS process, principle of sinter bondingprocess, Laser sintering materials, products, advantages, limitations, applications anduses. Three Dimensional Printing – process, major applications, research anddevelopment. Direct shell production casting – key strengths, process, applications anduses, case studies, research and development. Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts,e-manufacturing - Laser Engineered Net Shaping (LENS).

UNIT IV MATERIALS FOR RAPID PROTOTYPING SYSTEMS   (9 Hrs)
Nature of material – type of material – polymers, metals, ceramics and composites liquidbased materials, photo polymer development – solid based materials, powder basedmaterials - case study.

UNIT V REVERSE ENGINEERING AND NEW TECHNOLOGIES   (9 Hrs)
Introduction, measuring device- contact type and non-contact type, CAD model creationfrom point clouds-

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preprocessing, point clouds to surface model creation, medical dataprocessing - types of medical imaging, software for making medical models, medicalmaterials, other applications - Case study.

Text Books

1. Rafiq I. Noorani, Rapid Prototyping – Principles and Applications, Wiley & Sons,2006.
2. 2. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping: Principles and Applications,second edition, World Scientific, 2003.
3. Amitav Ghosh Introduction to Rapid Prototyping, North West Publication, New Delhi,2008.

Reference Books

1. Hopkinson N, R.J.M, Hauge, P M, Dickens, "Rapid Manufacturing – An Industrial revolution for the digital age", Wiley, 2006
2. Ian gibson, "Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototying", Wiley, 2006
3. Paul F.Jacobs, Rapid Prototyping and Manufacturing, "Fundamentals ofStereolithography", McGraw Hill 1993.
4. Pham D.T and Dimov, "Rapid Manufacturing", Springer Verlog 2001.
5. Liou W.Liou, Frank W.Liou ,"Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.

Web References

1. https://nptel.ac.in/courses/112/104/112104265/
2. https://www.digimat.in/nptel/courses/video/112104265/L01.html
3. https://nptel.ac.in/courses/112/107/112107078/
4. https://www.youtube.com/watch?v=oDdOqLblmVQ
5. https://www.youtube.com/watch?v=OhNnKTaciVI

COs Mapping with POs and PSOs (BME)

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	1	-	-	-	-	-	-	2	1	1	1
2	3	3	3	3	1	-	-	-	-	-	-	2	1	1	1
3	3	3	3	3	1	-	-	-	-	-	-	2	1	1	1
4	3	3	3	3	1	-	-	-	-	-	-	2	1	1	1
5	3	3	3	3	1	-	-	-	-	-	-	2	1	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19CEO41	**ENERGY AND ENVIRONMENT**	L	T	P	C	Hours
	(Common to EEE, ECE, MECH, BME, IT, Mechatronics)	3	0	0	3	45

Course Objectives
- Explain the importance of energy, classifications of energy sources and energy demand scenario
- Analyze the impacts of energy on environment & sustainability energy options
- Outline the harness of hydropower and geothermal energy sources
- Discuss the aspects of solar and wind energy
- To study the importance of biomass energy and its applications

Course Outcomes
After completion of the course, the students will be able to
CO1 - Apply the knowledge of science & engineering to the contemporary issues of Energy for better humankind & environment **(K3)**
CO2 - Identify, review & analyze the complex problems of Energy crises in environment **(K4)**
CO3 - Designing solutions for the energy crises in the form of renewable energy systems to meet the needs by understanding the limitations **(K4)**
CO4 - Understanding the impact of energy on environment and providing solutions for sustainable development. **(K5)**
CO5 - Apply biomass energy under relevant technologies **(K3)**

UNIT I ENERGY   (9 Hrs)
Introduction, Importance of energy, role of energy consumption in economic and social transformation, Energy needs and crisis. Energy production and utilization. Types and classification of energy sources, Conventional & unconventional energy, Renewable sources & Nonrenewable sources of energy advantages, limitations, comparisons

UNIT II ENVIRONMENT   (9 Hrs)
Impact of energy on economy &environment. Regional impacts of temperature change - Global warming, Greenhouse effect, Acid rain, Ozone layer depletion. Indian environment degradation, Environmental laws - Water Act-1974 (Prevention & control of pollution), The environment protection act 1986, Air act.

UNIT III HYDROPOWER & GEOTHERMAL ENERGY   (9 Hrs)
Hydropower Energy – Introduction, Site selection, layout of hydro power plant, components & working, classifications, power station, structure and control. Geothermal Energy - Introduction, Site selection, layout of power plant, components & working, Advantages and disadvantages.

UNIT IV SOLAR & WIND ENERGY   (9 Hrs)
Sun as source of energy - Introduction, Site selection, layout of power plant components & working, classifications, Types of collectors, collection systems efficiency, Solar cells. Wind Energy - Introduction, advantages/limitations, Site selection, layout of power plant, components &working, classification.

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UNIT V BIOMASS ENERGY (9 Hrs)

Introduction, advantages/limitations, Photosynthesis, biomass fuel, biomass gasification, biogas from waste biomass, factors affecting biogas generation, types of biogas plant, Biomass programme in India,

Text Books

1. Trivedi R.R. and Jalka K.R, "Energy Management", Commonwealth Publication, 20177.
2. Diamant R.M.E., "Total Energy", Pergamon, OxfordPublishers, 2017.
3. N.G. AJJANNA " Energy auditing & demand side management" first edition, Gouthami Publications, Shimoga
4. Chakrabarti, M.L.Soni, P.V. Gupta,U.S. Bhatnagar " Power system Engineering" 2001, DhanpatRai&Co, New Delhi.
5. D.P.Kothari, K.C Singal, Rajesh Ranjan, "Renewable Energy sources and Emerging Technologies" second edition , PHI , India

Reference Books

1. Boyle G, Everett B and Ramett J, "Energy systems and sustainability", Oxford University Press, 2018
2. "Pollution Control Acts, Rules and Notifications", CPCB, Pollution Control series, PC/2/2014, Vol.I,2014
3. Peavy.H, Rowe.D, and Tchobanoglous, G., Environmental Engineering, Tata McGraw-Hill, 2013
4. S.Rao, Dr. BB Parulekar "Energy Technologies" Khanna Publications , New Delhi
5. David M Buchla, Thomas E Kissel, Thomas L Floyd "Renewable Energy systems" Pearson, India
6. Godfrey Boyle "Renewable Energy power for sustainable future" oxford Publications , New Delhi

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2. https://swayam.gov.in/nd1_noc20_ce23/preview
3. www.iucn.org
4. www.cites.org
5. www.thesummitbali.com/
6. http://engineering geology.gov.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	2	2	1	-	-	-	-	3	-	-	-
CO2	1	1	1	-	-	2	1	-	-	-	-	3	-	-	-
CO3	2	2	2	2	2	3	3	-	1	1	2	3	-	-	-
CO4	2	2	2	2	3	3	3	-	1	1	2	3	-	-	-
CO5	2	2	2	2	3	3	3	-	1	1	2	3	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U19CEO42	**BUILDING SCIENCE AND ENGINEERING**	L	T	P	C	Hours
	(Common to EEE, MECH, BME)	3	0	0	3	45

Course Objectives

- Understand the basic materials in civil engineering and Have an insight to different types of doors, windows.
- Analyze the types of foundation.
- Gain the knowledge of bylaws for the planning of a public/private building
- Understand the different methods and materials of interiors for building
- Understand the concept of landscaping

Course Outcomes

After completion of the course, the students will be able to

CO1 - Apply the knowledge of engineering fundamentals to understand, the characteristics of basic civil engineering materials **(K2)**

CO2 - Apply the knowledge of engineering fundamentals and analyze the types of foundation **(K2)**

CO3 - Develop plan, section and apply bylaws and investigate causes and remedies for cracks, have an insight to cost effective construction **(K3)**

CO4 - Understand, design and work in a team and develop the interiors**(K5)**

CO5 - Understand, design and work in a team and develop landscaping for buildings as per design guidelines.**(K5)**

UNIT I MATERIALS FOR CONSTRUCTION (9 Hrs)

Cement concrete: introduction, ingredients of cement, grade of concrete, properties..Steel :definition , types of steel, uses of steel, market forms of steel used in construction Doors and windows : location of doors and windows, types of doors, types of windows, Stairs : requirements of good stairs, types , stairs of different materials

UNIT II FOUNDATION AND STRUCTURAL MEMBERS (9 Hrs)

Selection of site, substructure, objectives of foundation, site inspection, soils, loads on foundations, essential requirements of good foundation, types of foundation, failure of foundation and remedial measures. Structural members: columns, lintels, roofing (flat roof and sloped roof), flooring (types of floors and floor covering), damp proofing, plastering.

UNIT III BUILDING PLANNING AND MAINTAINENCE (9 Hrs)

Plan, section and elevation .Introduction, classification of buildings, components of buildings, building bylaws, orientation of buildings, ventilation, acoustic requirements, Superstructure: introduction, brick masonry, stone masonry and rcc. Building maintenance Deterioration of concrete, deterioration of masonry works, prevention of cracks and leaks, cost effective construction, anti-termite treatment in building.

UNIT IV INTERIOR DESIGN (9 Hrs)

Functional requirement of interior designer, basic elements of interior design, design problems :Interior design for spacious rooms, comfortable rooms, theme rooms, living area, cooking area, drinking area dining area,

home offices, sleeping area, bathrooms, public/private buildings

UNIT V LANDSCAPING   (9 Hrs)

Elements of Landscape architecture, specialization in landscape, landscape products, landscape materials, and water efficient landscaping, design guidelines for interior landscape

Text Books

1. Basic civil engineering : M.S.palanichamy fourth edition Tata mcgraw hill limited ,2005
2. Basic civil engineering : sateeshgopi ,pearson, 2010
3. Building Science: Concepts and Applications: Jens Pohl, Wiley-Blackwell, 2011

Reference Books

1. Basic civil engineering : Dr.B.C.Punmia, Ashok kumarjain, ArunkumarjainLaxmi publications year of publication ,2004
2. Basic civil engineering : S.S.Bhavikatti New Age International Limited, 2010
3. Interior Design and Decoration: Seetharaman P.2019

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1. https://www.youtube.com/watch?v=XsFeVuVQE-E
2. https://www.youtube.com/watch?v=LYvDoy7MtkE
3. https://www.youtube.com/watch?v=zjZVlFt3WQY
4. https://www.youtube.com/watch?v=pYAXsbsFBC8
5. https://www.youtube.com/watch?v=PIY63QacRTc

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	3	3	3	2	3	3	3	-	-	-
2	3	3	2	3	1	3	3	3	2	3	3	3	-	-	-
3	3	3	2	3	1	3	3	3	2	3	3	3	-	-	-
4	3	3	2	3	2	3	3	3	2	3	3	3	-	-	-
5	3	3	2	3	2	3	2	3	2	3	3	3	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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	BASIC DBMS	**L**	**T**	**P**	**C**	**Hrs**
U19CCO41	(Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand about basics of Database Management System.
- To provide a general introduction to relational model and relational algebra.
- To study about normalization and SQL.
- To acquire knowledge about storage indexing and transaction management.
- To gain knowledge about the backup and recovery in database.

Course Outcomes

After completion of the course, the students will be able to

CO1 – Explain the concept of database management system.(**K2**)

CO2 – Create conceptual data model using entity relationship diagram.(**K2**)

CO3 – Analyze the various normalization.(**K4**)

CO4 – Describe the concept of storage indexing and transactions.(**K2**)

CO5 – Explain the database recovery and security.(**K2**)

UNIT - I INTRODUCTION TO DATABASE MANAGEMENT **(9 Hrs)**

Introduction to Database Management systems – History - Characteristics – Users- three-level architecture- Entity-- relationship data model.

UNIT - II THE RELATIONAL DATA MODEL AND RELATIONAL ALGEBRA **(9 Hrs)**

Data structures – Mapping E-R Model to Relational model – data manipulation – integrity – advantages – rules for fully relational systems – relational algebra – relational algebra queries.

UNIT - III STRUCTURED QUERY LANGUAGE AND NORMALIZATION **(9 Hrs)**

SQL – Data definition – manipulation – views SQL in procedural programming – data integrity and constraints – triggers – data control – database security. Normalization – Undesirable properties – single-valued normalization – desirable properties of decompositions – multivalued dependencies

UNIT -IV STORAGE INDEXING AND TRANSACTIONS MANAGEMENT **(9 Hrs)**

Different types of memories – secondary storage – buffer management – file structures – heap files – sorted files – index and types – indexed sequential file – B-tree – B+ tree. Transaction management – concepts – examples – schedules – serializability – concurrency control – deadlocks – lock and multiple granularity – nonlocking techniques.

UNIT -V DATABASE BACKUP, RECOVERY AND SECURITY **(9 Hrs)**

Database system failure – backup – recovery and concept of log – log-based recovery techniques – types of recovery – log-based immediate update recovery technique. Database Security – violations –

identifications and authentication – authorization / access control – security of statistical databases – audit policy – internet applications and encryption.

Text Books
1. Gupta.G.K, "Database Management Systems", Tata McGraw Hill, 2011
2. Abraham Silberschatz, Henry F Korth, S Sudharshan, Database System Concepts 7th Edition, McGraw-Hill International Edition, 2019.
3. Ramez Elmasri and Shamkant Navathe, Durvasula V L N Somayajulu, Shyam K Gupta, "Fundamentals of Database Systems", Pearson Education, United States of America, 2018.

Reference Books
1. Silberschatz, Korth.H and Sudarshan.S, "Database System Concepts", 6th Edition, McGraw-HillInternational, 2011.
2. Hector Garcia-Molina, Jeffrey D.Ullman, Jennifer Widom, "Database System The Complete Book, 1st Edition, Pearson 2002.
3. Date CJ, Kannan A, Swamynathan S, An Introduction to Database System, 8th Edition, Pearson Education-2006.
4. Raghu Ramakrishna, Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw Hill, 2014.
5. Ramez Elmasri, Durvasul VLN Somyazulu, Shamkant B Navathe, Shyam K Gupta, Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016.

Web References
1. https://docs.oracle.com/cd/E11882_01/server.112/e41084/toc.htm MySQL Online Documentation
2. http://dev.mysql.com/doc/
3. http://www.rjspm.com/PDF/BCA-428%20Oracle.pdf
4. http://www.w3schools.com/
5. https://www.codecademy.com/learn/learn-

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	-	-	-	1	1	-	2	-
2	3	1	1	-	1	-	-	-	-	-	1	1	-	2	-
3	3	3	1	-	1	-	-	-	-	-	1	1	-	2	-
4	3	1	1	-	1	-	-	-	-	-	1	1	-	2	-
5	3	1	1	-	1	-	-	-	-	-	1	1	-	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

OPEN ELECTIVE-II

U19HS051/	PRODUCT DEVELOPMENT AND DESIGN	L	T	P	C	Hrs
		3	1	0	3	45

Course Objectives
- To provide the basic concepts of product design, product features and its architecture.
- To have a basic knowledge in the common features a product has and how to incorporate them suitably in product.
- To enhance team working skills.
- To design some products for the given set of applications.
- To compete with a set of tools and methods for product design and development.

Course Outcomes
After completion of the course, the students will be able to
CO1 - Apply the concept for new product development. **(K3)**
CO2 - Validate knowledge on the concepts of product specification. **(K5)**
CO3 - Describe the principles of industrial design and prototyping. **(K2)**
CO4 - Apply knowledge on product architecture. **(K3)**
CO5 - Review the concept of product development and customer needs. **(K5)**

UNIT I: INTRODUCTION TO PRODUCT DEVELOPMENT (9 Hrs)
Product development versus design, product development process, product cost analysis, cost models, reverse engineering and redesign product development process, new product development, tear down method.

UNIT II: PRODUCT SPECIFICATIONS (9 Hrs)
Establishing the product specifications– Target specifications – Refining specifications, concept generation-Clarify the problem – Search internally – Search externally – Explore systematically - Reflect on the Results and the Process.

UNIT III: PRODUCT CONCEPTS (9 Hrs)
A: Concept generation, product configuration, concept evaluation and selection, product embodiments.
B: Quality function deployment, product design specification, physical prototypes-types and technique, dimensional analysis, design of experiments.

UNIT IV: PRODUCT ARCHITECTURE (9 Hrs)
Concept selection- Screening – scoring, Product architecture – Implication of architecture - Establishing the architecture – Related system level design issues.

UNIT V: PROTOTYPING (9 Hrs)
Reliability, failure identification techniques, Poka-Yoke, Design for the environment, design for maintainability, product safety, liability and design, design for packaging.

Text Books

1. Kari T.Ulrich and Steven D.Eppinger,"Product Design and Development", McGraw-Hill International Edns.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood,
3. Otto, K. N. Product design: techniques in reverse engineering and new product development.

Reference Books

1. Ashby, M. F., & Johnson, K... *Materials and design: the art and science of material selection in product design.* Butterworth-Heinemann.
2. Kevin Otto and Kristin Wood, "Techniques in Reverse Engineering and New Product Development", Pearson Education, Chennai, Edition III.
3. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 6th Edition, PHI.
4. Taurt Pugh,"Tool Design – Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY
5. Kumar, A., Jain, P. K., & Pathak, P. M. Reverse engineering in product manufacturing: an overview. DAAAM international scientific book,

Web References

1. http://www.worldcat.org/title/product-design-and-development/oclc/904505863
2. https://www.pdfdrive.com/product-design-and-development-e38289913.html
3. https://www.smashingmagazine.com/2018/01/comprehensive-guide-product-design/
4. https://www.smashingmagazine.com/2018/01/comprehensive-guide-product-design/
5. https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-development-spring-2006/lecture-notes/clas1_int_crse_6.pdf
6. https://swayam.gov.in/nd1_noc20_de05/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	3	-	3	-	-	-	-	-	-	2	-	-	-
2	1	-	2	-	3	-	-	-	-	-	-	3	-	-	-
3	1	-	3	-	2	-	-	-	-	-	-	2	-	-	-
4	3	-	1	-	3	-	-	-	-	-	-	1	-	-	-
5	1	-	3	-	3	-	-	-	-	-	-	2	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

		L	**T**	**P**	**C**	**Hrs**
U19HS052	**INTELLECTUAL PROPERTY RIGHTS**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To introduce fundamental aspects of Intellectual Property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights and its related rights and registration aspects
- To disseminate knowledge on trademarks and registration aspects
- Awareness about current trends in IPR and Government steps in fostering IPR

Course Outcomes

After completion of the course, the students will be able to

CO1: Complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works **(K2)**

CO2: Presenting useful insight on novelty of their idea from state-of-the art search during their project work period. **(K3)**

CO3: Posting Intellectual Property as a career option like R&D IP Counsel, Government Jobs – Patent Examiner, Private Jobs, Patent agent and/or Trademark agent and Entrepreneur **(K5)**

CO4: To disseminate knowledge on Design, Geographical Indication, Plant Variety and Layout Design Protection and their registration aspects **(K1)**

CO5: Organizing their idea or innovations and analyse ethical and professional issues which arise in the intellectual property law context. **(K4)**

UNIT I OVERVIEW OF INTELLECTUAL PROPERTY (9 Hrs)

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994

UNIT II PATENTS (9 Hrs)

Patents - Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board

UNIT III COPYRIGHTS   **(9 Hrs)**

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights

UNIT IV TRADEMARKS   **(9 Hrs)**

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board

UNIT V OTHER FORMS OF IP   **(9 Hrs)**

Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection Geographical Indication (GI) Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection.

Text Books
1. Nithyananda, K V. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited, 2019
2. Neeraj, P., & Khusdeep, D. Intellectual Property Rights. India, IN: PHI learning Private Limited. 2014

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1. Ahuja, V K. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis, 2017.

2. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cengage Learning, Third Edition, 2012.

3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

4. Prabuddha Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education, 2011.

5. S.V. Satakar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.

6. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012.

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1. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf
3. Cell for IPR Promotion and Management (http://cipam.gov.in/)

4. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
5. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)
6. Journal of Intellectual Property Rights (JIPR): NISCAIR

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	3	-	2	-	1	2	-	-	-	2	-	-	-
2	1	-	3	-	2	-	2	2	-	-	-	2	-	-	-
3	-	-	2	-	1	-	3	3	-	-	-	2	-	-	-
4	2	-	3	-	2	-	2	2	-	-	-	2	-	-	-
5	1	-	1	-	2	-	1	2	-	-	-	2	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

U19HS053	**MARKETING MANAGEMENT AND RESEARCH**	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives
- To facilitate understanding of the conceptual framework of marketing in engineering.
- To understand the concepts of product and market segmentation for engineering services and technological products.
- Analyzing the various pricing concepts and promotional strategies for engineering and technology markets.
- Learn to focus on a research problem using scientific methods in engineering and technological enterprises.
- To be able to design and execute a basic survey research reports in in engineering and technological enterprises

Course Outcomes
After completion of the course, the students will be able to

CO1 - Analyze the fundamental principles involved in managing engineering and technological markets **(K3)**

CO2 - Understand and develop product, and Market Segmentation for engineering services and technological
    Products **(K4)**

CO3 - Develop pricing and promotional strategies for engineering and technology markets **(K6)**

CO4 - Analyze market problems and be capable of applying relevant models to generate appropriate solutions
    to meet challenges in engineering and technological enterprises **(K3)**

CO5 - Identify the interrelationships between market trends, innovation, sustainability and communication
    in engineering and technological enterprises **(K5)**

UNIT I MARKETING – AN OVERVIEW   (9 Hrs)
Definition, Marketing Process, Dynamics, Needs, Wants and Demands, Marketing Concepts, Environment, Mix, Types, Philosophies, Selling vs Marketing, Consumer Goods, Industrial Goods.

UNIT II PRODUCT AND MARKET SEGMENTATION   (9 Hrs)
Product, Classifications of product, Product Life Cycle, New product development, Branding, Segmentation factors, Demographic, Psycho graphic and Geographic Segmentation, Process, Patterns. Services marketing and Industrial marketing.

UNIT III PRICING AND PROMOTIONAL STRATEGIES   (9 Hrs)
Price: Objectives, Pricing Decisions and Pricing Methods, Pricing Management. Advertising-Characteristics, Impact, Goals, Types, Sales Promotion – Point of purchase, Unique Selling Propositions, Characteristics, Wholesaling, Retailing, Channel Design, Logistics.

UNIT IV RESEARCH AND ITS FUNDAMENTALS   (9 Hrs)

B.Tech. Biomedical Engineering

Research: Meaning, Objectives of Research, Types of Research, Significance of Research - Methods Vs Methodology - Research Process – Components of Research Problem, Literature Survey – Primary Data and Secondary Data, Questionnaire design, Measurement and Scaling Techniques.

UNIT V BASIC STATISTICAL ANALYSIS AND REPORT WRITING (9 Hrs)

Fundamentals of Statistical Analysis and Inference- Measures of Central Tendency -Measures of Dispersion -Measures of Asymmetry - Report Writing: Types of research reports, Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different Steps in Report Writing, Layout of Research Report, Mechanics of Writing Research Report, Ethics in Research

Text Books
1. Philip Kolter & Keller, "Marketing Management", Prentice Hall of India, 14th edition, 2012.
2. Lilien, Gary I., and Arvind Rangaswamy. "Marketing managers make ongoing decisions about product features, prices, distribution options", The Handbook of Marketing Research: Uses, Misuses, and Future Advances (2006).

Reference Books
1. Chandrasekar. K.S., "Marketing Management Text and Cases", 1st Edition, Tata McGraw Hill - Vijaynicole, 2010.
2. Kothari, C. "Research Methodology Methods and Techniques", New Age International (P) Ltd., 2017
3. RajanSexena. Marketing Management: Text cases in Indian Context.(3rd edition) New Delhi, Tata McGraw hill, 2006
4. Moisander J, Valtonen A, "Qualitative marketing research: A cultural approach", Sage Publisher, 2006.
5. Malhotra NK, Satyabhushan Dash, "Marketing Research: An Applied Orientation", 7th ed, Pearson Education, 2019

Web References
1. https://swayam.gov.in/nd1_noc20_mg26/preview
2. https://swayam.gov.in/nd1_noc20_mg26/preview
3. https://www.entrepreneur.com/encyclopedia/market-research

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	-	-	1	-	-	-	2	-	-	1	-	1	-	-	-
2	-	1	2	-	1	-	3	-	-	2	-	1	-	-	-
3	-	-	1	-	1	-	-	-	2	1	-	1	-	-	-
4	-	3	2	2	-	1	-	1	1	2	-	1	-	-	-
5	-	2	2	1	2	2	-	2	2	2	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

U19HS054	**PROJECT MANAGEMENT FOR ENGINEERS**	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives
- To understand the various concepts and steps in project management.
- To familiarize the students with the project feasibility studies and project life cycle
- To enable the students to prepare a project schedule
- To understand the risk management and project Control process.
- To learn about the closure of a project and strategies to be an effective project manager.

Course Outcomes
After completion of the course, the students will be able to
CO1 - Interpret the different concepts and the various steps in defining a project. **(K2)**
CO2 - Examining the feasibility of a project. **(K3)**
CO3 - Build a schedule for a Project. **(K6)**
CO4 - Predict the risk associated with a project and demonstrate the project audit. **(K2)**
CO5 - Analyse the project team and outline the Project closure. **(K4)**

UNIT I PROJECT MANAGEMENT CONCEPTS   (9 Hrs)
Project: Meaning, Attributes of a project, Project Life cycle, Project Stakeholders, Classification, Importance of project management, Project Portfolio Management System, Different Project Management Structure, Steps in Defining the Project, Project Rollup – Process breakdown structure – Responsibility Matrices – External causes of delay and internal constraints

UNIT II PROJECT FEASIBILITY ANALYSIS   (9 Hrs)
Opportunity Studies, Pre-Feasibility studies, and Feasibility Study: Market Feasibility, Technical Feasibility, Financial Feasibility and Economic Feasibility. Financial and Economic Appraisal of a project, Social Cost Benefit Analysis in India and Project Life Cycle.

UNIT III PROJECT SCHEDULING & NETWORK TECHNIQUES   (9 Hrs)
Scheduling Resources and reducing Project duration: Types of project constraints, classification of scheduling problem, Resources allocation methods, Splitting, Multitasking, Benefits of scheduling resources, Rationale for reducing project duration, Options for accelerating Project completion
Developing and Constructing the Project Network (Problems), PERT, CPM; Crashing of Project Network,

UNIT IV PROJECT RISK MANAGEMENT AND PROJECT CONTROL   (9 Hrs)
Project Risk management; Risk concept, Risk identification, Risk assessment, Risk response development, Contingency planning, Contingency funding and time buffers, Risk response control, and Change control management
Budgeting and Project Control Process, Control issues, Tendering and Contract Administration. Steps in Project Appraisal Process and Project Audits

UNIT V PROJECT CLOSURE AND MANAGING PROJECT (9 Hrs)

Project Closure: Team, Team Member and Project Manager Evaluations. Managing versus Leading a Project: Qualities of an Effective Project Manager, Managing Project Stakeholders, Managing Project Teams: Five Stage Team Development Model, Situational factors affecting team development and project team pitfalls.

Text Books

1. Erik Larson and Clifford Gray. "Project Management: The Managerial Process". 6th Edn. McGraw Hill Education; 2017.
2. Harold Kerzner. "Project Management: A systems approach to Planning, Scheduling and Controlling. 12th Edn. John Wiley & Sons; 2017

Reference Books

1. Meredith, J.R. & Mantel, S. J. "Project Management- A Managerial Approach". John Wiley.:2017
2. Prasanna Chandra. "Projects: Planning, Analysis, Selection, Financing, Implementation, and Review". 9th Edn. McGraw Hill Education; 2019.
3. B C Punmia by K K Khandelwal. "Project Planning and Control with PERT and CPM". 4th Edn. Laxmi Publications Private Limited; 2016.
4. Hira N Ahuja, S.P.Dozzi, S.M.Abourizk. "Project Management". 2nd Edn. Wiley India Pvt Ltd; 2013.
5. "A guide to Project Management Body of Knowledge". 6th Edn. Project Management Institute; 2017

Web Resources

1. www.pmi.org
2. www.projectmanagement.com
3. https://www.sciencedirect.com/journal/international-journal-of-project-management
4. https://nptel.ac.in/courses/110/107/110107081/
5. https://nptel.ac.in/courses/110/104/110104073/

COs/POs/PSOs Mapping

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1	2	-	1	-	-	-	-	-	2	-	2	2	-	-	-
2	-	2	1	-	-	1	-	-	1	1	1	1	-	-	-
3	-	1	3	-	-	-	-	-	-	-	1	-	-	-	-
4	3	1	1	-	-	1	1	-	-	1	1	3	-	-	-
5	3	-	3	-	-	-	-	3	3	2	3	2	-	-	-

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Correlation Level: 1 - Low, 2 - Medium, 3 - High

		L	**T**	**P**	**C**
U19HS055	**FINANCE FOR ENGINEERS**	**2**	**1**	**0**	**3**

Course Objectives
- To develop a deeper understanding of the fundamentals of Accounting and Finance
- To learn how to apply mathematical principles in Finance and the concepts of Risk and Return
- To understand the need and procedure for conducting Financial Analysis for better decision-making
- To be familiar with the modes of generating funds for business and their implications
- To understand the scientific ways to determine deployment of funds in business

Course Outcomes
After completion of the course, the students will be able to
CO1: Understand basic concepts in accounting and finance and their importance for engineers **(K2)**
CO2: Demonstrate knowledge and understanding of the applications of mathematics in finance **(K3)**
CO3: Conduct Financial Analysis and use the outcome in making informed decisions in investing **(K4)**
CO4: Identify and Appreciate various sources of procurement of funds in business and their critical evaluation **(K2)**
CO5: Know how to scientifically determine the investing in long-term and short-term assets in business **(K3)**

UNIT I: UNDERSTANDING THE FUNDAMENTALS   (9 Hrs)
Assets – Need and Functions of Assets – Types of Assets – Factors determining Investments in Assets. Liabilities – Meaning and Functions of Liabilities – Types of Liabilities – Capital as a Liability: Why and How — Concept and Meaning of Finance – Distinction between Accounting and Finance – Significance of Accounting and Finance for Engineers.

UNIT II: MATHEMATICS OF FINANCE   (9 Hrs)
Time Value of Money – Computation of Present Value and Future Value – Implications of TVM in Financial Decisions – Concept of Risk and Return – Measuring Risk and Return – Concept of Required Rate of Return and its significance in Investment Decisions.

UNIT III: FINANCIAL ANALYSIS   (9 Hrs)
Meaning and Objectives of Financial Analysis – Annual Report As an Input for Analysis – Basic Understanding of Annual Reports - Tools of Financial Analysis – Horizontal Analysis – Vertical Analysis – Trend Analysis – Accounting Ratios – Significance of Ratio Analysis in Decision-making – Snap-shot of the Past to predict the Future – Computation of Key Ratios – Liquidity Ratios – Profitability Ratios – Performance Ratios – Ratios that are helpful for Potential Investors.

UNIT IV: FUNDS PROCUREMENT   (9 Hrs)
Meaning of Funds – Sources of Funds – Long-Term Sources – Short-Term Sources – Financing Decisions in Business – Capital Structure – Need and Importance of Capital Structure – Determining

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Optimum Capital Structure – Concept and Computation of Earnings Before Interest and Tax (EBIT), Earnings Before Tax (EBT), and Earnings After Tax (EAT)(Simple Problems) - Leverage in Finance – Types and Computation of Leverages – Operating Leverage, Financial Leverage, and Combined Leverage.

UNIT V: FUNDS DEPLOYMENT **(9 Hrs)**

Investment Decisions – Types of Investment Decisions: Long-Term Investment Decisions. Significance – Methods: Pay-Back Period Method, Net Present Value Method and Benefit-Cost Ratio Method. Short-Term Investment Decisions – Concept of Working Capital – Need and Importance of Working Capital in Business – Determinants of Working Capital in a Business. Components of Working Capital. Dividends: Concept and Meaning – Implications of Dividend Decisions on Liquidity Management.

Text Books

1. R. Narayanaswamy, Financial Accounting – A managerial perspective, PHI Learning, New Delhi. (2015 or later edition)
2. C. Paramasivan and T. Subramanian. Financial Management. New Age International, New Delhi. (2015 or later edition)

Reference Books

1. S.N. Maheswari, Sharad K. Maheswari & Suneel K. Maheswari. Accounting For Management. Vikas Publishing (2017 or later edition)
2. Varun Dawar & Narendar L. Ahuja. Financial Accounting and Analysis. Taxmann Publications. (2018 or later edition)
3. Athma. P. Financial Accounting and Analysis. Himalaya Publishing House. (2017 or later edtion)
4. Prasanna Chandra. Financial Management. Tata-McGraw Hill Publishers, New Delhi. (2019 or later edition)
5. S.C. Kuchhal. Financial Management. Chaitanya Publishing House, Allahabad. (2014 or later edition)

Web Resources

1. http://www.annualreports.com/
2. http://www.mmachennai.org/
3. https://finance.yahoo.com/
4. https://icmai.in/icmai/
5. https://nptel.ac.in/courses/110/107/110107144/
6. https://web.utk.edu/~jwachowi/wacho_world.html
7. https://www.icai.org/indexbkp.html
8. https://www.icsi.edu/home/
9. https://www.investopedia.com/
10. https://www.moneycontrol.com/
11. https://www.rbi.org.in/

COs/POs/PSOs Mapping

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1	-	-	1	-	-	-	2	-	-	1	2	1	-	-	-
2	-	1	2	-	1	-	3	-	-	2	2	1	-	-	-
3	-	-	1	-	1	-	-	-	2	1	2	1	-	-	-
4	-	3	2	2	-	1	-	1	1	2	2	1	-	-	-
5	-	2	2	1	2	2	-	2	2	2	2	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

OPEN ELECTIVE – III

		L	T	P	C	Hrs
U19EEO63	**CONVENTIONAL AND NON-CONVENTIONAL ENERGY SOURCES** (Common to ECE, ICE, MECH, CIVIL, BME, Mechatronics)	3	0	0	3	45

Course Objectives

- To get knowledge on the status of conventional and non-conventional energy resources in world.
- To have a clear idea about the operation of conventional power plant and its associated equipment's.
- To learn about the concept of energy harvesting of solar through thermal and PV module
- To understand the technological basis for harnessing wind energy.
- To get a clear knowledge on power generation using Ocean, Tidal Energy and Bio-Energy

Course Outcomes

After completion of the course, the students will be able to

CO1 – Identify the world and Indian energy scenario and the necessity of renewable energy sources **(K1)**

CO2 – Gain knowledge for the generation of electrical power from various power plants **(K1)**

CO3 – Analyze and compare the various solar harvesting techniques **(K3)**

CO4 – Describe the aerodynamics of wind turbines and calculate their power, energy production **(K1)**

CO5 – Describe the construction and working principle of various equipment's used in Ocean, Tidal Energy and Bio-Energy power plants **(K2)**

UNIT I ENERGY RESOURCES   (9 Hrs)

Perspective of energy resources – Forms of Energy – Conventional and non-conventional sources of energy– World's energy status - Energy reserves in India. Limitations of Conventional sources of energy efficiency – Renewable Energy Sources – Energy parameters – Energy Intensity - Gross Domestic product.

UNIT II POWER PLANTS   (9 Hrs)

Thermal power plant – layout, working principle. Gas turbine power plant – layout, working principle. Nuclear power plants: fuels, nuclear fuel cycle, reactors and nuclear waste management. Hydro Electric plants – Types, energy conversion schemes, environmental aspects.

UNIT III SOLAR ENERGY SYSTEMS   (9 Hrs)

Solar radiation - Principles of solar energy collection –Types of collector – working principles - Characteristics - efficiency - Solar Energy applications – water heaters, air heaters, solar cooling; solar drying and power generation – solar tower concept – solar pump. Photovoltaic (PV) technology – photovoltaic effect – modelling - Characteristics – efficiency of solar cells.

UNIT IV WIND ENERGY SYSTEMS   (9 Hrs)

General theory of wind mills – Types of wind mills – performance of wind machines–wind power – efficiency. Merits and Limitations of Wind energy system – Modes of wind power generation.

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UNIT V ALTERNATE ENERGY SYSTEMS   (9 Hrs)

Ocean and Tidal energy conversion - working principle of OTEC – Anderson closed cycle OTEC System. Tidal power – tides - tidal range - types of tidal power plants, single basin and double basins schemes. Bio-mass Energy – Biogas plants.

Text Books

1. S. Rao and Dr. B. B. Parulekar, "Energy Technology", Khanna Publication, 3rd Edition, 1999.
2. B. H. Khan, "Non-Conventional Energy Resources", Tata McGraw Hill Education, 2nd Edition, 2009.
3. D. P. Kothari, K. C. Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI, 2011

Reference Books

1. G. D. Rai, "Non-conventional energy sources", Khanna Publication. 4th Edition, 2002.
2. Pulfrey, David. L, "Photo voltaic Power Generation", Van Nostrand reinhold Company, 1983.
3. Abbasik, "Renewable Energy Sources and their Environment", PHI, 2008.
4. Steve Doty, Wayne C. Turner, "Energy Management Handbook", Fairmont Press, 8th Edition, 2012.
5. S.A.Abbasi and N. Abbasi, "Renewable Energy Sources and Their Environmental Impact", PHI, 2001.

Web References

1. https://www.tutorialspoint.com/renewable_energy/index.htm
2. https://nptel.ac.in/courses/112/107/112107291/
3. https://byjus.com/physics/conventional-and-nonconventional-sources-of-energy/
4. https://www.jagranjosh.com/general-knowledge/nonconventional-sources-of-energy-1448698715-1
5. https://wb.gov.in/departments-power-and-non-conventional-energy-sources.aspx

COs / POs and PSOs Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	2	-	1	2	-	-	-	-	1	-	-	-
2	3	1	1	2	-	1	2	-	-	-	-	1	-	-	-
3	3	1	1	2	-	1	2	-	-	-	-	1	-	-	-
4	3	1	1	2	-	1	2	-	-	-	-	1	-	-	-
5	3	1	1	2	-	1	2	-	-	-	-	1	-	-	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

		L	T	P	C	Hrs
U19ECO63	**ELECTRONIC PRODUCT DESIGN AND PACKAGING** (Common to EEE, CSE, IT, ICE MECH, BME, Mechatronics)	3	0	0	3	45

Course Objectives

- To provide basic knowledge about Electronic Product and Packaging
- To introduce and discuss various issues related to the system packaging
- To get clear idea about design of packages which can withstand higher temperature, vibrations and shock
- To Design of PCBs which minimize the EMI and operate at higher frequency
- To acquire depth knowledge about the concepts of Testing and testing methods

Course Outcomes

After completion of the course, students are able to

CO1 - Explain the basics of Electronic Product and Packaging. (K2)

CO2 - Infer various issues related to the system packaging. (K2)

CO3 - Summarize the clear idea about design of packages which can withstand higher temperature, vibrations and shock (K2)

CO4 - Describe the design of PCBs which minimize the EMI and operate at higher frequency (K2)

CO5 - Explain the various testing methods (K2)

UNIT I : OVERVIEW OF ELECTRONIC SYSTEMS PACKAGING   (9 Hrs)

Definition of a system and history of semiconductors, Products and levels of packaging, Packaging aspects of handheld products, Definition of PWB, Basics of Semiconductor and Process flowchart, Wafer fabrication, inspection and testing, Wafer packaging; Packaging evolution; Chip connection choices, Wire bonding, TAB and flip chip.

UNIT II : SEMICONDUCTOR PACKAGES   (9 Hrs)

Single chip packages or modules (SCM), Commonly used packages and advanced packages; Materials in packages; Thermal mismatch in packages; Multichip modules (MCM)-types; System-in-package (SIP); Packaging roadmaps; Hybrid circuits;

UNIT III ELECTRICAL ISSUES IN PACKAGING   (9 Hrs)

Electrical Issues of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference, Transmission Lines, Clock Distribution, Noise Sources, Digital and RF Issues. Design Process Electrical Design: Interconnect Capacitance, Resistance and Inductance fundamentals; Packaging roadmaps – Hybrid circuits – Resistive, Capacitive and Inductive parasitic

UNIT IV CHIP PACKAGES   (9 Hrs)

IC Assembly – Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging, reliability, wafer level burn – in and test. Single chip packaging: functions,

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types, materials processes, properties, characteristics, trends. Multi chip packaging: types, design, comparison, trends. System – in – package (SIP); Passives: discrete, integrated, and embedded

UNIT IV TESTING   (9 Hrs)

Testing Reliability, Basic concepts, Environmental interactions. Thermal mismatch and fatigue – failures - thermo mechanically induced -electrically induced – chemically induced. Electrical Testing: System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability

Text Books

1. Tummala, Rao R., Fundamentals of Microsystems Packaging, McGraw Hill, 2001
2. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011
3. Tummala, Rao R, Microelectronics packaging handbook, McGraw Hill, 2008.

References Books

1. Blackwell (Ed), "The electronic packaging handbook", CRC Press, 2000.
2. R.S.Khandpur, "Printed Circuit Board", Tata McGraw Hill, 2005
3. R. K. Ulrich, "Recent literature in Electronic Packaging", 2005
4. Michael L. Bushnell and Vishwani D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed signal VLSI Circuits", Kluwer Academic Publishers.2000.
5. M. Abramovici, M. A. Breuer, and A.D. Friedman, "Digital System Testing and Testable Design", Computer Science Press,

Web References

1. http://www.logopeople.in/blog/awesome-packaging-design-of-electronic-products-for-inspiration/
2. https://www.pinterest.com/PackagingTPI/electronic-packaging/
3. https://www.einfochips.com/blog/semiconductor-and-electronic-design-networks-and-profiles-to-follow-in-2018/
4. https://en.wikipedia.org/wiki/Electronic_packaging
5. https://nptel.ac.in/courses/108/108/108108031/

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3	3	1	1	-	-	-	-	-	-	1	-	-	2	-	1
4	3	1	1	-	-	-	-	-	-	1	-	-	2	-	1
5	3	1	1	-	-	-	-	-	-	1	-	-	2	-	1

Correlation Level: 1-Low, 2-Medium, 3- High

		L	**T**	**P**	**C**	**Hrs**

U19CSO64   **PLATFORM TECHNOLOGY**

(Common to EEE, ECE, ICE, CIVIL & BME)   **3**   **0**   **0**   **3**   **45**

Course Objectives

- To understand the fundamentals of developing modular application by using object oriented concepts.
- To utilize the C# and .NET framework to build distributed enterprise applications.
- To develop Console Application, Windows Application and Web Applications.
- To connect to multiple data sources and managing them effectively.
- To develop the Enterprise kind of applications

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the concept of .NET Framework. **(K2)**

CO2 - Develop, implement and creating Applications with C#. **(K4)**

CO3 - Evaluate various graphics and window forms. **(K5)**

CO4 - Integrating front end applications with Database connectivity. **(K3)**

CO5 - Classifying various Enterprise applications into real world problems. **(K3)**

UNIT I INTRODUCTION TO .NET FRAMEWORK   (9 Hrs)

.NET Framework - Common language Runtime (CLR) – Common Type System (CTS) – Common language Specification (CLS) – Compilation process – Assemblies – Namespaces – Command line compiler.

UNIT II C# FUNDAMENTALS   (9 Hrs)

C# class - object - string formatting - Types - scope - Constants - C# iteration - Control flow - Operators - Array - String - Enumerations - Structures - Custom namespaces. Programming constructs – value types and reference types – object oriented concepts – Encapsulation – Inheritance – polymorphism – Interfaces – collections – Multithreading.

UNIT III GRAPHICS AND WINDOWS FORMS   (9 Hrs)

Tool box controls – Container control – Menu – Tool bar – Tool tip Controls during design time – Run time – Graphics programming GDI+.

UNIT IV DATABASE PROGRAMMING   (9 Hrs)

Data Access with ADO.NET – Architecture – Data reader – Data Adapter – Command – Connection – Data set – Data binding – Data Grid Control – XML based Data sets.

UNIT V J2EE (9 Hrs)

Enterprise Edition Overview – Multi-Tier Architecture – Best Practices – Comparison between J2EE and .NET.

Text Books

1. David Chappell, "Understanding .NET – A Tutorial and Analysis", Addison Wesley, 2002.
2. Herbert Schildt, "C# 3.0 The Complete Reference", McGraw-Hill Professional, Third Edition, 2008.
3. Keogh, "J2EE The Complete Reference", Tata McGraw-Hill, 2008.

Reference Books

1. Andrew Troelsen, "Pro C# 5.0 and the .NET 4.5 Framework", Sixth edition, A Press, 2012.
2. Joh Skeet, "C# in depth, Manning publications", Third Edition, 2014.
3. Adrew Stellman and Jennifer Greene, "Head First C#", Third Edition, O'Reilly, 2013.
4. Rod Johnson, "J2EE Design and Development", Wrox, 2002
5. Michael Schmalz, "C# Database Basics", O'Reilly Media, January 2012.

Web Resources

1. https://www. nptel.ac.in/
2. https://www.c-sharpcorner.com/csharp-tutorials
3. https://www.guru99.com/c-sharp-tutorial.html

COs/POs/PSOs Mapping

CO'S	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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1	1	-	-	-	3	2	-	-	-	-	-	-	-	1	-
2	1	2	2	2	-	-	-	-	-	-	-	-	-	1	-
3	2	3	-	3	3	-	2	-	-	-	-	-	-	1	-
4	2	-	-	-	-	-	-	-	2	-	-	-	-	1	-
5	2	2	2	2	-	1	-	-	-	-	-	-	-	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

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	GRAPHICS DESIGNING	L	T	P	C	Hrs
U19CSO65	(Common to EEE, ECE, ICE, CIVIL & BME)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To develop basic skills using graphics and theory used in design process.
- Create computer-based projects using Adobe Photoshop.
- Understand, develop and employ visual hierarchy using images and text
- Use a computer to create and manipulate images and layers for use in various print and digital mediums.
- To acquire the knowledge of Animation

Course Outcomes

After the completion of the course, the students will be able to

CO1 – Develop the basic design elements of graphics. **(K3)**

CO2 – Apply the various photoshop tools. **(K3)**

CO3 – Modify the image size, selection and grids using tools. **(k3)**

CO4 – Create and Work with colored layers. **(K4)**

CO5 – Apply different methods for Animation & Panoramic Picture creation. **(K5)**

UNIT I BASIC CONCEPTS   (9 Hrs)

Basic Concepts of Designing - Design Principles – Basics of design elements – Typography – Color theory - Introduction to Graphics - Introduction to Photoshop - Bitmap and Vector Images - Understanding Image Size and Resolution

UNIT II INTRODUCTION TO PHOTOSHOP   (9 Hrs)

Introduction to Tools - Environment - layout of Photoshop - Design layout setup - color - resolution setting - using basic marquee - selection tools Usage of lasso tools - Using brushes - using and filling colors - layers Using text tool - free transform tool - Exercise: Designing Greeting card / Advertisement

UNIT III IMAGE SIZE, SELECTION, GRID AND GUIDES   (9 Hrs)

Modifying Image Size - Resolution, Marquee - Lasso - Magic Wand - Selection Tools – Selecting – Saving - Crop tool - Coping Selection And Image - Grid and Guide Options – Masks – Channel - Painting and editing - Working with quick masks - Painting (Brush, and its effects) - Blending Modes, Color palettes – Editing - Background - Color - Touchup - Cleanup - Gradient tools - layer blending modes - all types of text tools - shape tools Exercise : Designing Magazine cover - Poster - Brochure

UNIT IV LAYERS (9 Hrs)

The layer Palette - Changing and controlling layer order - Editing layers - Adjustment layers - Layer Effects Filters - Actions - Automation - Extract - Filter Gallery - Liquefy , Pattern making - Vanishing point - Built in Bitmap Filters - 3rd party Plug-ins - Using predefined Actions - Creating and Recording Actions - Using built in automation - Learning Filter effects - managing the files with layers and layer effects - plugins Manipulation tools - Image control options – HUE - Levels - brightness control Using image – modifying - changing color Exercise : Converting black and white photo to color - designing a photo album

UNIT V ANIMATION & PANORAMIC PICTURE CREATION (9 Hrs)

Creating product Packaging designs - CD cover - Book and magazine front cover - Envelope - Visiting card - Color correction and color channel management - Design automation theory and Practical's Samples and demos - guidelines for freelance work - website links - resource sharing - Preparing Image For Print and Web -
Calculating Image size and Resolution, Changing Image Dimensions - Layout Preview - Color Separation - Optimizing Images for Web - File Formats - Creating Webpages - web photo galleries

Text Books

1. Adobe Creative Team, "Adobe Photoshop – Classroom in a Book", Adobe system incorporation, Adobe Press, 2010.
2. Katherine A.Hughes, "Graphic Design", Learn It,Do It,CRC Press 2019.
3. Ken Pender, "Digital color in Graphics Design", CRC Press 2012.

Reference Books

1. Mike Wooldridge , "Teach Yourself Visually Adobe Photoshop CS 5", Wiley Publishing , 2010
2. Lesa Snider, "Photoshop the missing Manual", O'Reilly Media, Inc, 2010.
3. Poppy Evans, Aaris Sherin, Irina Lee, "The Graphic Design", Rockport, 2013.
4. Peter Bauer, "Photoshop CC for Dummies", Wiley, 2013.
5. Scott Onstott, "Enhancing CAD Drawings with Photoshop", Wiley,2006

Web Resources

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-831-user-interface-design-and-implementation-spring-2011/lecture-notes/MIT6_831S11_lec18.pdfhttp://www.moshplant.com/direct-or/bezier/
2. https://www.cs.montana.edu/courses/spring2004/352/lectures/CS351-GUIDesign.pdf
3. https://www.university.youth4work.com/study-material/graphic-design-lecture
4. https://kmayeunhia.wordpress.com/lecture-notes/
5. https://nptel.ac.in/courses/106/106/106106090/

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	-	-	1	-	-	-	-	-	-	1	1	-
2	3	2	2	1	-	1	-	-	-	-	-	-	1	2	-
3	3	2	-	1	-	2	-	-	-	-	-	-	1	2	-
4	-	2	-	3	-	-	-	-	-	-	-	-	2	2	-
5	3	2	1	-	-	2	-	-	-	-	-	-	2	2	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

U19ITO63	ESSENTIALS OF DATA SCIENCE	L	T	P	C	Hrs
	(Common to EEE, ECE, ICE, MECH, CIVIL, BME)	3	0	0	3	45

Course Objectives

- To gain knowledge about the concepts involved in data analytics.
- To discover insights in data using R programming.
- To summarize the operations involved in Hadoop Map Reduce.
- To make use of algorithms related to regression and classification.
- To examine data using time series analysis and text analysis

Course Outcomes

After completion of the course, the students will be able to

CO1 - Experiment with data analytics using R language**. (K3)**
CO2 - Demonstrate clustering algorithms and association rules. **(K3)**
CO3 - Use algorithms related to regression and classification. **(K3)**
CO4 - Explore data using time series analysis and text analysis. **(K2)**
CO5 - Summarize Hadoop platform to solve map reduce problems. **(K2)**

UNIT I DATA ANALYTICS USING R (9 Hrs)

Big Data Overview-Examples of Big Data Analytics-Data Analytics Lifecycle overview-Phases in the lifecycle-GINA Case Study-Introduction to R programming-Exploratory Data Analysis-Statistical Methods for Evaluation.

UNIT II CLUSTERING AND ASSOCIATION RULES (9 Hrs)

Overview of clustering-Scope of Clustering Techniques- K Means clustering- Additional Algorithms-Clustering in practise: Fake news identification-Overview of Association rules-Apriori Algorithm-Evaluation of Candidate Rules-Applications of Association Rules-An Example: Transactions in a grocery store-Validation and Testing-Diagnosis

UNIT III REGRESSION AND CLASSIFICATION (9 Hrs)

Scope of Regression Techniques-Linear Regression-Logistic Regression-Additional Regression models-Scope of Classification Techniques-Decision Trees-Naïve Bayes-Diagnostics of Classifiers-Additional Classification Methods-Applications: Prediction of crop yield

UNIT IV TIME SERIES ANALYSIS AND TEXT ANALYSIS (9 Hrs)

Overview of Time Series Analysis-ARIMA Model-Additional Methods-Text Analysis Steps-A Text Analysis Example-Collecting Raw Text-Representing Texts-TFIDF-Categorizing documents by topics-Determining Sentiments-Gaining Insights.

UNIT V HADOOP MAP REDUCE AND DATA ANALYTICS (9 Hrs)

Installing and Understanding Hadoop-HDFS and Map Reduce Architecture-Hadoop Map Reduce Example-Hadoop Map Reduce in R-Data Analytics Problems: Exploring web pages categorization - Computing the frequency of stock market change-Real Time Recommender model using Apache Spark.

Text Books

1. David Dietrich, Barry Heller and Beibei Yang, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", EMC Education Services, Reprint 2015, Wiley, ISBN: 9788126556533.
2. VigneshPrajapathi, "Big Data Analytics with R and Hadoop", Packt Publishing, 2013, Birmingham, Mumbai.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding opportunities in Huge DataStreams with Advanced Analytics", John Wiley & sons, 2012.

Reference Books

1. Roger D. Peng, "R Programming for Data Science", LeanPub, 2015.
2. Bart Baesens , "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2014.

Web References

1. www.ibm.com/Data Analytics/
2. https://www.ijser.org/researchpaper/Importance-of-Clustering-in-Data-Mining.pdf
3. https://datafloq.com/read/7-innovative-uses-of-clustering-algorithms/6224
4. https://publications.waset.org/10011058/improving-fake-news-detection-using-k-means-and-support-vector-machine-approaches
5. https://statisticsbyjim.com/regression/when-use-regression-analysis/

COs/POs/PSOs Mapping (BME)

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	2	-	-	-	-	-	-	-	-	1	-
2	3	2	1	1	2	-	-	-	-	-	-	-	-	1	-
3	3	2	1	1	2	-	-	-	-	-	-	-	-	1	-
4	2	1	-	-	2	-	-	-	-	-	-	-	-	1	-
5	2	1	-	-	2	-	-	-	-	-	-	-	-	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

U19ITO64	**MOBILE APPLICATION DEVELOPMENT**	**L**	**T**	**P**	**C**	**Hrs**
	(Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives
- To understand the basic concepts of mobile computing
- To be familiar with the network protocol stack
- To learn the basics of mobile telecommunication system
- To be exposed to Ad-Hoc networks
- To gain knowledge about different mobile platforms and application development

Course Outcomes
After completion of the course, the students will be able to
CO1 - Explain the basics of mobile telecommunication system **(K2)**
CO2 - Articulate the required functionality at each layer for given application **(K2)**
CO3 - Identify solution for all functionality at each layer. **(K2)**
CO4 - Use simulator tools and design Ad hoc networks **(K3)**
CO5 - Develop a mobile application **(K3)**

UNIT I   INTRODUCTION   (9 Hrs)
Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications – Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes.

UNIT II MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER   (9 Hrs)
Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Overview of TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP Performance.

UNIT III MOBILE TELECOMMUNICATION SYSTEM   (9 Hrs)
Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) – Universal Mobile Telecommunication System (UMTS).

UNIT III MOBILE AD-HOC NETWORKS   (9 Hrs)
Ad-Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing – Essential of Traditional Routing Protocols –Popular Routing Protocols – Vehicular Ad Hoc networks (VANET) – MANET Vs VANET – Security.

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UNIT V MOBILE PLATFORMS AND APPLICATIONS (9 Hrs)

Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – M- Commerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

Text Books

1. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt. Ltd, New Delhi – 2012.
2. Jochen H. Schller, "Mobile Communications", Second Edition, Pearson Education, New Delhi, 2007
3. C.K.Toh, "AdHoc Mobile Wireless Networks", First Edition, Pearson Education, 2002.

Reference Books

1. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems", Thomson Asia Pvt Ltd, 2005.
2. William.C.Y.Lee,"Mobile Cellular Telecommunications-Analog and Digital Systems", Second Edition,TataMcGraw Hill Edition ,2006.
3. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.

Web References

1. Developers : http://developer.android.com/index.html
2. Apple Developer : https://developer.apple.com/
3. http://developer.windowsphone.com
4. BlackBerry Developer : http://developer.blackberry.com/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	-	1	-
2	2	1	-	-	-	-	-	-	-	-	-	-	-	1	-
3	2	1	-	-	1	-	-	-	-	-	-	-	-	1	-
4	3	2	1	1	-	1	-	-	-	-	-	-	-	1	-
5	3	2	1	1	2	1	-	-	-	-	-	-	-	1	-

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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U19ICO63   **FUZZY LOGIC AND NEURAL NETWORKS   L   T   P   C   Hrs**
(Common to CSE, IT, CIVIL, BME)   **3   0   0   3   45**

Course Objectives
● To expose the students to learn different architecture of neural network.
● To provide adequate knowledge about different training algorithm of neural network. -
● To provide adequate knowledge about properties and operations of fuzzy sets.
● To provide comprehensive knowledge of fuzzy logic control to real time systems.
● To provide adequate knowledge of Neuro-fuzzy logic controllers.

Course Outcomes
After completion of the course, the students will be able to
CO1 - Understand properties of fuzzy set, fuzzy relations, fuzzy rule base and algorithm **(K2)**
CO2 - Understand fuzzy logic controllers and its applications. **(K2)**
CO3 - Understand neural network architecture. **(K2)**
CO4 - Learn various training algorithm of neural network and its application. **(K2)**
CO5 - Understand Neuro-fuzzy logic controllers. **(K2)**

UNIT I   INTRODUCTION TO FUZZY LOGIC   (9 Hrs)
Fuzzy sets – properties of fuzzy sets – operations on fuzzy sets. Fuzzy relations linguistic variables – Linguistic approximation. Fuzzy statements: Assignments, Conditional and unconditional statements fuzzy rule base – fuzzy algorithm

UNIT II   FUZZY LOGIC CONTROL SYSTEM   (9 Hrs)
Fuzzy logic controller – Fuzzification, Membership functions. Triangular, Trapezoidal, Grassian – Membership value assignments using neural networks, intention, inference – knowledge base – Inference Mechanism –Defuzzification case study: Fuzzy logic controller for a temperature process – inverted pendulum control problem.

UNIT III INTRODUCTION TO NEURAL NETWORK   (9 Hrs)
Motivation for the development of neural networks – artificial Neural networks –biological neural networks – Typical architecture – Training common Activation functions. McCulloh Pitts neuron: Architecture, algorithm and applications – Back propagation neural net – standard architecture – Algorithm – derivation of learning rules – number of hidden layers – Hopfield net architecture algorithm and applications Adaptive Resonance Theory: Architecture and operation

UNIT IV NEURAL NETWORKS BASED ON COMPETITION   (9 Hrs)
Kohinoor's Self Organizing map- Counter propagation Networks – Neural networks for control: Schemes of neuro control –Inverse dynamics. Case study: Neuro controller for a temperature process and Inverted Pendulum problem

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UNIT V   NEURO FUZZY LOGIC CONTROL   (9 Hrs)
Adaptive fuzzy controller – self timing and self organizing controllers – stability of FLC – Non linear Fuzzy control – Fuzzy neuron.

Text Books
1. LaureneFausett, "Fundamentals of Neural Networks", Pearson Education, 2008
2. Timothy J. Ross , "Fuzzy Logic with Engineering Applications", McGraw- Hill International Editions,2010
3. George J. Klir and Bo Yuan, "Fuzzy sets and Fuzzy Logic", Prentice Hall, USA .2015

Reference Books
1. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley, 2019
2. Rajasekaran. S, Pai. G.A.V. "Neural Networks, Fuzzy Logic and Genetic Algorithms", Prentice-Hall of India, 2003
3. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and soft computing", Pearson Education 2007
4. W.T.Miller, R.S.Sutton and P.J.Webrose, Neural Networks for Control, MIT Press, 1996.
5.   C.Cortes and V.Vapnik, Support-Vector Networks, Machine Learning, 1995.

Web References
1. https://lecturenotes.in/subject/922.
2. https://www.ifi.uzh.ch/dam/jcr:00000000-2826-155d-0000-00005e4763e3/fuzzylogicscript.pdf.
3. https://nptel.ac.in/courses/106/105/106105173/.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	2	-	-	-	2	-	1	2	-	1
2	3	3	-	3	3	2	-	-	-	2	-	2	2	-	1
3	3	3	2	3	3	2	-	-	-	2	-	2	2	-	1
4	3	3	3	3	3	2	-	-	-	2	-	2	2	-	1
5	3	3	3	2	2	2	-	-	-	2	-	2	2	-	1

Correlation Level: 1 - Low, 2 - Medium, 3 - High

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		L	T	P	C	Hrs
U19MEO65	**CREATIVITY INNOVATION AND NEW PRODUCT DEVELOPMENT** (Common to EEE, ECE, ICE, CIVIL, BME, Mechatronics)	3	0	0	3	45

Course Objectives

- To understand the need for creativity and innovation
- To learn about the project selection and evaluation
- To learn about the Patent and IPR
- To understand the quality standards and new product planning
- To learn model preparation and evaluation

Course Outcomes

After completion of the course, the students will be able to

CO1 - Describe the creativity and problem solving. **(K1)**

CO2 - Analyse the methods for project selection and evaluation. **(K4)**

CO3 - Analyse the patent laws and IPR. **(K4)**

CO4 - Describe the new product planning. **(K1)**

CO5 - Acquire knowledge about the patent applications. **(K1)**

UNIT I INTRODUCTION **(9 Hrs)**

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving -brainstorming - different techniques

UNIT II PROJECT SELECTION AND EVALUATION **(9 Hrs)**

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products evaluation techniques

UNIT III NEW PRODUCT DEVELOPMENT **(9 Hrs)**

Research and new product development - Patents - Patent search - Patent laws-International code for patents - Intellectual property rights (IPR)

UNIT IV NEW PRODUCT PLANNING **(9 Hrs)**

Design of proto type - testing - quality standards - marketing research introducing new Products

UNIT V MODEL PREPARATION & EVALUATION **(9 Hrs)**

Creative design - Model Preparation - Testing - Cost evaluation – Patent application

Text books

1. Twiss, Brian. "Managing Technological Innovation", Pitman Publishing Ltd., 1992.
2. Watton, Harry B. "New Product Planning", Prentice Hall Inc., 1992.

3. Lawrence Sanders G, Saylor foundation Publishing Ltd., 2012.

Reference books
1. Nystrom, Harry "Creativity and Innovation", John Wiley & Sons, 1979.
2. Dr Paul Trott, Innovation Management and New Product Development, 6th Edition, Pearson Publication, 2017
3. Khandwalla, N – "Fourth Eye (Excellence through Creativity) - Wheeler Publishing", 1992.
4. Bulletins I.P.R, TIFAC, New Delhi, 1997.
5. Jacob Goldenberg, Creativity in Product Innovation, Cambridge University Press, 2002.

Web References
1. https://nptel.ac.in/courses/107/103/107103082/
2. https://nptel.ac.in/courses/107/101/107101086/
3. https://nptel.ac.in/courses/110/107/110107094/
4. https://www.youtube.com/watch?v=H6OlyjLJf6k
5. https://www.youtube.com/watch?v=CnKeVs-_9zs

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	1	-	1
2	3	2	1	1	-	-	-	-	-	-	-	-	1	-	1
3	3	2	1	1	-	-	-	-	-	-	-	-	1	-	1
4	3	2	1	1	-	-	-	-	-	-	-	-	1	-	1
5	3	2	1	1	-	-	-	-	-	-	-	-	1	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

	DISASTER MANAGEMENT	**L**	**T**	**P**	**C**	**Hours**

U19CEO63

(Common to EEE, ECE, CSE, IT, ICE, MECH, BME)   **3**   **0**   **0**   **3**   **45**

Course Objectives

This course should enable the students to
- Understand the basic conceptual understanding of disasters
- Understand approaches of Disaster Management
- Build skills to respond to disaster
- Understand the safety precaution
- Understand the basic planning and policy act of the disaster

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understanding Disasters, man-made Hazards and Vulnerabilities **(K2)**

CO2 – Understanding the flood management studies **(K2)**

CO3 - Understanding disaster mitigation and management mechanism **(K1)**

CO4 - Understanding the disaster safety precaution **(K2)**

CO5 – Understanding the disaster plan and act **(K3)**

UNIT I DEFINITION AND TYPES   **(9 Hrs)**

Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

UNIT II STUDY OF IMPORTANT DISASTERS   **(9 Hrs)**

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) Earthquakes, Landside). Social Economics and Environmental impact of disasters.

UNIT III MITIGATION AND MANAGEMENT   **(9 Hrs)**

Concepts of risk management and crisis management - Disaster management cycle - Response and Recovery - Development, Prevention, Mitigation and Preparedness- Planning for relief.

UNIT IV SAFETY PROCESS   **(9 Hrs)**

Coping with Disaster: Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

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UNIT V PLANNING AND ACT (9 Hrs)

Planning for disaster management: Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India - Organizational structure for disaster management in India - Preparation of state and district disaster management plans

Text Books

1. Dr. Mrinalini Pandey, Disaster Management, Wiley India Pvt. Ltd
2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill Education (India) Pvt. Ltd.
3. Jagbir Singh, Disaster Management : Future Challenges and Opportunities, K W Publishers Pvt. Ltd.
4. J. P. Singhal, Disaster Management, Laxmi Publications
5. C. K. Rajan, Navale Pandharinath, Earth and Atmospheric Disaster Management : Nature and Manmade, B S Publication

Reference Books

1. Disaster Management by Mrinalini Pandey Wiley 2014.
2. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015
3. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
4. National Disaster Management Plan, Ministry of Home affairs, Government of India
5. Manual on Disaster Management, National Disaster Management, Agency Govt of India.

Web References

1. http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf
2. http://nidm.gov.in/pdf/guidelines/new/sdmp.pdf
3. http://sdmassam.nic.in/pdf/publication/undp/disaster_management_in_india.pdf

COs/POs/PSOs Mapping

	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	3	3	2	-	2	2	2	3	1	-	1
CO2	3	2	3	2	3	3	2	-	2	2	2	3	1	-	1
CO3	3	2	3	2	3	3	2	-	2	2	2	3	1	-	1
CO4	3	2	3	2	3	3	2	-	2	2	2	3	1	-	1
CO5	3	2	3	2	3	3	2	-	2	2	2	3	1	-	1

Correlation Level: 1-Low, 2-Medium, 3- High

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AIR POLLUTION AND SOLID WASTE MANAGEMENT	L	T	P	C	Hours
(Common to EEE, ECE, CSE, IT, ICE, MECH, BME)	3	0	0	3	45

Course Objectives

This course should enable the students to

- Provide general understanding of air pollution, air pollutants, their sources and their effects
- Provide knowledge about meteorological parameters, air sampling and measurement of pollutants.
- Provide knowledge of air pollution controlling technologies, air pollution due to automobiles and general Idea of noise pollution.
- Study the importance of solid waste management by processing, treatment, disposal and reuse of solid waste.
- Study about the equipment used for waste collection and transportation of solids waste.

Course Outcome

After completion of the course, the students will be able to

CO1 - understand the type, sources & effect of air pollutants (**K2**)

CO2 – know the parameters affecting air pollution and various methods of measurement and estimation of pollutants **(K3)**

CO3 - gain knowledge of basics of noise pollution **(K2)**

CO4 - understand various air pollution control equipment's & pollution caused due to automobile exhaust **(K4)**

CO5 - understand the concepts of solid waste management **(K2)**

UNIT I INTRODUCTION TO AIR POLLUTION   (8 Hrs)

Introduction to air pollution: Air pollution episodes, Atmosphere and its zones, classification and sources of air pollutants, effects of air pollutants on man, plants animal & materials

UNIT II METEOROLOGICAL ASPECTS   (8Hrs)

Meteorological Aspects: Atmospheric stability, plume behavior, Ambient air sampling and stack sampling, collection of particulates and gaseous pollutants, methods of estimation.

UNIT III AIR POLLUTION CONTROL METHODS   (9 Hrs)

Air pollution control methods and equipment: Principle of control methods for particulates and gaseous pollutants, gravity settlers, electrostatic precipitators, bag filters cyclones, wet scrubbers, automobile exhaust: Pollution due to diesel and petrol engines, exhaust treatment and abatement, noise Pollution: Sources, ill effects, control measures.

UNIT IV SOLID WASTE MANAGEMENT   (8Hrs)

Introduction to solid waste management, sources, quantification and characterisation, classification and components, sampling and analysis, Method of collection

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B.Tech. Biomedical Engineering

UNIT V EQUIPMENT (12 Hrs)

Equipment used for collection and transportation, transfer stations, solid waste processing and management. Treatment and disposal methods: composting, sanitary landfills, Incineration – concept, components and applications, leachate management.

Text Books

1. M.N. Rao & H.V.N. Rao, 1988, Air Pollution, Tata McGraw Hill Publishing Co. Ltd.
2. C.S. RAO, 2007, Environmental Pollution Control Engineering, New Age International, Wiley Estern Ltd. New Delhi.
3. Stern A. C., 1973, Air pollution, Academic Press.
4. A.D. Bhide & Sunderesan B.B., 1983, Solid Waste Management in Developing countries, INSDOC, New Delhi.
5. Tohobanoglous, 1993, Intgrated Solid Waste Management Engineering Principle and Management Issues, McGraw-Hill publication Ltd.

Reference books

1. P. Aarne Vesilind, William Worrell & Debra Reinhart, 2002, Solid Waste Engineering, Cengage Learning India pvt. Ltd.
2. Dr. Y Anjaneyulu, 2002, Air Pollution and Control Technologies, Allied Publisher pvt. Ltd.
3. Waste Management: A Reference Handbook. Contributors: Jacqueline Vaughn - Author. Publisher: ABC-Clio
4. K. V. S. G. Murlikrishna, 1995, Air Pollution, Kaushal& Company.

Web References

1. https://nptel.ac.in/courses/120108005/
2. http://cpheeo.gov.in/upload/uploadfiles/files/Part1
3. https://nptel.ac.in/content/storage2/courses/104103022

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	3	2	3	3	3	3	3	2	3	3	2	3
CO2	3	3	2	3	3	3	3	2	3	2	2	3	3	3	3
CO3	3	3	3	2	2	2	3	3	3	3	2	3	3	3	2
CO4	2	3	2	3	2	3	2	3	3	2	2	3	3	3	3
CO5	3	3	3	2	3	3	3	3	3	2	3	3	3	3	3

Correlation Level: 1- Low, 2 - Medium, 3 – High

	NETWORK ESSENTIALS	L	T	P	C	Hrs
U19CCO63	(Common to EEE, MECH, CIVIL, ICE MECHATRONICS, BME)	3	0	0	3	45

Course Objectives

- To understand the fundamental concepts of computer communication and data networks
- To gain the necessary knowledge and skills to work effectively with network engineering and administrators
- To learn how to research, communicated network and IT issuing by reading relevant industry information
- To understanding the basic technologies and step required for setting up managing small LAN
- To understand the various technologies of security to protect the information in network

Course Outcomes

After completion of the course, the students will be able to

CO1- Understand the basic knowledge and skills to implement defined network architecture

CO2- Explain the performances of data link control and their access medium

CO3- Describe about internet Protocol and their working processes in IPV.

CO4- Explain the basic concepts of Transport Protocols and working of TCP layer

CO5- Design and study the operations of Security and their different algorithm

UNIT I NETWORK MODELS   (9 Hrs)

Data communications- Networks-PAN, LAN, MAN and WAN- Internet, Intranet and Extranets-Protocols and standards- OSI/ISO reference model- TCP/IP protocol suite-Broadband ISDN-ATM protocol reference model-- SONET/SDH architecture-Bluetooth and UWB –WiFi-WiMax Cognitive Radios- Adhoc and Sensor Networks-Green communications.

UNIT II DATA LINK CONTROL AND MEDIUM ACCESS   (9 Hrs)

Types of errors- Error detection and correction- Checksum- Framing-Flow control-Stop and wait protocol- Go-back N- Selective repeat protocols HDLC-Random access protocols- Controlled access-Wired LANs- IEEE standards, IEEE 802.3, 802.4, 802.5 and 802.6- - Fast Ethernet- Gigabit Ethernet – Wireless LANs- IEEE 802.11.

UNIT III   NETWORK ROUTING   (9 Hrs)

Logical addressing- IPv4 addresses- IPv6- Internet protocol- Transition from IPv4 to IPv6- Mapping logical to physical address- Mapping physical to logical address- ICMP-Direct Vs indirect delivery-Forwarding-Unicast and Multicast routing protocols- Different Routing Algorithms-Internetworking-Routers and gateways.

UNIT IV TRANSPORT AND CONGESTION   (9 Hrs)

 Elements of Transport Protocols: addressing, Connection Establishment, Connection Release, Error Control and Flow Control – Congestion control: Desirable Bandwidth Allocation, Regulating the Sending Rate, Wireless Issues- UDP, RPC -TCP Protocol, TCP connection management, TCP sliding window and congestion control.

A. மு

UNIT V SECURITY   (9 Hrs)

Introduction to Cryptography, Cipher text, symmetric key cryptography – AES and DES, RSA public key and private keys- Digital signature .Security in the Internet: IPSec, PGP, VPN and Firewalls. Authentication Protocols: Shared Secret Key, The Diffie-Hellman Key Exchange, Authentication Using Kerberos. Wireless Security- issues and challenge

Text Books
1. William Stallings, "Data and computer communications", Ninth Edition,Pearson Education, New Delhi, 2014.
2. Behrouz. A. Forouzan, "Data Communication and Networking", Fifth Edition,McGraw Hill, New Delhi, 2013.
3. Pallapa Venkatram and Sathish Babu.B, "Wireless &Mobile Network security ",Tata McGraw Hill, New Delhi, 2010

Reference Books
1. Douglas E. Comer, "Internetworking with TCP/IP (Volume I) Principles, Protocols and Architecture",6th Edition, Pearson Education, 2013.
2. Nader F. Mir, "Computer and Communication Networks", 2nd Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, "Computer Networks: An Open Source Approach",McGraw Hill Publisher, 2011.
4. Behrouz A. Forouzan and Firouz Mosharraf, "Computer Networks a Top Down Approach", TataMcGraw-Hill, 2017.
5. Rich Seifert, James Edwards, "The All New Switch Book: The Complete Guide to LAN SwitchingTechnology", 2nd Edition , Wiley Publishing Inc, 2011

Web References
1. https://tinyurl.com/ycy6x454
2. https://tinyurl.com/yapn9ac7
3. https://tinyurl.com/ydf33ye6
4. https://nptel.ac.in/courses/106/105/106105081/
5. https://nptel.ac.in/courses/106/105/106105183/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1		1	-	-	-	-	-	1	1	1	-
2	2	1	2	1		1	-	-	-	-	-	1	1	1	-
3	2	1	2	1		1	-	-	-	-	-	1	1	1	-
4	2	1	1	1		1	-	-	-	-	-	1	1	1	-
5	2	1	1	1	1	1	-	-	-	-	-	1	1	1	-

Correlation Level: 1-Low, 2-Medium, 3- High

B.Tech. Biomedical Engineering

U19CCO64	**WEB PROGRAMMING** (Common to EEE,ECE, MECH, CIVIL, ICE MECHATRONICS, BME)	**L**	**T**	**P**	**C**	**Hrs**
		3	-	-	3	45

Course Objectives
- To Learn the fundamentals of web application development
- To understand the design components and tools using CSS
- To Learn the concepts of JavaScript and programming fundamentals.
- To understand the working procedure of XML
- To study about advance scripting and Ajax applications

Course Outcomes
After completion of the course, the students will be able to
CO1 - Comprehend basic web applications using HTML**(K2)**
CO2 - Use CSS to design web applications **(K3)**
CO3 - Use java scripts functions for the web page creation **(K3)**
CO4 - Explain XML structure **(K2)**
CO5 - Demonstrate the web 2.0 application to advance scripts**(K2)**

UNIT - I INTRODUCTION TO WWW & HTML (9 Hrs)
Protocols, secure connections, application and development tools, the web browser, What is server, dynamic IP, Web Design: Web site design principles, planning the site and navigation. **HTML:** The development process, Html tags and simple HTML forms.

UNIT – II STYLE SHEETS (9 Hrs)
CSS: Need for CSS, Introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2.

UNIT - III JAVA SCRIPTS (9 Hrs)
Client side scripting, JavaScript, develop JavaScript, simple JavaScript, variables, functions, conditions, loops and repetition.

UNIT –IV XML (9 Hrs)
XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT.

UNIT –V ADVANCE SCRIPT (9 Hrs)
JavaScript and objects, JavaScript own objects, the DOM and web browser environments, forms and validations **DHTML:** Combining HTML, CSS and JavaScript, events and buttons, controlling your browser, **AJAX**: Introduction, advantages & disadvantages, AJAX based web application, alternatives of AJAX.

Text Books

1. Ralph Moseley, M.T. Savaliya, "Developing Web Applications", BPB Publications, 2017.
2. Hirdesh Bhardwaj,, "Web Designing", Pothi.com, 2016
3. P.J. Deitel and H.M. Deitel, Internet and World Wide Web - How to Program, Pearson Education, 2009.

Reference Books

1. Ralph Moseley, "Developing Web Applications", Wiley India Pvt. Ltd, 2013
2. Joel Sklar, " Principles of Web Design", 6th edition, Cengage Learning, Inc, 2014
3. B. M. Harwani," Developing Web Applications in PHP and AJAX", Tata McGraw-Hill Education, 2010
   4.   UttamK.Roy, Web Technologies, Oxford University Press, 2010.
   5.   Rajkamal, Web Technology, Tata McGraw-Hill, 2009.

Web References

1. https://nptel.ac.in/courses/106/106/106106156/
2. https://www.coursera.org/learn/html-css-javascript-for-web-developers
3. https://code.tutsplus.com/courses/how-to-become-a-web-developer
4. https://webdesignerwall.com/
5. https://www.smashingmagazine.com/

COs/POs/PSOs Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	1	1	2	1	-	-	-	-	-	1	1	-	-
2	2	1	2	1	2	1	-	-	-	-	-	1	1	-	-
3	2	1	2	1	2	1	-	-	-	-	-	1	1	-	-
4	2	1	1	1	2	1	-	-	-	-	-	1	1	-	-
5	2	1	1	1	2	1	-	-	-	-	-	1	1	-	-

Correlation Level: 1-Low, 2-Medium, 3- High

	DATA SCIENCE APPLICATION OF VISION	**L**	**T**	**P**	**C**	**Hrs**
U19ADO62	(Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives
- To understand the capability of a machine to get and analyze visual information and make decisions
- To learn methods and algorithms for Vision
- To learn how to use deep learning for Vision tasks
- To understand the neural network concepts
- To study the real world applications using computer vision

Course Outcomes
After completion of the course, the students will be able to
CO1 - Understand the methods and algorithms for image processing. **(K2)**
CO2 - Apply object detection and segmentation concepts for image processing. **(K4)**
CO3 - Apply scalable algorithms for large datasets in vision. **(K4)**
CO4 - Analyze deep learning and neural network architectures for image and video processing. **(K3)**
CO5 - Apply vision-based solutions for specific real-world applications. **(K4)**

UNIT I IMAGE FUNDAMENTALS   (9 Hrs)
Pixels - The Building Blocks of Images - The Image Coordinate System - RGB and BGR Ordering - Scaling and Aspect Ratios. Image filters - Gaussian blur - Median filter - Dilation and erosion - Custom filters - Image thresholding - Edge detection - Sobel edge detector - Canny edge detector.

UNIT II OBJECT DETECTION AND SEGMENTATION   (9 Hrs)
Image Features - Harris corner detection - Local Binary Patterns - Image stitching - Segmentation: Contour detection - The Watershed algorithm - Super pixels - Normalized graph cut.

UNIT III MACHINE LEARNING WITH COMPUTER VISION   (9 Hrs)
Data pre-processing - Image translation through random cropping - Image rotation and scaling - Applications of machine learning for computer vision - Logistic regression - Support vector machines - K-means clustering.

UNIT IV IMAGE CLASSIFICATION USING NEURAL NETWORKS   (9 Hrs)
Image Classification Basics Types of Learning - The Deep Learning Classification Pipeline - Introduction to Neural Networks - The Perceptron Algorithm - Backpropagation and Multi-layer Networks - The Four Ingredients in a Neural Network Recipe - Weight Initialization - Constant Initialization - Uniform and Normal Distributions - LeCun Uniform and Normal - Understanding Convolutions - CNN Building Blocks - Common Architectures and Training Patterns.

UNIT V COMPUTER VISION AS A SERVICE   (9 Hrs)
Computer vision as a service – architecture - Developing a server-client model - Computer vision engine.

Text Books
1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2009.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision", Third Edition, Cengage Learning, 2007.

3. Gary Bradski, "Learning OpenCV", First Edition, 2008.

Reference Books

1. Alok Kumar Singh Kushwaha, Rajeev Srivastava, "Recognition of Humans and Their Activitiesfor Video Surveillance", IGI Global, 2014.
2. Ying-li Tian, Arun Hampapur, Lisa Brown, Rogerio Feris, Max Lu, Andrew Senior, "EventDetection, Query, and Retrieval for Video Surveillance", IGI Global, 2009.
3. Matthew Turk, Gang Hua, "Vision-based Interaction", First Edition, Morgan Claypool, 2013.
4. Ian Goodfellow, Yoshuo Bengio, Aaron Courville, "Deep Learning (Adaptive Computation and Machine Learning series)", MIT Press, 2017.
5. Fan Jiang, "Anomalous Event Detection from Surveillance Video", ProQuest, 2012.

Web Resources

1. https://www.kaggle.com/learn/computer-vision
2. https://machinelearningmastery.com/what-is-computer-vision/
3. https://www.udemy.com/course/pythoncv/
4. https://www.analyticsvidhya.com/blog/2019/03/opencv-functions-computer-vision-python/
5. https://www.youtube.com/watch?v=N81PCpADwKQ&ab_channel=ProgrammingKnowledge

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	2	1	-	-	-	-	-	-	-	2	2	-
2	2	1	1	2	–	-	-	-	-	-	-	-	1	1	1
3	2	2	2	1	–	-	-	-	-	-	-	-	1	1	1
4	1	2	2	2	1	-	-	-	-	-	-	-	1	2	-
5	2	1	2	2	1	-	-	-	-	-	-	-	1	1	1

Correlation Level: 1-Low, 2-Medium, 3- High

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

B.TECH.

BIOMEDICAL ENGINEERING

ACADEMIC REGULATIONS 2020
(R-2020)

CURRICULUM AND SYLLABI

COLLEGE VISION AND MISSION

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society

Mission

M1: Quality Education

To provide comprehensive academic system that amalgamates the cutting edge technologies with best practices.

M2: Research and Innovation

To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues

M3: Employability and Entrepreneurship

To inculcate the employability and entrepreneurial skills through value and skill based training.

M4: Ethical Values

To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society

DEPARTMENT VISION AND MISSION

Vision

To provide quality education in Biomedical Engineering focused on promoting continuous enrichment in the relevant research field and innovations in medical diagnosis for human health care.

Mission

M1: Medical science Engineering

To provide quality Biomedical Engineering education that integrates engineering principles with biomedical sciences

M2: Research and Development

To develop Biomedical engineers to apply innovative strategies for the design and development of medical equipments

M3: Industrial Intelligence

To incorporate novel technologies towards the healthcare industrial needs for medical applications and to become an entrepreneur.

M4: Ethical Responsibilities

To impart the desirable skill sets to become globally competent ethical professional**.**

B.Tech. Biomedical Engineering

PROGRAM OUTCOMES (POs)

PO1: Engineering knowledge:

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis:

Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions:

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems:

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage:**

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society:

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability:

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

PO8: Ethics:

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work:

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication:

Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance:

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning:

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

B.Tech. Biomedical Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Professional Skills
To become outstanding professionals to demonstrate their skills in solving challenges for healthcare diagnosis

PEO2: Higher Education and Research
To work successfully in multi-disciplinary environments or pursue higher studies

PEO3: Entrepreneurial Competencies
To address the challenges in biomedical engineering that supports employment and entrepreneurship to serve the society.

PEO4: Leadership Quality
To enable the graduates to exhibit leadership, make decisions with ethical responsibilities

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Knowledge in Biomedical Engineering
Comprehending fundamental concepts in Biomedical Engineering to meet the emerging trends

PSO2: Problem Solving in Medical Diagnosis
Apply Bio Signal and Image processing techniques to solve real time problems in medical field

PSO3: Troubleshooting of Medical Equipments
Troubleshoot the faulty medical Equipment's used in health care industry.

B.Tech. Biomedical Engineering

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

Sl.No	Course Category	Breakdown of Credits
1	Humanities and Social Sciences (HS)	7
2	Basic Sciences (BS)	23
3	Engineering Sciences (ES)	20
4	Professional Core (PC)	75
5	Professional Electives (PE)	18
6	Open Electives (OE)	9
7	Project work and Internship (PW)	12
8	Employability Enhancement Courses (EEC*)	-
9	Mandatory courses (MC*)	-
Total		**164**

SCHEME OF CREDIT DISTRIBUTION – SUMMARY

Sl.No	Course Category	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences (HS)	-	-	1	1	3	-	1	1	7
2	Basic Sciences(BS)	10	3	3	3	4	-	-	-	23
3	Engineering Sciences (ES)	8	4	4	4	-	-	-	-	20
4	Professional Core (PC)	-	14	14	8	12	15	9	3	75
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	-	3	3	-	9
7	Project work (PW)	-	-	-	-	-	-	2	8	10
8	Internship (PW)	-	-	-	-	-	-	2	-	2
9	Employability Enhancement Courses (EEC*)	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC*)	-	-	-	-	-	-	-	-	-
Total		**18**	**21**	**22**	**22**	**22**	**21**	**20**	**18**	**164**

EEC and MC credits are not included for CGPA calculation

B.Tech. Biomedical Engineering

SI. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
SEMESTER – I										
Theory										
1	U20BST101	Engineering Mathematics – I Calculus and Linear Algebra	BS	2	2	0	3	25	75	100
2	U20BST110	Biophysics and Biochemistry	BS	3	0	0	3	25	75	100
3	U20BST111	Human Anatomy and Physiology	BS	3	0	0	3	25	75	100
4	U20EST132	Basic Electrical Circuits	ES	2	2	0	3	25	75	100
5	U20EST103	Fundamentals of Civil and Mechanical Engineering	ES	3	0	0	3	25	75	100
Practical										
6	U20BSP112	Biochemistry and Human Physiology Laboratory	BS	0	0	2	1	50	50	100
7	U20ESP133	Basic Electrical Circuits Laboratory	ES	0	0	2	1	50	50	100
8	U20ESP112	Engineering Graphics using AutoCAD	ES	0	0	2	1	50	50	100
Employability Enhancement Course										
9	U20BMC1XX	Certification Course – I**	EEC	0	0	4	-	100	-	100
Mandatory Course										
10	U20BMM101	Induction Program	MC	3 Weeks			-	-	-	-
							18	375	525	900

SI. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
SEMESTER – II										
Theory										
1	U20BST215	Engineering Mathematics – II Multiple Integrals and Transforms	BS	2	2	0	3	25	75	100
2	U20EST201	Programming in C	ES	3	0	0	3	25	75	100
3	U20BMT201	Electron Devices and Circuits	PC	3	0	0	3	25	75	100
4	U20BMT202	Pathology and Microbiology	PC	3	0	0	3	25	75	100
5	U20BMT203	Measurements and Instruments	PC	3	0	0	3	25	75	100
6	U20BMT204	Communication Systems	PC	3	0	0	3	25	75	100
Practical										
7	U20ESP202	Programming in C Laboratory	ES	0	0	2	1	50	50	100
8	U20BMP201	Electron Devices and Circuits Laboratory	PC	0	0	2	1	50	50	100
9	U20BMP202	Instrumentation Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20BMC2XX	Certification Course – II**	EEC	0	0	4	-	100	-	100
11	U20BMS201	Skill Development Course 1: Demonstration of workshop Practices	EEC	0	0	2	-	100	-	100

B.Tech. Biomedical Engineering

		Mandatory Course								
12	U20BMM202	Environmental Science	MC	2	0	0	-	100	-	100
							21	600	600	1200

*** Certification courses are to be selected from the list given in Annexure III*

SEMESTER – III										
Sl. No.	Course Code	Course Title	Category	\multicolumn{3}{c}{Periods}	Credits	\multicolumn{3}{c}{Max. Marks}
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST322	Numerical Methods	BS	2	2	0	3	25	75	100
2	U20EST356	Data Structures	ES	3	0	0	3	25	75	100
3	U20BMT305	Biosensors and Transducers	PC	3	0	0	3	25	75	100
4	U20BMT306	Biosignals and Systems	PC	2	2	0	3	25	75	100
5	U20BMT307	Digital Logic Circuits	PC	3	0	0	3	25	75	100
6	U20BMT308	Biomechanics	PC	3	0	0	3	25	75	100
Practical										
7	U20HSP301	General Proficiency – I	HS	0	0	2	1	50	50	100
8	U20ESP357	Data Structures Laboratory	ES	0	0	2	1	50	50	100
9	U20BMP303	Biosensors and Transducers Laboratory	PC	0	0	2	1	50	50	100
10	U20BMP304	Digital Logic Circuits Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20BMC3XX	Certification Course – III **	EEC	0	0	4	-	100	-	100
12	U20BMS302	Skill Development Course 2 *	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20BMM303	Physical Education	MC	0	0	2	-	100	-	100
							22	650	650	1300

SEMESTER – IV										
Sl. No	Course Code	Course Title	Category	\multicolumn{3}{c}{Periods}	Credits	\multicolumn{3}{c}{Max. Marks}
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST433	Probability and Queuing Theory	BS	2	2	0	3	25	75	100
2	U20EST467	Programming in Java	ES	3	0	0	3	25	75	100
3	U20BMT409	Biosignal Processing	PC	2	2	0	3	25	75	100
4	U20BMT410	Linear Integrated Circuits	PC	3	0	0	3	25	75	100
5	U20BME4XX	Professional Elective –I #	PE	3	0	0	3	25	75	100
6	U20XXO4XX	Open Elective-I $	OE	3	0	0	3	25	75	100
Practical										
7	U20HSP402	General Proficiency – II	HS	0	0	2	1	50	50	100
8	U20ESP468	Programming in Java Laboratory	ES	0	0	2	1	50	50	100
9	U20BMP405	Biosignal Processing using MATLAB	PC	0	0	2	1	50	50	100
10	U20BMP406	Linear Integrated Circuits Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20BMC4XX	Certification Course – IV **	EEC	0	0	4	-	100	-	100

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12	U20BMS403	Skill Development Course 3 *	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20BMM404	NCC/NSS	MC	0	0	2	-	100	-	100
							22	650	650	1300

*Professional Electives are to be selected from the list given in Annexure I*
$ *Open electives are to be selected from the list given in Annexure II*
** *Certification courses are to be selected from the list given in Annexure III*
* *Skill Development Courses (2 and 3) are to be selected from the list given in Annexure IV*

SEMESTER – V										
SI. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST552	Bio Statistics	BS	2	2	0	3	25	75	100
2	U20BMT511	Biomedical Instrumentation	PC	3	0	0	3	25	75	100
3	U20BMT512	Microcontroller and Embedded Systems	PC	3	0	0	3	25	75	100
4	U20BMT513	Biocontrol Systems	PC	2	2	0	3	25	75	100
5	U20BME5XX	Professional Elective – II #	PE	3	0	0	3	25	75	100
6	U20XXO5XX	Open Elective-II $	HS	3	0	0	3	25	75	100
Practical										
7	U20BSP545	Statistical Laboratory	BS	0	0	2	1	50	50	100
8	U20BMP507	Biomedical Instrumentation Laboratory	PC	0	0	2	1	50	50	100
9	U20BMP508	Microcontroller and Embedded Systems Laboratory	PC	0	0	2	1	50	50	100
10	U20BMP509	Computation Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20BMC5XX	Certification Course – V **	EEC	0	0	4	-	100	-	100
12	U20BMS504	Skill Development Course 4: Foreign Language / IELTS - I	EEC	0	0	2	-	100	-	100
13	U20BMS505	Skill Development Course 5: Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U20BMM505	Indian Constitution	MC	2	0	0	-	100	-	100
							22	750	650	1400

SEMESTER – VI										
SI. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BMT614	Biomaterials and Artifical Organs	PC	3	0	0	3	25	75	100
2	U20BMT615	Diagnostic and Therapeutic Equipment's	PC	3	0	0	3	25	75	100
3	U20BMT616	Medical Internet of Things	PC	3	0	0	3	25	75	100
4	U20BMT617	Artificial Intelligence and Machine learning in Medicines	PC	2	2	0	3	25	75	100
5	U20BME6XX	Professional Elective – III #	PE	3	0	0	3	25	75	100
6	U20XXO6XX	Open Elective – III $	OE	3	0	0	3	25	75	100
Practical										
7	U20BMP610	Diagnostic and Therapeutic	PC	0	0	2	1	50	50	100

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SI. No	Course Code	Course Title	Category	L	T	P	Credits	CAM	ESM	Total
		Equipment's Laboratory								
8	U20BMP611	Medical Internet of Things Laboratory	PC	0	0	2	1	50	50	100
9	U20BMP612	Hospital Training	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20BMC6XX	Certification Course – VI **	EEC	0	0	4	-	100	-	100
11	U20BMS606	Skill Development Course 6: Foreign Language / IELTS - II	EEC	0	0	2	-	100	-	100
12	U20BMS607	Skill Development Course 7: Technical Seminar	EEC	0	0	2	-	100	-	100
13	U20BMS608	Skill Development Course 8: NPTEL / MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U20BMM606	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	800	600	1400

SEMESTER – VII										
SI. No	Course Code	Course Title	Category	**Periods**			Credits	**Max. Marks**		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BMT718	Virtual Bio-Instrumentation	PC	3	0	0	3	25	75	100
2	U20BMT719	Medical image processing	PC	3	0	0	3	25	75	100
3	U20BME7XX	Professional Elective – IV#	PE	3	0	0	3	25	75	100
4	U20XXO7XX	Open Elective – IV$	OE	3	0	0	3	25	75	100
Practical										
5	U20HSP703	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U20BMP713	Virtual Bio-Instrumentation Laboratory	PC	0	0	2	1	50	50	100
7	U20BMP714	Medical Image Processing Laboratory	PC	0	0	2	1	50	50	100
8	U20BMP715	Comprehensive Viva voce	PC	0	0	2	1	50	50	100
Project Work										
9	U20BMW701	Project Phase – I	PW	0	0	4	2	50	50	100
10	U20BMW702	Internship / Inplant Training	PW	0	0	0	2	100	-	100
Mandatory Course										
11	U20BMM707	Professional Ethics	MC	2	0	0	-	100	-	100
							19	600	500	1100

SEMESTER – VIII										
SI. No.	Course Code	Course Title	Category	**Periods**			Credits	**Max. Marks**		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BMT820	Rehabilitation Engineering	PC	3	0	0	3	25	75	100

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2	U20BME8XX	Professional Elective – V#	PE	3	0	0	3	25	75	100
3	U20BME8XX	Professional Elective – VI#	PE	3	0	0	3	25	75	100
Practical										
4	U20HSP804	Entrepreneurship Management	HS	0	0	2	1	100	-	100
Project Work										
5	U20BMW803	Project phase – II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U20BMS809	Skill Development Course 9: NPTEL/MOOC-II	MC	0	0	0	-	100	-	100
							18	315	285	600

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Annexure – I
PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)

Sl. No.	Course Code	Course Title
1	U20BME401	Medical Physics
2	U20BME402	Hospital Equipment Safety and Management
3	U20BME403	Environmental Biotechnology
4	U20BME404	Biometric Recognization System
5	U20BME405	Laser and Fiber Optics in Medicine

Professional Elective – II (Offered in Semester V)

Sl. No.	Course Code	Course Title
1	U20BME506	Bio Telemetry and Telemedicine
2	U20BME507	Transportation in Living Systems
3	U20BME508	Medical Informatics
4	U20BME509	VLSI Design
5	U20BME510	Computers in Medicine

Professional Elective – III (Offered in Semester VI)

Sl. No.	Course Code	Course Title
1	U20BME611	Hospital Engineering and Information Systems
2	U20BME612	Physiological System Modelling
3	U20BME613	Soft Computing Techniques
4	U20BME614	Medical Image Acquisition Techniques
5	U20BME615	Troubleshooting and Quality Control in Medical Equipment's

Professional Elective – IV (Offered in Semester VII)

Sl. No.	Course Code	Course Title
1	U20BME716	Dynamics of Biofluids
2	U20BME717	MRI and its Clinical Applications
3	U20BME718	Radiological Equipments
4	U20BME719	Cryptography and Network Security

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5	U20BME720	Nanotechnology in Medicine

Professional Elective – V (Offered in Semester VIII)

Sl. No.	Course Code	Course Title
1	U20BME821	Tissue Engineering
2	U20BME822	Pattern Recognition and Expert Systems in Medicine
3	U20BME823	Human Assist Devices
4	U20BME824	Bio MEMS
5	U20BME825	Wearable Systems

Professional Elective – VI (Offered in Semester VIII)

Sl. No.	Course Code	Course Title
1	U20BME826	Brain Computer Interface and Application
2	U20BME827	Neural Networks
3	U20BME828	Acoustics and Optical Imaging
4	U20BME829	Biomedical Laser Instruments
5	U20BME830	Virtual Reality in Medicine

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Annexure – II
OPEN ELECTIVE COURSES

S.No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)			
1	U20EEO401	Solar Photovoltaic Fundamental and applications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE
2	U20EEO402	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, CCE, BME, IT, CSE, FT
3	U20ECO401	Engineering Computation with MATLAB	ECE	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS, Mechatronics
4	U20ECO402	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics, FT
5	U20CSO401	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U20CSO402	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U20ITO401	Database System: Design & Development	IT	EEE, ECE, ICE, CCE, BME
8	U20ITO402	R programming	IT	EEE, ECE, ICE, CCE, BME, MECH, Mechatronics
9	U20ICO401	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL, CCE, AI&DS, FT
10	U20ICO402	Control System Engineering	ICE	CSE, IT, MECH, CCE, AI&DS
11	U20MEO401	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME, FT
12	U20MEO402	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
13	U20MEO403	Industrial Engineering for Textile	MECH	FT
14	U20CEO401	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics, FT
15	U20CEO402	Building Science and Engineering	CIVIL	EEE, MECH, BME
16	U20BMO401	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics, AI&DS
17	U20BMO402	Telemedicine	BME	EEE, ECE, CSE, IT, ICE, CCE, AI&DS
18	U20CCO401	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20CCO402	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics

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20	U20ADO401	Knowledge Representation and Reasoning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20ADO402	Introduction to Data Science	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics

Open Elective – II / Open Elective – III				
1	U20HSO501/ U20HSO601	Product Development and Design	MBA	**Common to B. Tech** (Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**) (Offered in Semester VI for **CSE, IT, MECH, Mechatronics, AI&DS**)
2	U20HSO502/ U20HSO602	Intellectual Property and Rights	MBA	
3	U20HSO503/ U20HSO603	Marketing Management and Research	MBA	
4	U20HSO504/ U20HSO604	Project Management for Engineers	MBA	
5	U20HSO505/ U20HSO605	Finance for Engineers	MBA	

Open Elective – II / Open Elective – III
(Offered in Semester V for **CSE, IT, MECH, Mechatronics, AI&DS**)
(Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME, CCE, FT**)

1	U20EEO503/ U20EEO603	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS, FT
2	U20EEO504/ U20EEO604	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics, AI&DS
3	U20ECO503/ U20ECO603	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE, MECH, CCE, BME, Mechatronics
4	U20ECO504/ U20ECO604	Automotive Electronics	ECE	EEE, ECE, ICE, MECH
5	U20CSO503/ U20CSO603	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL, CCE, BME, AI&DS
6	U20CSO504/ U20CSO604	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, FT
7	U20ITO503/ U20ITO603	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL, BME
8	U20ITO504/ U20ITO604	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics, AI&DS
9	U20ICO503/ U20ICO603	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME, AI&DS
10	U20ICO504/ U20ICO604	Measurement and Instrumentation	ICE	ECE, Mechatronics
11	U20MEO504/ U20MEO604	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO505/ U20MEO605	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
13	U20CEO503/ U20CEO603	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT

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14	U20CEO504/ U20CEO604	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20BMO503/ U20BMO603	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, Mechatronics
16	U20BMO504/ U20BMO604	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, CCE, MECH, CIVIL , Mechatronics
17	U20CCO503/ U20CCO603	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
18	U20CCO504/ U20CCO604	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
19	U20ADO503/ U20ADO603	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE
20	U20ADO504/ U20ADO604	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics
21	U20MCO501/ U20MCO601	Industrial Automation for Textile	Mechatronics	FT
Open Elective – IV (Offered in Semester VII)				
1	U20EEO705	Hybrid and Electrical Vehicle	EEE	ECE, Mechatronics , MECH
2	U20EEO706	Electrical Energy Conservation and auditing	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics, CCE, AI&DS
3	U20ECO705	IoT and its Applications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, FT
4	U20ECO706	Cellular and Mobile Communications	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
5	U20CSO705	Artificial Intelligence	CSE	EEE, ICE, CIVIL, CCE, MECH, FT
6	U20CSO706	Cloud Technology and its Applications	CSE	EEE, ICE, MECH, CIVIL, CCE, BME, Mechatronics
7	U20ITO705	Automation Techniques & Tools- DevOps	IT	EEE, ECE, ICE, CSE, MECH, CIVIL, CCE, BME, Mechatronics, AI&DS
8	U20ITO706	Augmented and Virtual Reality	IT	EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS
9	U20ICO705	Process Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
10	U20ICO706	Virtual Instrumentation	ICE	EEE, ECE, MECH, Mechatronics
11	U20MEO706	Principles of Hydraulic and Pneumatic System	MECH	EEE, ECE, ICE, CIVIL
12	U20MEO707	Supply Chain Management	MECH	EEE, ECE, CIVIL, Mechatronics
13	U20CEO705	Energy Efficient Buildings	CIVIL	EEE, ECE, MECH

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14	U20CEO706	Global Warming and Climate Change	CIVIL	EEE, ECE, CSE, IT, ICE, MECH, BME, CCE, AI&DS, FT
15	U20MCO702	Building Automation	Mechatronics	MECH, CIVIL
16	U20MCO703	Automation in Manufacturing Systems	Mechatronics	MECH, CIVIL
17	U20BMO705	Internet of Things for Healthcare	BME	EEE, ECE, ICE, CCE
18	U20BMO706	Telehealth Technology	BME	EEE, ECE, ICE, CCE
19	U20CCO705	Data Science using python	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U20CCO706	Mobile Applications Development using Android	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
21	U20ADO705	Data Science Application of NLP	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics.
22	U20ADO706	Artificial Intelligence Applications	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME
23	U20HSO706	Industrial Safety and Human Resource Management	MBA	FT
24	U20HSO707	Operation Research in Textile Industry	MBA	FT
25	U20HSO708	Global marketing and Sourcing Strategies	MBA	FT
26	U20HSO709	Fashion Advertising and sales promotions	MBA	FT
27	U20HSO710	Luxury Brand management	MBA	FT
28	U20HSO711	Fashion Retail Store Operations	MBA	FT

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Annexure – III
EMPLOYABILITY ENHANCEMENT COURSES – (A). CERTIFICATION COURSES

Sl. No.	Course Code	Course Title
1	U20BMCX01	3ds Max
2	U20BMCX02	Advance Structural Analysis of Building using ETABS
3	U20BMCX03	Advanced Java Programming
4	U20BMCX04	Advanced Python Programming
5	U20BMCX05	Analog System Lab Kit
6	U20BMCX06	Android Medical App Development
7	U20BMCX07	Android Programming
8	U20BMCX08	ANSYS -Multiphysics
9	U20BMCX09	Artificial Intelligence
10	U20BMCX10	Artificial Intelligence and Edge Computing
11	U20BMCX11	Artificial Intelligence in Medicines
12	U20BMCX12	AutoCAD for Architecture
13	U20BMCX13	AutoCAD for Civil
14	U20BMCX14	AutoCAD for Electrical
15	U20BMCX15	AutoCAD for Mechanical
16	U20BMCX16	Azure DevOps
17	U20BMCX17	Basic Course on ePLAN
18	U20BMCX18	Basic Electro Pneumatics
19	U20BMCX19	Basic Hydraulics
20	U20BMCX20	Bio Signal and Image Processing Development System
21	U20BMCX21	Blockchain
22	U20BMCX22	Bridge Analysis
23	U20BMCX23	Building Analysis and Construction Management
24	U20BMCX24	Building Design and Analysis Using AECO Sim Building Designer
25	U20BMCX25	CATIA
26	U20BMCX26	CCNA (Routing and Switching)
27	U20BMCX27	CCNA (Wireless)
28	U20BMCX28	Cloud Computing
29	U20BMCX29	Computer Programming for Medical Equipments
30	U20BMCX30	Corel Draw
31	U20BMCX31	Creo (Modeling and Simulation)
32	U20BMCX32	Cyber Security
33	U20BMCX33	Data Science and Data Analytics
34	U20BMCX34	Data Science using Python

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35	U20BMCX35	Data Science using R
36	U20BMCX36	Deep Learning
37	U20BMCX37	Design and Documentation using ePLAN Electric P8
38	U20BMCX38	Design of Biomedical Devices and Systems
39	U20BMCX39	Digital Marketing
40	U20BMCX40	Digital Signal Processing Development System
41	U20BMCX41	DigSILENT Power Factory
42	U20BMCX42	Electro Hydraulic Automation with PLC
43	U20BMCX43	Embedded System using Arduino
44	U20BMCX44	Embedded System using C
45	U20BMCX45	Embedded System with IoT
46	U20BMCX46	ePLAN Data Portal
47	U20BMCX47	ePLAN Electric P8
48	U20BMCX48	ePLAN Fluid
49	U20BMCX49	ePLAN PPE
50	U20BMCX50	Fusion 360
51	U20BMCX51	Fuzzy Logic and Neural Networks
52	U20BMCX52	Google Analytics
53	U20BMCX53	Hydraulic Automation
54	U20BMCX54	Industrial Automation
55	U20BMCX55	Industry 4.0
56	U20BMCX56	Internet of Things
57	U20BMCX57	Introduction to C Programming
58	U20BMCX58	Introduction to C++ Programming
59	U20BMCX59	IoT using Python
60	U20BMCX60	Java Programming
61	U20BMCX61	Machine Learning
62	U20BMCX62	Machine Learning and Deep Learning
63	U20BMCX63	Machine Learning for Medical Diagnosis
64	U20BMCX64	Mechatronics
65	U20BMCX65	Medical Robotics
66	U20BMCX66	Microsoft Dynamics 365 ERP for HR , Marketing and Finance
67	U20BMCX67	Mobile Edge Computing
68	U20BMCX68	Modeling and Visualization using Micro station
69	U20BMCX69	MX Road
70	U20BMCX70	Photoshop
71	U20BMCX71	PLC
72	U20BMCX72	Pneumatics Automation
73	U20BMCX73	Project Management
74	U20BMCX74	Python Programming

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75	U20BMCX75	Revit Architecture
76	U20BMCX76	Revit Inventor
77	U20BMCX77	Revit MEP
78	U20BMCX78	Robotics
79	U20BMCX79	Search Engine Optimization
80	U20BMCX80	Software Testing
81	U20BMCX81	Solar and Smart Energy System with IoT
82	U20BMCX82	Solid Works
83	U20BMCX83	Solid Works with Electrical Schematics
84	U20BMCX84	Speech Processing
85	U20BMCX85	STAAD PRO V8i
86	U20BMCX86	Structural Design and Analysis using Bentley
87	U20BMCX87	Total Station
88	U20BMCX88	Video and Image Processing Development System
89	U20BMCX89	VLSI Design
90	U20BMCX90	Web Programming - I
91	U20BMCX91	Web Programming - II

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Annexure – IV
EMPLOYABILITY ENHANCEMENT COURSES – (B). SKILL DEVELOPMENT COURSES

Sl. No.	Course Code	Course Title
1	U20BMS201	Skill Development Course 1: Demonstration of Workshop Practices
2	U20BMS302	Skill Development Course 2 *
		1) PowerPoint Presentation Design and Animation
		2) Masters in Microsoft Excel
		3) Microsoft Word Documentation
3	U20BMS403	Skill Development Course 3 *
		1) Trouble Shooting of Medical Instruments
		2) PCB Board Designing
		3) Testing of Electronic and Medical Devices
4	U20BMS504	Skill Development Course 4: Foreign Language/ IELTS -I
5	U20BMS505	Skill Development Course 5: Presentation Skills using ICT
6	U20BMS606	Skill Development Course 6: Foreign Language/ IELTS - II
7	U20BMS607	Skill Development Course 7: Technical Seminar
8	U20BMS608	Skill Development Course 8: NPTEL/MOOC - I
9	U20BMS809	Skill Development Course 9: NPTEL/MOOC-II

 * *Choose any one skill development course in the list for SDC 2 and SDC 3*

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U20BST101	ENGINEERING MATHEMATICS-I CALCULUS AND LINEAR ALGEBRA (Common to all branches except CSBS)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To familiarize the concept of matrices.
- To introduce mathematical tools to solve first order differential equations.
- To learn linear differential equations of higher order with constant coefficients.
- To understand the concept of partial differentiation.
- To introduce the concepts of curl, divergence and integration of vectors in vector calculus.

Course Outcomes

After completion of the course, the students will be able to

CO 1 - Understand the concept of Eigen values and Eigen vectors, Diagonalization of a matrix. **(K2)**

CO 2 - Solve differential equations**. (K3)**

CO 3 - Solve higher order differential equations. **(K3)**

CO 4 - Solve different types of partial differential equation. **(K3)**

CO 5 - Understand the use of vector calculus. **(K2)**

UNIT I MATRICES　　　　　　　　　　　　　　　　　　　　　　　　(12 Hrs)

Rank of a Matrix- Consistency of system of equations. Eigen values and Eigen vectors of a rea matrix - Characteristic equation - Properties of Eigen values and Eigen vectors. Cayley-Hamilton Theorem - Diagonalization of matrices.

UNIT II DIFFERENTIAL EQUATIONS　　　　　　　　　　　　　　　　(12 Hrs)

Exact equations, First order linear equations, Bernoulli's equation, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

UNIT III DIFFERENTIAL EQUATIONS (HIGHER ORDER)　　　　　　　(12 Hrs)

Linear differential equations of higher order with constant coefficients, the operator D, Euler's linear equation of higher order with variable coefficients, Solution by variation of parameter method.

UNIT IV PARTIAL DIFFERENTIAL EQUATIONS　　　　　　　　　　　(12 Hrs)

Partial derivatives, Total derivatives, Differentiation of implicit functions, Maxima and Minima of two variables. Partial differential equations of higher order with constant coefficients.

UNIT V VECTOR CALCULUS　　　　　　　　　　　　　　　　　　　(12 Hrs)

Gradient, divergence and curl - Directional derivative- Irrotational and Solenoidal vector fields - Gauss Divergence Theorem and Stokes Theorem.

Text Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley, Tenth edition, 2019
2. B.V.Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill, New Delhi, Sixth edition, 2018.
3. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Lakshmi Publications, New Delhi, Ninth Edition, 2018

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Reference Books

1. C W. Evans, "Engineering Mathematics", A Programmed Approach, 3th Edition, 2019
2. Dr.A.Singaravelu, "Engineering Mathematics - I", Meenakshi publications, Tamil Nadu, 2019
3. M.K. Venkataraman, "Engineering Mathematics" The National Publishing Company, Madras, 2016.
4. S. Narayanan**,"** Differential Equations and Its Applications**,** Viswanathan, S., Printers & Publishers Pvt Ltd , 2009
5. Dr.G Balaji., " Engineering Mathematics-I", G.Balaji publishers, 2017

Web References

1. http://www.yorku.ca/yaoguo/math1025/slides/chapter/kuttler-linearalgebra–slides-systemsofquation-handout.pdf
2. http://www.math.cum.edu/~wn0g/2ch6a.pdf
3. https://nptel.ac.in/courses/122/104/122104017/
4. https://nptel.ac.in/courses/111/106/111106051/
5. https://nptel.ac.in/courses/111/108/111108081/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	1	-	-	-	-	1	2	1	-
2	3	2	1	1	-	1	1	-	-	-	-	1	2	1	-
3	3	2	1	1	-	1	1	-	-	-	-	1	2	1	-
4	3	2	1	1	-	1	1	-	-	-	-	1	2	1	-
5	2	1	-	-	-	-	1	-	-	-	-	1	2	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

U20BST110	BIOPHYSICS AND BIOCHEMISTRY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To get a clear idea of bioelectricity and their functions
- To know the effects of radiation and biophysical activities
- To understand the concept of Enzymes and nucleic acids
- To study the significance of macromolecules
- To understand the importance of Measurement chemistry

Course Outcomes

After completion of the course, the students will be able to

CO1 - Gain knowledge in bioelectricity and membranes **(K2)**
CO2 - Analyse the effects of radiations and distinguish the biophysical activities **(K3)**
CO3 - Know the functions of enzymes and its characteristics **(K2)**
CO4 - Categorize the functions of macromolecules such as Carbohydrates, Lipids and Protein **(K3)**
CO5 - Assess the significance of measuring equipments used in biochemistry **(K3)**

UNIT I BIO ELECTRICITY (9 Hrs)

Membrane Potential, Local and propagator types, Diffusion potential, phase boundary potentials, Generator Potentials, compound Action Potentials (AP), Propagation of AP, factors influencing propagation of AP, Bio-signal and types, Electrical properties of excitable membranes, Membrane Capacitance, Resistance, conductance, dielectric properties of membrane.

UNIT II RADIATION AND BIOPHYSICAL ACTIVITY (9 Hrs)

Radio sensitivity protocol of different tissues in human, Effect of radiation on skin, Threshold of linear dose effect, relationship, factors affecting frequency of radiation induced mutation, Electrical activity of brain (EEG), different wave forms and their characteristics, Electrical activity of heart (ECG), waveform and significance, Electrical activity of muscles (EMG) and muscle tone.

UNIT III ENZYMES (9 Hrs)

Enzymes: Chemical Nature, General Properties, Spectrophotometric measurement of enzymes, Isolation techniques, Diagnostic enzymes. Enzyme biotechnology, Hormones: Chemical Nature, Properties of hormones, Hormonal Assay and their Significance.

UNIT IV MACROMOLECULES (9 Hrs)

Carbohydrate: Classification, Metabolism of carbohydrate and its dysfunction. Uses of Carbohydrates, **Lipids:** Classification, Metabolism of lipids, Cholesterol, bile acids, Transport of lipids, Lipid metabolism dysfunction, **Protein:** Classification, Amino acids, Chromatography, electrophoresis and architecture of protein molecules.

UNIT V MEASUREMENT CHEMISTRY (9 Hrs)

Principles and Application of Photometry, Spectrophotometry, Flurometry, Flame Photometry, Densitometry, Calorimetry, Automation in Clinical Laboratory, Use of Isotopes in Biochemistry.

Text Books

1. Edward L. Alpen," Radiation Biophysics", Second Edition, Academic Press, 2011
2. Glaser, Roland, "Bio-Physics an Introduction", Springer;2012
3. Chatterjea M.N &Rana Shinde, "Textbook of Medical Biochemistry", Jaypee Brothers Medical Publishers, 8th Edition, 2012.

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Reference Books

1. Donald Voet, Judith .Voet, Charlotte W. Pratt. "Fundamentals of Biochemistry", Fifth Edition, Wiley Publisher, 2016
2. U. Satyanarayana and U. Chakrapani. "Biochemistry", Fourth Edition, Elsevier, 2013
3. Murray R K, "Harper's Illustrated Biochemistry". 29th Edition, McGraw Hill Professional, 2012.
4. Keith Wilson & John Walker, "Practical Biochemistry – Principles & Techniques", Oxford university press, 2011
5. Michael M. Cox and David L. Nelson, "Lehninger Principles of Biochemistry", W. H. Freeman and Company, Sixth Edition, 2012.

Web References

1. https://ocw.mit.edu/courses/biology/7-012-introduction-to-biology-fall-2004/videolectures/lecture-2-biochemistry-1
2. https://ocw.mit.edu/courses/biology/7-012-introduction-to-biology-fall-2004/videolectures/lecture-2-biochemistry-1
3. nptel.ac.in/courses/102105034

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	1	-	-	-	1	2	-	-
2	3	-	2	2	2	-	-	1	-	-	-	1	2	-	1
3	3	-	-	-	-	-	-	1	-	-	-	1	2	-	-
4	3	-	-	-	-	-	-	1	-	-	-	1	2	-	-
5	3	2	2	2	2	-	-	1	-	-	-	1	2	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BST111	HUMAN ANATOMY AND PHYSIOLOGY	L 3	T 0	P 0	C 3	Hrs 45

Course Objectives
- To know the basic structural and functional elements of human body.
- To gain knowledge about cardiovascular systems and nervous system
- To understand the basic concepts of respiratory and human skeletal
- To understand the urinary system
- To understand the basic concepts of visual and hearing system

Course Outcomes
After completion of the course, the students will be able to
CO1 - Describe basic structural and functional elements of human body **(K2)**
CO2 - Explain the function of heart and its conduction and knowledge on nervous systems **(K2)**
CO3 - Distinguish the types of skeletal systems and functions of respiration **(K4)**
CO4 - Illustrate the Physiological function of Digestive and Excretory systems **(K4)**
CO5 - Elucidate special senses in the human body **(K3)**

UNIT I BASIC ELEMENTS OF HUMAN BODY (9 Hrs)
Structure and function of Cell and cellular components, Membrane Potential, Action Potential, Generation and Conduction, Blood Cell: Composition, Fluid and electrolytic balance, Blood Groups - ABO and Rh System, Estimation of RBC and WBC.

UNIT II CARDIOVASCULAR AND NERVOUS SYSTEM (9 Hrs)
Cardiovascular system - Heart and vascular system, ECG, Blood Pressure, Homeostasis, Cardiac Cycle, Basics of Cardiac Output and Heart Sounds
Nervous System - Structure and functions of Neurons, Synapse, Reflex action and Receptors, Velocity of Conduction of Nerve Impulses, Nervous control of Heart.

UNIT III MUSCULO SKELETAL AND RESPIRATORY SYSTEM (9 Hrs)
Musculo Skeletal System: Muscle Tissue, Structure of Skeletal Muscle, Types of Muscle, Types of Joints, Major Muscles of Limbs and their actions.
Respiratory system: Physiological aspects of respiration, Exchange of gases, Regulation of Respiration, Disturbance of respiration function, Pulmonary function test, Artificial respiration, Cardio-pulmonary Resuscitation.

UNIT IV URINARY SYSTEM (9 Hrs)
Gastro Urinal system, Digestion and absorption, Movement of GI tract, Structure and function of kidneys and Nephron, Mechanism of Urine formation, Urine Reflex, Skin and Sweat Gland, Temperature regulation.

UNIT V ENT SYSTEM (9 Hrs)
Optics of Eye: Retina, Photochemistry of Vision, Accommodation Neurophysiology of Vision, EOG, Structure and functions Internal Ear, Mechanism of Hearing, Auditory pathway, Hearing Tests.

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Text Books

1. Guyton, "Text book of Medical Physiology",Tenth edition, WB Jaunder company Philadelphia, 2010
2. Elaine.N. Marieb, "Essential of human Anatomy and Physiology", Eight edition, Pearson Education New Delhi, 2010
3. C.L.Ghai, "A textbook of Practical physiology" Fifth edition, Jaypee Medical Publishers, 2013

Reference Books

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, "Fundamentals of Anatomy and Physiology", Pearson Publishers, 2014
2. Gillian Pocock, Christopher D. Richards, "The Human Body – An introduction for Biomedical and Health Sciences", Oxford University Press, USA, 2013
3. William F.Ganong, "Review of Medical Physiology", 22nd Edition, McGraw Hill, New Delhi, 2010
4. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", W.B. Saunders Company, 2015
5. Guyton & Hall, "Medical Physiology", Thirteenth Edition, Elsevier Saunders, 2015

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1. https://byjus.com/biology/human-body-anatomy/
2. https://www.khanacademy.org/
3. https://www.youtube.com/channel/UCJayvjGvKEblkA3KYK1BQQw
4. https://www.britannica.com/browse/Anatomy-Physiology

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	-	-	-	1	-	-	-	-	1	-	-
2	3	3	2	-	-	-	-	1	-	-	-	-	2	-	-
3	3	3	2	-	-	-	-	1	-	-	-	-	2	-	-
4	3	3	2	-	-	-	-	1	-	-	-	-	2	-	-
5	3	3	2	-	-	-	-	1	-	-	-	-	2	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20EST132	BASIC ELECTRICAL CIRCUITS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives
- To study the basic concepts of electrical circuits
- To gain knowledge in Network theorems
- To understand the concept of AC Circuits
- To study about steady state and transient response of RL, RC and RLC circuits
- To study the working principle and application of electrical machines.

Course Outcomes
After completion of the course, the students will be able to
CO1 - Gain knowledge in fundamentals of electrical circuits **(K2)**
CO2 - Analyse the electrical parameters of the circuits using basic theorems **(K3)**
CO3 - Compare frequency response of resonant circuits **(K3)**
CO4 - Determine the steady state and transient response of RL, RC and RLC circuits **(K4)**
CO5 - Analyse the working principle and application of electrical machines **(K3)**

UNIT I INTRODUCTION TO ELECTRICAL CIRCUITS   (12 Hrs)
Basic Components of electric Circuits, Ohms Law, Kirchhoff's Law, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis, Mesh analysis,. Concepts of AC circuits - rms value, average value , form factor, peak factor, study of RL, RC,RLC series circuit, RLC parallel circuit, phasor representation in Polar and rectangular form, concept of impedance, admittance, active, reactive, apparent and complex power, power factor,

UNIT II NETWORK THEOREMS   (12 Hrs)
Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Compensation Theorem, Maximum Power Transfer Theorem, Millman's Theorem, Star-Delta conversion.

UNIT III RESONANCE AND COUPLED CIRCUITS   (12 Hrs)
Average and RMS values of Sinusoidal Current and Voltage – Reactance – Impedance -Power factor - Resonance: Series and Parallel resonance, Variation of Impedance, Current and Voltage with frequency in series and parallel resonant circuits, Bandwidth, Q factor and Selectivity, Coupled Circuits: Self-inductance, Mutual inductance, Dot rule, Coefficient of coupling - Series and Parallel connection of coupled inductors - Single tuned coupled circuit.

UNIT IV TRANSIENT RESPONSE ANALYSIS   (12 Hrs)
Steady State and Transient Response, Source free, Step, Impulse, Sinusoidal and exponential response for RL, RC and RLC circuits.

UNIT V ELECTRICAL MACHINES AND SAFETY   (12 Hrs)
Working principle of DC generator, motor-EMF and Torque equation – Types: Shunt, Series and Compound, Applications. Working principle of transformer-EMF equation-Operating principles of three phase and single-phase induction motor-Applications. Operating principles of Synchronous motor, stepper motor-Applications. Safety measures in electrical system- Electrical tools and accessories–wiring standards,

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Text Books

1. Schaum's Series, "Basic Circuit Analysis", Fifth Edition, McGraw Hill India Private Ltd., 2011(Reprint)
2. Chakrabati A, "Circuit Theory Analysis and Synthesis", Seventh edition, Dhanpath Raiand Sons, New Delhi, 2018 (revised)
3. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", Eighth Edition, McGraw Hill Science Engineering, 11th Reprint 2016.

Reference Books

1. William Hayt, Jack, E Kemmerly and Steven M Durbin, "Engineering Circuits Analysis", Eight edition, Tata McGraw-Hill, 2013,
2. John Bird, "Electrical Circuit theory and technology", Fifth Edition, Routledge, 2013.
3. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education, 2014.
4. Joseph Edminister and Mahmood Nahvi, "Electric Circuits", Schaum's Outline Series, Fifth Edition, Tata McGraw Hill Publishing Company, New Delhi, Reprint 2016.
5. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Fifth Edition, McGraw Hill, 9th Reprint 2015.

Web References

1. https://www.khanacademy.org/science/electrical-engineering/ee-circuit-analysis-topic
2. https://www.thelearningpoint.net/home/electrical-science-andengineering/circuit-theory
3. https://www.classcentral.com/course/edx-circuits-and-electronics-1-basic-circuit-analysis-444
4. https://swayam.gov.in/nd1_noc19_ee36/preview
5. https://nptel.ac.in/courses/117/106/117106108/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2	-	-	-	-	-	2	2	2	-	1
2	3	2	2	2	2	-	-	-	-	-	2	2	2	-	1
3	3	2	2	2	2	-	-	-	-	-	2	2	2	-	1
4	3	2	2	2	2	-	-	-	-	-	2	2	2	-	1
5	3	2	2	2	2	-	-	-	-	-	2	2	2	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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	FUNDAMENTALS OF CIVIL AND MECHANICAL	**L**	**T**	**P**	**C**	**Hrs**
U20EST103	ENGINEERING					
	(Common to ECE, ICE, BME)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To distinguish the building types with its construction materials
- To understand the building components, infrastructure with their functions
- To understand the various infrastructure facilities and their importance
- To familiarize the working principles of IC engines and automobile systems
- To understand about the power generation systems and its components
- To acquire knowledge about the various machining process such as lathe, drilling and boring machines

Course Outcomes

After completion of the course, the students will be able to

CO1 - To Gain knowledge on types of buildings and about various construction materials. (**K2)**

CO2 - To study about the components of buildings **(K2)**

CO3 - To identify the various infrastructure facilities **(K2)**

CO4 - Summarize the working principle of IC engines and energy systems. **(K2)**

CO5 - Explain the basic concepts and fundamentals of power generation, Refrigeration and Air conditioning Systems **(K1)**

CO6 - To study the various machining process with tool materials. **(K2)**

PART A - CIVIL ENGINEERING

UNIT I BUILDINGS, BUILDING MATERIALS   (8 Hrs)

Buildings – Definition –Classification according to NBC-plinth area, Floor area, carpet area, floor space index - Development of Smart cities - Construction Materials - stone, brick , cement, cement-mortar, concrete, steel - their properties and uses

UNIT II BUILDINGS COMPONENTS AND FOUNDATION   (8 Hrs)

Various Buildings Components and their functions. Soils and their classification -**Foundation:** function and types. Masonry: function and types - Floors: definition and types of floors -**Roofs:** definition and types.

UNIT III BASIC INFRASTRUCTURE   (6 Hrs)

Surveying: Classification-Chain Survey-Ranging-Compass Survey-exhibition of different survey equipment-**Roads** - types: components, types and their advantage and disadvantages. **Bridges:** components and types of bridges -**Sources of Water -** Water Supply-Quality of Water-Wastewater Treatment – Recharge of Ground Water (Rain water harvesting) – Dams: site selection for dam construction, types of dams**.**

PART B - MECHANICAL ENGINEERING

UNIT IV INTERNAL AND EXTERNAL COMBUSTION SYSTEMS   (8 Hrs)

IC engines – Classification – Working principles – Diesel and Petrol Engines: Two stroke and four stroke engines – merits and demerits.

Steam generators (Boilers) – Classification – Constructional features (of only low-pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications.

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UNIT V POWER GENERATION SYSTEMS, REFRIGERATION AND AIR CONDITIONING SYSTEM
(8 Hrs)

Power plants: Thermal – Nuclear, Hydraulic, Solar, Wind, Geothermal, Wave, Tidal and Ocean Thermal Energy Conversion systems - Functions, Applications - Schemes and layouts (Description only)
Refrigeration and Air Conditioning System: Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

UNIT VI   MANUFACTURING PROCESS   (7 Hrs)
Lathe - types, Specifications, Operations of a centre lathe. Casting- Pattern making, Allowances, Green sand and dry sand moulding, casting defects. Welding - Arc and Gas welding process, brazing and soldering (process description only).

Text Books
1. G Shanmugam, MS Palanichamy, Basic Civil and Mechanical Engineering, McGraw Hill Education, 1st Edition, 2018.
2. R. Vaishnavi, M. Prabhakaran, V. Vijayan, Basic Civil and Mechanical Engineering, S. Chand Publisher, 2013.
3. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.

Reference Books
1. M.P. Poonia, S.C. Sharma and T.R. Banga, Basic Mechanical Engineering, Khanna Publishing House 2018.
2. V. Rameshbabu, Basic Civil & Mechanical Engineering, VRB Publishers Private Limited, January 2017.
3. Serope Kalpakjian, Steven Schmid, Manufacturing Engineering and Technology, 7th Edition, Pearson Publication, 2014.
4. S.S.Bhavikatti, Basic Civil engineering, New Age International Ltd. 2018.
5. Gopi Satheesh, Basic Civil engineering, Pearson Publications, 3rd Edition, 2015.

Web References
1. https://nptel.ac.in/courses/112107291/
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/ lecture-notes/
4. https://nptel.ac.in/courses/105102088/
5. https://nptel.ac.in/courses/105104101/

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	3	3	3	-	3	-	2	3	-	-	-
2	3	2	3	2	2	3	3	-	3	-	2	3	-	-	-
3	3	2	3	2	3	3	3	-	3	-	2	3	-	-	-
4	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-
5	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-
6	3	1	-	-	-	-	-	-	-	-	-	1	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 – High

B.Tech. Biomedical Engineering

U20BSP112	**BIOCHEMISTRY AND HUMAN PHYSIOLOGY LABORATORY**	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To give an insight into the chemical aspects of biological molecules and their importance
- To study the measurements of pH
- To understand the known amount of Macromolecules
- To know the significance of blood and its grouping system
- To understand the counting mechanisms of Blood cells

Course Outcomes

After completion of the course, the students will be able to

CO1 - Evaluate data and design experiments to test relevant to the practice of Biochemistry **(K4)**

CO2 - Identify the biochemical analyser tools for biological study and research **(K4)**

CO3 - Apply the principles of blood tests and serum separation from blood **(K3)**

CO4 - Analyse the type of antigen, antibody and components of blood **(K3)**

CO5 - Apply the principles of hearing aids to investigate the hearing capabilities of ear **(K3)**

List of Experiments

1. General tests for carbohydrates, proteins and lipids
2. Preparation of Serum and Plasma from blood
3. Quantitative estimation of Blood Glucose
4. Quantitative estimation of Creatinine
5. Quantitative estimation of Cholesterol
6. Study of Measurement of pH and conductivity of body fluids
7. Identification of Blood Groups
8. Estimation of Bleeding and Clotting time
9. Count RBC
10. Count WBC
11. Estimation of Haemoglobin
12. Estimation of ESR
13. Study of Hearing test –Tuning fork

Text Books

1. Edward L. Alpen," Radiation Biophysics", Second Edition, Academic Press, 2011
2. Glaser, Roland, "Bio-Physics an Introduction", Springer;2012
3. Chatterjea M.N &Rana Shinde, "Textbook of Medical Biochemistry", Jaypee Brothers Medical Publishers, 8th Edition, 2012.

Reference Books

1. Donald Voet, Judith .Voet, Charlotte W. Pratt. "Fundamentals of Biochemistry", Fifth Edition, Wiley Publisher, 2016
2. U. Satyanarayana and U. Chakrapani. "Biochemistry", Fourth Edition, Elsevier, 2013
3. Murray R K, "Harper's Illustrated Biochemistry". 29th Edition, McGraw Hill Professional, 2012.
4. Keith Wilson & John Walker, "Practical Biochemistry – Principles & Techniques", Oxford university press, 2011
5. Michael M. Cox and David L. Nelson, "Lehninger Principles of Biochemistry", W. H. Freeman and Company, Sixth Edition, 2012.

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Web References

1. https://ocw.mit.edu/courses/biology/7-012-introduction-to-biology-fall-2004/videolectures/lecture-2-biochemistry-1/
2. https://ocw.mit.edu/courses/biology/8-012-introduction-to-biology-fall-2004/videolectures/lecture-2-biochemistry-1
3. nptel.ac.in/courses/102105034/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1
2	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1
3	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1
4	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1
5	3	1	2	2	2	-	-	1	-	-	-	1	2	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20ESP133	**BASIC ELECTRICAL CIRCUITS LABORATORY**	**L**	**T**	**P**	**C**	**Hrs**
		0	0	2	1	30

Course Objectives

- To analyze the operation of basic electrical circuits
- To construct and verify the various network theorems
- To enable the student to select appropriate devices to design a circuit for a particular application
- To implement various theorems in electrical circuits
- To study the types of wiring and electrical equipments

Course Outcomes

After completion of the course, the students will be able to

CO1 - Construct electrical circuits to analyze the basic laws **(K4)**

CO2 - Observe and analyze the theorems in electrical circuits **(K2)**

CO3 - Analyze the electrical characteristics of RL, RC and RLC circuits **(K3)**

CO4 - Classify the operation of types of lamps **(K3)**

CO5 - Understand the wiring concepts and troubleshooting of electrical equipments **(K2)**

List of Experiments

1. Verification of ohms law and Kirchhoff law
2. Verification of superposition theorem
3. Verification of Thevenin's and Norton's Theorem
4. Verification of maximum power transfer theorem and reciprocity theorem
5. Verification of mesh and nodal analysis
6. Measurement of electrical quantities – voltage, current, power & power factor in RL, RC and RLC circuits.
7. Study of types of wiring (fluorescent lamp wiring, staircase wiring, etc.)
8. Study of types of lamps.
9. Measurement of resistance to earth of an electrical equipment
10. Study of trouble shooting of electrical equipment's (fan, iron box, mixer-grinder, etc)

Text Books

1. Joseph Edminister and Mahmood Nahri, "Theory and Problems of Electric Circuits", Tata McGraw- Hill, 2019.
2. Chakrabati A, "Circuit Theory Analysis and Synthesis", Seventh edition, Dhanpath Rai and Sons, New Delhi, 2018 (revised)
3. Metha V.K, Rohit Methaa, "Basic Electrical Engineering", Fifth edition, S.Chandand company, 2012

Reference Books

1. William Hayt, JVJack, E Kemmerly and Steven M Durbin, "Engineering Circuits Analysis", 8th edition, Tata McGraw-Hill, 2013
2. Schaum's Series, "Basic Circuit Analysis" ,5th Edition, McGraw Hill India Private Ltd., 2011(Reprint)
3. P. Ramesh Babu, "Circuits and Networks", second Edition, Scitech Publications, 2010, Chennai
4. Sudhakar. A and Shyam Mohan. SP, "Circuits and Network Analysis and Synthesis" 5th edition, Tata McGraw Hill, 2015
5. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Fifth Edition, McGraw Hill, 9th Reprint 2015.

Web References

1. https://www.classcentral.com/course/edx-circuits-and-electronics-1-basic-circuit-analysis-444
2. http://mjcollege.ac.in/eee/labmannual.php
3. www.circuitstoday.com

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	1	2	2	1	-	-	1	-	-	-	1	2	-	-
2	3	1	2	2	1	-	-	1	-	-	-	1	2	-	-
3	3	1	2	2	1	-	-	1	-	-	-	1	2	-	1
4	3	1	2	2	1	-	-	1	-	-	-	1	2	-	-
5	3	1	2	2	1	-	-	1	-	-	-	1	2	-	3

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20ESP112	**ENGINEERING GRAPHICS USING AUTOCAD** (Common to ECE, IT, CSE, ICE, MECH, BME, CSBS, CCE, MECHATRONICS)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To understand the basic principles of engineering drawing
- To develop graphical skills using the concepts, ideas and design of engineering products
- To generate the pictorial views and development of surfaces
- To expose the technical existing national standards related to drawing
- To develop software skills for creating 2D and 3D models.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Familiarize with the fundamentals and standards of engineering graphics.
CO2 - Perform freehand sketching of basic geometrical constructions and multiple views of objects
CO3 - Project and draw orthographic projections of lines & plane surfaces and development of surfaces
CO4 - Visualize the isometric and perspective sections of simple solids.
CO5 - Usage of software packages for drafting and modelling

LIST OF EXPERIMENTS

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc., and Dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. Vblock, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-Dmodel.

Note: Plotting of drawings must be made for each exercise and attached to the records written by Students.

Reference Books

1. James D. Bethune , "Engineering Graphics with AutoCAD A Spectrum book", 1st Edition, Macromedia Press, Pearson, 2020
2. NS Parthasarathy and Vela Murali, "Engineering Drawing", Oxford university press, 2015.
3. Bhatt N.D and Panchal V.M, Engineering Drawing: Plane and Solid Geometry, Charotar Publishing House, 2017.
4. Jeyapoovan T, Engineering Drawing and Graphics Using AutoCAD, 7th Edition, Vikas Publishing House Pvt Ltd., New Delhi, 2016
5. C M Agrawal, BasantAgrawal, "Engineering Graphics", McGraw Hill, 2012.

Web Resources

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/egraphics_lab/labs/index.php
2. https://www.autodesk.com/solutions/technical-drawing
3. https://www.mbit.org/domain/44

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4. https://dl.acm.org/doi/book/10.5555/580969
5. https://www.brooklinebooksmith.com/book/9781133960393

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	3	1	-	-	-	-	-	2	2	-	-
2	3	2	2	2	3	1	-	-	-	-	-	2	2	-	-
3	3	2	2	2	3	1	-	-	-	-	-	2	2	-	-
4	3	2	2	2	3	1	-	-	-	-	-	2	2	-	-
5	3	2	2	2	3	1	-	-	-	-	-	2	2	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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		L	**T**	**P**	**C**	**Hrs**
U20BMC1XX	**CERTIFICATION COURSE - I**	0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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U20BMM101   **INDUCTION PROGRAM**

Induction program for students to be offered right at the start of the first year

Duration of the Program	3 Weeks
Induction program	• Physical Activity • Creative Arts and Culture • Mentoring & Universal Human Values • Familiarization with College, Dept./Branch • Literary Activity • Proficiency Modules • Lectures & Workshops by Eminent People • Visits in Local Area • Extra-Curricular Activities in College

1. **Physical Activity**

This would involve a daily routine of physical activity with games and sports. There would be games in the evening or at other suitable times according to the local climate. These would help develop team work besides health. Each student could pick one game and learn it for the duration of the induction program and hopefully, continue with it later.

2. **Creative Arts**

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, music, dance, pottery, sculpture etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering design later.

3. **Mentoring and Universal Human Values**

Mentoring and connecting the students with faculty members is the most important part of student induction. Mentoring takes place in the context and setting of Universal Human Values. It gets the student to explore oneself and experience the joy of learning, prepares one to stand up to peer pressure and take decisions with courage, be aware of relationships and be sensitive to others, understand the role of money in life and experience the feeling of prosperity. Need for character building has been underlined by many thinkers, universal human values provide the base. Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but by getting the students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Experiments in this direction at IIT(BHU) are noteworthy and one can learn from them. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possibly beyond.

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4. Other Activity

Activities that are not there on a daily basis, but are conducted for 3-4 days (typically in the afternoons) and change thereafter.

4.1. Familiarization with College, Department/Branch

The incoming students should be told about the credit and grading system, and about the examinations. They should be informed about how study in college differs from study in school. They should also be taken on a tour of the college and shown important points such as library, canteen, and other facilities. They should be shown their department, and told what it means to get into the branch or department. Describe what role the technology related to their department plays in society, and after graduation what role the student would play in society as an engineer in that branch. A lecture by an alumnus of the Dept. would be very helpful in this regard. They should also be shown the laboratories, workshops and other facilities. The above should be done right in the first two days, and then over the afternoons thereafter, as appropriate.

4.2. Literary Activity

Literary activity would encompass reading a book, writing a summary, debating, enacting a play etc.

4.3. Proficiency Modules

The induction program period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.

4.4. Lectures & Workshops by Eminent People

Lectures by eminent people should be organized, say, once a week. It would give the students exposure to people who are eminent, in industry or engineering, in social service, or in public life. Alumni could be invited as well. Motivational lectures about life, meditation, etc. by Ramakrishna Mission, Art of Living, Vivekanand Kendras, S-VYASA, etc. may be organized. Workshops which rejuvenate or bring relief to students would also be welcome, such as, Art of Living workshops (3 sessions, 9 hours).

4.5. Visits in Local Area

A couple of visits to the local landmarks including historical monuments should be organized. This would familiarize the students with the area together with bonding with each other, like in a picnic. Visits should also be organized to a hospital, orphanage or a village. These would expose them to people in suffering or to different lifestyles. This might also sensitize them to engineering needs in these areas.

4.6. Extra-Curricular Activities in College

The new students should be introduced to the extra-curricular activities at the college/university. They should be shown the facilities and informed about activities related to different clubs etc. This is when selected senior students involved in or leading these activities can give presentations, under faculty supervision.

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U20BST215	ENGINEERING MATHEMATICS-II MULTIPLE INTEGRALS AND TRANSFORMS (Common to all branches except CSBS)	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To develop logical thinking and analytic skills in evaluating multiple integrals.
- To equip themselves familiar with Laplace, transform and solve the differential equations using Laplace transform techniques.
- To enable the students to expand functions into Fourier series using change of intervals.
- To gain good knowledge in application of Fourier transform.
- To inculcate the computational knowledge in Z-transforms.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the concept of double and triple integrals. **(K2)**
CO2 - Apply Laplace transform and inverse transform of simple functions**. (K5)**
CO3 - Convert a periodic function into series form. **(K3)**
CO4 - Compute Fourier transforms of various functions. **(K3)**
CO5 - Solve difference equations using Z- transforms. **(K3)**

UNIT I MULTIPLE INTEGRALS   (12 Hrs)

Multiple Integrals, change of order of integration and change of variables in double integrals (Cartesian to polar). Applications: Areas by double integration and volumes by triple integration (Cartesian and polar).

UNIT II LAPLACE TRANSFORMS AND INVERSE LAPLACE TRANSFORMS   (12 Hrs)

Definition, Transforms of elementary functions, properties. Transform of derivatives and integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and final value theorems, Methods for determining inverse Laplace Transforms, Convolution theorem, Application to differential equations and integral equations. Evaluation of integrals by Laplace transforms.

UNIT III FOURIER SERIES   (12 Hrs)

Dirichlet's conditions – General Fourier series – Expansion of periodic function into Fourier series – Fourier series for odd and even functions – Half-range Fourier cosine and sine series – Change of interval – Related problems.

UNIT IV FOURIER TRANSFORMS   (12 Hrs)

Fourier Integral theorem. Fourier transform and its inverse, properties. Fourier sine and cosine Transforms, their properties, Convolution and Parseval's identity.

UNIT V Z - TRANSFORMS   (12 Hrs)

Difference equations, basic definition, z-transform - definition, Standard z-transforms, Damping rule, Shifting rule, Initial value and final value theorems and problems, Inverse z-transform. Applications of z-transforms to solve difference equations.

Text Books

1. Ravish R Singh and Mukul Bhatt, "Engineering Mathematics", Tata McGraw Hill, 1st Edition, New Delhi, 2016.
2. Sivaramakrishna Das P. and Vijayakumar C., "Engineering Mathematics", Pearsons, New Delhi, 2017.

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3. M.D.Petale, "A text book on Z- Transforms (Engineering Mathematics)", Bames and Noble, New Edition, 2020.

Reference Books

1. H.K. Dass, "Advanced Engineering Mathematics", S. Chand & Co. New Delhi, 2019.
2. N.P. Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi, 10th Edition 2019.
4. C. B. Gupta, Shree Ram Singh, M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 2016.
5. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi 2018.

Web References

1. https://nptel.ac.in/courses/111105121**/**
2. https://nptel.ac.in/courses/111105035/
3. https://nptel.ac.in/courses/111107119/
4. https://swayam.gov.in/nd1_noc20_ma17/preview
5. https://nptel.ac.in/courses/111/103/111103021/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	1	1	-	-
2	3	2	1	1	-	1	-	-	-	-	-	1	2	1	-
3	3	2	1	1	-	1	-	-	-	-	-	1	2	1	-
4	3	2	1	1	-	1	-	-	-	-	-	1	2	1	-
5	3	2	1	1	-	1	-	-	-	-	-	1	2	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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		L	T	P	C	Hrs
U20EST201	**PROGRAMMING IN C** (Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS, CCE)	3	0	0	3	45

Course Objectives

- To understand the Fundamentals of Computers and introduction to C language.
- To study about the programs using Control structures.
- To understand programs using looping and arrays.
- To understand the concepts of Functions and Pointers.
- To study about Structure, Union and File Management Operations in C.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Comprehend the basic constructs of C programming. **(K2)**

CO2 - Illustrate the concepts of sequential, selection and repetition control structures in C program. **(K2)**

CO3 - Implement simple programs using looping structure and arrays. **(K3)**

CO4 - Demonstrate programs using Functions and Pointers. **(K3)**

CO5 - Build programs using Structure, Union and understand the concept of File management Operations. **(K3)**

UNIT I INTRODUCTION TO C   (9 Hrs)

C programming: Overview of C - Visual Studio code-Constants- Compiling a C Program -Variables and Data Types- Technical Difference between Keywords and Identifiers- - Types of C Qualifiers and format specifies - Operators and Expressions-Operators Precedence-Type conversion-Input-Output Statements.

UNIT II DECISION MAKING   (9 Hrs)

Decision making and branching- Relational operators – Logical operators- if – if else-if else if –nested if. Switch-case.

UNIT III LOOPING AND ARRAYS   (9 Hrs)

Looping: while - do while – for – break – continue - nested loop. Arrays: One Dimensional Arrays-Two-Dimensional Arrays-Multi-Dimensional Array-Dynamic arrays-Character Arrays and String-Sorting - Searching.

UNIT IV FUNCTIONS, POINTERS   (9 Hrs)

Functions: Introduction - Definition – Declaration – Categories of Functions - Nesting of Functions, Recursive functions - Passing Arrays to Functions - Strings – String library function. Pointers: Introduction - Declaring Pointer Variables - Initialization of Pointer Variables - Accessing the address of a variable - Accessing a variable thorough Pointer - Chain of Pointers - Pointer Expressions - Pointers and arrays – Pointers and functions – Call by Reference - Pointers and character strings - Array of Pointers - Pointers and Structures.

UNIT V STRUCTURES AND UNIONS, FILE MANAGEMENT   (9 Hrs)

User defined data types: Introduction – Structure: definition - declaration - Arrays of Structures – Nested structures – Passing structures to functions –– Union - Enumeration and Typedef. Introduction to File Handling in C, Input and Output operations on a file – Error Handling - Random access to files – command line arguments. Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives.

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Text Books

1. Balagurusamy. E, "Programming in ANSI C", Tata McGraw Hill, 8th Edition, 2019.
2. Herbert Schildt," C: The Complete Reference", McGraw Hill, Fourth Edition, 2014.
3. Yashvant Kanetkar, "Let us C", BPB Publications, 16th Edition, 2017.

Reference Books

1. Ashok N Kamthane, "Computer Programming", Pearson education, Second Impression, 2012.
2. Vikas Verma, "A Workbook on C ", Cengage Learning, Second Edition, 2012.
3. Dr. P. Rizwan Ahmed, "Office Automation", Margham Publications, 2016.
4. P.Visu, R.Srinivasan and S.Koteeswaran, "Fundamentals of Computing and Programming", Fourth Edition, Sri Krishna Publications, 2012.
5. Pradip Dev, Manas Ghoush, "Programming in C", Second Edition, Oxford University Press, 2011.

Web References

1. https://www.programiz.com/c-programming
2. https://www.geeksforgeeks.org/c-language-set-1-introduction/
3. https://www.tutorialspoint.com/cprogramming
4. https://www.assignment2do.wordpress.com/.../solution-programming-in-ansi-c
5. https://nptel.ac.in/courses/106/104/106104128/

COs/POs/PSOs Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	3	-	-	-	-	-	-	-	2	3	2
2	2	1	-	-	3	-	-	-	-	-	-	-	2	3	2
3	3	2	1	1	3	-	-	-	-	-	-	-	2	3	2
4	3	2	1	1	3	-	-	-	-	-	-	-	2	3	2
5	3	2	1	1	3	-	-	-	-	-	-	-	2	3	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BMT201	ELECTRON DEVICES AND CIRCUITS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the basic semiconductor diodes and its applications.
- To understand the characteristics of transistors
- To enable the student to select appropriate devices for a particular application
- To classify and understand the types of amplifiers
- To know the functions of feedback amplifiers and oscillators

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explains the operation of basic semiconductor diodes and its applications **(K2)**
CO2 - Categorize the transistors configuration and analyse its characteristics **(K3)**
CO3 - Distinguish the special semiconductor diodes and its applications **(K3)**
CO4 - Analyse the transistor using small signal model and understand the operation of different categories of amplifiers **(K4)**
CO5 - Investigate the operation of different types of feedback amplifiers and oscillators **(K3)**

UNIT I DIODES AND THEIR APPLICATIONS (9 Hrs)

Formation of P-N junction diode- forward and reverse biased P-N junction, V-I characteristics, diffusion and transient capacitance, Zener diode and its reverse characteristics, Zener breakdown, Avalanche breakdown, Rectifiers-half wave rectifier, full wave rectifier with and without filters, Clippers, Clampers, Voltage Regulator – Zener diode as Voltage regulator.

UNIT II BIPOLAR JUNCTION TRANSISTOR AND FIELD EFFECT TRANSISTOR (9 Hrs)

Principle of transistor action–Current components, CE, CB, and CC Configurations, Input and output characteristics – Cut-off, active and saturation region, Transistor as a switch, Transistor as an amplifier.
FET Classification-Fundamentals of JFETs and its characteristics – JFET parameters, MOSFET – principle of operation- Depletion and enhancement modes.

UNIT III SPECIAL SEMICONDUCTOR DEVICES (9 Hrs)

Unijunction Transistor (UJT), Tunnel diode, Varactor diode, Schottky diode, Gunn diode, Light Emitting Diode (LED), Laser,PIN diode, Photo diode, Liquid Crystal Display (LCD), Silicon Control Rectifier (SCR), DIAC, TRIAC, Applications of SCR, DIAC, TRIAC.

UNIT IV AMPLIFIERS (9 Hrs)

BJT small signal low frequency model using h parameter – Analysis of CE, CB and CC amplifiers, Differential amplifier – Common mode and Differential mode analysis, RC coupled amplifiers, Cascade amplifier, Power amplifiers –Class A, Class B, Class AB, Push Pull, Class C amplifiers.

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS (9 Hrs)

Feedback amplifiers-Properties of negative feedback-voltage and current, series, Shunt feedback, Positive feedback, Barkhausen Condition for oscillations, Classification of Oscillators, RC phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators, Clapp Oscillators.

Text Books

1. Jacob Millman,Chritos C Halkias," Electronic Devices and Circuits", Fourth edition, McGraw Hill Education India Private Ltd., 2015.
2. Robert L. Boylestad, "Electronic Devices and Circuit Theory", Eleventh Edition, 2015
3. David A. Bell, "Electronic Devices and Circuits", Prentice Hall of India, 5th Edition, 2008

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Reference Books

1. Thomas L. Floyd, "Electronic devices" Prentice Hall", Tenth Edition, 2018.
2. Donald A Neaman, "Semiconductor Physics and Devices", Fourth edition, McGraw Hill Education India Private Ltd., 2011
3. Salivahanan," Electron Devices and Circuits", Fourth edition, McGraw Hill Education India Private Ltd., 2016
4. Sedra and Smith, "Microelectronic Circuits, Fifth Edition, Oxford University Press 2012
5. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits", Second edition, PHI learning private limited, 2014.

Web References

1. www.allaboutcircuits.com
2. www.circuitstoday.com
3. http://www.electronics-tutorials.ws
4. https://nptel.ac.in/courses/108/108/108108112/
5. https://nptel.ac.in/courses/117/103/117103063/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	-	-	-	-	1	-	-	-	-	3	-	2
2	3	3	2	-	-	-	-	1	-	-	-	-	3	-	2
3	3	3	2	1	-	-	-	1	-	-	-	-	3	-	2
4	3	3	2	1	-	-	-	1	-	-	-	-	3	-	2
5	3	3	2	-	-	-	-	1	-	-	-	-	3	-	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BMT202	PATHOLOGY AND MICROBIOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives
- To Gain knowledge on the structural and functional aspects of living organisms.
- To know the etiology and remedy in treating the pathological diseases.
- To study the structure of Bacteria and virus
- To know the functions of microscope
- To study about immune system and disorders

Course Outcomes
After completion of the course, the students will be able to
CO1 - Understand the structural and functional aspects of living organisms **(K2)**
CO2 - Understand the importance of Fluid related disorders **(K2)**
CO3 - Describe the structure of Bacteria and virus **(K3)**
CO4 - Knowledge about the function of microscope. **(K3)**
CO5 - Define methods involved in easing the pathological diseases. **(K3)**

UNIT I CELL DEGENERATION, REPAIR AND NEOPLASIA (9 Hrs)
Cell injury – Reversible cell injury and Irreversible cell injury and Necrosis, Apoptosis, Intracellular accumulations, Pathological calcification – Dystrophic and Metastatic.Cellular adaptions of growth and differentiation, Inflammation and Repair including fracture healing, Neoplasia, Classification, Benign and Malignant tumours, carcinogenesis, spread of tumours Autopsy and biopsy.

UNIT II FLUID AND HEMODYNAMIC DERANGEMENTS (9 Hrs)
Edema, Hyperemia/Ischemia, normal hemostasis, thrombosis, disseminated intravascular coagulation, embolism, infarction, shock, chronic venous congestion. Hematologica disorders-Bleeding disorders, Leukaemia's, Lymphomas Haemorrhage.

UNIT III MICROBIOLOGY (9 Hrs)
Structure of Bacteria and Virus: Routes of infection and spread; endogenous and exogenous infections, Morphological features and structural organization of bacteria and virus, growth curve, identification of bacteria, culture media and its types, culture techniques and observation of culture. Disease caused by bacteria, fungi, protozal, virus and helminthes.

UNIT IV MICROSCOPES (9 Hrs)
Light microscope – bright field, dark field, phase contrast, fluorescence, Electron microscope (TEM and SEM). Preparation of samples for electron microscope. Staining methods – simple, gram staining and AFB staining

UNIT V IMMUNOPATHOLOGY (9 Hrs)
Natural and artificial immunity, types of Hypersensitivity, antibody and cell mediated tissue injury; opsonization, phagocytosis, inflammation, Secondary immunodeficiency including HIV infection. Auto – immune disorders: Basic concepts and classification, SLE. Antibodies and its types, antigen and antibody reactions, immunological techniques; immune diffusion, immune electrophoresis, RIA and ELISA, monoclonal antibodies.

Text Books
1. Robbins and Cotran," Pathologic Basis of Disease", Ninth edition Saunders, 2014
2. Ananthanarayan and Paniker's,"Textbook of Microbiology", Tenth Revised edition, The Orient Blackswan, 2017.

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3. Harsh Mohan, "Text book of Pathology", Seventh Edition, Jaypee Brothers Medical publishers private Limited, 2014.

Reference Books

1. James Underwood Simon Cross," General and Systematic Pathology", Churchill Livingstone, 2009
2. R C Dubey and D K Maheshwari, "A Textbook of Microbiology", Third edition, S. Chand Publishing, 2013.
3. Prescott, Harley and Klein, Microbiology, Tenth edition, McGraw Hill, 2017.
4. Ramzi S Cotran, Vinay Kumar & Stanley L Robbins, "Pathologic Basis of Diseases", Seventh edition, WB Saunders Co. 2010
5. Kanika Sharma Ane's student edition, "Manual of Microbiology tools and techniques", 2010.

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2. http://www.rkmyat.in/up1/34/1629.pdf
3. http://moscmm.org/pdf/Ananthanarayan%20microbio.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	-	-	1	1	-	-	-	1	2	-	-
2	3	3	3	1	-	-	1	1	-	-	-	1	2	-	-
3	3	3	3	1	-	-	1	1	-	-	-	1	2	-	-
4	3	3	3	3	3	-	1	1	-	-	2	1	2	1	1
5	3	2	2	1	3	-	1	1	-	-	-	1	2	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BMT203	MEASUREMENTS AND INSTRUMENTS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To analyse the various measuring devices used in instruments.
- To know about the different types of bridges
- To get a clear idea about the oscilloscopes and signal generator
- To understand the parameters of various signals
- To analyse the concept of magnetic instruments

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the parameters of various measurement devices **(K2)**

CO2 - Study and compare various bridges **(K3)**

CO3 - Apply the constraints for Selection of the appropriate instrument to measure the given parameters (**K3**)

CO4 - Evaluate the various measurements for the analysis of a signal **(K4)**

CO5 - Understand the need for magnetics measurements to analyse the BH curve **(K2)**

UNIT I BASICS OF MEASUREMENTS (9 Hrs)

Functional elements of an instrument, Static and dynamic characteristics, Errors in measurement Statistical evaluation of measurement data, Standards and calibration.

UNIT II COMPARISON METHODS OF MEASUREMENTS (9 Hrs)

D.C & A.C potentiometers, DC Bridges –Wheatstone, Kelvin, AC bridges- Maxwell, Hay, Schering and Wien Bridge. Electronic Instruments for Measuring Basic Parameters: Amplified DC meter, AC Voltmeter, True- RMS responding Voltmeter, Electronic multi-meter, Digital voltmeter, Vector Voltmeter. .

UNIT III OSCILLOSCOPES AND SIGNAL GENERATORS (9 Hrs)

Magnetic disk and tape Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & dot matrix display – Data Loggers. Signal Generators: Sine wave generator, Frequency Synthesized Signal Generator, Sweep frequency Generator, Pulse and square wave generators, Function Generators.

UNIT IV SIGNAL ANALYZER (9 Hrs)

Wave Analyzer, Spectrum Analyzer. Frequency Counters: Simple Frequency Counter; Measurement errors; extending frequency range of counters X ray imaging and measurements x ray generation, x ray machine, C arm machine, image intensifiers, x ray films, photographic imaging, Fluoroscopy, computed tomography, CAT scan block schematic, Gantry, detectors.

UNIT V MAGNETIC INSTRUMENTS (9 Hrs)

Measurement of flux and permeability, flux meter, Hall Effect Gauss meter, BH curve and permeability measurement, Hysteresis measurement, Ballistic galvanometer-principle-determination of BH curve-hysteresis loop, Lloyd Fisher square, measurement of iron losses Measurement of rotational speed using proximity sensors and optical sensors

Text Books

1. E. O. Deobelin, "Measurement Systems – Application and Design", Tata McGraw-Hill, India Private Ltd., 2016
2. A.K.Sawhney, "A Course in Electrical and Electronic measurements and Instruments", DhanpatRai and Sons, 2015.

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3. A. D. Helfrick and W. D. Cooper, "Modern Electronic Instrumentation and Measuring Techniques", Pearson Education, 2017

Reference Books

1. Nandini K. Jog, "Electronics in Medicine and Biomedical Instrumentation ", Second Edition, PHI, 2013.
2. R. A. Witte, "Electronic Test Instruments", Pearson Education, 2010.
3. B. E. Jones, "Instrumentation, Measurement, and Feedback", Tata McGraw- Hill, 2011.
4. R. P. Areny and T. G. Webster, "Sensors and Signal Conditioning", Wiley- Interscience, 2015
5. Albert D. Helfrick and William D.Cooper. "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007

Web References

1. uspas.fnal.gov/materials/04UW/Instrumentation.pdf
2. www.scilab.in/textbook_companion/generate_book/174
3. https://nptel.ac.in/courses/108/105/108105153/
4. https://nptel.ac.in/courses/108/108/108108147/
5. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	-	-	-	-	-	1	1	3	1	1
2	2	3	2	1	3	-	-	1	-	-	1	1	3	2	1
3	3	3	2	1	3	-	-	1	-	-	1	1	3	2	1
4	3	3	2	1	3	-	-	-	-	-	1	1	3	2	1
5	3	3	2	2	3	-	-	-	-	-	1	1	3	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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	L	T	P	C	Hrs

U20BMT204   **COMMUNICATION SYSTEMS**   **L T P C Hrs**   **3 0 0 3 45**

Course Objectives
- To understand the various Analog modulation techniques
- To learn the concepts of various Digital modulation techniques.
- To study fiber optic and satellite communication systems.
- To understand the Spread spectrum and multiple access techniques.
- To Gain knowledge on radio communication.

Course Outcomes
After completion of the course, the students will be able to
CO1 - Understand the various Analog modulation techniques **(K2)**
CO2 - Gain knowledge in Digital modulation techniques **(K2)**
CO3 - Knowledge about fiber optic and satellite communication systems **(K2)**
CO4 - Analyse spread spectrum and multiple access techniques **(K3)**
CO5 - Asses the importance of radio communication system **(K3)**

UNIT I ANALOG MODULATION   (9 Hrs)
Need for modulation - Amplitude modulation – Frequency spectrum of AM wave – Representation of AM – Power relation – Frequency modulation – Frequency spectrum of FM wave –AM transmitter – FM transmitter – Super heterodyne AM receiver –FM receivers.

UNIT II DIGITAL MODULATION   (9 Hrs)
Principles of pulse modulation – sampling theorem, PAM, PWM, PPM, Conversion of PWM wave to PPM wave – Generation of PAM, PPM and PWM waves – Demodulation of PAM, PWM, PPM – An introduction to digital modulation systems – PCM, DPCM, Delta Modulation, ADM, ASK, FSK and PSK.

UNIT III FIBER OPTIC AND SATELLITE COMMUNICATION   (9 Hrs)
Need for fiber optics- principle of light transmission through a fiber- fiber classification-fiber losses- Light sources and photo detectors- Block diagram of a fiber optic system - Power budget analysis for an optical link-Recent medical application of fiber optics.
Block diagram of a satellite communication system, Satellite Orbits, satellite parameters, satellite link model, GPS services.

UNIT IV SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES   (9 Hrs)
Pseudo-noise sequence, DS spread spectrum, FH spread spectrum, multiple access techniques –TDMA and FDMA, source coding of speech for wireless communication.

UNIT V RADIO COMMUNICATION   (9 Hrs)
Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Hand off.

Text Books
1. Wayne Tomasi, "Advanced Electronic Communication Systems", Sixth Edition, Pearson Education, 2010.
2. Kennedy Davis, "Electronic Communication Systems", Fifth Edition,Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.
3. William C.Y. Lee, "Mobile Cellular Telecommunication Systems", McGraw Hill International Edition, Third edition, 2008.

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Reference Books

1. Simon Haykin, "Communication Systems", Fourth Edition, John Wiley and Sons, 2009.
2. Rappaport T.S, "Wireless Communications: Principles and Practice", Second Edition, Pearson Education, 2010
3. H.Taub, D L Schilling and G Saha, "Principles of Communication", Third Edition, Pearson Education, 2010
4. B. P.Lathi, "Modern Analog and Digital Communication Systems", Third Edition, Oxford University Press, 2009
5. Martin S.Roden, "Analog and Digital Communication System", Fifth Edition, Prentice Hall of India, 2012.

Web References

1. https://nptel.ac.in/courses/108104091/
2. https://www.docsity.com/en/lecture-notes-of-intro-to-communication-systems/4580827/
3. https://nptel.ac.in/courses/117/101/117101051/
4. https://nptel.ac.in/courses/117/105/117105143/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	1	2	-	-	-	-	3	1	1	2	2	-
2	3	2	2	1	2	-	-	-	-	3	1	1	2	2	-
3	3	3	-	1	1	-	-	-	-	3	1	1	2	2	-
4	3	2	-	1	1	-	-	-	-	3	1	1	2	2	-
5	3	3	2	1	2	-	-	-	-	3	1	1	2	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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	PROGRAMMING IN C LABORATORY	**L**	**T**	**P**	**C**	**Hrs**
U20ESP202	(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL,BME,MECHATRONICS, CCE)	**0**	**0**	**2**	**1**	**30**

Course Objectives

- To practice the fundamental programming methodologies in the C programming language.
- To apply logical skills for problem solving using control structures and arrays.
- To design, implement, test and debug programs that use different data types, variables, strings, arrays, pointers and structures.
- To design modular programming and provide recursive solution to problems.
- To understand the miscellaneous aspects of C and comprehension of file operations.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Implement logical formulations to solve simple problems leading to specific applications. **(K3)**
CO2 - Execute C programs for simple applications making use of basic constructs, arrays and strings. **(K3)**
CO3 - Experiment C programs involving functions, recursion, pointers, and structures. **(K3)**
CO4 - Demonstrate applications using sequential and random access file processing. **(K3)**
CO5 - Build solutions for online coding challenges. **(K3)**

List of Exercises

1. Simple programming exercises to familiarize the basic C language constructs.
2. Develop programs using identifiers and operators.
3. Develop programs using decision-making and looping constructs.
4. Develop programs using functions as mathematical functions.
5. Develop programs with user defined functions – includes parameter passing.
6. Develop program for one dimensional and two dimensional arrays.
7. Develop program for sorting and searching elements.
8. Develop program to illustrate pointers.
9. Develop program with arrays and pointers.
10. Develop program for dynamic memory allocation.
11. Develop programs for file operations.

Reference Books

1. Zed A Shaw," Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (Like C)", Addison Wesley, 2016.
2. Anita Goel and Ajay Mittal, "Computer Fundamentals and programming in C", First edition, Pearson Education ,2011.
3. Yashvanth Kanethkar, "Let us C", 13th Edition, BPB Publications, 2008.
4. Maureen Sprankle,Jim Hubbard," Problem Solving and Programming Concepts," 9th Edition, Pearson, 2011.
5. B.W. Kernighan and D.M. Ritchie, "The C Programming language", 2nd Edition, Pearson Education, 2006.

Web References

1. https://alison.com/course/introduction-to-c-programming
2. https://www.geeksforgeeks.org/c-programming-language/
3. http://cad-lab.github.io/cadlab_data/files/1993_prog_in_c.pdf
4. https://www.tenouk.com/clabworksheet/clabworksheet.html
5. https://fresh2refresh.com/c-programming

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
1	3	2	1	1	3	-	-	-	-	-	-	-	2	3	2
2	3	2	1	1	3	-	-	-	-	-	-	-	2	3	2
3	3	2	1	1	3	-	-	-	-	-	-	-	2	3	2
4	3	2	1	1	3	-	-	-	-	-	-	-	2	3	2
5	3	2	1	1	3	-	-	-	-	-	-	-	2	3	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BMP201	ELECTRON DEVICES AND CIRCUITS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To conduct experiment and verify the basic Semiconductor diode characteristics.
- To study experimentally the characteristics of BJT, FET
- To understand the operation of UJT and thyristors
- To understand the applications of diodes
- To study PCB Simulation Tool

Course Outcomes

After completion of the course, the students will be able to

CO1 - Analyse the characteristic of PN Junction diode and Zener diode **(K4)**

CO2 - Experiment the characteristics of various transistors and analyse its characteristics (**K4**)

CO3 - Construct and analyse the applications of diodes **(K4)**

CO4 - Measure voltage and frequency of the waveform using CRO and plot the frequency response **(K4)**

CO5 - Construct transistor amplifier using PCB Simulation Tool **(K4)**

List of Experiments

1. Characteristic analysis of PN Junction Diode (V-I Characteristics of Forward and Reverse Bias)
2. Characteristic analysis of Zener Diode (V-I Characteristics of Forward and Reverse Bias)
3. Characteristic analysis of BJT (Input and output characteristics)
4. Characteristic analysis of JFET devices (Drain and Transfer Characteristics)
5. Negative resistance characteristics of UJT
6. Characteristic analysis of Thyristors
7. Analysis of wave shaping circuits (Clippers and Clampers)
8. Design and analysis of Half wave Rectifiers and Full wave rectifiers
9. Study of frequency response of BJT Amplifier
10. Study of PCB Simulation Tool
11. Deign and study of Transistor as a switch using Simulation tool
12. Soldering of components on the PCB and testing of PCB (Regulated power supply)

Text Books

1. Jacob Millman,Chritos C Halkias," Electronic Devices and Circuits", Fourth edition. McGraw Hill Education India Private Ltd., 2015.
2. Robert L. Boylestad, "Electronic Devices and Circuit Theory", Eleventh Edition, 2015
3. Thomas L.Floyd,"Electronic device, Tenth Edition, Pearson prentice hall, 2018.

Reference Books

1. Donald A Neaman, "Semiconductor Physics and Devices", Fourth edition, McGraw Hill Education India Private Ltd., 2011
2. Salivahanan, "Electron Devices and Circuits", Fourth edition, McGraw Hill Education India Private Ltd., 2016
3. Sedra and Smith, "Microelectronic Circuits, Fifth Edition, Oxford University Press, 2012
4. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits", Second edition, PHI learning private limited, 2014.
5. David A. Bell, "Electronic Devices and Circuits", Prentice Hall of India, 5th Edition, 2008

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Web References

1. www.allaboutcircuits.com
2. www.circuitstoday.com
3. www.tutorialspoint.com
4. www.nptel.ac.in

COs/POs/PSOs Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	3	2	1	-	-	1	-	-	1	3	1	1
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3	3	2	1	3	2	1	-	-	1	-	-	1	3	1	2
4	3	1	1	3	2	2	-	-	1	-	-	2	3	2	2
5	3	1	1	1	2	2	-	-	1	-	-	1	3	1	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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	L	**T**	**P**	**C**	**Hrs**
U20BMP202 **INSTRUMENTATION LABORATORY**	0	0	2	1	30

Course Objectives

- To provide knowledge of uncertainties involved in any measurement.
- To train the students in the calibration and use of different measuring instruments
- To understand the parameters of non-electrical quantities
- To analyse the concept of data transmission and signal recovery
- To understand the modern test equipment used in instruments

Course Outcomes

After completion of the course, the students will able to

CO1 - Evaluate the uncertainties involved in any measurement **(K4)**

CO2 - Perceive expertise on various calibration methods and measuring instruments for various applications **(K2)**

CO3 - Elucidate the construction and working of various industrial devices used to measure pressure, sound and flow physical quantities. **(K3)**

CO4 - Analyse, formulate and select suitable sensor for the given industrial applications **(K3)**

CO5 - Analyse different techniques to measure industrial gas and air pollution and a suitable instrumentation system for various industries **(K3)**

List of Experiments

1. Study of Instruments and measurements
2. Measurement of change in temperature using thermocouple, thermistor and RTDs.
3. Measurement of weight with the aid of resistive transducer in strain gauge
4. Measurement of change in displacement with the aid of LVDT.
5. Measurement of optical variables with the aid of photo diodes and photo transistors
6. Measurement of environmental parameters like Air pollution. altitude and atmospheric pressure using pollution meter
7. Measurement of mean arterial blood pressure, pulse rate and saturated oxygen
8. Measurement of Resistance using DC bridges
9. Measurement of Inductance using AC bridges
10. Measurement of Capacitance using AC bridges
11. Demonstration of CRO (Measurement of Amplitude, Time and Frequency).

Text Books

1. E. O. Deobelin, "Measurement Systems – Application and Design", Tata McGraw-Hill, India Private Ltd., 2016
2. A.K.Sawhney, "A Course in Electrical and Electronic measurements and Instruments", DhanpatRai and Sons, 2015.
3. A. D. Helfrick and W. D. Cooper, "Modern Electronic Instrumentation and Measuring Techniques", Pearson Education, 2017

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1. Nandini K. Jog, "Electronics in Medicine and Biomedical Instrumentation ", Second Edition, PHI, 2013.
2. R. A. Witte, "Electronic Test Instruments", Pearson Education, 2010.
3. B. E. Jones, "Instrumentation, Measurement, and Feedback", Tata McGraw- Hill, 2011.
4. R. P. Areny and T. G. Webster, "Sensors and Signal Conditioning", Wiley- Interscience, 2015
5. Albert D. Helfrick and William D.Cooper. "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007

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2. www.scilab.in/textbook_companion/generate_book/174
3. https://nptel.ac.in/courses/108/105/108105153/
4. https://nptel.ac.in/courses/108/108/108108147/
5. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf

COs/POs/PSOs Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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2	2	3	3	3	3	-	-	1	1	-	-	1	3	2	1
3	3	3	3	-	3	-	-	1	1	-	-	1	3	2	1
4	3	3	3	-	3	-	-	-	1	-	-	1	3	2	1
5	3	3	3	2	3	-	-	-	1	-	-	1	3	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

		L	T	P	C	Hrs
U20BMC2XX	**CERTIFICATION COURSE - II**	0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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		L	**T**	**P**	**C**	**Hrs**
U20BMS201	**DEMONSTRATION OF WORKSHOP PRACTICES** (Common to ECE, CSE, IT, ICE, BME, CCE)	**0**	**0**	**2**	**-**	**30**

Course Objectives

- To have practical exposure to various welding and joining processes.
- To impart skill in fabricating simple components using sheet metal
- To train the students in metal joining processes like soldering in PCB.
- To understand the working procedure of various Conventional Machines.
- To cultivate safety aspects in handling of tools and equipment.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Identify different prototypes in the carpentry trade such as lap joint, Butt joint. **(K1)**

CO2 - Classify the fabrication of simple sheet metal parts. **(K2)**

CO3 - Interpret the casting preparation. **(K2)**

CO4 - Identify the conventional machine operations. **(K1)**

CO5 - Describe the skills, and modern engineering tools necessary for engineering practice. **(K1)**

Demonstration of Experiments

1. Welding Exercises
    a. Introduction to BI Standards and reading of welding drawings.
    b. Butt Joint
    c. Lap Joint
    d. Arc Welding
    e. Gas Welding
2. Sheet Metal Exercises
    a. Making of Cube
    b. Making of Cone using development of surface
3. Casting
    a. Green Sand Moulding preparation
4. Demonstration of Conventional Machines.
5. Bosch Tools Demonstration
    a. Demonstration of all Bosch tools.

Reference Books

1. K.C. John, "Mechanical Workshop Practice", PHI Learning Private Limited, 2010
2. KA Navas, "Electronics Lab Manual", Fifth edition, PHI Learning Private Limited, 2015
3. S K Hajra, Choudhary and A K Chaoudhary, Workshop Technology I,II,III, by. Media Promoters and Publishers Pvt. Ltd., Bombay
4. T Jeyapoovan, Basic Workshop Practice Manual, Vikas Publishing House (P) Ltd.,New Delhi
5. K Venkata Reddy, KL Narayana, Manual on Workshop Practice, MacMillan India Ltd.

Web References

1. https://www.weld.com/
2. https://welding.com/
3. https://sciencing.com/soldering-desoldering-techniques-8288017.html
4. https://nptel.ac.in/courses/112/107/112107084/
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COs Mapping with POs and PSOs

CO s	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	-	-	3	-	-	-	3	-	-	3	-	-	-
2	3	1	-	-	3	-	-	-	3	-	-	3	-	-	-
3	3	1	-	-	3	-	-	-	3	-	-	3	-	-	-
4	3	1	-	-	3	-	-	-	3	-	-	3	-	-	-
5	3	1	-	-	3	-	-	-	3	-	-	3	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 – High

B.Tech. Biomedical Engineering

		L	**T**	**P**	**C**	**Hrs**
U20BMM202	**ENVIRONMENTAL SCIENCE**	**2**	**0**	**0**	**-**	**30**

We as human being are not an entity separate from the environment around us rather, we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects this ethos. There is a direct application of this wisdom even in modern times. Idea of an activity-based course on environment protection is to sensitize the students on the above issues through following two types of activities.

(a) Awareness Activities:
  i.   Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
  ii. Slogan making event
  iii. Poster making event
  iv. Cycle rally
  v.   Lectures from experts

(b) Actual Activities:
  i.   Plantation
  ii.   Gifting a tree to see its full growth
  iii. Cleanliness drive
  iv.   Drive for segregation of waste
  v.   To live some big environmentalist for a week or so to understand his work
  vi.   To work in kitchen garden for mess
  vii. To know about the different varieties of plants
  viii. Shutting down the fans and ACs of the campus for an hour or so

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U20BST322	**NUMERICAL METHODS** (Common to CSE, IT, BME)	**L**	**T**	**P**	**C**	**Hrs**
		2	**2**	**0**	**3**	**60**

Course Objectives

- To know the solution of algebraic and transcendental equations.
- To learn the techniques of solving simultaneous equations.
- To introduce the numerical techniques of differentiation and integration.
- To solve ordinary differential equations by using numerical methods.
- To know the solution of partial differential equations by using numerical methods.

Course Outcomes

After completion of the course, the students will be able to
CO1 - Use numerical techniques to solve algebraic and transcendental equations. **(K2)**
CO2 - Find the solution of simultaneous equations. **(K2)**
CO3 - Apply the knowledge of differentiation and integration by using numerical methods. **(K3)**
CO4 - Solve the ordinary differential equations by various methods. **(K3)**
CO5 - Solve the partial differential equations by numerical methods. **(K3)**

UNIT I SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS AND EIGEN VALUE PROBLEMS (12Hrs)

Bisection method- Method of false position -Newton Raphson method (single and system of two equations) - Eigen value and Eigen vector by power method.

UNIT II LINEAR SIMULTANEOUS EQUATIONS (12 Hrs)

Solution of linear simultaneous equations and matrix inversion - Gauss elimination method - Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel.

UNIT III INTERPOLATION (12 Hrs)

Finite Differences - Relation between operators - Interpolation by Newton's forward and backward difference formula for equal intervals - Newton's divided difference method and Lagrange's method for unequal intervals - Differentiation based on finite differences - Integrations by Trapezoidal and Simpson's rules.

UNIT IV SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS (12 Hrs)

Single step methods -Taylor series method -Picard's method -Euler method and Improved Euler method- RungeKutta method of fourth order only.

UNIT V SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)

Solution of Laplace and Poisson equations -Leibmann's iterative method -Diffusion equation: Bender-Schmitt method and Crank-Nicholson implicit difference method -Wave equation: Explicit difference method.

Text Books

1. B.S.Grewal, "Numerical Methods in Engineering and Science", Mercury learning and Information, Kindle Edition, 2018.
2. Rajesh Kumar Gupta, "Numerical Methods - Fundamentals and Applications", Cambridge University Press, 2019
3. M.K. Jain, R.K. Jain, S.R.K. Iyengar, "Numerical Methods for Scientific and Engineering Computation",New Age International Pvt. Ltd., 7th Edition,2019.

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Reference Books

1. C. Xavier, "C Language And Numerical Methods",New Age International,2007.
2. P.Siva Ramakrishna Das,"Numerical Analysis", Kindle Edition, 2016.
3. Timo Heister, Leo G. Rebholz, FeiXue, "Numerical Analysisan Introduction", Publisher De Gruyter, 2019.
4. K. SankaraRao,"Numerical Methods for Scientists and Engineers", 3rd Edition, PHI Learning Pvt.Ltd, New Delhi, 2018.
5. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers" McGraw – Hill Higher Education, 2010.

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2. http://nptel.ac.in/courses/122102009
3. https://nptel.ac.in/courses/111/107/111107105/
4. http://www.math.iitb.ac.in/~baskar/book.pdf
5. https://www.math.ust.hk/~machas/numerical-methods.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	-	-	-	-	-	1	1	2	-
2	2	1	-	-	-	1	-	-	-	-	-	1	1	2	-
3	3	2	1	1	-	1	-	-	-	-	-	1	1	2	-
4	3	2	1	1	-	-	-	-	-	-	-	1	1	2	-
5	3	2	1	1	-	-	-	-	-	-	-	1	1	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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DATA STRUCTURES	L	T	P	C	Hrs
U20EST356 (Common to ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS,CCE)	3	0	0	3	45

Course Objectives
- To impart the basic concepts of data structures and its terminologies.
- To understand concepts about stack and queue operations.
- To understand basic concepts about linked list and its various operations.
- To understand concepts about Tree and its applications.
- To understand basic concepts about Sorting, Hashing and Graph.

Course Outcomes
After completion of the course, the students will be able to

CO1 - Compute time and space complexity for given problems **(K3)**
CO2 - Demonstrate stack, queue and its operation. **(K3)**
CO3 - Illustrate the various operations of linked list. **(K3)**
CO4 - Use the concepts of tree for various applications. **(K3)**
CO5 - Outline the various sorting, hashing and graph techniques. **(K3)**

UNIT I BASIC TERMINOLOGIES OF DATA STRUCTURES (9 Hrs)
Introduction: Basic Terminologies: Elementary Data Organizations. Data Structure Operations: insertion, deletion, traversal. Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Array and its operations. Searching: Linear Search and Binary Search Techniques and their complexity analysis.

UNIT II STACK AND QUEUE OPERATIONS (9 Hrs)
Stacks and Queues: ADT Stack and its operations, Applications of Stacks: Expression Conversion and evaluation. ADT Queue: Types of Queue: Simple Queue, Circular Queue, Priority Queue. Operations on each type of Queues.

UNIT III LINKED LIST OPERATIONS (9 Hrs)
Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion, Deletion in linked list; Linked representation of Stack and Queue. Doubly linked list: operations. Circular Linked Lists: operations.

UNIT IV TREES (9 Hrs)
Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, Binary Tree Traversals, AVL Tree. Introduction to B-Tree and B+ Tree.

UNIT V SORTING, HASHING AND GRAPHS (9 Hrs)
Sorting: Bubble Sort, Selection Sort, Insertion Sort, Heap Sort, Shell Sort and Radix Sort. Performance and Comparison among the sorting methods. Hashing: Hash Table, Hash Function and its characteristics. Graph: Basic Terminologies and Representations, Graph traversal algorithms.

Text Books
1. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Illustrated Edition, Computer Science Press, 2018.
2. Thomas H. Coreman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI, 2010.

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3. Alfred V. Aho, Jeffrey D. Ullman, John E. Hopcroft, "Data Structures and Algorithms", Fourth Edition, 2009.

Reference Books

1. Mark Allen Weiss," Algorithms, Data Structures and Problem Solving with C++", Illustrated Edition,Addison-Wesley Publishing Company, 1995.
2. D.Samanta, "Classic Data Structures, Second Edition, Prentice-Hall of India, Pvt. Ltd., India 2012.
3. Robert Kruse, C.L. Tondo and Bruce Leung, "Data Structures and Program Design in c", Prentice-Hall of India, Pvt.Ltd., Second edition, 2007.
4. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education, Second edition, 2006.
5. Balagurusamy, "Data Structures", Tata McGraw-Hill Education, 2019.

Web References

1. https://www.geeksforgeeks.org/data-structures/
2. https://www.javatpoint.com/data-structure-tutorial/
3. https://www.studytonight.com/data-structures/
4. https://www.tutorialspoint.com/data_structures_algorithms/
5. https://www.w3schools.in/data-structures-tutorial/intro/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
2	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
3	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
4	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-
5	3	2	1	1	-	-	-	-	-	-	-	-	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BMT305	BIOSENSORS AND TRANSDUCERS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives
- To know about the types of transducers available and their applications in different fields.
- To understand the concepts of photo sensors and its functions
- To study chemical biosensors
- To get exposure in biopotential sensors
- To get an idea about the various biological sensors

Course Outcomes
After completion of the course, the students are able to

CO1 - Understand various sensors and transducers available for physiological measurements **(K2)**
CO2 - Apply fundamental transduction and photo sensing principles **(K3)**
CO3 - Interpret various chemical sensors used in physiological measurements **(K3)**
CO4 - Analyse different types of recording physiological signals using various bio potential electrodes **(K4)**
CO5 - Critically review the application area biological sensors and its problems areas **(K4)**

UNIT I TRANSDUCERS AND SENSORS   (9 Hrs)
Resistive Transducers: Strain Gauge: Gauge factor, sensing elements, configuration, biomedical applications; strain gauge as displacement & pressure transducers, RTD materials & range, Characteristics, thermistor characteristics, biomedical applications of Temperature sensors Capacitive transducer, Inductive transducer, LVDT, Active type: Thermocouple –characteristics.

UNIT II PHOTOELECTRIC AND PIEZOELECTRIC SENSORS   (9 Hrs)
Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic, Photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectrophotometric applications of photo electric transducers. Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer.

UNIT III CHEMICAL BIOSENSORS   (9 Hrs)
Blood gas and Acid-Base Physiology, Electrochemical sensors, reference electrode, pH, pO2, pCO2 electrodes, Ion-Selective Field-Effect Transistor (ISFET), Non-invasive Blood-Gas Monitoring, Blood Glucose Sensors. Transcuteneous arterial oxygen tension and carbon dioxide tension monitoring enzyme electrode.

UNIT IV BIO POTENTIAL ELECTRODES   (9 Hrs)
Action Potential , Electrode electrolyte interface, polarization, polarizable and nonpolarizable electrodes, Electrode Behavior and, Circuit Models, Electrode-skin Interface and Motion Artifact, Body-Surface Recording Electrodes, Internal Electrodes: Needle and wire electrodes, Electrode Arrays, Microelectrodes: Metal supported metal , micropipette (metal filled glass and glass micropipette electrodes), microelectronic, properties of microelectrodes. Electrodes for Electric Stimulation of Tissue (i.e. for ECG, EMG and EEG)

UNIT V BIOLOGICAL SENSORS   (9 Hrs)
Sensors / receptors in the human body, basic organization of nervous system-neural mechanism, Chemoreceptor: hot and cold receptors, baroreceptors, sensors for smell, sound, vision, Ion exchange membrane electrodes, enzyme electrode, glucose sensors, immunosensors, Basic principles of MOSFET biosensors and BIOMEMS, basic idea about Smart sensors.

Text Books
1. A.K.Sawhney, "A Course in Electrical and Electronic measurements and Instruments", DhanpatRai and Sons, 2000.
2. Prof. Ping Wang andDr.QingjunLiu , "Biomedical Sensors and Measurement ",First Edition, Springer Publications", 2011.

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3. Tatsuo Togawa ,Toshiyo Tamura andAke Oberg, " Biomedical Sensors and Instruments", Second Edition, CRC Press Taylor and Francis Group, 2011.

Reference Books

1. R.Anandanatarajan, "Biomedical Instrumentation and measurements", Second Edition, PHI Learning, December 2015.
2. Ernest O Doebelin and Dhanesh N Manik, "Measurement Systems, Applications and Design", Fifth edition MC Graw-Hill, 2007.
3. Michael J. McGrath, CliodhnaNíScanaill, "Sensor Technologies: Healthcare, Wellness and Environmental Applications,Apress, 2013.
4. Richard S.C. Cobbold , " Transducers for Biomedical Measurements: Principles and Applications ", John Wiley and Sons, 2004.
5. Nandini K. Jog, "Electronics in Medicine and Biomedical Instrumentation ", Second Edition, PHI, 2013.

Web References

1. http://www.gvpcew.ac.in/unit%202.pdf
2. http://www.123seminarsonly.com/Seminar-Reports/018/31005914-Notes-on-Transducers.pdf
3. https://nptel.ac.in/courses/108/108/108108147/
4. https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf
5. https://www.uvpce.ac.in/content/biomedical-transducers-and-biosensors-laboratory

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	-	-	-	-	-	-	1	3	2	-
2	2	3	3	3	3	-	-	1	-	-	-	1	3	2	-
3	3	3	3	-	3	-	-	1	-	-	-	1	3	2	-
4	3	3	3	-	3	-	-	-	-	-	-	1	3	2	-
5	3	3	3	2	3	-	-	-	-	-		1	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

	L	**T**	**P**	**C**	**Hrs**
U20BMT306 **BIOSIGNALS AND SYSTEMS**	**2**	**2**	**0**	**3**	**60**

Course Objectives
- To understand classifications, properties of signal and systems
- To introduce Laplace Transform and their properties
- To know the methods of characterization of LTI systems in time domain
- To introduce Z transform and their properties
- To learn discrete fourier transform, properties of DFT and its application to linear filtering

Course Outcomes
After completion of the course, the students will be able to
CO1 - Distinguish the continuous and discrete-time signals and systems **(K2)**
CO2 - Capable of characterizing LTI-CT systems in the Transform domain **(K3)**
CO3 - Understand the concepts of Z-transform and discrete Fourier transform **(K3)**
CO4 - Capable of characterizing LTI-DT systems in the Transform domain **(K4)**
CO5 - Apply DFT for the analysis of digital signals and systems **(K4)**

UNIT I BASICS OF DISCRETE AND CONTINUOUS TIME SIGNALS AND SYSTEMS   (12 Hrs)
Generation, representation of discrete time signals and continuous time signals, standard discrete time signals, standard continuous time signals. **Classification of signals:** Continuous time (CT) Discrete time (DT) signals, Mathematical operations on CTS and DTS-scaling, folding, time shifting, addition and multiplication.
Classification of systems: static and dynamic systems, time invariant and time variant, linear and nonlinear systems, causal and non-causal systems, stable and unstable systems Basic bio signal measurements

UNIT II LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS   (12 Hrs)
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in analysis of CT systems - Systems connected in series / parallel.

UNIT III TRANSFORMS OF DISCRETE TIME SIGNALS   (12 Hrs)
Z transform-properties-region of convergence- representation of poles and zeros in z transform, Inverse z transform-Power series expansion, Partial Fraction method, residue method, Discrete time Fourier transform-properties, Relation between Z transform and DTFT

UNIT IV LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS   (12 Hrs)
Impulse response – Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

UNIT V DISCRETE FOURIER TRANSFORMS   (12 Hrs)
Discrete Fourier transforms (DFT) - properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.

Text Books
1. B. P. Lathi, "Principles of Linear Systems and Signals", Third Edition, Oxford University Press, 2012.
2. Allan V. Oppenheim, Allan S.Willsky and S.HamidNawab, "Signals and Systems", Second Edition, PHI Learning, New Delhi, 2010.
3. P. Ramesh Babu, "Signals and Systems", Fifth Edition, Scitech Publishers, 2014.

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Reference Books

1. A. Anand Kumar, "Signals and systems", Third edition PHI learning Pvt. Ltd., 2015.
2. M.J. Roberts, "Signals and Systems: Analysis using transform methods and MATLAB", Second edition,Tata McGraw Hill, 2012.
3. Suresh R, Devashayam, "Signals and Systems in Biomedical Engineering", Second edition, Springer US, 2013.
4. Dr Chitode "Signals and system", Technical Publications 2014.
5. A.Nagoor Kani,"Digital Signal Processing", 2nd edition, McGraw Hill Education, 2016.

Web References

1. http://www.nptelvideos.in/2012/12/signals-and-system.html
2. http://freevideolectures.com/Course/3177/Signals-and-Systems
3. https://nptel.ac.in/courses/117/101/117101055/
4. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20 System/Course_home2.20.html
5. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20 System/Course_home4.30.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	-	-	-	-	1	-	-	-	-	2	2	-
2	3	3	3	2	-	-	-	1	-	-	-	-	2	2	-
3	3	3	3	2	-	-	-	1	-	-	-	-	2	2	-
4	3	3	3	2	-	-	-	1	-	-	-	-	2	2	-
5	3	3	3	2	-	-	-	1	-	-	-	-	2	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BMT307	DIGITAL LOGIC CIRCUITS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives
- To present the Digital fundamentals, Boolean algebra and its applications in digital systems
- To familiarize with the design of various combinational digital circuits using logic gates
- To introduce the analysis and design procedures for synchronous sequential circuits
- To introduce the analysis and design procedures for asynchronous sequential circuits
- To explain the various semiconductor memories and related technology

Course Outcomes
After completion of the course, the students will be able to
CO1 - Gain knowledge in the fundamentals of digital electronics **(K2)**
CO2 - Design various combinational digital circuits using logic gates **(K4)**
CO3 - Analyse and design synchronous sequential circuits **(K4)**
CO4 - Analyse and design asynchronous sequential circuits **(K4)**
CO5 - Understand semiconductor memories and logic families **(K2)**

UNIT I DIGITAL FUNDAMENTALS (9 Hrs)
Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

UNIT II COMBINATIONAL CIRCUIT DESIGN (9 Hrs)
Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS (9 Hrs)
Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS (9 Hrs)
Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT V MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS (9 Hrs)
Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using PLA, PAL. Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan in, noise margin, logic families and their characteristics-RTL, TTL, ECL, CMOS

Text Books
1. M.Morris Mano, Michael D. Ciletti , "Digital Logic Design", Sixth Edition, Pearson Education, 2018.
2. Anil K. Maini," Digital Electronics", Wiley, India, 2007.
3. G.K. Kharate, "Digital Electronics", Oxford, 2012.

Reference Books
1. Donald D. Givone," Digital Principles and Design", McGrawHill , 2017.
2. Soumitra Kumar Mandal, "Digital Electronics Principles and Applications", McGraw Hill, 2017.

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3. James Bignelland Robert Donovan, "Digital Electronics", Fifth edition, Cenage Learning, 2007.
4. P.Raja, "Digital Electronics", Scitech Publications, 2011.
5. Anand Kumar, "Fundamentals of Digital Circuits", Fourth Edition, PHI, 2016.

Web References
1. https://nptel.ac.in/courses/108/105/108105113/
2. http://web.iitd.ac.in/~shouri/eel201/lectures.php
3. https://www.freebookcentre.net/Electronics/Digital-Circuits-Books.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	2	-	-	-	-	-	-	1	3	-	-
2	3	3	3	1	2	-	-	-	-	-	-	1	3	2	-
3	3	3	3	1	2	-	-	-	-	-	-	1	2	-	-
4	3	3	3	1	2	-	-	-	-	-	-	1	2	-	-
5	3	2	2	1	2	-	-	-	-	-	-	1	-	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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	L	**T**	**P**	**C**	**Hrs**
U20BMT308 **BIOMECHANICS**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the basics of biomechanics
- To describe the properties of blood, bone and soft tissues
- To gain knowledge about the mechanics of moving systems
- To understand Cardiac mechanisms
- To study respiratory Biomechanics

Course Outcomes

After completion of the course, the students will able to

CO1 - Describe the fundamentals of biomechanics. **(K2)**

CO2 - Analyse the properties, functions of hard and flexible tissues **(K3)**

CO3 - Describe the types and mechanics of skeletal joints and movement mechanics **(K2)**

CO4 - Explain the mechanical properties of Cardiac system. **(K2)**

CO5 - Understand the respiratory mechanisms **(K2)**

UNIT I INTRODUCTION TO BIOMECHANICS   (9 Hrs)

Review of the principles of mechanics, Vector mechanics- Resultant forces of Coplanar and Non coplanar, Concurrent and non-concurrent forces, parallel force in space, Equilibrium of coplanar forces, Newton's laws of motion, Work and energy, Moment of inertia.

UNIT II TISSUE BIOMECHANICS   (9 Hrs)

Hard Tissues: Bone structure and properties of bones, cortical and cancellous bones, type of fractures, biomechanics of fracture healing. **Soft Tissues:** Structure and functions of Soft Tissues: Cartilage, Tendon, Ligament, and Muscle; Material Properties: Cartilage, Tendon, Ligament, and Muscle.

UNIT III JOINTS AND MOVEMENT BIOMECHANICS   (9 Hrs)

Joints - forces and stresses in human joints, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, hip, knee and ankle. Body and limbs- mass and motion characteristics actions, forces transmitted by joints. Biomechanics of push - like motions, Biomechanics of throw - like motions.

UNIT IV CARDIAC BIOMECHANICS   (9 Hrs)

Cardiovascular system, Mechanical properties of blood vessels: arteries, arterioles, capillaries, and veins. artificial heart valves, biological and mechanical valves development, testing of valves.

UNIT V RESPIRATORY BIOMECHANICS   (9 Hrs)

Alveoli mechanics, Interaction of blood and lung, P-V curve of lung, breathing mechanism, Airway resistance, lung diseases.

Text Books

1. Gerhard A. Holzapfel, Ray W. Ogden, "Mechanics of Biological Tissue", Springer, 2010.
2. Sean P. Flanagan and Flanagan, "Biomechanics: A case-based Approach", Jones and Bartlett Publishers, 2018.
3. Carol A. Oatis, "The Mechanics and Pathomechanics of Human Movement", Lippincott Williams and Wilkins, 2010.

Reference Books

1. Ozkaya, N, Leger, D, Goldsheyder, D, Nordin, M, "Fundamentals of Biomechanics: Equilibrium, Motion, and Deformation", 4th edition. Springer International Publishing, 2017.
2. Donald R. Peterson and Joseph D. Bronzino," Biomechanics: principles and applications", third edition. CRC Press, 2011.
3. Ray W. Ogden, "Biomechanics of Soft Tissue in Cardiovascular Systems", Springer Vienna, 2014.

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4. Subrata Pal, "Text book of Biomechanics", Viva education Private limited, New Delhi. 2009
5. Susan J.Hall, "Basics Bio Mechanics" 5th Edition, McGraw-Hill Publishing Co, Newyork, 2007.

Web References
1. https://tinyurl.com/y9bm4f9q
2. https://tinyurl.com/y8osnq6d
3. https://tinyurl.com/y78y4cvy

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
2	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
3	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
4	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2
5	3	3	3	1	2	-	-	-	-	-	-	1	2	-	2

Correlation Level: 1-Low, 2-Medium, 3- High

B.Tech. Biomedical Engineering

U20HSP301	GENERAL PROFICIENCY – I	L	T	P	C	Hrs
	(Common to all branches except CSBS)	0	0	2	1	30

Course Objectives

- To enrich strong vocabulary and decoding skills through comprehension analysis
- To advance communication and leadership skills pragmatically
- To pronounce English sounds in isolation and in connected speech
- To expand effective written communication skills to meet organizational goals
- To extend knowledge on verbal aptitude and prepare for interviews

Course Outcomes

After completion of the course, the students will be able to

CO1- Interpret meaning and apply reading strategies in technical and non-technical context *(K2)*

CO2-Develop interpersonal communication skills professionally **(K3)**

CO3-Infer the distinct speech sounds and overcome native language influence **(K2)**

CO4- Demonstrate various forms of formal writing **(K2)**

CO5-Apply the techniques of verbal aptitude in competitive exams **(K3)**

UNIT I COMPREHENSION ANALYSIS (6 Hrs)

Listening: Listening Comprehension (IELTS based) – **Speaking**: Break the iceberg - **Reading:** Reading technical passage (IELTS based) - **Writing:** Writing Task: 1 (IELTS: Graph/ Process /Chart Description) **Vocabulary:** Synonyms (IELTS)

UNIT II PERSONALITY DEVELOPMENT (6 Hrs)

Listening: Interview Videos- **Speaking:** Extempore& Presentation (Soft Skills) - **Reading:** British & American Vocabulary, Read and review (Books, Magazines) - **Writing**: SWOT Analysis **Vocabulary:** Idioms (IELTS)

UNIT III INFERENTIAL LEARNING (6 Hrs)

Listening: Listening Speech sounds to overcome Mother Tongue Influence, Anecdotes– **Speaking**: Interpersonal Interaction & Situational attribution–**Reading**: Distinguish between facts & opinions - **Writing:** Writing Conversation to different context **Vocabulary:** Phrasal Verbs (IELTS)

UNIT IV INTERPRETATION AND FUNCTIONAL WRITING (6 Hrs)

Listening: Group Discussion videos - **Speaking:** Group Discussion Practice - **Reading:** Interpretation of data - Graph, table, chart, diagram (IELTS based) -**Writing**: Writing Task: 2 (IELTS) **Vocabulary:** Collocations (IELTS)

UNIT V APTITUDE (6 Hrs)

Language Enhancement: Articles**,** Preposition, Tenses**, Verbal Ability Enhancement:** Blood Relation, Completing Statements- Cloze test, Spotting Errors –Sentence Improvement, One Word Substitution, Word Analogy, Word Groups(**GATE**)

Reference Books

1   Jeff Butterfield, "Soft Skills for Everyone", Cengage Learning, New Delhi, 2012.
2   Mn,Taylor, and Grant Taylor. "English Conversation Practice". Tata McGraw-Hill Education, 1975.
3   Bailey, Stephen. "Academic writing: A practical guide for students". Psychology Press, 2003.
4   Aggarwal, R. S. "A Modern Approach to Verbal & Non Verbal Reasoning". S. Chand, 2010.
5   Wren, Percival Christopher, and Wren Martin. "High School English Grammar and Composition". S Chand, 2005.

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2   https://ieltsfocus.com/2017/08/02/collocations-ielts/
3   https://www.fresherslive.com/online-test/blood-relations-questions-and-answers
4   https://www.toppr.com/guides/english-language/reading-comprehension/cloze-test/

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5   https://www.examsbook.com/word-analogy-test-questions-with-answers

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
2	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
3	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
4	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
5	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

	DATA STRUCTURES LABORATORY	L	T	P	C	Hrs
U20ESP357	(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS,CCE)	0	0	2	1	30

Course Objectives

- To learn the basic concepts of Data Structures.
- To learn about the concepts of Searching and Sorting.
- To study about the linear and non-linear Data Structures.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Implement exemplary applications related to searching and sorting techniques. **(K3)**
CO2 - Compile, run and manipulate Programs using core data structures. **(K3)**
CO3 - Solve problems by applying linear Data Structures. **(K3)**
CO4 - Solve problems by applying non-linear Data Structures **(K3)**
CO5 -.Build solutions for online coding challenges **(K3)**

List of Exercises

1. Write a C program to implement recursive and non-recursive i) Linear search ii) Binary Search.
2. Write a C program to implement i) Bubble sort ii) Selection sort iii) Insertion sort iv) Shell sort v) Heap sort.
3. Write a C program to implement the following using an array. a) Stack ADT b) Queue ADT
4. Write a C program to implement list ADT to perform following operations a) Insert an element into a list. b) Delete an element from list c) Search for a key element in list d) count number of nodes in list.
5. Write a C program to implement the following using a singly linked list. a) Stack ADT b) Queue ADT.
6. Write a C program to implement the dequeue (double ended queue) ADT using a doubly linked list and an array.
7. Write a C program to perform the following operations:
   a) Insert an element into a binary search tree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary search tree.
8. Write a C program that use recursive functions to traverse the given binary tree in
   a) Preorder
   b) Inorder and
   c) Postorder.
9. Write a C program to perform the AVL tree operations.
10. Write a C program to implement Graph Traversal Techniques.

Reference Books

1. Yashavant Kanetkar, "Data Structures through C", BPB Publications, 3rd edition, 2019.
2. Gav.pai, "Data Structures and Algorithms", McGraw-Hill India, 1st edition, 2013.
3. Manjunath Aradhya M and Srinivas Subramiam, "C Programming and Data Structures", Cengage India 1st edition, 2017.
4. Reema Thareja, "Data structures using C", 2nd edition, Oxford University, 2014.
5. Tenebaum Aaron M, "Data Structures using C', Pearson Publisher, 1st edition, 2019.

Web References

1. https://www.tutorialspoint.com/data_structures_algorithms/
2. https://www.w3schools.in/data-structures-tutorial/intro/
3. https://nptel.ac.in/courses/106103069/

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4. https://swayam.gov.in/nd1_noc20_cs70/preview
5. https://nptel.ac.in/courses/106103069/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	2	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	2	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	2	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	2	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BMP303	BIO SENSORS AND TRANSDUCERS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives
- To study and analyse the practical characteristics of the various transducers for the measurement of the vital physiological signals
- To get familiar with the various types of transducers and to study the compatibility for any clinical measurements
- To get exposure in bio transducers in physiological parameter measurements
- To study the characteristics of various bioelectrodes and their placements to measure ECG, EEG, EMG
- To get an idea about the various electrodes and their characteristics in measuring the conductivity of the solution

Course Outcomes
After completion of the course, the students will be able to
CO1 - Perform temperature, pressure and displacement measurement using relevant sensors / transducers **(K3)**
CO2 - Study the characteristics of an LDR, load cell and pH electrodes **(K3)**
CO3 - Perform torque measurement with strain gauge **(K4)**
CO4 - Study the characteristics of biotransducers and bioelectrodes **(K4)**
CO5 - Analyse the characteristics of Polarized Electrodes, Non-polarized Electrodes and Multi Point Electrodes **(K4)**

List of Experiments
1. Temperature measurement using AD590 IC sensor
2. Displacement measurement by using a capacitive transducer
3. Study of the characteristics of a LDR
4. Pressure and displacement measurement by using LVDT
5. Study of a load cell with tensile and compressive load
6. Torque measurement Strain gauge transducer
7. Study and characterize Bio transducers – Pressure, Temperature, Humidity
8. Study and characterize Bioelectrodes – ECG, EMG, EEG
9. Study and Characterize pH electrodes
10. Characteristics of Ultrasound Transducer and Phono Transducer.
11. Determination of characteristics of Polarized Electrodes, Non-polarized Electrodes and Multi Point Electrodes

Text Books
1. A.K.Sawhney, "A Course in Electrical and Electronic measurements and Instruments", Dhanpat Rai and Sons, 2010.
2. Prof. Ping Wang and Dr.Qingjun Liu, "Biomedical Sensors and Measurement ",First Edition, Springer Publications", 2011.
3. Tatsuo Togawa ,Toshiyo Tamura andAke Oberg, " Biomedical Sensors and Instruments", Second Edition, CRC Press Taylor and Francis Group, 2011.

Reference Books
1. R.Anandanatarajan, "Biomedical Instrumentation and measurements", Second Edition, PHI Learning, December 2015.

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2. Ernest O Doebelin and Dhanesh N Manik, "Measurement Systems, Applications and Design", Fifth edition MC Graw-Hill, 2011.
3. Michael J. McGrath, CliodhnaNíScanaill, "Sensor Technologies: Healthcare, Wellness and Environmental Applications,Apress, 2013.
4. Richard S.C. Cobbold , " Transducers for Biomedical Measurements: Principles and Applications ", John Wiley and Sons, 2004.
5. Nandini K. Jog, "Electronics in Medicine and Biomedical Instrumentation ", Second Edition, PHI, 2013.

Web References

1.   http://www.gvpcew.ac.in/unit%202.pdf
2.   http://www.123seminarsonly.com/Seminar-Reports/018/31005914-Notes-on-Transducers.pdf
3.   https://nptel.ac.in/courses/108/108/108108147/
4.   https://nptel.ac.in/content/storage2/courses/112103174/pdf/mod2.pdf
5.   https://www.uvpce.ac.in/content/biomedical-transducers-and-biosensors-laboratory

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	1	-	-	1	3	1	1
2	3	-	-	-	-	-	-	-	1	-	-	1	3	1	1
3	3	3	3	3	3	-	-	-	1	-	-	1	3	1	1
4	3	3	3	3	3	-	-	-	1	-	-	1	3	1	1
5	3	3	3	3	3	-	-	-	1	-	-	1	3	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BMP304	**DIGITAL LOGIC CIRCUITS LABORATORY**	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives
- To familiarize students with different Digital ICs corresponding to different logic gates.
- To show the working operation of basic logic gates and Universal logic gates.
- To familiarize students with the design of combinational circuits.
- To introduce students with basic components of sequential circuits.
- To familiarize students with the design of sequential circuits.

Course Outcomes
After completion of the course, the students are able to
CO1 - Understand the basic digital ICs and its operation **(K2)**
CO2 - Construct basic arithmetic circuits and verify their functionalities **(K4)**
CO3 - Apply the design procedures to design code conversion circuit **(K3)**
CO4 - Design different types of flip-flops **(K4)**
CO5 - Build synchronous and asynchronous counters **(K5)**

List of Experiments
1. Familiarization with different digital IC's and Testing
2. Realization of different gates like AND, OR, NOT, NAND, NOR, EX-OR and EX-NOR.
3. Construction of simple arithmetic circuits-Adder, Subtractor.
4. Gray Code to Binary Code Conversion and Vice Versa.
5. Code Conversion between BCD and Excess-3
6. Four-bit parity generator and comparator circuits
7. Construction of Decoder and Multiplexer circuits using logic gates.
8. Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer.
9. Realization of RS, JK,T and D flip-flops using Universal logic gates.
10. Realization of Shift Registers using flip-flops and logic gates.
11. Realization of Universal Register using multiplexer and flip-flops.
12. Realization of Asynchronous Up/Down counters.

Text Books
1. M.Morris Mano, Michael D. Ciletti , "Digital Logic Design", Sixth Edition, Pearson Education, 2018.
2. Anil K. Maini," Digital Electronics", Wiley, India, 2007.
3. G.K. Kharate, "Digital Electronics", Oxford, 2012.

Reference Books
1. Donald D. Givone," Digital Principles and Design", McGrawHill , 2017.
2. Soumitra Kumar Mandal, "Digital Electronics Principles and Applications", McGraw Hill, 2017.
3. James Bignelland Robert Donovan, "Digital Electronics", Fifth edition, Cenage Learning, 2007.
4. P.Raja, "Digital Electronics", Scitech Publications, 2011.
5. Anand Kumar, "Fundamentals of Digital Circuits", Fourth Edition, PHI, 2016.

Web References
1. https://nptel.ac.in/courses/108105132/
2. https://www.iitg.ac.in/cseweb/vlab/Digital-System-Lab/experiments.php
3. http://web.iitd.ac.in/~shouri/eep201/experiments.php
4. https://kader05cuet.files.wordpress.com/2015/10/dld-lab-manual_final.pdf

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	-	-	-	-	-	-	1	-	-	1	2	1	1
2	3	-	-	-	-	-	-	-	1	-	-	1	2	1	1
3	3	2	3	3	3	-	-	-	1	-	-	1	2	1	1
4	3	2	2	1	3	-	-	-	1	-	-	1	2	1	1
5	3	2	2	1	3	-	-	-	1	-	-	1	2	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BMC3XX	**CERTIFICATION COURSE - III**	**L**	**T**	**P**	**C**	**Hrs**
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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		L	T	P	C	Hrs
U20BMS302	**SKILL DEVELOPMENT COURSE 2**	0	0	2	-	30

1. POWERPOINT PRESENTATION DESIGN AND ANIMATION

Course Content:

Module I: Getting acquainted with PowerPoint (6 Hrs)
Understanding and working with the PowerPoint interface including: the Outline and Slides pane, the Ribbon, Quick Access toolbar, notes pane and the Status Bar.

Module II: Objects and Formatting (6 Hrs)
Working with objects in PowerPoint. Copying and moving objects. Formatting including the format painter. Fonts and effects. Inserting new slides. Slide layout. Selecting multiple objects. Grouping objects. The different objects that you can include on a slide. Six slides that demonstrate the six content types: Table, Chart, Graphic, Picture, Clip art, Media clip (movie).

Module III: Slide Design (6 Hrs)
Templates and Slide Masters, How to use themes, masters and templates to make slide design quick and consistent. Layouts and footers. Principles of slide design - Principles to guide good, clean design and formatting of slides. Making your slides clearer. Creating professional-looking slides with real impact.

Module IV: Making an Impact (6 Hrs)
When and why to use images. How to insert and edit images. Cropping, resizing and manipulating images. Screenshots and videos. Removing picture backgrounds. Applying artistic effects.

Module V: Animation (6 Hrs)
Adding and controlling transition effects between slides. Detailed animation and transition options. Animating individual elements of text boxes, charts and diagrams. Presenter tools and features. Custom slide shows. Annotating your slide during a talk. Navigating a presentation. Self-running presentations.

Text Books
1. Joan Lambert, "Microsoft PowerPoint step by step 2016", Microsoft Press, 2016
2. Curtis Frye, Joan Preppernau, and Joyce Cox, "Microsoft® Office PowerPoint® 2007 Step by Step", Microsoft Press, 2015
3. John Walkenbach, Michael R. Groh, Herb Tyson, Faithe Wempen, "Office 2010 Library: Excel 2010 Bible, Access 2010 Bible, PowerPoint 2010 Bible, Word 2010 Bible", John Wiley & Sons, 2010

Reference Books
1. Joan Lambert, "Microsoft PowerPoint step by step 2019", Microsoft Press, 2019
2. David W. Beskeen, "Illustrated Course Guide: Microsoft PowerPoint 2013 Advanced" Cengage Learning, 2014
3. Joan Preppernau and Joyce Cox, "PowerPoint 2010", Microsoft Press, 2010
4. "Microsoft PowerPoint 2013", John Wiley and Sons, 2013
5. Ann Shaffer and Katherine T. Pinard, "New Perspectives Microsoft Office 365 & PowerPoint 2016: Intermediate", Course Technology, 2016

Web References
1. https://smallbusiness.chron.com/bibliography-powerpoint-40572.html
2. https://bookboon.com/en/powerpoint-ebooks
3. https://penandthepad.com/cite-book-powerpoint-8344519.html

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4. https://www.bookdepository.com/category/1931/PowerPoint

2. MASTERS IN MICROSOFT EXCEL

Course Content:

Module I: Excel Basics (6 Hrs)
About Excel, The Excel environment, The Title Bar – The Ribbon – Scroll Bars – The MS Office Button – The Quick Access Toolbar – The Formula Bar – The Workbook Window – The Status bar – The Workbook View Buttons – The Zoom Slider – the Mini toolbar – Keyboard Shortcuts.

Module II: Data handling (6 Hrs)
Sorting & Filtering: Techniques for sorting and filtering data, including controlling the order of precedence in a sort, advanced filters, and an introduction to PivotTables. Using sorting and filtering to check and 'clean' data. Controlling user input: Controlling the way users can enter data into a spreadsheet to reduce risk of error and increase efficiency. Covers Data Validation and using IS- functions to trap errors. Working with Text: Entering and formatting text, extracting or combining parts of text. 'Cleaning' data for typos and bugs. Lookup & Reference: Looking up information in a basic table, and more flexibly. VLOOKUP() and the more flexible INDEX()/MATCH() combination. Advanced lookups.

Module III: Formatting (6 Hrs)
Cell Formatting - Basic font formatting, alignment – Including horizontal and vertical alignment, wrapping, merging, orientation, Alt-Return; consistent, sensible row heights & column. Number Formatting - Types of number (E.g., currency, %, decimal, negative numbers) – and Excel formats best employed. Custom number formats and how to maximise impact and clarity. Conditional Formatting - Changing the format of cells depending on their value. Graphical conditional formats. Writing conditional format formulas.

Module IV: Presentation (6 Hrs)
Graphs and Charts - Creating simple charts and editing them to control and improve formatting. Choosing the right chart Principles and guidelines for communicating well with charts. Sparkline's and Maps (when and how to use). Page & Print Setup - Displaying spreadsheets as pages. Page layout view, page breaks, print area,. Printing from multiple Worksheets (and that default will be to print only from active Worksheet). Headers and footers. Adjusting page setup. Printing very large sheets of data And finally printing!

Module V: Advanced Excel Capabilities (6 Hrs)
Conditional formatting, Importing data and text to columns, Functions – Mathematical, String, IF, AND, OR, Searching: match, search, vlookup, Dates, Misc, Pivot tables, Recording and editing Macros.

Text Books
1. Michael Alexander, "Excel 2007 Dashboards and Reports for Dummies", John Wiley & Sons, 2011
2. Ellen Monk, Spring Davidson, Joseph Brady, "Problem Solving Cases in Microsoft Access and Excel", Cengage Learning, 2009
3. Colleen Conmy, Bill Hazlett, Bill Jelen, Adrienne Soucy, "Excel for Teachers", Tickling Keys, 2010

Reference Books
1. Noreen Brown, Barbara Lave, Julie Romey, "Beginning Excel 2019", Open Oregon Educational Resources, 2017
2. Greg Harvey, "Excel 2019 All-in-One For Dummies", John Wiley & Sons, 2018
3. John Walkenbach, "Excel 2007 Bible", John Wiley & Sons, 2011
4. Matthew MacDonald, "Excel 2010: The Missing Manual", O'Reilly Media, Inc., 2010

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5. Rob Bovey, Stephen Bullen, Dennis Wallentin, John Green, "Professional Excel Development: The Definitive Guide to Developing Applications Using Microsoft Excel, VBA, and .NET", Addison-Wesley Professional, 2009

Web References

1. https://www.google.com/search?q=ms+excel+working&oq=MS+Excel+working&aqs=chrome.0.0i457j0l3j0 i22i30l4.9421j0j4&sourceid=chrome&ie=UTF-8
2. https://www.investintech.com/resources/blog/archives/5430-excel-data-tips.html
3. https://edu.gcfglobal.org/en/excel2010/working-with-basic-functions/1/
4. https://www.online-tech-tips.com/ms-office-tips/microsoft-excel-basics-tutorial-learning-how-to-use-excel/
5. https://spreadsheeto.com/how-to-use-excel/

3. MICROSOFT WORD DOCUMENTATION

Course Content:

Module I: Getting Familiar and Document Navigation   (6 Hrs)
Introduction, Interface Overview, Common Buttons, Tabs and Ribbons, What's The Flashing Line, How Navigation Tips Help, Using The Slider, Keyboard Navigation Tips, Using Browse Objects Tools, Selecting Text Options

Module II: Manipulating Text and Formatting   (6 Hrs)
Introduction, Page Layout, Cut, Copy, Paste, Move, Find and Replace, How Formatting Makes a Difference, Changing Fonts, Typical Text Format Options, Bullet and Numbered Lists, Other Formatting Tools, Line Spacing, What Are Quick Styles, More Quick Styles, Creating A New Quick Style, Paragraph Marks

Module III: Themes and Templates   (6 Hrs)
Introduction, Applying Themes, Opening Existing Templates, Creating Templates, Working With Existing Content, Quick Parts – Options, Creating Quick Parts, Quick Parts - Inserting Fields, Quick Parts - Inserting Images

Module IV: Organizing Content   (6 Hrs)
Introduction, Creating Lists, Creating and Formatting Tables, Converting Text To Tables, Table Borders and Shading, Creating Columns, Creating Tabular Lists, Creating Charts, Character Spacing, Inserting Shapes, Inserting Images, Using Word Art, Using Text Boxes, Sorting Text, Using Smart Art

Module V: Review, Protect, Share, and Print   (6 Hrs)
Introduction, Document Views, Split Screen View, Tracking Changes, Collaboration options, Combining and Approving Changes, Using Comments, Compatibility Checker, Previous Word Versions Compatibility, Digital Signatures, Restricting Permissions, Spell and grammar Check, Saving a Document, Printing and Preview Options

Text Books
1. Alexander Mamishev, Murray Sargent, "Creating Research and Scientific Documents Using Microsoft Word", Microsoft Press, 2014
2. Jennifer Duffy, Carol Cram, "Microsoft Word 2010: Illustrated Complete", Cengage Learning, 2010
3. Geoff Evelyn, John Pierce, "MOS 2010 Study Guide for Microsoft Word Expert, Excel Expert, Access, and SharePoint Exams", Pearson Education, 2011

Reference Books
1. Ann Shaffer and Katherine T. Pinard, "New Perspectives Microsoft Office 365 & PowerPoint 2016: Intermediate", Course Technology, 2016

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2. Diane Koers, "Picture Yourself Learning Microsoft Word 2010", Cengage Learning, 2014
3. Gary B. Shelly, Misty E. Vermaat, "Microsoft Word 2010: Complete", Cengage Learning, 2010
4. Pasewark/Pasewark, Katherine T. Pinard, "Microsoft Word 2010 Introductory", Cengage Learning, 2012
5. Jennifer Duffy, "Microsoft Word 2013: Illustrated Introductory", Cengage Learning, 2013

Web References

1. https://www.investintech.com/resources/articles/beginnersmsoffice/
2. https://www.javatpoint.com/ms-word-tutorial
3. https://www.tutorialspoint.com/word/index.htm
4. https://www.thewindowsclub.com/microsoft-word-tutorial-for-beginners

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U20BMM303	**PHYSICAL EDUCATION**	**L**	**T**	**P**	**C**	**Hrs**
		0	**0**	**2**	**-**	**30**

Physical Education is compulsory for all the Undergraduate students and Pass in this course is mandatory for the award of degree. Physical Education activities will include games and sports/extension lectures. The student participation shall be for minimum period of 30 hours. Physical Education activities will be monitored by the Director of Physical Education. Pass/Fail will be determined on the basis of participation, attendance, performance and conduct. If a candidate fails, he/she has to repeat the course in the subsequent years.

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U20BST433	**PROBABILITY AND QUEUEING THEORY** (Common to MECHANICAL and BME)	**L**	**T**	**P**	**C**	**Hrs**
		2	**2**	**0**	**3**	**60**

Course Objectives

- Apply fundamental knowledge of the basic probability concepts.
- To introduce knowledge of standard discrete distributions.
- To acquire knowledge on Probability Distributions.
- To understand strength and weakness of Queuing model.
- To gain strong knowledge in principles of Queuing theory.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the fundamental knowledge of the probability concepts. **(K2)**

CO2 - Apply the basic rules of discrete random variables. **(K3)**

CO3 - Apply the fundamentals of probability theory and random processes. **(K3)**

CO4 - Understand and extend Queuing models to analyze real world systems. **(K2)**

CO5 - Apply the knowledge of Queuing theory in computer field. **(K3)**

UNIT I PROBABILITY AND RANDOM VARIABLE   (12 Hrs)

Axioms of probability - Conditional probability - Total probability – Bayes theorem– Moments–Moment generating functions and their properties.

UNIT II DISCRETE RANDOM VARIABLES   (12Hrs)

Random Variables and their event spaces, Random variable – Probability mass function – Probability density function- Distribution functions, Binomial, Geometric, Negative Binomial and Poisson.

UNIT III CONTINUOUS RANDOM VARIABLES   (12 Hrs)

Some important distributions: Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties – Functions of a random variable.

UNIT IV QUEUING MODELS   (12 Hrs)

Markovian queues – Birth and Death processes – Single and multiple server queuing models – Little's formula – Queues with finite waiting rooms – Queues with impatient customers: Balking and reneging.(M/M/I):(∞/FIFO), (M/M/I):(N/FIFO), (M/M/C):(∞/FIFO), (M/M/C):(N/FIFO)

UNIT V ADVANCED QUEUING MODELS   (12 Hrs)

Finite source models – M/G/1 queue – Pollaczek-Khinchin formula – M/D/1 and M/EK/1 as special cases – Series queues – Open Jackson networks.

Text Books

1. N.P.Bali and Dr. Manish Goyal, "Engineering Mathematics", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.
2. T. Veerarajan," Probability and Statistics, Random Process and Queuing Theory", McGraw Hill Education, 2018
3. P. Sivaramakrishna Das, C. Vijayakumari , "Probability and Queuing Theory", Pearson Education, 6th Edition, 2019

Reference Books

1. Gupta.C., B. Shree Ram Singh, M. Kumar, "Engineering Mathematics for semester I & II", Tata McGraw Hill, New Delhi, 2015.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New Delhi,10th Edition, 2019.
3. John F. Shortle, James M. Thomson, Donald Gross, "Fundamental of Queuing theory", 5Th Edition, Wiley series., 2018.

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4. M.Bhatt and Ravish R Singh, "Probability and Statistics", McGraw Hill Education, 2017.
5. P.Kandasamy, Thilagavathi.K and Gunavathi.K, "Probability and Queuing Theory",S.Chand&Co. Pvt. Ltd, 2015

Web References

1. http://www.maths.qmul.ac.uk/~pjc/notes/prob.pdf
2. https://nptel.ac.in/courses/117/103/117103017/
3. https://youtu.be/COI0BUmNHT8
4. https://nptel.ac.in/courses/111107119/
5. http://www.sasurieengg.com/e-course-material/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	1	-	-	-	-	-	1	2	-	-
2	3	2	1	1	-	1	-	-	-	-	-	1	2	-	-
3	3	2	1	1	-	1	-	-	-	-	-	1	2	-	-
4	2	1	-	-	-	1	-	-	-	-	-	1	1	1	-
5	3	2	1	1	-	1	-	-	-	-	-	1	1	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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	PROGRAMMING IN JAVA	**L**	**T**	**P**	**C**	**Hrs**
U20EST467	(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS, CCE)	**3**	**0**	**0**	**3**	**45**

Course Objectives
- To gain and explore the knowledge of java programming
- To know the principles of inheritances, packages, interfaces
- To get familiarized to generic programming, multithreading concepts.
- To gain and explore the advanced concepts in Java.
- To explore database connectivity

Course Outcomes
After completion of the course, the students will be able to

CO1 - Write a maintainable java Program for a given algorithm and implement the same. **(K2)**
CO2 - Demonstrate the use of inheritance, interface and package in relevant applications. **(K3)**
CO3 - Create java applications using exception handling, thread and generic programming. **(K3)**
CO4 - Build java distributed applications using Collections and IO streams. **(K3)**
CO5 - Exemplify simple graphical user interfaces using GUI components and database programs. **(K3)**

UNIT I INTRODUCTION TO JAVA PROGRAMMING (9 Hrs)
The History and Evolution of Java - Byte code - Java buzzwords - Data types – Variables – Arrays – operators - Control statements - Type conversion and casting. Concepts of classes and objects: Basic Concepts of OOPs, constructors, static keyword, Final with data, Access control, This key word - Garbage collection- Nested classes and inner classes - String class

UNIT II INHERITANCE, PACKAGES AND INTERFACES (9 Hrs)
Inheritance: Basic concepts - forms of inheritance - super key word – method overriding, abstract classes, dynamic method dispatch - the Object class. Packages: Defining, Creating and Accessing, importing packages. Interfaces: Defining, implementing, applying, variables and extending interfaces

UNIT III EXCEPTION HANDLING, MULTITHREADING (9 Hrs)
Concepts of Exception handling, types of exceptions, creating own exception, Concepts of Multithreading, creating multiple threads, Synchronization, inter thread communication. Enumeration - Autoboxing - Generics.

UNIT IV COLLECTIONS, I/O STREAMS (9 Hrs)
Collections: List –Vector – Stack - Queue – Dequeue –Set - SortedSet. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files.

UNIT V EVENT DRIVEN PROGRAMMING AND JDBC (9 Hrs)
Events - Delegation event model - Event handling - Adapter classes. AWT: Concepts of components - Font class, Color class and Graphics. - Introduction to Swing – layout management - Swing Components. Java Database Connectivity- Develop real time applications.

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Text Books
1. Herbert Schildt, "Java: The Complete Reference", TMH Publishing Company Ltd, Eleventh Edition, 2018.
2. Sagayaraj, Denis, Karthik, Gajalakshmi , "JAVA Programming for core and advanced learners" , Universities Press Private Limited, 2018
3. Herbert Schildt, "The Complete Reference JAVA 2", TMH, Seventh Edition, 2006.

Reference Books
1. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013.
2. H.M.Dietel and P.J.Dietel, "Java How to Program", Pearson Education/PHI , 11th Edition, , 2017.
3. Cay.S.Horstmann and Gary Cornell, "Core Java, Vol 2, Advanced Features", Pearson Education, 8th Edition, 2008.
4. "Java for Programmers", P.J. Dietel and H.M Dietel,Pearson Education (OR) JAVA:
5. "Programming in Java", S. Malhotra and S. Choudary, Oxford Univ. Press.

Web References
1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM's tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog
5. https://www.geeksforgeeks.org

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	2	-	-	-	-	-	-	-	3	-	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

		L	T	P	C	Hrs
U20BMT409	**BIOSIGNAL PROCESSING**	2	2	0	3	60

Course Objectives
- To understand the characteristics of digital filters, design digital IIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the characteristics of digital filters, design digital FIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the effects of finite precision representation on digital filters
- To gain knowledge on the signal processing techniques used for ECG in cardiology
- To gain knowledge on the signal processing techniques used for EEG in neurology

Course Outcomes
After completion of the course, the students will be able to
CO1 - Design and implement IIR digital filters **(K4)**
CO2 - Design and implement FIR digital filters **(K4)**
CO3 - Characterise the effects of finite precision representation on digital filters **(K3)**
CO4 - Know the process of analysing ECG Signals **(K2)**
CO5 - Know the process of analysing EEG Signals **(K2)**

UNIT I INFINITE IMPULSE RESPONSE FILTERS (12 Hrs)
Characteristics of practical frequency selective filters. Characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analogdomain.Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT II FINITE IMPULSE RESPONSE FILTERS (12 Hrs)
Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

UNIT III FINITE WORD LENGTH EFFECTS (12 Hrs)
Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.

UNIT IV CARDIOLOGICAL SIGNAL PROCESSING (12 Hrs)
Preprocessing of ECG signal, QRS detection Methods-Differentiation-based and template-based. Rhythm analysis and Arrhythmia detection algorithms.Automated ECG analysis. Data compression techniques: Turning Point algorithm, AZTEC, CORTES, and the KL transform. Adaptive filters, Weiner filter principles, LMS and RLS, medical Applications of Adaptive Noise Cancellation.

UNIT V NEUROLOGICAL SIGNAL PROCESSING (12 Hrs)
Stochastic process.Linear prediction.Yule-Walker equations. Auto Regressive Modeling of EEG signal. Detection of EEG Rhythms, Template matching for EEG spike-and-wave detection, Detection of EEG spike-and-wave complexes, Coherence analysis of EEG channels, Adaptive segmentation of EEG signals. Sleep stage analysis using Markov model. Analysis of evoked potential using Prony's method.

Text Books
1. John L. Semmlow, Benjamin Griffel , "Biosignal and Medical Image Processing", CRC Press,2014
2. Willis J. Tompkins , "Biomedical Digital Signal Processing", Prentice-Hall of India Pvt. Ltd., 2012
3. Christoph Hintermuller , "Advanced Biosignal Processing and Diagnostic Methods", In Tech Open, 2016

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Reference Books

1. Jonathan Wolpaw and Elizabeth Winter Wolpaw, "Brain-Computer Interfaces: Principles and Practice", Oxford University Press, 2012.
2. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling", Wiley-India, 2010.
3. StephaneMallat, "Wavelet Tour of Signal Processing: The Sparse Way", Third edition. Academic Press, 2011.
4. Kayvan Najarian Robert Splinter "Biomedical Signal and Image Processing" by Taylor & Francis Group, LLC, Second edition. 2012
5. Li Tan , Jean Jiang   "Digital Signal Processing fundamentals and Applications", Second edition, Academic Press, 2013

Web References

1. https://www.youtube.com/watch?v=S_U-s27nPLE
2. https://www.youtube.com/watch?v=bFeYjFtSsrg
3. https://www.journals.elsevier.com/biomedical-signal-processing-and-control/recent-articles
4. https://www.classcentral.com/course/swayam-biomedical-signal-processing-10069
5. https://nptel.ac.in/content/syllabus_pdf/108105101.pdf

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2	3	3	3	3	3	2	-	-	-	-	-	1	3	3	-
3	2	2	3	3	3	2	-	-	-	-	-	1	3	3	-
4	3	3	3	3	3	2	-	-	-	-	-	1	3	3	-
5	3	3	3	3	3	2	-	-	-	-	-	1	3	3	-

COs/POs/PSOs Mapping

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

	L	T	P	C	Hrs
U20BMT410 **LINEAR INTEGRATED CIRCUITS**	3	0	0	3	45

Course Objectives

- To acquire knowledge on the operation of Operational Amplifier characteristics
- To understand the operation of Operational Amplifier applications
- To Understand the concepts multi vibrators and waveform generators
- To study the types of filters and data converters
- To understand the concept of Timer, PLL and voltage regulators

Course Outcomes

After completion of the course, students shall have ability to

CO1 - Explain the basic building blocks of operational amplifier and its characteristics **(K2)**
CO2 - Construct the various operational amplifier application circuits **(K3)**
CO3 - Design and develop the comparators and waveform generators **(K4)**
CO4 - Demonstrate the basic concepts and design of active filters and data converters **(K4)**
CO5 - Explain the operation, applications of timers and describe the basic concepts of PLL and Voltage regulators **(K4)**

UNIT I OPAMP AND ITS CHARACTERISTICS (9 Hrs)

Basics of operational amplifier (op amp) and its ideal characteristics, Op amp-inverting amplifier, non-inverting amplifier, buffer amplifier, AC amplifier, Differential amplifier, Instrumentation amplifier, Basics of DC characteristics and AC characteristics,

UNIT II BASIC OP AMP APPLICATIONS (9 Hrs)

Scale changer, Inverting and non-inverting adder, subtractor, V-I and I-V converter, Half wave rectifier and full wave rectifier, Peak detector, clipper and clamper, Sample and hold circuit and log amplifier, Differentiator and integrator, Instrumentation amplifier

UNIT III COMPARATORS AND WAVEFORM GENERATORS (9 Hrs)

Comparator and its applications - Schmitt trigger, Astable multivibrator, Monostable multivibrator, Triangular wave generator, Sawtooth wave generator, RC Phase shift oscillator and Wien bridge oscillator

UNIT IV ACTIVE FILTERS AND DATA CONVERTERS (9 Hrs)

First order RC active low pass and high pass filter, Band pass filter and basics of Notch filter, Digital to analog converter (DAC)/Analog to digital converter (ADC) specifications, Weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, Flash type ADC, successive approximation ADC and dual slope ADC

UNIT V TIMER, PLL AND VOLTAGE REGULATORS (9 Hrs)

555 timer IC pin diagram and functional diagram, 555 timer in monostable mode and its application as pulse width modulation, 555 timer in as table mode and its application as frequency shift keying (FSK), Phase Locked loop (PLL), Series op-amp regulator, fixed voltage regulator and 723 general purpose regulator, Medical Applications: pulse oximetry, bio data acquisition system

Text Books

1. D Roy Choudhury and Shail Jain, "Linear integrated circuits", New Age Science Limited, Fourth edition, 2018
2. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", Fourth Edition, Prentice Hall / Pearson Education, 2015
3. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2010.

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1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Fourth Edition, Tata Mc Graw-Hill, 2016.
2. S.Salivahanan& V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", Second Edition, TMH, 4th Reprint, 2016.
3. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2008.
4. B.S.Sonde, "System design using Integrated Circuits", Second Edition, New Age Pub, 2010
5. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2009.

Web References

1. http://www.ti.com/applications/industrial/medical/technical-documents.html
2. https://e-box.co.in/linear-integrated-circuits.shtml
3. https://www.tutorialspoint.com/linear_integrated_circuits_applications/index.html

COs/POs/PSOs Mapping

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1	3	2	-	1	-	-	-	-	1	-	-	1	3	1	-
2	3	2	1	1	1	-	-	-	1	-	-	1	3	1	-
3	3	2	2	1	1s	-	-	-	1	-	-	1	3	1	1
4	3	2	2	2	1	-	-	-	1	-	-	1	3	1	-
5	3	2	2	2	1	-	-	-	1	-	-	1	3	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

U20HSP402	**GENERAL PROFICIENCY–II** (Common to all branches except CSBS)	**L**	**T**	**P**	**C**	**Hrs**
		0	**0**	**2**	**1**	**30**

Course Objectives
- To examine various standardized test in English language
- To recognize the key features of various technical writing
- To integrate LSRW skills to endorse multifarious skill set in practical situation
- To understand the factors that influence the usage of grammar
- To understand the basic concepts of logical reasoning skills

Course Outcomes
After completion of the course, the students will be able to

CO1 - Infer ideas to attend international standardized test by broadening receptive and productive skills **(K2)**

CO2 - Interpret the types of writing in different state of affairs **(K2)**

CO3 - Develop language skills professionally to groom the overall personality through sensitizing various etiquettes in real time situation **(K3)**

CO4 - Identify the rules of grammar in academic discourse settings **(K3)**

CO5 - Extend the skills to compete in various competitive exams like GATE, GRE, CAT, UPSC, etc**. (K2)**

UNIT I CAREER SKILLS   (6 Hrs)
Listening: Listening at specific contexts-**Speaking:** Mock interview (Personal & Telephonic)-**Reading**: Read and Review -Newspaper, Advertisement, Company Handbooks, and Guidelines (IELTS based) **Writing:** Essay Writing (TOEFL) **Vocabulary:** Words at specified context (IELTS)

UNIT II CORPORATE SKILLS   (6 Hrs)
Listening: Listening and replicating **Speaking**: Team Presentation (Work Place Etiquettes) **Reading:** Short texts (signs, emoticons, messages) **Writing:** E-mail writing- Hard skills -Resume' Writing, Job Application Letter, Formal Letter **Vocabulary:** Glossary (IELTS)

UNIT III FUNCTIONAL SKILLS   (6 Hrs)
Listening: Listening TED Talks – **Speaking:** Brainstorming &Individual Presentation, Persuasive Communication –- **Reading:** Text Completion (GRE Based) **Writing:** Expansion of Compound Words **Vocabulary:** Expansion of vocabulary (IELTS)

UNIT IV TRANSFERABLE SKILLS   (6 Hrs)
Listening: Listening Documentaries and making notes –**Speaking:** Conversation practice at formal & informal context **Reading:** Read and transform- report, memo, notice and advertisement, **Writing:** Euphemism, Redundancy, and Intensifiers **Vocabulary:** Refinement of vocabulary (IELTS)

UNIT V APTITUDE   (6 Hrs)
Transformational Grammar: Phrases & Clauses, Concord, Conditional Clauses, Voice, Modals
Verbal Ability Enhancement: Letter Series, Coding &Decoding**,** Sentence Completion (GATE), Critical Reasoning & Verbal Deduction (GATE), Syllogism

Reference Books
1. Lougheed, Lin. "Barron's Writing for the TOEFL IBT: With Audio CD". Barron's Educational series, 2008.
2. Tulgan, Bruce**.** "Bridging the soft skills gap: How to teach the missing basics to today's young talent". John Wiley & Sons, 2015.
3. Sherfield, Robert M. "Cornerstone: Developing Soft Skills". Pearson Education India, 2009.
4. Cullen, Pauline, Amanda French, and Vanessa Jakeman**.** "The official Cambridge guide to IELTS for academic & general training".Cambridge, 2014.

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5. Ramesh, Gopalaswamy. "The ace of soft skills: attitude, communication and etiquette for success". Pearson Education India, 2010.

Web References
1. https://www.englishclub.com/grammar/nouns-compound.htm
2. https://lofoya.com/Verbal-Test-Questions-and-Answers/Sentence-Completion/l3p1
3. https://www.grammarwiz.com/phrases-and-clauses-quiz.html
4. https://www.clarkandmiller.com/25-english-euphemisms-for-delicate-situations/
5. http://www.englishvocabularyexercises.com/general-vocabulary/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
2	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
3	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
4	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-
5	1	-	-	-	-	-	-	1	-	3	-	2	1	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

	PROGRAMMING IN JAVA LABORATORY	**L**	**T**	**P**	**C**	**Hrs**
U20ESP468	(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHATRONICS, CCE)	**0**	**0**	**2**	**1**	**30**

Course Objectives

- To acquire programming skill in core java.
- To learn how to design java program and applications.
- To acquire object oriented skills in java.
- To develop the skill of designing applications.
- To explore database connectivity.

Course Outcomes

After completion of the course, students will be able to

CO1 - Apply and practice logical formulations to solve simple problems leading to specific applications. **(K3)**

CO2 - Demonstrate the use of inheritance, interface and package in relevant applications. **(K3)**

CO3 - Create java applications using exception handling, multithread. **(K3)**

CO4 - Build java distributed applications using Collections and IO streams. **(K3)**

CO5 - Develop simple database programs. **(K3)**

List of Experiments

1. Develop simple programs using java technologies and testing tools.
2. Develop a java program that implements class and object.
3. Write a java program to demonstrate inheritance.
4. Develop a simple real life application program to illustrate the use of Multi Threads.
5. Implement simple applications using Collections.
6. Develop a simple application and use JDBC to connect to a back-end database.
7. Create a student application with Add, Edit, Delete, Show functions using JDBC.
8. Create a Bill Application to store sales details using JDBC.
9. Create java applications using Exception Handling for error handling.
10. Develop a java program that implements the Packages.

Reference Books

1. E. Balaguruswamy, "Programming with Java", TMH Publ, 2nd Edition, 2005.
2. JAVA How to programming by DIETEL & DIETEL.
3. Herbert Schil dt, "The Complete Reference JAVA 2", TMH, Seventh Edition, 2006.
4. Cay.S.Horstmann and Gary Cornell, "Core Java 2", Vol 2, Advanced Features, Pearson Education, Seventh Edition, 2010.

Web References

1. http://www.ibm.com/developerworks/java/
2. http://docs.oracle.com/javase/tutorial/rmi/.
3. IBM's tutorials on Swings, AWT controls and JDBC.
4. https://www.edureka.co/blog
5. ttps://www.geeksforgeeks.org

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
2	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
3	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
4	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-
5	3	2	1	1	3	-	-	-	-	-	-	-	3	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

U20BMP405	BIOSIGNAL PROCESSING USING MATLAB	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To familiarize the students with various computation techniques involved in signal processing.
- To introduce the theory and application of IIR and FIR filters along with its implementation.
- To impart knowledge on the various types of errors that affect signals during digital signal processing.
- To learn the characteristics of various bio signals.
- To learn the properties of Fourier Transform.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Understand the computation of convolution and analyses of various systems **(K2)**
CO2 - Implement the FIR and IIR filters in various applications **(K3)**
CO3 - Rectifies various types of error that affects signal during processing **(K3)**
CO4 - Simulates and analyses Bio signals **(K3)**
CO5 - Analyses various Fourier transform properties **(K4)**

List of Experiments

1. Generation of Discrete and Continuous time signals
2. Linear and Circular Convolution
3. Auto Correlation and Cross Correlation
4. Frequency analysis using DFT
5. ECG and Arrhythmia signal generation
6. Spectrum analysis and noise removal of biomedical signals
7. ECG Data reduction algorithms
8. Detection of QRS Component from ECG signal.
9. Down sampling and up-sampling of ECG signals
10. IIR Filter Design
11. FIR Filter Design
12. Design of Notch filter for elimination of 50Hz from ECG Signal
13. Measurement of respiration rate using thermistor

Text Books

1. John L. Semmlow, Benjamin Griffel , "Biosignal and Medical Image Processing", CRC Press,2014
2. Willis J. Tompkins , "Biomedical Digital Signal Processing", Prentice-Hall of India Pvt. Ltd., 2012
3. Christoph Hintermuller , "Advanced Biosignal Processing and Diagnostic Methods", InTechOpen, 2016

Reference Books

1. Jonathan Wolpaw and Elizabeth Winter Wolpaw, "Brain-Computer Interfaces: Principles and Practice", Oxford University Press, 2012.
2. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling", Wiley-India, 2009.
3. Stephane Mallat, "Wavelet Tour of Signal Processing: The Sparse Way", Third edition. Academic Press, 2011.
4. Kayvan Najarian Robert Splinter "Biomedical Signal and Image Processing" by Taylor & Francis Group, LLC, Second edition. 2012
5. Li Tan , Jean Jiang "Digital Signal Processing fundamentals and Applications", Second edition, Academic Press, 2013

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2. https://www.youtube.com/watch?v=bFeYjFtSsrg
3. https://www.journals.elsevier.com/biomedical-signal-processing-and-control/recent-articles
4. https://www.classcentral.com/course/swayam-biomedical-signal-processing-10069
5. https://nptel.ac.in/content/syllabus_pdf/108105101.pdf

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3	3	2	-	-	3	2	1	-	1	-	-	1	3	2	-
4	3	2	3	3	3	2	1	-	1	-	-	1	3	2	-
5	3	2	3	3	3	2	1	-	1	-	-	1	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

U20BMP406	LINEAR INTEGRATED CIRCUITS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives
- To design the buffer circuits, inverting and non-inverting amplifiers
- To realize the op amp characteristics
- To design the op amp for bio signal acquisition
- To design and understand the various filters and its response
- To understand the design concepts Digital to Analog Converters

Course Outcomes
After completion of the course, students will be able to

CO1 - Demonstrate the various applications of Operational Amplifier **(K3)**

CO2 - Analyze zero crossing detector, window detector and Schmitt trigger using op-Amp **(K3)**

CO3 - Compare the working of clipper, clamper and Rectifiers using Op-Amp **(K4)**

CO4 - Evaluates the performance of Active filters **(K4)**

CO5 - Design the working of DAC using op-amp **(K5)**

List of Experiments
1. Realization of voltage follower, inverting and non-inverting amplifier using op-amp
2. Design of Summer, Subtractor, differentiator and integrator using op-amp
3. Design of instrumentation amplifier for bio-signal acquisition
4. Design of half wave and full wave rectifier using op-amp
5. Realize the zero-crossing detector and time marker using opamp
6. Design a RC phase shift oscillator and Wien bridge oscillator using op-amp
7. Design of first order and second order active filters
8. Design of weighted resistor DAC and R-2R ladder DAC using op-amp
9. Design of Multivibrator using IC 555
10. Simulation - Realization of buffer, inverting and non-inverting amplifier using op-amp
11. Simulation -Design of summer, differentiator and integrator using op-amp
12. Simulation -Design of instrumentation amplifier for bio-signal acquisition
13. Simulation -Design of half wave and full wave rectifier using op-amp
14. Simulation -Design of clipper and clamper using op-amp

Text Books
1. D Roy Choudhury and Shail Jain, "Linear integrated circuits", New Age Science Limited, Fourth edition, 2018
2. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", Fourth Edition, Prentice Hall / Pearson Education, 2015
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4. B.S.Sonde, "System design using Integrated Circuits", Second Edition, New Age Pub, 2010
5. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley International, 2009.

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2. https://e-box.co.in/linear-integrated-circuits.shtml
3. https://www.tutorialspoint.com/linear_integrated_circuits_applications/index.html

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3	3	1	-	-	2	-	-	-	-	-	-	1	3	1	1
4	3	2	3	3	2	-	-	-	-	-	-	1	3	1	1
5	3	2	3	3	2	-	-	-	-	-	-	1	3	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

		L	**T**	**P**	**C**	**Hrs**
U20BMC4XX	**CERTIFICATION COURSE - IV**	0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

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U20BMS403	SKILL DEVELOPMENT COURSE 3	L	T	P	C	Hrs
		0	0	2	-	30

1. TROUBLE SHOOTIING OF MEDICAL EQUIPMENTS

Course Content:
1. Rules of Engagements
2. Blood Pressure Monitor Equipment (Manual)
   a. Preventive Maintenance
   b. Dissembling a Mercury Manometer
   c. Mercury handling protocol
3. Cell Counter Equipment
   a. Preventive maintenance
   b. Run a test cycle
   c. Adjustments of Probe and unclogging aperture
   d. Checking Motor Functions
   e. Lamp Functions and Allignments
4. Centrifuge Equipment
   a. Preventive Maintenance
   b. Checking Motor Functions
   c. RPM Measurements
   d. Bypassing Interlock
5. Microscope
   a. Preventive Maintenance
   b. Checking Light Source
   c. Adjustments of Knobs
   d. Ensuring the amount of Lubricants

Reference Books
1. Justin Cooper and Alex Dahinten, "Medical Equipment Troubleshooting Flowchart Handbook" Published by: Engineering world health, Vesion- 6, 2013

Web References
1. https://www.youtube.com/watch?v=whp2pnCBs6s
2. https://www.youtube.com/watch?v=EJJVrCm3YT4
3. https://www.youtube.com/watch?v=T0QmUe0bwL8
4. https://www.youtube.com/watch?v=3kXnL0AQhYA
5. https://www.usms.biz/preventive-maintenance-for-medical-devices/

2. PCB BOARD DESIGNING

Course Content:

MODULE 1: INTRODUCTION TO PCB DESIGNING CONCEPTS   (6 Hrs)
Introduction & Brief History - What is PCB, Difference between PWB and PCB, Types of PCBs: Single Sided (Single Layer), Multi-Layer (Double Layer), PCB Materials? Introduction to Electronic design Automation (EDA) - Brief History of EDA, Latest Trends in Market, How it helps and why it requires, Different EDA tools, Introduction to SPICE and PSPICE Environment, Introduction and Working of PROTEUS.

MODULE 2: COMPONENT INTRODUCTION AND THEIR CATEGORIES   (6 Hrs)
Types of Components - Active Components, Passive Components, Component Package Types - Through Hole Packages: Axial lead o Radial Lead, Single Inline Package(SIP), Dual Inline Package(DIP), Transistor Outline(TO), Pin Grid Array(PGA), Through Hole Packages: Metal Electrode Face(MELF), Leadless Chip

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Carrier(LCC), Small Outline Integrated Circuit(SOIC), Quad Flat Pack(QPF) and Thin QFP (TQFP), Ball Grid Array(BGA), Plastic Leaded Chip Carrier(PLCC)

MODULE 3: INTRODUCTION TO DEVELOPMENT TOOLS (6 Hrs)

Introduction to PCB Design using OrCAD tool, Introduction to PCB Design using PROTEUS tool

MODULE 4: DETAILED DESCRIPTION AND PRACTICAL OF PCB DESIGNING (6 Hrs)

PCB Designing Flow Chart - Schematic Entry, Net listing, PCB Layout Designing, Prototype Designing - Design Rule Check(DRC), Design For Manufacturing(DFM), PCB Making - Printing, Etching, Drilling, Assembly of components. Description of PCB Layers - Electrical Layers, Mechanical Layers, Documentation Layers, PCB Materials, Rules for Track, Study of IPC Standards

MODULE 5: DESIGNING AND FABRICATION PROCESS (6 Hrs)

Starting the PCB designing, Understanding the schematic Entry, Creating Library & Components, Drawing a Schematic, Flat Design / hierarchical Design, Setting up Environment for PCB, Design a Board Auto routing - Introduction to Auto routing, Setting up Rules, Defining Constraints, Auto router Setup, PCB Designing Practice, Post Designing & PCB Fabrication Process.

Reference Books

1. Christopher T Robertson, Printed Circuit Board Designer's Reference; Basics, Prentice Hall Modern Semiconductor Design, 2003
2. Bosshart, Printed Circuit Boards: Design and Technology, Tata McGraw-Hill Education, 1983
3. R. S. Khandpur, Printed Circuit Boards, McGraw-Hills, 2005.
4. Charles A. Harper, High Performance Printed Circuit Boards, McGraw Hill Professional, 2000
5. Jon Varteresian, Fabricating Printed Circuit Boards, Newnes, 2002

Web References

1. https://www.electronics-notes.com/articles/analogue_circuits/pcb-design/how-to-design-pcb-board-basics.php
2. https://www.circuitbasics.com/make-custom-pcb/
3. https://learn.sparkfun.com/tutorials/pcb-basics/all
4. https://www.pcbpower.com/
5. https://www.build-electronic-circuits.com/pcb-design/

3. TESTING OF ELECTRONIC MEDICAL DEVICES

Course Content:
MODULE 1: TESTING OF ELECTRICAL EQUIPMENTS (6 Hrs)

AC, DC power supply, Grounding, shielding, Guarding, insulation testing, insulation resistance measurement, Types of Circuit Breakers, Rating – Testing of circuit breakers –Transformer testing- Earthing –Earth wires - Earthing of appliances –contactor, relay testing–CT and PT, Panel wiring- Megger-Testing equipment and instruments

MODULE 2: TESTING OF ELECTRONIC COMPONENTS (6 Hrs)

Troubleshooting of PCB boards, Calibration of analog and digital sensor probe, Display interface, DC Power supply design, testing, Safe electrical practice, Cables and standard, Fuse

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MODULE 3: TESTING OF SURGICAL EQUIPMENT   (6 Hrs)

Functions and operating procedure-Testing and maintenance of Heart lung machine, surgical lights, ventilator, patient monitor, anesthesia machine, dialyzer, surgical tools.

MODULE 4: TESTING OF ICU EQUIPMENTS   (6 Hrs)

X-ray machines, Testing of ECG recorders, incubator, baby warmer, infusion pumps, annual maintenance, contract requirements, vendor services, quality and safety standards.

MODULE 5: LIFE CYCLE MANAGEMENT OF MEDICAL EQUIPMENT   (6 Hrs)

Cost of the medical equipment, maintenance cost, replacement analysis, managing equipment service, decision making, extracting optimal benefit from medical equipment over its life cycle, Case study.

Reference Books

1. Joseph. J Carr, John M Brown, Introduction to Biomedical Equipment Technology, John Wiley& Sons, New York, 4th edition, 2008.
2. Keith Willson, Keith Ison, Slavik Tabakov, "Medical equipment management", CRC Press, UK, 2014.
3. Jenny Dooley,John Lehnert Virginia Evans, "Career Paths: Medical Equipment Repair", Express Publishing, UK,2018
4. Shakti Chatterjee, Aubert Miller, "Biomedical Instrumentation systems", Cengage Learning Technology & Engineering, 2010.
5. David Herres, "Troubleshooting and Repairing Commercial Electrical Equipment", McGraw Hill Professional edition, 2013.

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1. https://www.element.com/connected-technologies/electronics-test-methods
2. https://www.electronics-notes.com/articles/test-method
3. https://www.element.com/more-sectors/medical-device
4. https://www.metlabs.com/industries/medical-device-testing/
5. https://www.intertek.com/medical/

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		L	**T**	**P**	**C**	**Hrs**
U20BMS404	**NCC / NSS**	**0**	**0**	**2**	**-**	**30**

NCC/NSS training is compulsory for all the Undergraduate students

1. The above activities will include Practical/field activities/Extension lectures.
2. The above activities shall be carried out outside class hours.
3. In the above activities, the student participation shall be for a minimum period of 30 hours.
4. The above activities will be monitored by the respective faculty in-charge.
5. Pass /Fail will be determined on the basis of participation, attendance, performance and behavior. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree

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PROFESSIONAL ELECTIVE -I

U20BME401	MEDICAL PHYSICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives:
- To study effects of sound and light in human body
- To understand the effects of radiation in matter and how isotopes are produced
- To explore the interaction of the radiation particles with matter
- To understand the various detectors of detecting the presence of ionizing radiation
- To study the effects of radiation to the human body

Course Outcomes:
After completion of the course, the students will be able to
CO1 - Comprehend the significance and role of non-ionizing radiation in Medical Applications **(K2)**
CO2 - Understand radioactive decay and production of radio nuclides **(K2)**
CO3 - Understand the concepts of different interaction of radiation with matter **(K2)**
CO4 - Discuss the measurement of ionizing radiation **(K3)**
CO5 - Enumerate the effect of ionizing radiation in human body **(K3)**

UNIT I NON IONIZING RADIATION AND ITS MEDICAL APPLICATION (9 Hrs)

Light- Physics of light, Intensity of light color vision and limits of vision sound - Normal sound levels – Ultrasound fundamentals- Generation of ultrasound (Ultrasound Transducer) Interaction of Ultrasound with Materials- Reflection and Refraction – Absorption and Scattering Non ionizing Electromagnetic Radiation, Tissue as a leaky dielectric – Relaxation process- overview of non-ionizing radiation effects- low frequency effect- high frequency effect

UNIT II PRINCIPLES OF RADIOACTIVE NUCLIDES (9 Hrs)

Radioactive Decay – Spontaneous Emission – Isometric Transition – Gamma ray emission, alpha, beta, Positron decay, electron capture, Sources of Radioisotopes Natural and Artificial radioactivity, Radionuclide used in Medicine and Technology ,Decay series, Production of radionuclides – Cyclotron produced Radionuclide- Reactor produced Radionuclide-fission and electron Capture reaction, radionuclide Generator- Milking process – Linear accelerator, Radionuclide used in medicine and Technology.

UNIT III INTERACTION OF RADIATION WITH MATTER (9 Hrs)

Interaction of charged particles with matter –Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of Gamma radiation with matter- Photoelectric effect, Compton Scattering , Pair production, Attenuation of Gamma Radiation ,Interaction of neutron with matter and their clinical significance.

UNIT IV PRINCIPLES OF RADIATION DETECTION AND DOSIMETERS (9 Hrs)

Principles of radiation detection, Properties of dosimeters, Theory of gas filled detectors, Ionization Chamber, Proportional chamber, G.M. Counter, Film dosimetry, luminescence dosimetry, scintillation detectors, Radiation detection instruments, Area survey meters, Personal Radiation monitoring device, Film badge.

UNIT IV RADIATION EFFECTS (9 Hrs)

Acute Radiation Effects - The concept of LD 50 – Radiation syndromes- Central nervous systemsyndrome - Gastro-intestinal syndrome –Bone Marrow syndrome Delayed Effects of Radiation -Stochastic and Deterministic effects – Late Deterministic effect in different organs and tissues.

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Text Books

1. Gopal B. Saha "Physics and Radiobiology of Nuclear Medicine", Fourth Edition, Springer, 2013.
2. ThayalanKuppusamy, "Basic Radiological Physics" Second Edition, Jaypee Brothers Medical Publishers, 2017.
3. Kwan Hoong Ng, "Problem and solutions in Medical Physics: Diagnostic imaging Physics", Third volume, CRC press, 2011.

Reference Books

1. Muhammad Maqbool," An Introduction to Medical Physics", Springer, 2018.
2. SlavikTabakov, "Encyclopedia of Medical Physics", volume 1, CRC press, 2012.
3. Andrew Webb, Nadrine Barrie Smith, "Introduction to Medical Imaging:Physics, Engineering and Clinical Applications, Cambridge University press, 2010.
4. Faiz M Khan,"Khan's Lecture: Handbook of the Physics of Radiation Therapy", 2011.
5. Faiz M Khan, John P Gibbons, "Khan's the physics of Radiation Therapy" Fifth Edition, 2014.

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1. https://g.co/kgs/CBBKUU
2. https://en.m.wikipedia.org/wiki/Medical_physics
3. https://www.medphys.org/
4. https://physicsworld.com/c/medical-physics/
5. https://www.classcentral.com/course/medical-applications-particle-accelerato-12557

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	-	-	-	-	-	1	-	-	-	-	3	-	-
2	3	3	-	-	-	-	-	1	-	-	-	-	3	-	-
3	3	3	2	-	-	-	-	1	-	-	-	-	3	-	-
4	3	3	2	3	3	-	-	1	-	-	-	-	3	-	2
5	3	3	2	3	3	-	2	1	-	-	-	-	3	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BME402	HOSPITAL EQUIPMENT SAFETY AND MANAGEMENT	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives:

- To provide a safe, functional, supportive, and effective environment
- To preserve the quality of the service by providing training and appraisal
- To effectively manage the accreditations of the hospitals
- To effectively manage the hospitals and its functions using Strategic tools
- To control known and potential safety hazards to patients, personnel and visitors

Course Outcomes:

After completion of the course, the students will be able to

CO1 - Assess practice-based learning and improvement in quality and health policies for patients **(K2)**

CO2- Increase the trend for developing educational interventions in patient safety **(K2)**

CO3 - Know the necessity of improving standard and quality of the hospital **(K2)**

CO4 - Gain the roles and responsibilities of hospital staffs in various functions of hospital **(K3)**

CO5 - Able to reach the hospital management standard for the patient safety **(K4)**

UNIT I CLINICAL ENGINEERING **(9 Hrs)**

Clinical engineering program, educational responsibilities, role to be performed by them in hospital, staff structure in hospital – HIS. Need for evolving health policy, health organization in state, health financing system, health education, health insurance, health legislation

UNIT II HOSPITAL AND INDUSTRIAL ORGANIZATION **(9 Hrs)**

Difference between hospital and industrial organization, levels of training, steps of training, developing training program, evaluation of training, wages and salary, employee appraisal method.

UNIT III STANDARDIZATION **(9 Hrs)**

Necessity for standardization, FDA, AERB, Joint Commission of Accreditation of hospitals, ICRP and other standard organization, methods to monitor the standards.

UNIT IV STRATEGIC MANAGEMENT IN HOSPITALS **(9 Hrs)**

Nature and value of strategic management in hospitals - Awareness on the application of IT in Various functions of Hospital. Application of statistical tools in the areas of Health services. Introduction to support services – Disaster management, Ambulance services, Laundry services, Civil Assets.

UNIT V SAFETY MEASURES **(9 Hrs)**

Elements of Safety - Safety Publications and Standards Organizations - Orientation to Laboratory Safety - Types of risks in the hospitals - factors of environment - Safety showers and Eye Washes – Radiation hazards – radiation detection – safety measures – standards. Ergonomics - Flammables and Explosives – Formaldehydes - PEL Standards and Calculations - Material Safety - Organization of Safety in the hospitals.

Text Books

1. Joydeep Das Gupta, "Hospital Administration and Management: A Comprehensive Guide", Jaypee Brothers Medical Publishers, 2015.
2. Saxena.M, "Hospital Management", CBS Publishing, First edition, 2016.
3. Girdhar J Gyani and Alexander Thomas, "Handbook of Healthcare quality and patient safety" Second edition, Jaypeebrothers medical publisher, 2019.

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Reference Books

1. Sonu Dr. Goel, "Textbook of Hospital Administration", Elsevier, 2014.
2. William Charney,"Handbook of Modern Hospital Safety", CRC press, Second edition, 2010.
3. Ramani. K. V, "Hospital Management", Pearson, 2011.
4. Arnold D. Kalcizony& Stephen M. Shortell, "Health Care Managementll", Sixth Edition,Cengage Learning, 2011.
5. Cindy Taylor, "The Hospital Safety Professional's Handbook", Fifth Edition, 2015.

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2. http://www.who.int/hac/techguidance/preparedness/hospital_safety_index_forms.pdf
3. https://www.who.int/news-room/fact-sheets/detail/patient-safety
4. https://www.coursera.org/browse/health/healthcare-management
5. https://www.who.int/management/newitems/en/index1.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	-	-	-	-	3	-	-	-	-	3	-	-
2	3	3	2	2	-	-	-	3	-	-	-	-	3	-	-
3	3	3	2	2	-	-	-	3	-	-	-	-	3	-	-
4	3	3	2	2	-	-	-	3	-	-	-	-	3	-	-
5	3	3	3	3	3	-	3	3	-	-	-	-	3	2	2

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BME403	ENVIRONMENTAL BIOTECHNOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn about the basic concepts of environmental biotechnology
- To understand about the biodegradation and bioremediation
- To gain knowledge on microbiological treatment technologies
- To replace conventional treatment methodologies by using biocatalyst and bioreactors
- To understand the various bioproducts production and composting technology

Course Outcomes

After completion of the course, the students will be able to

CO1 - Gain knowledge in the basic concepts of environmental biotechnology **(K2)**

CO2 - Familiarize with the biodegrading and bioremediation modules and its functions **(K2)**

CO3 - Describe the principles of microbiological treatment technologies to clean up contaminated environments. **(K3)**

CO4 - Explain the replacement of conventional treatment methodologies by using biocatalyst and bioreactors **(K3)**

CO5 - Understand the various bioproducts production and composting technology **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Biotechnology in the reduction of carbon dioxide emission- Microbial flora of soil - Microbial treatment of heavy Metal – bioleaching, bioaccumulation, biosorption and bioprecipitation Understand the various bioproducts production and composting technology of heavy metals - Soil, water and air - sources and effects - Removal of Pollutants.

UNIT II BIODEGRADATION AND BIOREMEDIATION (9 Hrs)

Aerobic degradation of aliphatic and aromatics compounds - Anaerobic degradation of aromatic compounds - Biodegradation of herbicides and pesticides - Remediation Technologies - Bioventing, biosparging and bioslurping, phytoremediation - Biodesulphurization of coal and oil - microbial treatment of oil pollution.

UNIT III MICROBIAL TREATMENT OF WASTE AND WASTE WATER (9 Hrs)

Biological treatment of anaerobic and aerobic- methanogenesis, methanogenic, acetogenic- Use of genetically engineered organisms - Biotechnological Processes in waste - water treatment; Applications include treatment of municipal and industrial wastewaters.

UNIT IV BIOCATALYSTS AND BIOREACTORS (9 Hrs)

Enzymes isolation, whole cell systems - Biocatalytic Application - Advantages & Disadvantages- Design of activated sludge process and anaerobic digestion system - Trickling Filter - Rotating biological contactors - Fluidized bed reactor - Up-flow anaerobic sludge blanket reactor (UASB) - High-rate anaerobic wastewater treatment.

UNIT V BIOPRODUCTS AND RENEWABLE SOURCES (9 Hrs)

Biofertilizers – Biopesticides - Biofuel production – Bioethanol – Biohydrogen – Biodiesel - Bioplastics and biopolymers - Composting technologies, composting systems, compost quality.

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Text Books:

1. Bhattacharya B. C. and Banerjee R, " Environmental Biotechnology", Oxford University Press, 2017.
2. Jordening H. J. and Winter J., "Environmental Biotechnology: Concepts and Application", Wiley , 2015.
3. Bruce Rittmann and Perry McCarty," Environmental Biotechnology", McGraw-Hill, 2011.

Reference Books:

1. W.D. Grant & P.E. Long, Blakie, Environmental Microbiology, Springer, 2019.
2. H. Polasa,Microbial Gene Technology, South Asian Publishers, 2011.
3. D. L. Wise, Biotreatment Systems.CRC Press, 2010.
4. A.K. Chatterji," Introduction to Environmental Biotechnology", Prentice Hall of India Pvt. Ltd.,2003
5.Pramod Kumar, Vipin Kumar**,** Pravin Kumar Sacha**,"**Textbook of Environmental Biotechnology **",** Woodhead Publishing India**,** 2019.

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2. http://dbtindia.gov.in/schemes-programmes/research-development/energy-environment-and-bio-resource-based-applications-0
3. https://www.hindawi.com/journals/scientifica/si/269412/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	2	-	-	2	-	-	-	-	-	2	2	-	-
2	2	2	2	-	-	2	-	-	-	-	-	2	2	-	-
3	2	2	3	2	-	2	-	-	-	-	-	2	2	-	-
4	2	2	2	2	2	2	-	-	-	-	-	2	2	-	-
5	2	2	2	2	2	2	-	-	-	-	-	2	2	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BME404	BIOMETRIC RECOGNIZATION SYSTEM	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the technological development and its importance of Biometrics
- To understand the general principles of design of biometric systems in Fingerprint and its underlying trade-offs.
- To recognize personal privacy and security implications of biometrics based Face identification technology.
- To understand the performance of multimodal biometric and evaluation.
- To identify issues in the realistic evaluation of biometrics based systems.

Course Outcomes

After completion of the course, the students will be able to

CO1-Understand the knowledge of engineering principles underlying biometric systems**(K2)**
CO2- Apply algorithms to model finger print**(K3)**
CO3- Classify different face recognition and hand geometry pattern**(K3)**
CO4 - Analyze the design and performance of biometrics**(K3)**
CO5- Explain various computations ofauthentication methods**(K2)**

UNIT I INTRODUCTION TO BIOMETRICS   (9 Hrs)

Introduction and back ground – biometric technologies – passive biometrics – active biometrics - Biometric systems – Enrollment – templates – algorithm – verification – Biometric applications – biometric characteristics-Authentication technologies –Need for strong authentication - Protecting privacy and biometrics and policy – Biometric applications – biometric characteristics.

UNIT II FINGERPRINT TECHNOLOGY   (9 Hrs)

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modeling of fingerprint images – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching

UNIT III FACE RECOGNITION AND HAND GEOMETRY   (9 Hrs)

Introduction to face recognition, Neural networks for face recognition – face recognition from correspondence maps – Hand geometry – scanning – Feature Extraction - Adaptive Classifiers - Visual-Based Feature Extraction and Pattern Classification - feature extraction – types of algorithm – Biometric fusion.

UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION   (9 Hrs)

Voice Scan – physiological biometrics –Behavioral Biometrics - Introduction to multimodal biometric system – Integration strategies – Architecture – level of fusion – combination strategy – training and adaptability – examples of multimodal biometric systems – Performance evaluation-Statistical Measures of Biometrics – FAR – FRR – FTE – EER – Memory requirement and allocation.

UNIT V BIOMETRIC AUTHENTICATION   (9 Hrs)

Introduction - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint -Biometric Authentication by Face Recognition. Expectation-Maximization theory - Support Vector Machines. Biometric authentication by fingerprint – biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication.

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Text Books

1. Joseph N. Pato, Lynette I. Millette, "Biometric Recognition: Challenges and Opportunities", 2010.

2. Zhenan Sun, Jianhuang Lai, Xilin Chen, Tieniu Tan, " Biometric Recognition" Sixth Chinese conference, 2011.

3. Anil Kumar Jain, Arun A Ross, KarthikNandakumar, "Introduction to Biometrics", Springer, 2011.

Reference Books

1. Ravi Das, "Biometric Technology: Authentication, Biocryptography and cloud based architecture", CRC Press, 2014.
2. Sebastien Marcel, Mark S Nixon, Stan Z. Li, "Handbook of Biometric Anti- spoofing", springer, 2014.
3. Mohammad S Obaidat, IssaTraoreIssacWoungang, "Biometric- Based Physical and cybersecurity systems", springer, 2018.
4. Amine Nait-ali, "Hidden Biometrics when biometric security meets Biomedical Engineering", Springer, 2019.
5. Ted Dunstone, "Biometric system and Data Analysis", Springer, 2010.

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1. https://www.mooc-list.com/tags/biometric
2. https://www.coursera.org/lecture/usable-security/biometric-authentication-RXVog
3. https://www.udemy.com/course/biometrics/
4. https://nptel.ac.in/courses/106/104/106104119/
5. http://www.scholarpedia.org/article/Biometric_authentication

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	1	-	-	-	-	3	2	-
2	3	2	2	2	2	-	-	1	-	-	-	-	3	2	-
3	3	2	2	2	2	-	-	1	-	-	-	-	3	2	-
4	3	2	2	2	2	-	-	1	-	-	-	-	3	2	-
5	3	2	2	2	2	-	-	1	-	-	-	-	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20BME405	LASER AND FIBER OPTICS IN MEDICINE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives:
- To expose the basic concepts of optical fibers and their industrial applications.
- To provide basic concepts of lasers.
- To understand how Lasers used in medical practice
- To provide adequate knowledge about application of optical fibers.
- To gain knowledge in the applications of laser in medicine

Course Outcomes:
After completion of the course, the students will be able to
CO1 -Understand the basic principles of optical fibers **(K2)**
CO2- Acquire knowledge on various types of lasers **(K2)**
CO3- Familiarize with the use of laser systems in medicine **(K2)**
CO4- Apply optical fiber technology for different applications **(K3)**
CO5 - Analyse the applications of laser in medicine**(K3)**

UNIT I OPTICAL FIBERS AND THEIR PROPERTIES (9 Hrs)
Introduction to optical fiber - fiber characteristics - principles of light propagation through a fiber - Different types of fibers and their properties - Losses in the optical fiber - Dispersion - advantages and disadvantages of optical fibers

UNIT II LASER FUNDAMENTALS (9 Hrs)
Laser Fundamentals: Introduction to lasers - Laser characteristics – Laser configuration – Three level and four level lasers – Q-switching – Mode locking – Types of lasers: Gas lasers, Solid lasers, Liquid lasers and Semiconductor lasers.

UNIT III LASER SYSTEMS (9 Hrs)
Lasers used in medical practice: Ruby laser, CO_2 laser, Nd-Y AG laser and related solid-state laser. Laser - Tissue Interaction: Terminology, spectral band designations, energy & power, irradiant & radiant exposure.

UNIT IV APPLICATIONS OF OPTICAL FIBERS (9 Hrs)
Interferometer method of measurement of length – Moire fringes – Measurement of pressure, Temperature, Current, Voltage, Liquid level and strain - fiber optic Gyroscope – Polarization maintaining fibers - Applications.

UNIT V LASER APPLICATIONS IN MEDICINE (9 Hrs)
Application in general surgery-Dermatology, Ophthalmology, Cardiovascular &chest surgery, Dentistry, Neuro surgery, Otolaryngology & head and neck surgery, Tumor surgery, Gynecologic laser, Endoscopy, Laparoscopy.

Text Books
1. Abraham Katzir, "Lasers and Optical Fibers in Medicine", Academic press Inc, 2012.
2. Helena Jelinkova, "Lasers for medical Applications", Woodhead Publishing, 2013.
3. David A Boas, "Handbook of Biomedical Optics", CRC Press, 2011.

Reference Books
1. Jeff Hecht, "Understanding Fiber Optics", fourth edition, Prentice Hall publishers, 2015.
2. Tuan Vo-Dinh, "Biomedical Photonics Handbook", 3 volume set, 2018.
3. Tosi Daniele, "Fiber optics Sensor for Biomedical Applications", 2010.
4. KeyvanNouri, "Laser in Dermatology and Medicine", Springer, 2011.

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5. Nagabhushana, "Laser and Optical Instrumentation", I.K International House Pvt Ltd. 2010.

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2. https://en.wikipedia.org/wiki/Optical_fiber
3. https://ethw.org/Fiber_Optics
4. https://www.classcentral.com/course/swayam-fiber-optics-7913
5. https://ocw.mit.edu/resources/res-6-005-understanding-lasers-and-fiberoptics-spring-2008/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	-	1	-	-	1	-	-	-	-	-	1	2	-	1
2	3	1	2	-	1	1	-	-	-	-	-	1	2	1	1
3	3	2	2	-	1	1	-	-	-	-	-	1	2	2	1
4	3	2	2	2	2	1	-	-	-	-	-	1	2	2	1
5	3	2	2	2	2	1	-	-	-	-	-	1	2	2	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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OPEN ELECTIVE -I

	ELECTRICAL SAFETY	L	T	P	C	Hrs
U20EEO402	(Common to ECE, ICE, MECH, CIVIL, Mechatronics, CCE, BME, IT, CSE, FT)	3	0	0	3	45

Course Objectives

* To familiarize the Indian Electricity Rules and Act related with electrical safety.
* To provide a knowledge about electrical shocks and safety precautions.
* To create awareness of the electrical safety associated with installation of electrical equipment.
* To analyze different Hazardous areas for electrical safety.
* To expose knowledge about necessity of safety policy and safety management.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Describe the Indian Electricity (IE) acts and various rules for electrical safety.**(K2)**
CO2 - Expose safety measures to prevent electrical shock in handling of domestic electrical appliances**. (K3)**
CO3 - Evaluate the safety aspects during installation of plant and equipment**. (K3)**
CO4 - Describe the various hazardous area and application of electrical safety in various places**. (K3)**
CO5 - Acquire knowledge about importance of electrical safety training to improve quality management in electrical systems**. (K3)**

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS   (9 Hrs)

Objective and scope of electrical safety - National electrical Safety code - Statutory requirements – Indian Electricity acts related to electrical Safety - Safety electrical one line diagram - International standards on electrical safety safe limits of current and voltage - Grounding of electrical equipment of low voltage and high voltage systems - Safety policy - Electrical safety certificate requirement

UNIT II ELECTRICAL SHOCKS AND THEIR PREVENTION   (9 Hrs)

Primary and secondary electrical shocks - Possibilities of getting electrical shock and its severity - Effect of electrical shock of human being - Shocks due to flash/ Spark over's - Firing shock - Multi storied building - Prevention of shocks - Safety precautions - Safe guards for operators - Do's and Don'ts for safety in the use of domestic electrical appliances - Case studies on electrical causes of fire and explosion

UNIT III SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE   (9 Hrs)

Need for inspection and maintenance - Preliminary preparations - Field quality and safety - Personal protective equipment - Safe guards for operators - Safety equipment - Risks during installation of electrical plant and equipment - Effect of lightning current on installation and buildings - Safety aspects during installation -Safety during installation of electrical rotating machines - Importance of earthing in installation– Agricultural pump installation

UNIT IV HAZARDOUS ZONES   (9 Hrs)

Primary and secondary hazards - Hazardous area classification and of electrical equipments (IS, NFPA, API and OSHA standards) - Explosive gas area classifications: Class I(Division 1) - Zone 0, Zone 1, zone 2 classified locations, Design Philosophy for Equipment and installations-Classification of equipment enclosure for various hazardous gases and vapors - flash hazard calculation and approach distances- calculating the required level of arc protection

UNIT V SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS   (9 Hrs)

Principles of Safety Management - Occupational safety and health administration standards - Safety organization - Safety auditing - Employee electrical safety teams - Electrical safety training to improve Quality management - Total quality control and management – Importance of high load factor - Causes of low power factor - Disadvantages of low power factor - Power factor improvement - Importance of P.F. improvement - Case studies of electrical workplace safety practices.

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Text books

1. John Cadick, Mary Capelli Schellpfeffer, Dennis Neitzel, Al Winfield, "Electrical Safety Handbook", McGraw-Hill Education, 4th Edition, 2012.
2. Madden, M. John, "Electrical Safety and the Law: A Guide to Compliance", Wiley publications, 4th Edition, 2002.
3. Mohamed A. El-Sharkawi, "Electric Safety: Practice and Standards", CRC Press; 1st Edition, 2013.

Reference books

1. Rob Zachariason, "Electrical Safety", Delmar Cengage Learning, 1st Edition, 2011.
2. Peter E. Sutherland, "Principles of Electrical Safety", Wiley-IEEE Press; 1st Edition, 2014.

Web References

1. https://www.apeasternpower.com/downloads/elecact2003.pdf
2. https://safetyculture.com/topics/electrical-hazards/
3. https://www.jove.com/science-education/10114/electrical-safety-precautions-and-basic-equipment
4. https://electrical-engineering-portal.com/21-safety-rules-for-working-with-electrical-equipment
5. https://www.electrical4u.com/safety-precautions-for-electrical-system/
6. https://www.constellation.com/energy-101/electrical-safety-tips.html

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	-	2	-	-	-	-	-	-	1	-	2
2	3	3	3	2	-	2	-	-	-	-	-	-	1	-	2
3	3	3	3	2	-	2	-	-	-	-	-	-	1	-	2
4	3	3	3	2	-	2	-	-	-	-	-	-	1	-	2
5	3	3	3	2	-	2	-	-	-	-	-	-	1	-	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20ECO401	**ENGINEERING COMPUTATION WITH MATLAB** (Common to EEE, ICE, MECH, CIVIL, CCE, BME, AI&DS, Mechatronics)	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives

- To understand basic representation of Matrices and vectors in MATLAB
- To learn various programming structures in MATLAB
- To study built in and user defined functions in MATLAB.
- To become conversant with 2D as well as 3D graphics in MATLAB
- To make a Graphical User Interface (GUI) in MATLAB in order to achieve interactivity

Course Outcomes

After completion of the course, students will be able to

CO1 - Statethe basics of MATLAB **(K1)**

CO2 - Explain how to work with matrices, and their operations **(K2)**

CO3 - Use the MATLAB functions relevant to communication engineering**, (K3)**

CO4 - Demonstrates various file operations in MATLAB **(K3)**

CO5 - Applying the plotting capabilities of MATLAB effectivelyto various systems. **(K3)**

UNIT I INTRODUCTION TO MATLAB   (9 Hrs)

Menus & Tool bars, Variables - Matrices and Vectors - initializing vectors - Data types- Functions – User defined functions - passing arguments - writing data to a file-reading data from a file - using functions with vectors and matrices- cell arrays & structures - Strings - 2D strings-String comparing - Concatenation - Input and Output statements - Script files .

UNIT II LOOPS& CONTROL STATEMENTS   (9 Hrs)

Introduction; Relational & Logical operations - Example programs - Operator precedence - Control & Decision statements- IF - IF ELSE - NESTED IF ELSE - SWITCH - TRY & CATCH - FOR -WHILE - NESTED FOR - FOR with IF statements, MATLAB program organization, Debugging methods - Error trapping using eval&lastern commands.

UNIT III PLOTS IN MATLAB & GUI   (9 Hrs)

Basic 2D plots, Labels, Line style, Markers, plot, subplot, LOG, LOG-LOG, SEMILOG-POLARCOMET, Grid axis, labeling, fplot, ezplot, ezpolar, polyval, exporting figures, HOLD, STEM, BAR, HIST, Interactive plotting, Basic Fitting Interface – Polyfit - 3D plots – Mesh - Contour - Example programs. GUI - Creation Fundamentals – Capturing mouse actions

UNIT IV MISCELLANEOUS TOPICS   (9 Hrs)

File & Directory management - Native Data Files - Data import & Export - Low Level File I/O – Directory management - FTP File Operations - Time Computations -Date & Time – Format Conversions - Date & Time, Functions - Plot labels - Optimization - zero Finding - Minimization in one Dimension - Minimization in Higher Dimensions- Practical Issues. Differentiation & Integration using MATLAB, 1D & 2D Data Interpolation

UNIT V SIMULINK & APPLICATIONS   (9 Hrs)

How to create & run Simulink, Simulink Designing - Using SIMULINK Generating an AM signal & 2nd order systems - Designing of FWR & HWR using Simulink - Creating a subsystem in Simulink. Applications Programs

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-Frequency response of filters. Open Loop gain of OPAMP, I/P characteristics of BJT, Plotting the graph between Breakdown voltage & Doping Concentration.

Text Books

1. RudraPratap, Getting Started with MATLAB 6.0 ,1st Edition, Oxford University Press-2004.
2. Duane Hanselman ,Bruce LittleField, "Mastering MATLAB 7", Pearson Education Inc, 2005
3. William J.Palm, "Introduction to MATLAB 6.0 for Engineers", McGraw Hill & Co, 2001.

Reference Books

1. M.Herniter, "Programming in MATLAB", Thomson Learning, 2001
2. John OkyereAltla, "Electronics and circuit analysis using MATLAB", CRC press, 1999
3. K.K.Sharma, "MATLAB Demustifyied", Vikas Publishing House Pvt Ltd. 2004

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1. https://www.mathworks.com/products/matlab.html
2. https://www.tutorialspoint.com/matlab/index.htm
3. https://www.cmu.edu/computing/software/all/matlab/
4. https://ctms.engin.umich.edu/CTMS/index.php?aux=Home

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	2	-	2	3	-	-	-	-	-	-	-	1	3	-
2	2	2	-	2	3	-	-	-	-	-	-	-	1	3	-
3	2	2	-	2	3	-	-	-	-	-	-	-	-	3	-
4	2	2	-	2	3	-	-	-	-	-	-	-	-	3	-
5	2	2	-	2	3	-	-	-	-	-	-	-	-	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20ECO402	**CONSUMER ELECTRONICS** (Common to EEE, ICE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics, FT)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To enable thetroubleshoot of different types of microphones and loudspeakers
- To make the students to analyse the working of digital console, digital FM tuner and troubleshoot audio systems
- To train to test the working of various colour TV
- To empower them to troubleshoot colour TV receivers
- To equip them to maintain various electronic home and office appliances

Course Outcomes

After completion of the course, students will be able to

CO1 - Describe the fundamental audio characteristics and measurements, operating principles of microphone and loudspeaker **(K1)**

CO2 - Explain the working of digital console, digital FM tuner and troubleshoot the audio systems **(K2)**

CO3 - Distinguish the salient features of colour TV and Monochrome and troubleshoot TV camera **(K2**)

CO4 - Demonstrate various interfaces in digital TV, the working of DTH receiver, CD/DVD players **(K3)**

CO5 - Explain the working of FAX, Microwave oven, Washing machine, Air conditioner, Refrigerators and camera **(K2)**

UNIT I AUDIO FUNDAMENTALS AND DEVICES (9 Hrs)

Basic characteristics of sound signal, Microphone- working principle, sensitivity, nature of response. Types of Microphone, Loud speaker- working principle, Woofers and Tweeters, characteristics.Types of Loudspeaker. Sound recording

UNIT II AUDIO SYSTEMS (9 Hrs)

Introduction to audio system, Digital Console- Block diagram, working principle,applications, FM tuner- concepts of digital tuning, ICs used in FM tuner TD702IT, PA address system- Planning, speaker impedance matching, characteristics, Power amplifier specification

UNIT III TELEVISION SYSTEMS (9 Hrs)

Monochrome TV standards, Components of TV system, scanning process, aspect ratio, persistence of vision and flicker, interlace scanning, picture resolution. Composite video signal,Colour TV standards, colour theory, hue, brightness, saturation, luminance and chrominance. Different types of TV camera.

UNIT IV TELEVISION RECEIVERS AND VIDEO STANDARDS (9 Hrs)

Colour TV receiver- block diagram, Digital TVs- LCD, LED , PLASMA, HDTV, 3-D TV, projection TV, DTH receiver, Video interface: Composite, Component, Separate Video, Digital Video, SDI, HDMI, Digital Video Interface, CD and DVD player: working principles, interfaces

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UNIT V HOME AND OFFICE APPLIANCES   (9 Hrs)

Microwave Oven: Types, technical specifications. Washing Machine: hardware and software. Air conditioner and Refrigerators: Components features, applications, and technical specification. Digital camera and cam coder: - pick up devices, picture processing, picture storage

Text Books

1 Bali S.P. , 'Consumer Electronics', **copyright 2008**,Pearson Education India
2 Bali R and Bali S.P. 'Audio video systems : principle practices & troubleshooting', Khanna Book Publishing Co. (P) Ltd
3 Gulati R.R., 'Modern Television practices', 5th edition, 2015, New Age International Publication (P) Ltd

Reference Books

1 Gupta R.G., 'Audio video systems', 2nd edition,2017, Tata Mcgraw Hill, New Delhi, India
2 Whitaker Jerry & Benson Blair, 'Mastering Digital Television', McGraw-Hill Professional, 2006
3 Whitaker Jerry & Benson Blair, 'Standard handbook of Audio engineering', 2nd edition,2002, McGraw-Hill Professional

Web References

1 http://www.scientificamerican.com/article.cfm?id = expertsbluetooth-work
2 http://www.cosc.brocku.ca/Offerings/3P92/seminars/HDTV.ppt
3 http://www.circuitstoday.com/blu-ray-technology-working
4 http://www.freevideolectures.com

COs Mapping with POs and PSOs

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	-	2	1	-	1	-	-	-	-	-	-	-	1	-
2	2	-	2	1	-	1	-	-	-	-	-	-	-	1	-
3	2	-	2	1	-	1	-	-	-	-	-	-	-	1	-
4	2	-	2	1	-	1	-	-	-	-	-	-	-	1	-
5	2	-	2	1	-	1	-	-	-	-	-	-	-	1	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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		L	**T**	**P**	**C**

U20CSO401

WEB DEVELOPMENT
(Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)   **3   0   0   3**

Course Objectives
- To study the fundamentals of web application development
- To understand the design components and tools using CSS
- To learn the concepts JavaScript and programming fundamentals.
- To study about advance scripting and Ajax applications.
- To understand the working procedure of XML

Course Outcomes
After the completion of the course, the students will be able to
CO1 - Develop basic web applications. **(K5)**
CO2 - Design the web applications using CSS. **(K5)**
CO3 - Validate the web pages using javascripts functions. **(K5)**
CO4 - Demonstrate the web 2.0 application to advance scripts. **(K3)**
CO5 - Update the knowledge of XML Data. **(K4)**

UNIT I INTRODUCTION TO WWW & HTML   (9 Hrs)
Protocols, secure connections, application and development tools, the web browser, What is server, dynamic IP, Web Design: Web site design principles, planning the site and navigation. HTML: The development process, Html tags and simple HTML forms, web site structure.

UNIT II STYLE SHEETS   (9 Hrs)
Need for CSS, introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2.

UNIT III JAVASCRIPTS   (9 Hrs)
Client side scripting, What is JavaScript, How to develop JavaScript, simple Javascript, variables, functions, conditions, loops and repetition.

UNIT IV ADVANCE SCRIPT   (9 Hrs)
JavaScript and objects, JavaScript own objects, the DOM and web browser environments, forms and validations DHTML: Combining HTML, CSS and Javascript, events and buttons, controlling your browser, Ajax: Introduction, advantages & disadvantages, ajax based web application, alternatives of ajax.

UNIT V XML   (9 Hrs)
Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application.XML, XSL and XSLT. Introduction toXSL, XML transformed simple example, XSL elements, transforming with XSLT.

Text Books
1. P.J. Deitel AND H.M. Deitel," Internet and World Wide Web - How to Program", Pearson   Education, 2009.
2. Keith Wald, Jason Lengstorf," Pro PHP and jQuery", Paperback, 2016.
3. Semmy Purewal, "Learning Web App Development", O'Reilly Media, Inc.

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Reference Books

1. UttamK.Roy, "Web Technologies", Oxford University Press, 2010.
2. Rajkamal, "Web Technology", Tata McGraw-Hill, 2009.
3. Steven Suehring, Janet Valade, "PHP, MySQL, JavaScript & HTML5 All-in-One", John Wiley & Sons, Inc, 2013.
4. Yakov Fain, Victor Rasputnis, Anatole Tartakovsky and Viktor Gamov, "Enterprise Web Development ", O'Reilly Media, 2014.
5. Shklar, Leon, Rosen, Rich, "Web Application Architecture: Principles, Protocols and Practices", Wiley Publication, 2009.

Web References

1. https://www.w3schools.com
2. https://www.geeksforgeeks.org/web-technology/
3. https://www.guru99.com/cakephp-tutorial.html
4. https://www.ithands.com/blog/cms-or-php-framework-which-technology-is-better-for-my-business
5. http://Oriel.ly/learning-web-app

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	3	3	3	3	-	-	3	-	3	2	-
2	2	2	2	2	-	2	-	2	-	2	-	2	3	2	-
3	3	3	3	3	3	3	3	3	-	-	3	-	3	2	-
4	2	2	2	2	-	2	-	2	-	2	-	2	3	2	-
5	2	2	2	2	-	2	-	2	-	2	-	2	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 – High

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ANALYSIS OF ALGORITHMS	**L**	**T**	**P**	**C**
U20CSO402 (Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)	**3**	**0**	**0**	**3**

Course Objectives

- To analyze the performance of algorithms in terms of time and space complexity
- To understand how the choice of algorithm design methods such as divide and conquer, greedy method impacts the performance of programs.
- To solve problems using Dynamic Programming and derive the time complexity
- To solve problems using Backtracking technique and derive the time complexity
- To solve problems using Branch and Bound technique and derive the time complexity

Course Outcomes

After the completion of the course, the students will be able to

CO1 - Choose the appropriate data structure and algorithm design method for a specified application.**(K2)**

CO2 - Ability to understand the design technique such as divide and conquer, greedy method applied to realistic problems and analyse them. **(K3)**

CO3 - Ability to understand the dynamic programming design technique and how it is applied to realistic problems and analyze them. **(K3)**

CO4 - Ability to understand the backtracking design technique and how it is applied to realistic problems and analyze them. **(K3)**

CO5 - Ability to understand Branch and Bound design technique and how it is applied to realistic problems and analyze them. **(K2)**

UNIT I INTRODUCTION   (9 Hrs)

Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Time complexity, Space complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation.

UNIT II DIVIDE AND CONQUER METHOD AND GREEDY METHOD   (9 Hrs)

Divide and Conquer method:, Applications- Binary search, Merge sort, Quick sort.
Greedy method: General method, applications -, Knapsack problem, Minimum cost spanning trees, Single source shortest path problem.

UNIT III DYNAMIC PROGRAMMING   (9 Hrs)

Dynamic Programming: Applications - Multistage graphs, 0/1 knapsack problem, All pairs shortest path problem, Traveling salesperson problem, Reliability design.

UNIT IV BACKTRACKING   (9 Hrs)

Backtracking: General method, Applications-N-queen problem, Sum of subsets problem, Graph coloring-Hamiltonian Cycles.

UNIT V BRANCH AND BOUND   (9 Hrs)

Branch and Bound: General method, Applications - Traveling sales person problem, 0/1 knapsack problem-LC Branch and Bound solution, FIFO Branch and Bound solution.

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Text Books

1. E. Horowitz and S.Sahni, "Fundamentals of Algorithms", 2nd Edition, Galgotia Publications, 2010.
2. T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, "Introduction to Algorithms", 3rdEdition, PHI/Pearson Education, 2009.
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.

Reference Books

1. Michael T. Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", Wiley India, 2006.
2. Sara Baase and Allen Van Gelder, "Computer Algorithms Introduction to Design and Analysis", 3rd Edition, Pearson Education Asia, 2010.
3. Donald E Knuth, "The Art of Computer Programming, Volume I & II", Revised Re-Third Edition, Addison Wessely, 2011.
4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.
5. Harsh Bhasin, "Algorithms Design and Analysis", Oxford university press, 2016.

Web References

1. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/
2. https://www.javatpoint.com/daa-tutorial
3. https://www.guru99.com/design-analysis-algorithms-tutorial.html
4. https://www.geeksforgeeks.org/fundamentals-of-algorithms/
5. https://swayam.gov.in/nd1_noc20_cs71/preview

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	2	2	1	-	-	-	-	-	3	2	-
2	3	2	3	3	2	2	1	-	-	-	-	-	3	2	-
3	3	3	3	3	2	2	2	-	2	-	-	-	3	2	-
4	3	2	3	3	3	2	2	-	-	-	3	-	3	2	-
5	3	3	3	3	2	2	2	-	-	-	3	2	3	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20ITO401	**DATABASE SYSTEM: DESIGN & DEVELOPMENT** (Common to EEE, ECE, ICE, CCE, BME)	**L** 3	**T** 0	**P** 0	**C** 3	**Hrs** 45

Course Objectives

- Understand the various data models, conceptualize E-R diagram and depict using relational model
- Gain knowledge about database languages and frame query using Relational Algebra and SQL
- Understand and design an efficient database schema using the various normal forms
- Impart knowledge on data storage and transaction processing, concurrency control techniques and recovery procedures
- Explore knowledge on tools and practice case studies

Course Outcomes

After completion of the course the students will be able to:

CO1 - Explain the concepts of Database Management System and develop Entity Relationship model and Relational Models for a given application **(K2)**

CO2 - Manipulate and build database queries using Structured Query Language and relational algebra **(K2)**

CO3 - Apply data normalization principles to develop a normalized database for a given application.**(K3)**

CO4 - Explain various storage & indexing techniques, transactions and recovery techniques **(K2)**

CO5 - Apply tools like NoSQL, MongoDB, Cassandra on real time applications **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Database Systems– Data Models – Database System Architecture - Entity-Relationship Model - ER Diagram- Extended ER Model –ER into Relational Model - **Relational Model**: Structure of Relational Databases, Database Schema, Keys, Tables

UNIT II DATABASE LANGUAGES (9 Hrs)

Relational Algebra – Extended-Relational Algebra Operations –**SQL**: Introduction – DDL – DML –Integrity Constraints-Set Operations-Joins – Nested Queries -View- Trigger - Stored Procedures

UNIT III RELATIONAL-DATABASE DESIGN (9 Hrs)

Introduction to Schema Refinement – Decomposition – Lossless Decomposition – Functional Dependencies – Normal Forms - First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Fourth Normal Form.

UNIT IV DATA STORAGE (9 Hrs)

RAID - File Organization - Indexing, Ordered Index, Index files, Hashing - Static and dynamic hashing. **Transactions**: Transaction concepts and states– Concurrent Execution-Serializability-Concurrency Control: Lock based Protocol - Timestamp based Protocol - **Recovery System**: – Log-Based Recovery – Shadow Paging

UNIT V CASE STUDY (9 Hrs)

NoSQL – Document Database : MongoDB - Multi-dimensional: Cassandra

Text Books

1. Silberschatz, Korth, Sudarshan, *Database System Concepts*, 7th Edition – McGraw-Hill Higher Education, International Edition, 2019.
2. Ramez Elmasri, and Shamkant B. Navathe, Fundamentals of Database Systems (7th edition), Publisher: Pearson,2016

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Reference Books

1. Raghu Ramakrishnan, —Database Management Systems, Fourth Edition, McGraw-Hill College Publications, 2015.
2. Date C J, Kannan A and Swamynathan S, —An Introduction to Database Systems‖, 8th Edition, Pearson Education, New Delhi, 2006.
3. Alan Beaulieu, Mastering SQL Fundamentals, Second Edition, O'Reilly,2009
4. Kristina Chodorow; Shannon Bradshaw MongoDB: The Definitive Guide, 3rd Edition, O'Reilly Media, Inc., 2018.
5. Pramod J. Sadalage (Author), Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence 1stEdition, Kindle Edition

Web References

1. http://www.database.com/
2. http://cassandra.apache.org/
3. https://www.mongodb.com/

CO-POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
2	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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	R PROGRAMMING	**L**	**T**	**P**	**C**	**Hrs**
U20ITO402	(Common to EEE, ECE, ICE, CCE, BME, MECH, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the basics in R programming in terms of constructs, control statements, string functions
- To learn to apply R programming for Text processing
- To understand the use of data frames and tables
- To able to appreciate and apply the R programming from a statistical perspective
- To understand the interface model

Course Outcomes

After completion of the course the students will be able to:

CO1 - Create artful graphs to visualize complex data sets and functions.**(K3)**
CO2 - Write more efficient code using parallel R and vectorization.**(K3)**
CO3 - Create data frames and working with tables.**(K3)**
CO4 - Interface R with C/C++ and Python for increased speed or functionality.**(K2)**
CO5 - Find new packages for text analysis, image manipulation & perform statistical analysis.**(K4)**

UNIT I INTRODUCTION   (9 Hrs)

Introducing to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names

UNIT II MATRICES AND ARRAYS   (9 Hrs)

Matrices, Arrays And Lists Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists.

UNIT III DATA FRAMES   (9 Hrs)

Data Frames Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions

UNIT IV FUNCTIONS AND ARGUMENTS   (9 Hrs)

Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Environment and Scope issues – Writing Upstairs - Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots

UNIT V INTERFACING   (9 Hrs)

Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear models – Non-linear models – Time Series and Auto-correlation – Clustering.

Text Books

1. Norman Matloff, "The Art of R Programming: A Tour of Statistical Software Design", No Starch Press, 2011.

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2. Jared P. Lander, "R for Everyone: Advanced Analytics and Graphics", Addison-Wesley Data & Analytics Series, 2013.

Reference books
1. Mark Gardener, " Beginning R – The Statistical Programming Language", Wiley, 2013
2. Robert Knell, "Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R", Amazon Digital South Asia Services Inc, 2013.

Web References
1. https://www.coursera.org/learn/r-programming
2. https://www.r-project.org/

CO-POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20MEO401	**RAPID PROTOYPING**	L	T	P	C	Hrs
	(Common to EEE, ECE, ICE, CIVIL, BME, FT)	3	0	0	3	45

Course Objectives

- To understand the development of RP systems
- To learn the classification of liquid based and solid based rapid prototyping systems
- To understand the powder based rapid prototyping systems
- To learn about the materials for rapid prototyping systems
- To discuss about the reverse engineering and new technologies

Course Outcomes

On successful completion of the course, students will be able to

CO1 - Acquire knowledge about the product development**(K1)**

CO2 -Analyse the classification of liquid based and solid based rapid prototyping systems**(K4)**

CO3 - Analyse the powder based rapid prototyping systems**(K4)**

CO4 -Acquire knowledge about the materials for rapid prototyping systems**(K1)**

CO5 - Acquire knowledge about reverse engineering and new technologies**(K1)**

UNIT I INTRODUCTION   (9 Hrs)

History – Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle – Fundamental – File format– Other translators – medical applications of RP - On demand manufacturing – Direct material deposition - Shape Deposition Manufacturing.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS   (9 Hrs)

Classification – Liquid based system - Stereolithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system- Fused Deposition Modelling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing**.**

UNIT III   POWDER BASED RAPID PROTOTYPING SYSTEMS   (9 Hrs)

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three-Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing - Laser Engineered Net Shaping (LENS).

UNIT IV MATERIALS FOR RAPID PROTOTYPING SYSTEMS   (9 Hrs)

Nature of material – type of material – polymers, metals, ceramics and composites liquid based materials, photo polymer development – solid based materials, powder based materials - case study.

UNIT V   REVERSE ENGINEERING AND NEW TECHNOLOGIES   (9 Hrs)

Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, other applications - Case study.

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Text Books

1. Rafiq I. Noorani, Rapid Prototyping – Principles and Applications, Wiley & Sons,2006.
2. 2. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping: Principles and Applications,second edition, World Scientific, 2003.
3. Amitav Ghosh Introduction to Rapid Prototyping, North West Publication, New Delhi,2008.

Reference Books

1. Hopkinson N, R.J.M, Hauge, P M, Dickens, "Rapid Manufacturing – AnIndustrial revolution for the digital age", Wiley, 2006
2. Ian gibson, "Advanced Manufacturing Technology for Medical applications:Reverse Engineering, Software conversion and Rapid Prototying", Wiley, 2006
3. Paul F.Jacobs, Rapid Prototyping and Manufacturing, "Fundamentals ofStereolithography", McGraw Hill 1993.
4. Pham D.T and Dimov, "Rapid Manufacturing", Springer Verlog 2001.
5. LiouW.Liou, Frank W.Liou ,"Rapid Prototyping and Engineering applications : A tool box for prototypedevelopment", CRC Press, 2007.

Web References

1. https://nptel.ac.in/courses/112/104/112104265/
2. https://www.digimat.in/nptel/courses/video/112104265/L01.html
3. https://nptel.ac.in/courses/112/107/112107078/
4. https://www.youtube.com/watch?v=oDdOqLblmVQ
5. https://www.youtube.com/watch?v=OhNnKTaciVI

COs Mapping with POs and PSOs (BME)

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	1	-	-	-	-	-	-	2	1	1	1
2	3	3	3	3	1	-	-	-	-	-	-	2	1	1	1
3	3	3	3	3	1	-	-	-	-	-	-	2	1	1	1
4	3	3	3	3	1	-	-	-	-	-	-	2	1	1	1
5	3	3	3	3	1	-	-	-	-	-	-	2	1	1	1

Correlation Level: 1- Low, 2 - Medium, 3 - High

B.Tech. Biomedical Engineering

	ENERGY AND ENVIRONMENT	L	T	P	C	Hours
U20CEO401	(Common to EEE, ECE, MECH, BME, IT, Mechatronics, FT)	3	0	0	3	45

Course Objectives

- Explain the importance of energy, classifications of energy sources and energy demand scenario
- Analyze the impacts of energy on environment & sustainability energy options
- Outline the harness of hydropower and geothermal energy sources
- Discuss the aspects of solar and wind energy
- To study the importance of biomass energy and its applications

Course Outcomes

After completion of the course, the students will be able to

CO1 - Apply the knowledge of science & engineering to the contemporary issues of Energy for better humankind & environment **(K3)**

CO2 - Identify, review & analyze the complex problems of Energy crises in environment **(K4)**

CO3 - Designing solutions for the energy crises in the form of renewable energy systems to meet the needs by understanding the limitations **(K4)**

CO4 - Understanding the impact of energy on environment and providing solutions for sustainable development. **(K5)**

CO5 - Apply biomass energy under relevant technologies **(K3)**

UNIT I ENERGY   (9 Hrs)

Introduction, Importance of energy, role of energy consumption in economic and social transformation, Energy needs and crisis. Energy production and utilization. Types and classification of energy sources, Conventional & unconventional energy, Renewable sources & Nonrenewable sources of energy advantages, limitations, comparisons

UNIT II ENVIRONMENT   (9 Hrs)

Impact of energy on economy &environment. Regional impacts of temperature change - Global warming, Greenhouse effect, Acid rain, Ozone layer depletion. Indian environment degradation, Environmental laws - Water Act-1974 (Prevention & control of pollution), The environment protection act 1986, Air act.

UNIT III HYDROPOWER & GEOTHERMAL ENERGY   (9 Hrs)

Hydropower Energy – Introduction, Site selection, layout of hydro power plant, components & working, classifications, power station, structure and control. Geothermal Energy - Introduction, Site selection, layout of power plant, components & working, Advantages and disadvantages.

UNIT IV SOLAR & WIND ENERGY   (9 Hrs)

Sun as source of energy - Introduction, Site selection, layout of power plant components & working, classifications, Types of collectors, collection systems efficiency, Solar cells. Wind Energy - Introduction, advantages/limitations, Site selection, layout of power plant, components &working, classification.

UNIT V BIOMASS ENERGY   (9 Hrs)

Introduction, advantages/limitations, Photosynthesis, biomass fuel, biomass gasification, biogas from waste biomass, factors affecting biogas generation, types of biogas plant, Biomass programme in India,

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Text Books

1. Trivedi R.R. and Jalka K.R, "Energy Management", Commonwealth Publication, 20177.
2. Diamant R.M.E., "Total Energy", Pergamon, OxfordPublishers, 2017.
3. N.G. AJJANNA " Energy auditing & demand side management" first edition, Gouthami Publications, Shimoga
4. Chakrabarti, M.L.Soni, P.V. Gupta,U.S. Bhatnagar " Power system Engineering" 2001, DhanpatRai&Co, New Delhi.
5. D.P.Kothari, K.C Singal, Rajesh Ranjan, "Renewable Energy sources and Emerging Technologies" second edition , PHI , India

Reference Books

1. Boyle G, Everett B and Ramett J, "Energy systems and sustainability", Oxford University Press, 2018
2. "Pollution Control Acts, Rules and Notifications", CPCB, Pollution Control series, PC/2/2014, Vol.I,2014
3. Peavy.H, Rowe.D, and Tchobanoglous, G., Environmental Engineering, Tata McGraw-Hill, 2013
4. S.Rao, Dr. BB Parulekar "Energy Technologies" Khanna Publications , New Delhi
5. David M Buchla, Thomas E Kissel, Thomas L Floyd "Renewable Energy systems" Pearson, India
6. Godfrey Boyle "Renewable Energy power for sustainable future" oxford Publications , New Delhi

Web References

1. https://onlinecourses.nptel.ac.in/noc20_ce23/announcements
2. https://swayam.gov.in/nd1_noc20_ce23/preview
3. www.iucn.org
4. www.cites.org
5. www.thesummitbali.com/
6. http://engineering geology.gov.in/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2	1	2	2	1	-	-	-	-	3	-	-	-
CO2	1	1	1	-	-	2	1	-	-	-	-	3	-	-	-
CO3	2	2	2	2	2	3	3	-	1	1	2	3	-	-	-
CO4	2	2	2	2	3	3	3	-	1	1	2	3	-	-	-
CO5	2	2	2	2	3	3	3	-	1	1	2	3	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20CEO402	**BUILDING SCIENCE AND ENGINEERING**	L	T	P	C	Hours
	(Common to ECE, MECH, BME)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- Understand the basic materials in civil engineering and Have an insight to different types of doors, windows.
- Analyze the types of foundation.
- Gain the knowledge of bylaws for the planning of a public/private building
- Understand the different methods and materials of interiors for building
- Understand the concept of landscaping

Course Outcomes

After completion of the course, the students will be able to

CO1 - Apply the knowledge of engineering fundamentals to understand, the characteristics of basic civil engineering materials **(K2)**

CO2 - Apply the knowledge of engineering fundamentals and analyze the types of foundation **(K2)**

CO3 - Develop plan, section and apply bylaws and investigate causes and remedies for cracks, have an insight to cost effective construction **(K3)**

CO4 - Understand, design and work in a team and develop the interiors**(K5)**

CO5 - Understand, design and work in a team and develop landscaping for buildings as per design guidelines.**(K5)**

UNIT I MATERIALS FOR CONSTRUCTION   (9 Hrs)

Cement concrete: introduction, ingredients of cement, grade of concrete, properties..Steel :definition , types of steel, uses of steel, market forms of steel used in construction Doors and windows : location of doors and windows, types of doors, types of windows, Stairs : requirements of good stairs, types , stairs of different materials

UNIT II FOUNDATION AND STRUCTURAL MEMBERS   (9 Hrs)

Selection of site, substructure, objectives of foundation, site inspection, soils, loads on foundations, essential requirements of good foundation, types of foundation, failure of foundation and remedial measures. Structural members: columns, lintels, roofing (flat roof and sloped roof), flooring (types of floors and floor covering), damp proofing, plastering.

UNIT III BUILDING PLANNING AND MAINTAINENCE   (9 Hrs)

Plan, section and elevation .Introduction, classification of buildings, components of buildings, building bylaws, orientation of buildings, ventilation, acoustic requirements, Superstructure: introduction, brick masonry, stone masonry and rcc. Building maintenance Deterioration of concrete, deterioration of masonry works, prevention of cracks and leaks, cost effective construction, anti-termite treatment in building.

UNIT IV INTERIOR DESIGN   (9 Hrs)

Functional requirement of interior designer, basic elements of interior design, design problems :Interior design for spacious rooms, comfortable rooms, theme rooms, living area, cooking area, drinking area dining area, home offices, sleeping area, bathrooms, public/private buildings

UNIT V LANDSCAPING   (9 Hrs)

Elements of Landscape architecture, specialization in landscape, landscape products, landscape materials, and water efficient landscaping, design guidelines for interior landscape

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Text Books

1. Basic civil engineering : M.S.palanichamy fourth edition Tata mcgraw hill limited ,2005
2. Basic civil engineering : sateeshgopi ,pearson, 2010
3. Building Science: Concepts and Applications: Jens Pohl, Wiley-Blackwell, 2011

Reference Books

1. Basic civil engineering : Dr.B.C.Punmia, Ashok kumarjain, ArunkumarjainLaxmi publications year of publication ,2004
2. Basic civil engineering : S.S.Bhavikatti New Age International Limited, 2010
3. Interior Design and Decoration: Seetharaman P.2019

Web References

1. https://www.youtube.com/watch?v=XsFeVuVQE-E
2. https://www.youtube.com/watch?v=LYvDoy7MtkE
3. https://www.youtube.com/watch?v=zjZVlFt3WQY
4. https://www.youtube.com/watch?v=pYAXsbsFBC8
5. https://www.youtube.com/watch?v=PIY63QacRTc

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	1	3	3	3	2	3	3	3	-	-	-
2	3	3	2	3	1	3	3	3	2	3	3	3	-	-	-
3	3	3	2	3	1	3	3	3	2	3	3	3	-	-	-
4	3	3	2	3	2	3	3	3	2	3	3	3	-	-	-
5	3	3	2	3	2	3	2	3	2	3	3	3	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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	BASIC DBMS	**L**	**T**	**P**	**C**	**Hrs**
U20CCO401	(Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand about basics of Database Management System.
- To provide a general introduction to relational model and relational algebra.
- To study about normalization and SQL.
- To acquire knowledge about storage indexing and transaction management.
- To gain knowledge about the backup and recovery in database.

Course Outcomes

After completion of the course, the students will be able to

CO1 – Explain the concept of database management system.(**K2**)

CO2 – Create conceptual data model using entity relationship diagram.(**K2**)

CO3 – Analyze the various normalization.(**K4**)

CO4 – Describe the concept of storage indexing and transactions.(**K2**)

CO5 – Explain the database recovery and security.(**K2**)

UNIT - I INTRODUCTION TO DATABASE MANAGEMENT (9 Hrs)

Introduction to Database Management systems – History - Characteristics – Users- three-level architecture-Entity-- relationship data model.

UNIT - II THE RELATIONAL DATA MODEL AND RELATIONAL ALGEBRA (9 Hrs)

Data structures – Mapping E-R Model to Relational model – data manipulation – integrity – advantages – rules for fully relational systems – relational algebra – relational algebra queries.

UNIT - III STRUCTURED QUERY LANGUAGE AND NORMALIZATION (9 Hrs)

SQL – Data definition – manipulation – views SQL in procedural programming – data integrity and constraints – triggers – data control – database security. Normalization – Undesirable properties – single-valued normalization – desirable properties of decompositions – multivalued dependencies

UNIT -IV STORAGE INDEXING AND TRANSACTIONS MANAGEMENT (9 Hrs)

Different types of memories – secondary storage – buffer management – file structures – heap files – sorted files – index and types – indexed sequential file – B-tree – B+ tree. Transaction management – concepts – examples – schedules – serializability – concurrency control – deadlocks – lock and multiple granularity – nonlocking techniques.

UNIT -V DATABASE BACKUP, RECOVERY AND SECURITY (9 Hrs)

Database system failure – backup – recovery and concept of log – log-based recovery techniques – types of recovery – log-based immediate update recovery technique. Database Security – violations – identifications and authentication – authorization / access control – security of statistical databases – audit policy – internet applications and encryption.

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Text Books

1. Gupta.G.K, "Database Management Systems", Tata McGraw Hill, 2011
2. Abraham Silberschatz, Henry F Korth, S Sudharshan, Database System Concepts 7th Edition, McGraw-Hill International Edition, 2019.
3. Ramez Elmasri and Shamkant Navathe, Durvasula V L N Somayajulu, Shyam K Gupta, "Fundamentals of Database Systems", Pearson Education, United States of America, 2018.

Reference Books

1. Silberschatz, Korth.H and Sudarshan.S, "Database System Concepts", 6th Edition, McGraw-HillInternational, 2011.
2. Hector Garcia-Molina, Jeffrey D.Ullman, Jennifer Widom, "Database System The Complete Book, 1st Edition, Pearson 2002.
3. Date CJ, Kannan A, Swamynathan S, An Introduction to Database System, 8th Edition, Pearson Education-2006.
4. Raghu Ramakrishna, Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw Hill, 2014.
5. Ramez Elmasri, Durvasul VLN Somyazulu, Shamkant B Navathe, Shyam K Gupta, Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016.

Web References

1. https://docs.oracle.com/cd/E11882_01/server.112/e41084/toc.htm MySQL Online Documentation
2. http://dev.mysql.com/doc/
3. http://www.rjspm.com/PDF/BCA-428%20Oracle.pdf
4. http://www.w3schools.com/
5. https://www.codecademy.com/learn/learn-

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	1	-	1	-	-	-	-	-	1	1	-	2	-
2	3	1	1	-	1	-	-	-	-	-	1	1	-	2	-
3	3	3	1	-	1	-	-	-	-	-	1	1	-	2	-
4	3	1	1	-	1	-	-	-	-	-	1	1	-	2	-
5	3	1	1	-	1	-	-	-	-	-	1	1	-	2	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20ADO401	Knowledge Representations and Reasoning (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	L	T	P	C	Hrs
		3	-	-	3	45

Course Objectives

- To investigate the key concepts of knowledge representation (KR) techniques and different notations.
- To integrate the KR view as knowledge engineering approach to model organizational knowledge.
- To introduce the study of ontologies as a KR paradigm and applications of ontologies.
- To understand various KR techniques.
- To understand process, knowledge acquisition and sharing of ontology.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Analyse and design knowledge based systems intended for computer implementation. **(K3)**

CO2 - Acquire theoretical knowledge about principles for logic-based representation and reasoning. **(K2)**

CO3 - Ability to understand knowledge-engineering process. **(K2)**

CO4 - Ability to implement production systems, frames, inheritance systems and approaches to handle uncertain or incomplete knowledge. **(K3)**

CO5 - Learn to think through the ethics surrounding privacy, data sharing and algorithmic decision-making. **(K2)**

UNIT I   (9 Hrs)

The Key Concepts: Knowledge, Representation, Reasoning, Why knowledge representation and reasoning, Role of logic. Logic: Historical background, Representing knowledge in logic, Varieties of logic, Name, Type, Measures, Unity Amidst diversity

UNIT II   (9 Hrs)

Ontology: Ontological categories, Philosophical background, Top-level categories, Describing physical entities, Defining abstractions, Sets, Collections, Types and Categories, Space and Time.

UNIT III   (9 Hrs)

Knowledge Representations: Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation.

UNIT IV INDUSTRIALIZATION, OPPURTUNITIES AND APPLICATIONS   (9 Hrs)

Processes: Times, Events and Situations, Classification of processes, Procedures, Processes and Histories, Concurrent processes, Computation, Constraint satisfaction, Change Contexts: Syntax of contexts, Semantics of contexts, First-order reasoning in contexts, Modal reasoning in contexts, Encapsulating objects in contexts.

UNIT V   ETHICS AND RECENT TRENDS   (9 Hrs)

Knowledge Soup: Vagueness, Uncertainty, Randomness and Ignorance, Limitations of logic, Fuzzy logic, Nonmonotonic Logic, Theories, Models and the world, Semiotics. Knowledge Acquisition and Sharing: Sharing Ontologies, Conceptual schema, Accommodating multiple paradigms, Relating different knowledge representations, Language patterns, Tools for knowledge acquisition.

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Text Books

1. John F. Sowa, Thomson Learning "Knowledge Representation logical, Philosophical, and Computational Foundations", Course Technology Inc. publication, 1999.
2. Ronald J. Brachman, Hector J. Levesque,"Knowledge Representation and Reasoning", Morgan Kaufmann; 1st edition, 2004.
3. Eileen Cornell Way "Knowledge Representation and Metaphor" Springer; 1991st edition, 1991.

Reference Books

1. Trevor Bench-Capon, "Knowledge representation: an approach to artificial intelligence", Academic Press, 2014.
2. Yulia Kahl, Michael Gelfond "Knowledge Representation, Reasoning, and the Design of Intelligent Agents The Answer-Set Programming Approach", Cambridge University Press; 1st edition, 2014.
3. Arthur B. Markman, "Knowledge representation" Psychology Press; 1st edition, 1998.
4. Sanida Omerović, Grega Jakus, V. Milutinovic, Sašo Tomažič "Concepts, Ontologies, and Knowledge Representation" Springer; 2013.
5. Bernhard Nebel, Gerhard Lakemeyer "Foundations of Knowledge Representation and Reasoning" Springer, 1994.

Web References

1. https://www.javatpoint.com/knowledge-representation-in-ai
2. https://nptel.ac.in/courses/106/106/106106140/
3. https://www.youtube.com/watch?v=kXlr6ydiPAQ

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	2	1	3	-	-	-	-	-	-	-	1	-	-
2	2	3	2	3	2	-	-	-	-	-	-	-	1	-	-
3	1	3	1	2	2	-	-	-	-	-	-	-	-	-	-
4	1	2	1	2	1	-	-	-	-	-	-	-	-	-	-
5	2	1	3	1	3	-	-	2	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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U20ADO402	**Introduction to Data Science** (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives

- To learn the basics of data science
- To enable the students to understand the statistics and probability.
- To understand the tools in developing and visualizing data.
- To gain good knowledge in the application areas of data science.
- To inculcate the perceiving, ethics surrounding privacy and acting of data science applications.

Course Outcomes

After completion of the course, the students will be able to

CO1 - Explore the fundamental concepts of data science. **(K2)**

CO2 - To understand the Mathematical Knowledge for Data Science.**(K2)**

CO3 - Visualize and present the inference using various tools. **(K3)**

CO4 - To expose the different opportunities in Industries. **(K3)**

CO5 - Learn to think through the ethics surrounding privacy, data sharing and decision-making. **(K2)**

UNIT I INTRODUCTION TO DATA SCIENCE   (9 Hrs)

Definition – Big Data and Data Science Hype – Why data science – Getting Past the Hype – The Current Landscape – Who is Data Scientist? - Data Science Process Overview – Defining goals – Retrieving data – Data preparation – Data exploration – Data modeling – Presentation..

UNIT II   MATHEMATICAL PRELIMINARIES   (9 Hrs)

Probability: Probability vs. Statistics – Compound Events and Independence – Conditional Probability – Probability Distribution. Descriptive Statistics: Centrality Measures – Variability Measures - Interpreting Variance – Characterizing Distributions. Correlation Analysis: Correlation Coefficient – The Power and Significance – Detection Periodicities. Logarithms: Logarithms and Multiplying Probabilities – Logarithms and Ratios – Logarithms and Normalizing Skewed Distributions.

UNIT III   DATA SCIENCE TOOLS   (9 Hrs)

Introduction to Data Science Tool – Data Cleaning Tools – Data Munging and Modelling Tools – Data Visualization Tools – Tools for Data Science.

UNIT IV INDUSTRIALIZATION, OPPURTUNITIES AND APPLICATIONS   (9 Hrs)

Data Economy and Industrialization – Introduction: Data Economy, Data Industry, Data Services – Data Science Application: Introduction, General Application Guidance - Different Domain – Advertising – Aerospace and Astronomy – Arts, Creative Design and Humanities – Bioinformatics – Consulting Services – Ecology and Environment – Ecommerce and Retail - Education – Engineering – Finance and Economy – Gaming.

UNIT V   ETHICS AND RECENT TRENDS   (9 Hrs)

Data Science Ethics – Doing good data science – Owners of the data - Valuing different aspects of privacy - Getting informed consent - The Five Cs – Diversity – Inclusion – Future Trends.

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Text Books

1. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", Manning Publications Co., 1st edition, 2016.
2. Chirag Shah, "A Hands-on Introduction to Data Science ", Cambridge University Press, 2020.
3. Sinan Ozdemir, "Principles of Data Science", Packt Publication, 2016.
4. D J Patil, Hilary Mason, Mike Loukides, "Ethics and Data Science", O' Reilly, 1st edition, 2018.

Reference Books

1. Hector Guerrero, "Excel Data Analysis: Modeling and Simulation", Springer International Publishing, 2nd Edition, 2019.
2. Paul Curzon, Peter W. Mc Owan, "The Power of Computational Thinking", World Scientific Publishing, 2017.
3. Steven S. Skiena, "Data Science Design Manual", Spring International Publication, 2017.
4. Rajendra Akerkar, Priti Srinivas Sajja, "Intelligence Techniques for Data Science", Spring International Publication, 2016.
5. Longbing Cao "Data Science Thinking: The Next Scientific, Technological and Economic Revolution", Spring International Publication, 2018.

Web References

1. https://www.youtube.com/watch?v=-ETQ97mXXF0&ab_channel=edureka%21
2. https://www.javatpoint.com/data-science
3. https://www.coursera.org/browse/data-science /

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	3	2	2	-	-	-	-	-	-	-	-	-	-
2	2	2	2	1	1	-	-	-	-	-	-	-	-	-	-
3	2	1	3	2	3	-	-	-	-	-	-	-	-	1	-
4	1	2	2	1	1	-	-	-	-	-	-	-	-	-	-
5	2	1	1	2	1	-	-	1	-	-	-	-	-	-	-

Correlation Level: 1- Low, 2 - Medium, 3 - High

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