SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(An Autonomous Institution)

Puducherry - 605 107

B.Tech - Electronics and Communication Engineering

(REGULATIONS-2020)

CURRICULUM & SYLLABI

Recommended by Board of Studies	17th September 2022
Approved by Academic Council	5th Academic Council Meeting (17th December 2022)

VISION AND MISSION OF THE INSTITUTE

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 incollaboration 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

VISION AND MISSION OF THE DEPARTMENT

VISION

Facilitate academic excellence and research among Electronics and Communication Engineers to meet the Global needs with high competence and ethical professionalism.

MISSION

M1: Academic Excellence: To impart learning skills to meet the global challenges in the fieldof Electronics and Communication Engineering.

M2: Research and Innovation: To provide excellence in research and innovation through multidisciplinary specialization

M3: Employability and Entrepreneurship: To enhance inter and intrapersonal skills among students to make them employable and entrepreneurs

M4: Ethics: To inculcate the significance of human values and professionalskills to serve the society

PROGRAMME OUT COMES (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 healthand 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 andenvironmental contexts and demonstrate the knowledge of and need for sustain able development.

PO8: Ethics:
Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Teamwork:
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 communityand 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 principlesand apply these to one's own work, as a member and leader in a team, to manage projectsand in multidisciplinary environments.

PO12: Life-Long Learning:
Recognize the need for and have the preparation and ability to engage in independent andlife-long learning in the broadest context of technological change.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Technical Knowledge
Graduates will be able to develop an insightful combination of modern electronics and communication technology through technical knowledge.

PEO2: Research and Development
Enhance analytical and thinking skills to develop initiatives and innovative ideas for research and development, industry and societal requirements.

PEO3: Leadership
Inculcate the qualities of teamwork as well as social, interpersonal and leadership skills and adapt to the changing professional environments in the fields of engineering and technology.

PEO4: Professional Ethics
Motivate graduates to become good human beings and responsible citizens for the overall welfare of the society.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Domain Knowledge
Ability to understand the concepts in Electronics and Communication Engineering and to apply to different fields, such as Consumer Electronics, Communications, Signal Processing, etc.

PSO2: Embedded System Design
Ability to design a system based on the technical knowledge gained for embedded applications in electronics and communications engineering.

PSO3: Professional Competency
Ability to select cutting-edge engineering hardware and software tools to solve complex problems in Electronics and Communication Engineering

STRUCTURE FOR UNDERGRADUATE ENGINEERING PROGRAM

Sl. No	Course Category	Breakdown of Credits
1	Humanities and Social Sciences (HS)	7
2	Basic Sciences (BS)	19
3	Engineering Sciences (ES)	30
4	Professional Core (PC)	69
5	Professional Electives (PE)	18
6	Open Electives (OE)	9
7	Project Work (PW) and Internship	12
8	Employability Enhancement Courses (EEC)	-
9	Mandatory courses (MC)	-
Total Credits		**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 Science (BS)	6	3	3	3	4	-	-	-	19
3	Engineering Sciences (ES)	12	10	4	4	-	-	-	-	30
4	Professional Core (PC)	-	8	14	8	12	15	9	3	69
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 are not included for CGPAcalculation*

SEMESTER–I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST101	Engineering Mathematics – I (Calculus and Linear Algebra)	BS	2	2	0	3	25	75	100
2	U20BST104	Semiconductor Opto Electronics	BS	3	0	0	3	25	75	100
3	U20EST101	Programming in C	ES	3	0	0	3	25	75	100
4	U20EST103	Fundamentals of Civil and Mechanical Engineering	ES	3	0	0	3	25	75	100
5	U20EST104	Electric Circuits	ES	2	2	0	3	25	75	100
Practical										
6	U20ESP102	Programming in C Laboratory	ES	0	0	2	1	50	50	100
7	U20ESP105	Electric 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	U20ECC1XX	Certification Course – I**	EEC	0	0	4	-	100	-	100
10	U20ECS101	Skill Development Course 1: Demonstration of Workshop Practices	EEC	0	0	2	-	100	-	100
Mandatory Course										
11	U20ECM101	Induction Program	MC	3Weeks			-	-	-	-
							18	475	525	1000

SEMESTER–II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST215	Engineering Mathematics–II (Multiple Integrals and Transforms)	BS	2	2	0	3	25	75	100
2	U20EST219	Engineering Mechanics	ES	2	2	0	3	25	75	100
3	U20EST239	Electrical Engineering	ES	3	0	0	3	25	75	100
4	U20EST240	Electronic Measurements and Instrumentation	ES	3	0	0	3	25	75	100
5	U20ECT201	Network Theory	PC	2	2	0	3	25	75	100
6	U20ECT202	Electron Devices	PC	3	0	0	3	25	75	100
Practical										
7	U20ESP240	Electrical Engineering Laboratory	ES	0	0	2	1	50	50	100
8	U20ECP201	Electron Devices Laboratory	PC	0	0	2	1	50	50	100
9	U20ECP202	Electronics Engineering Practices	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20ECC2XX	Certification Course – II**	EEC	0	0	4	-	100	-	100
Mandatory Course										
11	U20ECM202	Environmental Science	MC	2	0	0	-	100	-	100
							21	500	600	1100

SEMESTER–III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST321	Numerical Methods and Optimization	BS	2	2	0	3	25	75	100
2	U20EST356	Data Structures	ES	3	0	0	3	25	75	100
3	U20ECT303	Analog Electronic Circuits	PC	3	0	0	3	25	75	100
4	U20ECT304	Digital Electronic Circuits	PC	3	0	0	3	25	75	100
5	U20ECT305	Signals and Systems	PC	2	2	0	3	25	75	100
6	U20ECT306	Electromagnetic Field Theory	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	U20ECP303	Analog Electronic Circuits Laboratory	PC	0	0	2	1	50	50	100
10	U20ECP304	Digital Electronic Circuits Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20ECC3XX	Certification Course -III**	EEC	0	0	4	-	100	-	100
12	U20ECS302	Skill Development Course 2*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20ECM303	Physical Education	MC	0	0	2	-	100	-	100
							22	650	650	1300

SEMESTER –IV										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST431	Probability and Random Processes	BS	2	2	0	3	25	75	100
2	U20EST467	Programming in JAVA	ES	3	0	0	3	25	75	100
3	U20ECT407	Analog and Digital Communication Systems	PC	3	0	0	3	25	75	100
4	U20ECT408	Linear Integrated Circuits	PC	3	0	0	3	25	75	100
5	U20ECE4XX	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	U20ECP405	Communication Systems Laboratory	PC	0	0	2	1	50	50	100
10	U20ECP406	Linear Integrated Circuits Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20ECC4XX	Certification Course - IV**	EEC	0	0	4	-	100	-	100
12	U20ECS403	Skill Development Course - 3*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20ECM404	NCC/ NSS	MC	0	0	2	-	100	-	100
							22	650	650	1300

SEMESTER– V										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST544	Statistical Methods for Engineers	BS	2	2	0	3	25	75	100
2	U20ECT509	Wireless Communication	PC	3	0	0	3	25	75	100
3	U20ECT510	Microcontroller	PC	3	0	0	3	25	75	100
4	U20ECT511	Digital Signal Processing	PC	2	2	0	3	25	75	100
5	U20ECE5XX	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 Methods Laboratory	BS	0	0	2	1	50	50	100
8	U20ECP507	Wireless Communication Laboratory	PC	0	0	2	1	50	50	100
9	U20ECP508	Microcontroller Laboratory	PC	0	0	2	1	50	50	100
10	U20ECP509	Digital Signal Processing Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20ECC5XX	Certification Course – V	EEC	0	0	4	-	100	-	100
12	U20ECS504	Skill Development Course 4: Foreign Language / IELTS-I / Career and Professional Skill Development Program - I	EEC	0	0	2	-	100	-	100
13	U20ECS505	Skill Development Course 5: Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U20ECM505	Indian Constitution	MC	2	0	0	-	100	-	100
							22	750	650	1400

***Certification courses are to be selected from the list given in Annexure- III*
 # 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
** Skill Development Courses (2 and 3) are to be selected from the list given in Annexure IV*

SEMESTER–VI										
Sl.No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ECT612	Control System Engineering	PC	2	2	0	3	25	75	100
2	U20ECT613	Digital VLSI System Design	PC	3	0	0	3	25	75	100
3	U20ECCM03	Digital Image Processing	PC	3	0	0	3	25	75	100
4	U20ECT615	Transmission Lines & Antennas	PC	3	0	0	3	25	75	100
5	U20ECE6XX	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	U20ECP610	VLSI Design Laboratory	PC	0	0	2	1	50	50	100
8	U20ECP611	Digital Image Processing Laboratory	PC	0	0	2	1	50	50	100
9	U20ECP612	Electronic Design Workshop	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20ECC6XX	Certification Course-VI**	EEC	0	0	4	-	100	-	100
11	U20ECS606	Skill Development Course 6: Foreign Language / IELTS - II / Career and Professional Skill Development Program - II	EEC	0	0	2	-	100	-	100
12	U20ECS607	Skill Development Course 7: Technical Seminar	EEC	0	0	2	-	100	-	100
13	U20ECS608	Skill Development Course 8: NPTEL/ MOOC - I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U20ECM606	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	800	600	1400

***Certification courses are to be selected from the list given in Annexure- III*
 # 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
** Skill Development Courses (2 and 3) are to be selected from the list given in Annexure IV*

SEMESTER–VII										
Sl.No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ECT716	Millimeter and Optical Wave Communication	PC	3	0	0	3	25	75	100
2	U20ECCM04	Internet of Things	PC	3	0	0	3	25	75	100
3	U20ECE7XX	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	U20ECP713	High Frequency Communication Laboratory	PC	0	0	2	1	50	50	100
7	U20ECP714	Internet of Things Laboratory	PC	0	0	2	1	50	50	100
8	U20ECP715	Comprehensive Viva Voce	PC	0	0	2	1	50	50	100
Project Work										
9	U20ECW701	Project Phase – I	PW	0	0	4	2	50	50	100
10	U20ECW702	Internship / In-plant Training	PW	0	0	0	2	100	-	100
Mandatory Course										
11	U20ECM707	Professional Ethics	MC	2	0	0	-	100	-	100
							20	600	500	1100

SEMESTER–VIII										
Sl.No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ECT818	Cyber Physical System and Security	PC	3	0	0	3	25	75	100
2	U20ECE8XX	Professional Elective – V#	PE	3	0	0	3	25	75	100
3	U20ECE8XX	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	U20ECW803	Project phase – II	PW	0	0	16	8	40	60	100
Employment Enhancement Course										
6	U20ECS809	Skill Development Course 9: NPTEL/ MOOC - II	MC	0	0	0	-	100	-	100
							18	315	285	600

***Certification courses are to be selected from the list given in Annexure- III*
 # 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
** Skill Development Courses (2 and 3) are to be selected from the list given in Annexure IV*

Annexure – I
PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl.No.	**Course Code**	**Course Title**
1	U20ECE401	Computer Networks
2	U20ECE402	Sensors for Industrial Applications
3	U20ECE403	Computer Architecture
4	U20ECE404	PLC and SCADA Systems and its Applications
5	U20ECE405	Introduction to MEMS
Professional Elective – II (Offered in Semester V)		
Sl.No	**Course Code**	**Course Title**
1	U20ECE506	Hardware Description Languages
2	U20ECCM01	Vehicular Communication
3	U20ECE508	Industry 4.0 Technology
4	U20ECE509	Information Theory and Coding
5	U20ECCM02	Robotics and Automation
Professional Elective – III (Offered in Semester VI)		
Sl.No	**Course Code**	**Course Title**
1	U20ECE611	Low Power VLSI Design
2	U20ECE612	Aircraft communication and Navigation Systems
3	U20ECE613	Nano - Electronics and Devices
4	U20ECE614	Speech and Audio Signal Processing
5	U20BMCM01	Soft Computing
Professional Elective – IV (Offered in Semester VII)		
Sl.No	**Course Code**	**Course Title**
1	U20ECE716	CAD for VLSI Circuits
2	U20ECCM05	Satellite Communication
3	U20ICCM01	Fuzzy logic and Neural Network
4	U20ECE719	Biomedical Signal Processing
5	U20ECE720	Wireless Sensor Networks
Professional Elective – VI (Offered in Semester VIII)		
Sl.No	**Course Code**	**Course Title**
1	U20ECE821	High Speed Electronics
2	U20ECE822	Machine Learning for Wireless Communication
3	U20ECE823	Virtual and Augmented Reality
4	U20ECE824	Adaptive Signal Processing
5	U20ECE825	Real Time Systems
Professional Elective – VI (Offered in Semester VIII)		
Sl.No	**Course Code**	**Course Title**
1	U20ECE826	VLSI for Communication Systems
2	U20ECE827	5G Wireless Communication Systems
3	U20ECE828	Biomedical Electronics
4	U20ECE829	Advanced Digital Image and Video Processing
5	U20ECE830	Hardware Software Co-design

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
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**)

S. No	Course Code	Course Title	Offering Department	Permitted Departments
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, 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
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)				
S. No	**Course Code**	**Course Title**	**Offering Department**	**Permitted Departments**
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	U20ECCM04	IoT and its Applications	ECE	EEE, CSE, MECH, IT, CIVIL, FT
4	U20ECO706	Sensors for industrial Automation	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	U20ITCM08	Automation Techniques &Tools-Dev Ops	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	Industrial Automation	ICE	EEE, ECE, CSE, MECH, IT, CIVIL, CCE, BME, Mechatronics
10	U20ICO706	Ultrasonic 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
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	Tele health 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

Annexure-III

EMPLOYABILITY ENHANCEMENT COURSES–(A) CERTIFICATION COURSES

S.No	Course Code	Course Title
1	U20ECCX01	3ds Max
2	U20ECCX02	Advance Structural Analysis of Building using ETABS
3	U20ECCX03	Advanced Java Programming
4	U20ECCX04	Advanced Python Programming
5	U20ECCX05	Analog System Lab Kit
6	U20ECCX06	Android Medical App Development
7	U20ECCX07	Android Programming
8	U20ECCX08	ANSYS-Multi physics
9	U20ECCX09	Artificial Intelligence
10	U20ECCX10	Artificial Intelligence and Edge Computing
11	U20ECCX11	Artificial Intelligence in Medicines
12	U20ECCX12	AutoCAD for Architecture
13	U20ECCX13	AutoCAD for Civil
14	U20ECCX14	AutoCAD for Electrical
15	U20ECCX15	AutoCAD for Mechanical
16	U20ECCX16	Azure Dev Ops
17	U20ECCX17	Basic Course one PLAN
18	U20ECCX18	Basic Electro Pneumatics
19	U20ECCX19	Basic Hydraulics
20	U20ECCX20	Bio Signal and Image Processing Development System
21	U20ECCX21	Block chain
22	U20ECCX22	Bridge Analysis
23	U20ECCX23	Building Analysis and Construction Management
24	U20ECCX24	Building Design and Analysis Using AECO Sim Building Designer
25	U20ECCX25	CATIA
26	U20ECCX26	CCNA (Routing and Switching)
27	U20ECCX27	CCNA (Wireless)
28	U20ECCX28	Cloud Computing
29	U20ECCX29	Computer Programming for Medical Equipment’s
30	U20ECCX30	CorelDraw
31	U20ECCX31	Creo (Modeling and Simulation)
32	U20ECCX32	Cyber Security
33	U20ECCX33	Data Science and Data Analytics
34	U20ECCX34	Data Science using Python
35	U20ECCX35	Data Science using R
36	U20ECCX36	Deep Learning
37	U20ECCX37	Design and Documentation usingePLANElectricP8
38	U20ECCX38	Design of Biomedical Devices and Systems
39	U20ECCX39	Digital Marketing
40	U20ECCX40	Digital Signal Processing Development System
41	U20ECCX41	Dig SILENT Power Factory
42	U20ECCX42	Electrohydraulic Automation with PLC
43	U20ECCX43	Embedded System using Arduino
44	U20ECCX44	Embedded System using C
45	U20ECCX45	Embedded System with IoT

46	U20ECCX46	ePLAN Data Portal
47	U20ECCX47	ePLAN Electric P8
48	U20ECCX48	ePLAN Fluid
49	U20ECCX49	ePLAN PPE
50	U20ECCX50	Fusion360
51	U20ECCX51	Fuzzy Logic and Neural Networks
52	U20ECCX52	Google Analytics
53	U20ECCX53	Hydraulic Automation
54	U20ECCX54	Industrial Automation
55	U20ECCX55	Industry4.0
56	U20ECCX56	Internet of Things
57	U20ECCX57	Introduction to C Programming
58	U20ECCX58	Introduction to C++ Programming
59	U20ECCX59	IoT using Python
60	U20ECCX60	Java Programming
61	U20ECCX61	Machine Learning
62	U20ECCX62	Machine Learning and Deep Learning
63	U20ECCX63	Machine Learning for Medical Diagnosis
64	U20ECCX64	Mechatronics
65	U20ECCX65	Medical Robotics
66	U20ECCX66	Microsoft Dynamics 365 ERP for HR, Marketing and Finance
67	U20ECCX67	Mobile Edge Computing
68	U20ECCX68	Modeling and Visualization using Micro station
69	U20ECCX69	MX Road
70	U20ECCX70	Photoshop
71	U20ECCX71	PLC
72	U20ECCX72	Pneumatics Automation
73	U20ECCX73	Project Management
74	U20ECCX74	Python Programming
75	U20ECCX75	Revit Architecture
76	U20ECCX76	Revit Inventor
77	U20ECCX77	Revit MEP
78	U20ECCX78	Robotics
79	U20ECCX79	Search Engine Optimization
80	U20ECCX80	Software Testing
81	U20ECCX81	Solar and Smart Energy System with IoT
82	U20ECCX82	Solid Works
83	U20ECCX83	Solid Works with Electrical Schematics
84	U20ECCX84	Speech Processing
85	U20ECCX85	STAADPROV8i
86	U20ECCX86	Structural Design and Analysis using Bentley
87	U20ECCX87	Total Station
88	U20ECCX88	Video and Image Processing Development System
89	U20ECCX89	VLSI Design
90	U20ECCX90	Web Programming -I
91	U20ECCX91	Web Programming -II

Annexure – IV

EMPLOYABILITY ENHANCEMENT COURSES – (B) SKILL DEVELOPMENT COURSES

Sl.No	Course Code	Course Title
1	U20ECS101	**Skill Development Course1:** Demonstration of Workshop Practices
2	U20ECS302	**Skill Development Course 2 ***
		1) Computer Hardware and Troubleshooting
		2) PCB Design
		3) Demonstration of Electronic Equipment's
3	U20ECS403	**Skill Development Course 3 ***
		1) Mobile Repairing
		2) Autonomous Robot
		3) Repair and Maintenance of Electronics Equipment
4	U20ECS504	**Skill Development Course 4:** Foreign Language/ IELTS - I / Career and Professional Skill Development Program - I
5	U20ECS505	**Skill Development Course 5:** Presentation Skills using ICT
6	U20ECS606	**Skill Development Course 6:** Foreign Language/ IELTS - II / / Career and Professional Skill Development Program - I
7	U20ECS607	**Skill Development Course 7:** Technical Seminar
8	U20ECS608	**Skill Development Course 8:** NPTEL/ MOOC - I
9	U20ECS609	**Skill Development Course 9:** NPTEL/ MOOC - II

**Any one course to be selected from the list*

SEMESTER–I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST101	Engineering Mathematics – I (Calculus and Linear Algebra)	BS	2	2	0	3	25	75	100
2	U20BST104	Semiconductor Opto – Electronics	BS	3	0	0	3	25	75	100
3	U20EST101	Programming in C	ES	3	0	0	3	25	75	100
4	U20EST103	Fundamentals of Civil and Mechanical Engineering	ES	3	0	0	3	25	75	100
5	U20EST104	Electric Circuits	ES	2	2	0	3	25	75	100
Practical										
6	U20ESP102	Programming in C Laboratory	ES	0	0	2	1	50	50	100
7	U20ESP105	Electric 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	U20ECC1XX	Certification Course – I**	EEC	0	0	4	-	100	-	100
10	U20ECS101	Skill Development Course 1: Demonstration of Workshop Practices	EEC	0	0	2	-	100	-	100
Mandatory Course										
11	U20ECM101	Induction Program	MC	3 Weeks			-	-	-	-
							18	475	525	1000

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

CO1 - Understand the concept of Eigen values and Eigen vectors, Diagonalization of a matrix**. (K2)**
CO2 - Solve differential equations**. (K3)**
CO3 - Solve higher order differential equations. **(K3)**
CO4 - Solve different types of partial differential equation. **(K3)**
CO5 - Understand the use of vector calculus. **(K2)**

UNIT– I MATRICES (12Hrs)

Rank of a Matrix – Consistency of system of equations. Eigen values and Eigen vectors of a real 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.

Textbooks

1. Erwin Kreyszig, "Advanced Engineering Mathematics ", Wiley, 10th Edition, 2019.
2. B.V.Ramana, "Higher Engineering Mathematics", Tata McGraw – Hill, New Delhi, 6th Edition, 2018.
3. N.P. Bali and Manish Goyal," A Textbook of Engineering Mathematics", Lakshmi Publications, New Delhi, 9th Edition, 2018.

Reference Books

1. C W. Evans, "Engineering Mathematics", A Programmed Approach, 3rd 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 and Manicavachagom T.K. Pillay," Differential Equations and Its Applications", Paperback, 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-linearalgebraslides-systemsofequation-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	3	-	1
2	3	2	1	1	-	1	1	-	-	-	-	1	3	-	1
3	3	2	1	1	-	1	1	-	-	-		1	3	-	1
4	3	2	1	1	-	1	1	-	-	-	-	1	3	-	1
5	2	1	-	-	-	-	1	-	-	-	-	1	3	-	1

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

U20BST104	SEMICONDUCTOR OPTOELECTRONICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart knowledge on semiconductors properties and crystalline structures
- To provide the knowledge on semiconductors light emitting diodes and its applications
- To instruct the principle of lasers and its properties
- To teach the interaction between light and semiconductor
- To study the basic principle of photodetectors

Course Outcomes

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

CO1 - Know the semiconductor conducting property with energy band analysis. (K1)
CO2 - Explain the properties of semiconductor light emitting diodes. (K2)
CO3 - Summarize the operating principle of lasers. (K2)
CO4 - Discuss the working of fibre optics with various operating profiles. (K2)
CO5 - Describe the photo detectors with its characteristics. (K1)

UNIT - I INTRODUCTION TO SEMICONDUCTOR PHYSICS (9 Hrs)

Semiconductor Physics: E-k diagram, Density of states, Occupation probability, Fermi level and quasi-Fermi level (variation by carrier concentration and temperature), p-n junction, Metal-semiconductor junction (Ohmic and Schottky); Carrier transport, generation, and recombination; Semiconductor materials of interest for optoelectronic devices, band gap modification, hetero-structures

UNIT - II SEMICONDUCTOR LIGHT EMITTING DIODES (LEDs) (9 Hrs)

Rate equations for carrier density, Radioactive and non-radioactive recombination mechanisms in semiconductors, LED: device structure, materials, characteristics, and figures of merit.

UNIT - III SEMICONDUCTOR LASERS (9 Hrs)

Review of laser physics; Rate equations for carrier- and photon-density, and their steady state solutions, Laserdynamics, Relaxation oscillations, Input-output characteristics of lasers. Semiconductor laser: structure, materials, device characteristics, and figures of merit; DFB, DBR, and vertical-cavity surface-emitting lasers (VECSEL), Tunable semiconductor lasers.

UNIT - IV LIGHT-SEMICONDUCTOR INTERACTION (9 Hrs)

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulate demission; Joint density of states, Density of states for photons, Transition rates (Fermi's golden rule), Optical loss and gain; Photovoltaic effect, Exciton, Drude model.

UNIT - V PHOTODETECTORS (9 Hrs)

Types of semiconductor photodetectors p-n junction, PIN, and Avalanche and their structure, materials, working principle, and characteristics, Noise limits on performance; Solar cells.
Low-dimensional optoelectronic devices: Quantum-well, wire, and dot-based LEDs, lasers, and photo detectors.

Textbooks

1. J. Singh, “Electronic and Optoelectronic Properties of Semiconductor Structures”, Cambridge University Press; 1 edition, March 2007.
2. Umesh Mishra, Jasprit Singh, “Semiconductor Device Physics and Design”, Springer; 2008
3. Pallab Bhattacharya “Semiconductor Opto Electronic Devices”, Prentice Hall of India Pvt., Ltd., New Delhi, 2006.

Reference Books

1. B. E. A. Saleh and M. C. Teich, “Fundamentals of Photonics”, John Wiley & Sons, 2012
2. S. M. Sze, “Semiconductor Devices: Physics and Technology”, Wiley, 2014.
3. A. Yariv and P. Yeh, “Photonics: Optical Electronics in Modern Communications”, OxfordUniversity Press, New York (2009).
4. S C Gupta, Opto Electronic Devices and Systems, Prentice Hal of India, 2005.
5. S.O. Kasap, “Optoelectronics and photonics”, Pearson, New Delhi (2009).

Web References

1. https://nptel.ac.in/courses/115102026/
2. https://nptel.ac.in/courses/115102103/
3. https://freevideolectures.com/course/3293/semiconductor-optoelectronics
4. https://en.wikipedia.org/wiki/Optoelectronics
5. https://www.tutorialspoint.com/basic_electronics/basic_electronics_optoelectronic_diodes.htm

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

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

U20EST101	PROGRAMMING IN C (Common to CSE, ECE, EEE, IT, ICE, MECH,CIVIL, BME, MECHTRONICS, CCE)	L	T	P	C	Hrs
		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 the 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, choice 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.

Textbooks

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

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

U20EST103	FUNDAMENTALS OF CIVIL AND MECHANICAL ENGINEERING (Common to ECE, ICE, BME)	L	T	P	C	Hrs
		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 (Rainwater 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.

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 (processdescription only).

Textbooks

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 /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	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

U20EST104	ELECTRIC CIRCUITS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To familiarize the basic laws of electrical circuits
- To know the concepts of alternating currents and voltages
- To impart the knowledge of circuit theorems
- To provide a comparative analysis on basic R, L and C circuits for detailed study on their electrical quantities
- To give the fundamentals of graph theory such as tie set and cut set matrix

Course Outcomes

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

CO1 - Discuss the equivalent resistance of a given resistive network **(K2)**
CO2 - Discover the knowledge of various techniques in circuit analysis **(K3)**
CO3 - Classify the application of circuit theorems for electronic circuits **(K2)**
CO4 - Interpret the concepts of resonance circuit **(K2)**
CO5 - Relate the basic concepts of graph of electric circuits using graph theory **(K3)**

UNIT I INTRODUCTION (12 Hrs)

Basic definitions: Charge, Voltage, Current, Power and Energy, Electric Network, Active and Passive elements; Ideal and Practical, dependent and independent sources with their V-I characteristics, Kirchhoff's Voltage law and Kirchhoff's Current law. Source transformation, Voltage and Current division, V-I characteristics of Passive elements and their series / parallel combination, Star Delta transformation, Energy stored in Inductors and Capacitors

UNIT II INTRODUCTION TO ALTERNATING CURRENTS AND VOLTAGES (12 Hrs)

Alternating Current : Instantaneous, Peak, Average and RMS values of various waveforms; Crest factor, Form factor; Concept of phase and phase difference in sinusoidal waveforms; Phase relation in pure resistor, Inductor and capacitor; Impedance diagram, phasor diagram, series and parallel circuits, compound Circuits.
Methods of Analysis: Introduction, Nodal Analysis, Super Node Analysis, Mesh Analysis, Super Mesh Analysis for DC and AC Circuits.

UNIT III CIRCUIT THEOREMS (12 Hrs)

Superposition theorem, Thevenin's and Norton's theorems, Reciprocity, Compensation, Maximum power transfer theorems, Tellegan's and Millman's theorems, Application of theorems to DC and AC circuits. Computation of active, reactive and apparent powers- power triangle, power factor.

UNIT IV RESONANCE (12 Hrs)

Series resonance, Impedance and phase angle, voltages and currents, bandwidth and Q factor and its effect on bandwidth, magnification, characteristics of series resonance. Parallel resonance, resonant frequency, variation of impedance with frequency, Q factor, magnification. Inductively coupled circuits- single tuned and double tuned circuits.

UNIT V NETWORK TOPOLOGY (12 Hrs)

Network terminology: Graph, oriented graph, tree, twig of a network, Incidence and reduced incidence matrices, Cut sets, Fundamental cut sets, Cut set matrix, Cut set schedules, Twig voltages, Tie sets, Link currents and Tie set schedules, Duality and dual networks.

Textbooks

1. A Sudhakar and Shyammohan S. Palli, “Circuits and Networks: Analysis and Synthesis”, McGraw Hill Education, Fifth edition July 2017
2. Charles K. Alexanderand Matthew N.O.Sadik, “Fundamentals of Electrical Circuit”, 5th Edition, Kindle Edition, 2013.February 2019
3. William H. Hayt, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuit Analysis”, 8th Edition, TMH, 2012.

Reference Books

1. Vincent Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, India, 2015.
2. Boylestad R. L., “Introductory Circuit Analysis”, Prentice Hall of India, 2009.
3. Decarlo R. A. and Pen-Min Lin, "Linear Circuit Analysis”, Oxford University press, 2010.
4. Smarajit Ghosh,” Fundamentals of Electrical and Electronics Engineering”, Prentice Hall of India, 2007
5. Joseph A.Edminister, Mahmood Nahvi,“Electric Circuits”, Schaum’s Series,Tata McGraw-Hill, New Delhi 2001.

Web References

1. https://nptel.ac.in/courses/108104139/
2. https://nptel.ac.in/courses/108105053/
3. https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc
4. https://esearch.sc4.edu/electronics/web
5. https://libguides.scu.edu/c.php?g=175772&p=1158041

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

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

U20ESP102	PROGRAMMING IN C LABORATORY (Common to CSE, ECE, EEE, IT, ICE, MECH,CIVIL, BME, MECHTRONICS, CCE)	L	T	P	C	Hrs
		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", Pearson Education, First edition, 2011.
3. Maureen Sprankle,Jim Hubbard," Problem Solving and Programming Concepts," Pearson, 9th Edition, 2011.
4. Yashwanth Kanethkar, "Let us C", BPB Publications, 13th Edition, 2008.
5. B.W.Kernighan and D.M. Ritchie, "The C Programming Language", Pearson Education, 2nd Edition, 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/

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

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

U20ESP105	ELECTRIC CIRCUITS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To study basics of active and passive components
- To construct series and parallel circuits with the help of Ohm's law and Kirchhoff's laws
- To find average value, RMS value, form factor and peak factor for different waveforms
- To study the frequency responses of RL, RC and RLC circuits
- To calculate the Q factor of tank circuits

Course Outcomes

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

CO1 - Summarize the practical implications of the fundamentals of Ohm's law, Kirchhoff's current and voltagelaws **(K2)**
CO2 - Use the meters to measure the voltage, current, power and impedance of any circuit **(K3)**
CO3 - Illustrate DC analysis and Frequency analysis of a given circuit depending on types of elements **(K4)**
CO4 - Use the DSO to measure the frequency and amplitude of any signal. **(K3)**
CO5 - Discover the implementation of circuit theorem. **(K3)**

LIST OF EXPERIMENTS

The following experiments to be carried out in both hardware and simulation using Multisim and compare both the results

1. Study of passive and active components
   a. Resistor Colour coding using digital multi-meter.
   b. Assembling electronic components on breadboard.
2. Construction of series and parallel circuits using resistors and verify using KVL and KCL
3. Determination of average value, RMS value, form factor, peak factor of sinusoidal wave, square wave.
4. Verification of mesh and nodal analysis
5. Verification of Thevenin's Theorem
6. Verification of Norton's Theorem
7. Verification of superposition Theorem
8. Verification of maximum power transfer theorem
9. Verification of reciprocity theorem
10. Analysis of Frequency response of RL, RC and RLC circuits
11. Q factor extraction in Tank circuits
12. Determination of self, mutual inductance and coefficient of coupling

Reference Books

1. Vincent Del Toro, "Electrical Engineering Fundamentals", Pearson Education, India, 2015.
2. Boylestad R. L., "Introductory Circuit Analysis", Prentice Hall of India, 2009.
3. Decarlo R. A. and Pen-Min Lin, "Linear Circuit Analysis", Oxford University press, 2010.
4. Smarajit Ghosh," Fundamentals of Electrical and Electronics Engineering" , Prentice Hall of India, 2007
5. Joseph A.Edminister, Mahmood Nahvi, "Electric Circuits", Schaum's Series, Tata McGraw-Hill, New Delhi 2001.

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2. https://nptel.ac.in/courses/108105053/
3. https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc
4. https://esearch.sc4.edu/electronics/web
5. https://libguides.scu.edu/c.php?g=175772&p=1158041

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	2	-	-	3	-	-	2	3	2	1
2	3	3	3	2	2	2	-	-	3	-	-	2	3	2	1
3	3	3	3	2	2	2	-	-	3	-	-	2	3	2	1
4	3	3	3	2	2	2	-	-	3	-	-	2	3	2	1
5	3	3	3	2	2	2	-	-	3	-	-	2	3	2	1

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

U20ESP112	ENGINEERING GRAPHICS USING AUTO CAD (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 - Define the fundamentals and standards of engineering graphics**. (K2)**
CO2 - Compare freehand sketching of basic geometrical constructions and multiple view of objects**. (K3)**
CO3 - Relate and draw orthographic projections of lines & plane surfaces and development of surfaces**. (K2)**
CO4 - Sketch the isometric and perspective sections of simple solids. **(K3)**
CO5 - Usage of software packages for drafting and modeling**. (K3)**

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 bedrooms, 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 References

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

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

U20ECC1XX	CERTIFICATION COURSE - I	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 Hrs 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 courseis mandatory for the award of degree.

U20ECS101	DEMONSTRATION OF WORKSHOP PRACTICES (Common to ECE, CSE, IT, ICE, BME, CCE)	L	T	P	C	Hrs
		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 gain a good basic working knowledge required for the production of various engineering products.
- 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 electrical components as per specific dimension. **(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. Troubleshooting of electrical appliances
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. Workshop Technology I, II, III by S K Hajra, Choudhary and A K Chaoudhary. Media Promoters andPublishers Pvt. Ltd., Bombay
4. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd.,New Delhi
5. Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; 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://www.instructables.com/id/The-Ultimate-Guide-to-Desoldering/
5. https://electronicsclub.info/soldering.htm

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

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

U20ECM101	INDUCTION PROGRAM	L	T	P	C	Hrs
		0	0	2	-	30

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 and Universal Human Values • Familiarization with College, Dept./Branch Literary Activity • Proficiency Modules • Lectures and 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 teamwork 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 many thinkers, universal human values provide the base, have underlined character building. Methodology of teaching this content is extremely important. It must not be through do's and dont's, 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.

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 and 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.

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST215	Engineering Mathematics–II (Multiple Integrals and Transforms)	BS	2	2	0	3	25	75	100
2	U20EST219	Engineering Mechanics	ES	2	2	0	3	25	75	100
3	U20EST239	Electrical Engineering	ES	3	0	0	3	25	75	100
4	U20EST240	Electronic Measurements and Instrumentation	ES	3	0	0	3	25	75	100
5	U20ECT201	Network Theory	PC	2	2	0	3	25	75	100
6	U20ECT202	Electron Devices	PC	3	0	0	3	25	75	100
Practical										
7	U20ESP240	Electrical Engineering Laboratory	ES	0	0	2	1	50	50	100
8	U20ECP201	Electron Devices Laboratory	PC	0	0	2	1	50	50	100
9	U20ECP202	Electronics Engineering Practices	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20ECC2XX	Certification Course - II**	EEC	0	0	4	-	100	-	100
Mandatory Course										
11	U20ECM202	Environmental Science	MC	2	0	0	-	100	-	100
							21	500	600	1100

U20BST215	ENGINEERING MATHEMATICS II	L	T	P	C	Hrs
		2	2	0	3	60

MULTIPLE INTEGRALS AND TRANSFORMS

(Common to all branches Except CSBS)

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 Laplace transform of simple functions**. (K3)**
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 – Fourierseries for odd and even functions – Half-range Fourier cosine and sine series – Change of interval – Relatedproblems.

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.

Textbooks

1. Ravish R Singh and Mukul Bhatt, "Engineering Mathematics", Tata McGraw Hill, 1st Edition, New Delhi, 2016.
2. P. Sivaramakrishna Das and C. Vijayakumari, "Engineering Mathematics", Pearsons, New Delhi, 2017.
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, 10thEdition 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	-	1
2	3	2	1	1	-	1	-	-	-	-	-	1	3	-	1
3	3	2	1	1	-	1	-	-	-	-	-	1	3	-	1
4	3	2	1	1	-	1	-	-	-	-	-	1	3	-	1
5	3	2	1	1	-	1	-	-	-	-	-	1	3	-	1

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

U20EST219	ENGINEERING MECHANICS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the basic of forces and moments, static equilibrium of particles in two and three dimensions
- To study about the equilibrium of rigid bodies and components of a moment
- To know the concept of properties of surfaces and solids
- To impart knowledge on relationship between the motion of bodies
- To learn the various structural analysis and load on system of rigid bodies

Course Outcomes

After completion of the course, students will be able to

CO1 - Recognize the basics of equilibrium of particles in 2D and 3D. **(K2)**
CO2 - Review the requirements of equilibrium of rigid bodies in 2D and 3D. **(K2)**
CO3 - Compute the center of mass and moment of inertia of surfaces and solids. **(K4)**
CO4 - Predict displacement, velocity and acceleration of dynamic particles. **(K2)**
CO5 - Solve for friction force and rigid body dynamics**. (K3)**

UNIT I BASICS & STATICS OF PARTICLES (12 Hrs)

Introduction - Units and Dimensions - Vectorial representation of forces and moments –Coplanar Forces - Laws of Mechanics - Lame's theorem, Parallelogram and triangular Law of forces -Resolution and Composition of forces -Equilibrium of a particle - Principle of transmissibility -Single equivalent force - Free body diagram

UNIT II EQUILIBRIUM OF RIGID BODIES (12 Hrs)

Types of supports and their reactions -requirements of stable equilibrium -Moments and Couples -Moment of a force about a point and about an axis -Vectorial representation of moments and couples - Scalar components of a moment -Varignon's theorem -Equilibrium of Rigid bodies in two dimensions –Forces in space -Equilibriumof a particle in space - Equivalent systems of forces - Equilibrium of Rigid bodies in three dimensions — Examples.

UNIT III PROPERTIES OF SURFACES AND SOLIDS (12 Hrs)

Determination of centroid of areas, volumes and mass - Pappus and Guldinus theorems - moment of inertia of plane and areas- Parallel axis theorem and perpendicular axis theorem, radius of gyration of area- product of inertia- mass moment of inertia.

UNIT IV DYNAMICS OF PARTICLES AND FRICTION (12 Hrs)

Displacements, Velocity and acceleration, their relationship - Relative motion -Curvilinear motion -Newton's law -Work Energy Equation of particles -Impulse and Momentum -Impact of elastic bodies. Friction force - Laws ofsliding friction - equilibrium analysis of simple systems with sliding friction -wedge friction- Rolling resistance

UNIT V STRUCTURAL ANALYSIS OF TRUSSES AND RIGID BODY DYNAMICS (12 Hrs)

Trusses: - Definition of a truss - Simple Trusses - Analysis of Trusses - Method of joints- Method of sections. - Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion of simple rigid bodies such as cylinder disc/wheel and sphere.

Textbooks

1. Beer, F.P and Johnston Jr. E.R. "Vector Mechanics for Engineers- Statics and Dynamics", McGraw-Hill Education Pvt Ltd. 12th Edition, June 2019.
2. J.L.Meriam& L.G. Karidge, Engineering Volume I) and Engineering Mechanics: Dynamics, 8th edition, Wiley student edition, 2016.
3. Hibbeller, R.C., "Engineering MechanicsPaperback **–**", 14th edition, Prentice hall (2017).

Reference books

1. Arthur P. Boresi and Richard J. Schmidt, “Engineering Mechanics: Statics and Dynamics”, Thomson Asia Private Limited, Singapore, 2010.
2. D.P.Sharma “Engineering Mechanics”, Dorling Kindersley (India) Pvt. Ltd, New Delhi 2010.
3. Rajasekaran, S, Sankarasubramanian, G., Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt., Ltd., 2012.
4. Bhavikatti,S.S and K.G. Rajashekarappa, Engineering Mechanics, New Age International (p) Ltd, New Delhi, 7th Edition , 2019
5. Dr.I.SGujral “Engineering Mechanical” second edition, Lakshmi Publication (P).Ltd.2011.

Web References

1. http://nptel.iitm.ac.in/video.php?subjectId=112103108
2. http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT
3. https://civilenggforall.com/engineering-mechanics-made-easy-gate-handwritten-notes
4. https://lecturenotes.in/subject/435/engineering-mechanics-em
5. https://www.researchgate.net/publication/322738790_Engineering_Mechanics_Statics_Lecture_Notes_

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

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

U20EST239	ELECTRICAL ENGINEERING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To make the students to learn basic concepts, construction and working of different types of transformers
- To study Construction, Principles of operation, Electrical and mechanical characteristics of DC machines
- To expose the Principles of operation and applications of AC machines
- To provide knowledge on methods to test the performance of AC and DC Machines
- To give overview of various domestic wiring

Course Outcomes

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

CO1 - Explain the working of single phase and three phase transformers. **(K2)**
CO2 - Demonstrate the operation of DC machines and their performance characteristics. **(K3)**
CO3 - Interpret the construction and working of AC machines for various applications**. (K2)**
CO4 - Describe the operation of special machines. **(K2)**
CO5 - Compare the various wiring diagrams for house and industries**. (K3)**

UNIT I TRANSFORMERS (9 Hrs)

Introduction: Single phase transformer construction and principle of operation, EMF equation of transformer- Types –Ideal Transformer-load test, phasor diagram of Transformer no–load and load, OC/SC test on transformer, Equivalent circuit of transformer, Regulation of transformer, Transformer losses and efficiency, All day efficiency , auto transformers- copper savings in auto transformer,
Introduction to three phase transformer-Power Measurement-Two Wattmeter method.

UNIT II D.C. MACHINES (9 Hrs)

DC Generators: Construction, Principles of operation of DC Generators, types, EMF equation, No load and Load characteristics of series and shunt generators. DC motor: Principle of operation, Torque Equation, load and no-load tests, electrical and mechanical characteristics of series and shunt motors, Speed control methods and applications, Need for starter and types of starter.

UNIT III INDUCTION MACHINES AND SYNCHRONOUS MACHINES (9 Hrs)

Three phase Induction Motors: Principle of operation of three-phase induction motors, Construction, Types, torque equation, Slip-torque characteristics. Single Phase Induction Motors: equivalent circuit, Construction, Types of single-phase induction motors, Double revolving field theory, starting methods, Alternator: Principles of alternator, Construction details, Types, Equation of induced EMF, Voltage regulation. Synchronous motors. Methods of starting of synchronous motors, Torque equation, V and inverted V curves.

UNIT IV SPECIAL MACHINES (9 Hrs)

Servo motor, DC and AC servomotors; stepper motors, variable reluctance and permanent magnet stepper motors, reluctance motor and hysteresis motor, universal motor, Repulsion motor, BLDC motor, Applications

UNIT V BASICS OF ELECTRICAL ENERGY (9 Hrs)

Introduction, conventional and non-conventional sources of Electrical Energy, Domestic wiring -Introduction, Wiring System at Home, Factors affecting the choice of wiring system, Types of Wiring, Cleat wiring, CTS wiring or TRS wiring or batten wiring, Metal sheathed wiring, Casing and capping, Conduit wiring, Typical House Wiring Circuits, Staircase lighting, Corridor lighting, Basics of Utility Supply, Knowledge about distribution box, MCB, plug type, live wire, neutral wire, plate earthing, pipe earthing, working of fluorescent tube, incandescent bulb, CFL, cables, fuses and insulators.

Textbooks

1. B.L. Theraja, “Electrical Technology Vol.- II AC/DC Machines”, S. Chand, 2008
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, Tata Mc Graw Hill Education Private Limited, 1st Edition, 2011.
3. D. P. Kothari and I. J. Nagrath, “Electric Machines”, Tata McGraw Hill Publishing Company Ltd, Reprint 2008.

Reference Books

1. G.C.Garg, “Utilisation of Electric power and electric traction”, Khanna Publications (p) Ltd, Delhi, 2006.
2. V. K. Mehta &RohitMehta, “Principle of Electrical Machines”, S. Chand Publishers, 2011.
3. D Kothari, I Nagrath, “Basic Electrical Engineering”, Tata Mcgraw Hill Education, 2009.
4. M. S. Sukhija, T. K Nagsarkar, “Basic Electrical Engineering”, Oxford University Press, 2005.
5. S. K. Sahdev,” Fundamentals of Electrical Engineering and Electronics”, Dhanpat Rai and Co, 2013.

Web References

1. https://www.coursera.org/lecture/linear-circuits-ac-analysis/5-1-transformers-dB0z9
2. https://www.elprocus.com/alternating-current-and-direct-current-and-its-applications/
3. https://www.electronicshub.org/electrical-systems-and-methods-of-electrical-wiring/
4. https://nptel.ac.in/courses/108/105/108105017/
5. https://lecturenotes.in/course/all/btech/electrical-engineering

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

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

U20EST240	ELECTRONIC MEASUREMENTS AND INSTRUMENTATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To know the measuring methods and instruments of electrical quantities.
- To recognize, design aspects and performance criterion of measuring instruments.
- To understand the working principle of various transducers.
- To create awareness about the different types of bridges
- To learn the basic principle of transducers.

Course Outcomes

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

CO1 - Discuss the operation of different instruments**. (K2)**
CO2 - Identify the industrial and laboratory applications of instruments **(K2)**
CO3 - Distinguish between the analog and digital meters **(K3)**
CO4 - Discuss the experiments to determine various types of errors in measurements **(K2)**
CO5 - Use of testing and measuring set up for electronic systems. **(K3)**

UNIT I PERFORMANCE CHARACTERISTICS OF INSTRUMENTS (9 Hrs)

Static characteristics, accuracy, resolution, precision, expected value, error and sensitivity. Errors in measurement and dynamic characteristics: speed of response, fidelity, lag and dynamic error. Voltmeters: Multirange, range extension, solid state and differential voltmeters. Ammeters: Shunt and thermocouple type ammeter. Ohmmeters: Series type, shunt type, multimeter for voltage, current and resistance measurements. Digital multimeters: Block diagram and specifications.

UNIT II SIGNAL GENERATORS (9 Hrs)

Fixed and variable, AF oscillators, standard and AF sine and square wave signal generators, function Generators, square pulse, random noise and sweep. Wave Analyzers: Harmonic distortion analyzers, spectrum analyzers and digital Fourier analyzers.

UNIT III CATHODE RAY OSCILLOSCOPES (9 Hrs)

CRT features, vertical amplifiers, horizontal deflection system, sweep, trigger pulse, delay line, sync selector circuits, simple CRO, triggered sweep CRO, dual beam CRO, measurement of amplitude and frequency. Dual trace oscilloscope, sampling oscilloscope, storage oscilloscope, digital storage oscilloscope, Lissajous method of frequency measurement, standard specifications of CRO, probes for CRO (active and passive), attenuator type.

UNIT IV AC BRIDGES (9 Hrs)

Measurement of inductance: Maxwell ‘s bridge, Anderson bridge. Measurement of capacitance: Schearing bridge. Kelvin ‘s bridge, Wheatstone bridge and Wien Bridge. Errors and precautions and related problems. Q – Meter. Bridges: Wheat Stone Bridge, Kelvin Bridge and Maxwell Bridge

UNIT V ACTIVE AND PASSIVE TRANSDUCERS (9 Hrs)

Resistance, capacitance, inductance, strain gauges, LVDT, piezo electric transducers, resistance thermometers, thermocouples, thermistors and sensistors. Basic Hall Effect sensors. Calibration and standardsand data acquisition systems.

Textbooks

1. H.S.Kalsi, “Electronic instrumentation” Tata McGraw Hill Education Pvt LTD, 2010,
2. A.D. Helfrick and W.D. Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, PHI, 2013.
3. Doebelin, E.O., Measurement systems, McGraw Hill, Fourth edition, Singapore, 1990.

Reference Books

1. David A. Bell, “Electronic Instrumentation & Measurements”, PHI, 2013
2. Robert A.Witte, “Electronic Test Instruments, Analog and Digital Measurements”, Pearson Education, 2014
3. Electronics Instruments and Instrumentation Technology – Anand, PHI
4. Elements of Electronics Instrumentation and Measurement-3rd Edition by Joshph J.Carr. Pearson Education.
5. A.K. Sawhney, ‘Electrical & Electronic Measurements and Instrumentation’, Dhanpath Rai & Co (P) Ltd, 2004.

Web References

1. https://www.researchgate.net/publication/288177357_Instrument_Types_and_Performance_Characteristics
2. https://www.gwinstek.com/en-global/products/layer/Signal_Generator
3. https://electronicscoach.com/difference-between-active-and-passive-transducer.html
4. https://eceschool.blogspot.com/p/electronic-measuring-instrumentation.html
5. https://www.docsity.com/en/subjects/electronics-measurement-and-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	2	3	1	1	-	-	-	-	-	1	-	3	2	-
2	3	1	2	1	2	-	-	-	-	-	2	1	3	2	-
3	3	1	2	1	-	-	-	-	-	-	2	1	3	2	-
4	3	2	2	1	-	-	-	-	-	-	1	-	2	2	-
5	3	1	2	1	1	-	-	-	-	-	2	-	3	1	-

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

U20ECT201	NETWORK THEORY	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To impart knowledge on Network Functions
- To provide various Network parameters and its applications
- To analyze the transient behavior of Electrical circuits
- To elaborate the concepts of Network Synthesis
- To study the various types of Filters and Attenuators with applications

Course Outcomes

After completion of the course, the students are able to

CO1 - Explain different network functions and also the stability of network. **(K2)**
CO2 - Discuss the basics of two port networks and its different parameters like Z. Y, h and ABCD. Along withtheir interconnection of two port networks. **(K2)**
CO3 - Problem-Solve the transient response of DC and AC circuits. **(K4)**
CO4 - Devise the synthesis of network using passive elements**. (K4)**
CO5 - Illustrate the passive filters and attenuators for various applications. **(K4)**

UNIT I NETWORK FUNCTIONS (12 Hrs)

Driving point impedance and admittance, Transfer impedance and admittance, Voltage and current Transfer ratio, Concept of pole-zeros in network function, Necessary conditions for Driving point and transfer functions, Open and short circuit natural frequencies, Routh-Hurwitz criteria for stability of Network functions.

UNIT II NETWORK PARAMETERS (12 Hrs)

Open circuit impedance (Z) parameters - short circuit admittance (Y) parameters - transmission (ABCD) parameters and inverse transmission parameters - Hybrid (h) parameters and inverse hybrid parameters - Conversion between parameters

UNIT III TRANSIENT RESPONSE AND COUPLED COILS (12 Hrs)

Natural response-Forced response - Transient response of RC, RL and RLC circuits to excitation by DC and exponential sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation-Transient analysis by Laplace Transformation Technique. Coupled Circuits: Self-inductance and Mutual inductance, Coefficient of coupling, dot convention, Ideal Transformer, Analysis of multi-winding coupled circuits, Analysis of single tuned and double tuned coupled circuits.

UNIT IV NETWORK SYNTHESIS (12 Hrs)

Reliability of one port network, Hurwitz property, positive realness, properties of positive real functions, Synthesis of R-L, R-C and L-C driving point functions, Foster and Cauer forms

UNIT V FILTERS AND ATTENUATORS (12 Hrs)

Fundamentals of filters, types of filters- low pass, high pass, band pass and band elimination filters, Constant K-filters. Attenuators: Symmetric and asymmetric attenuators, T-attenuators, π-attenuators

Textbooks

1. Van, Valkenburg.; “Network analysis”; Prentice hall of India, 3rd edition 2019
2. Sudhakar. A., Shyammohan, S. P.; “Circuits and Network”; Tata McGraw-Hill New Delhi, 2017
3. A William Hayt, “Engineering Circuit Analysis” 8th Edition, McGraw-Hill Education, 2016

Reference Books

1. John. D. Ryder, “Network lines and fields”, PHI Learning, Second Edition, 2015
2. Edward C. Jordan and Keith G. Balaman, “Electromagnetic waves and radiating systems”, Second Edition, PHI Learning, 2012.
3. Franklin Fa-Kun. Kuo, “Network Analysis & Synthesis”, John Wiley & Sons.
4. M. L. Soni, J. C. Gupta, “A Course in Electrical Circuits and Analysis”,
5. Joseph A. Edminister, Mahmood Maqvi, “Theory and Problems of Electric Circuits”, Schaum's Outline Series, TMH

Web References

1. https://www.tutorialspoint.com/network_theory/network_theory_twoport_parameter_conversions.htm
2. https://www.allaboutcircuits.com/textbook/alternating-current/chpt-8/low-pass-filters/
3. https://nptel.ac.in/courses/108/105/108105159/
4. https://lecturenotes.in/subject/25/network-theory-nt
5. https://www.newtondesk.com/network-theory-handwritten-study-notes/

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

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

U20ECT202	ELECTRON DEVICES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To observe the concepts of semiconductor diodes through its operation, characteristics and various parameters
- To gain insight into the operation, characteristics and functional aspects of BJT in different configurations
- To understand in depth about the construction, operation, characteristics and various parameters of JFET and MOSFET
- To study the construction, operation and characteristics several special semiconductor devices
- To acquaint the various rectifier circuits with filters and IC regulator circuits

Course Outcomes

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

CO1 - Explain the basic semiconductor theory concepts. **(K1)**
CO2 - Summarize the working principle and characteristics of BJTs**. (K2)**
CO3 - Interpret the working principle and characteristics of JFET and MOSFETs. **(K2)**
CO4 - Explain the characteristic of Special Semiconductor devices and other special devices. **(K1)**
CO5 - Discuss the operations of Rectifiers and Regulators. **(K2)**

UNIT I SEMICONDUCTOR DIODE (9 Hrs)

Diode: PN Junction Diode, Resistance Levels, Diode Equivalent Circuits, Transition and Diffusion Capacitance, Reverse Recovery Time, Diode Testing, Zener Diodes, Diode Approximations, Series Diode Configurations with DC Inputs, Parallel and Series-Parallel Configurations, Clippers, Clampers, Voltage-Multiplier Circuits.

UNIT II BIPOLAR JUNCTION TRANSISTORS (9 Hrs)

BJT: Construction and operation of NPN and PNP transistors, Early Effect, Current equations, Input and Output characteristics of CE, CB, CC, Hybrid-π model, h-parameter model, Ebers Moll Model, Gummel Poon-model, Multi Emitter Transistor.

UNIT III FIELD EFFECT TRANSISTORS (9 Hrs)

FET: JFETs, Drain and Transfer characteristics, -Current Equations-Pinch off voltage and its significance-MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET-Characteristics – Comparison of MOSFET with JFET.

UNIT IV SPECIAL SEMICONDUCTOR DEVICES (9 Hrs)

Metal-Semiconductor Junction- MESFET, FINFET, PINFET, CNTFET, DUAL GATE MOSFET, Schottky barrier diode, Varactor diode, Tunnel diode, Gallium Arsenide device, LASER diode, LDR.
Power Devices: Construction, operation and applications of UJT, SCR, DIAC, TRIAC

UNIT V APPLICATIONS OF SEMICONDUCTOR DEVICES (9 Hrs)

Rectifiers and Filters: Half wave, Full wave and bridge rectifier, Ripple factor calculation for C, L, LC and CLC filter. Regulators: Voltage regulators, Shunt voltage regulator, Series voltage regulator, Short circuit protection circuit, Current limiting circuit, Fold back limiting, Op-Amp voltage regulator, switching regulator, Step up and step-down converters.

Textbooks

1. Robert L. Boylestad, “Electronic Devices and Circuit Theory”, Pearson, 11th edition 2015
2. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, “Electronic Devices and circuits”, Third Edition, Tata McGraw- Hill, 2012
3. David A. Bell,” Electronic devices and circuits”, Oxford University higher education, 5th edition 2008.

Reference Books

1. Sedra and Smith, “Microelectronic Circuits”, Oxford University Press, 5th Edition, 2005.
2. Donald A Neaman, “Semiconductor Physics and Devices”,4th edition, McGraw Hill Education India PrivateLtd., 2011.
3. homas L.Floyd, “Electronic devices” Conventional current version, Pearson prentice hall, 10th Edition, 2017.
4. Balbir Kumar, Shail.B.Jain, “Electronic devices and circuits” PHI learning private limited, 2nd edition
5. Yang, “Fundamentals of Semiconductor devices”, McGraw Hill International Edition, 1978.

Web References

1. https://www.electrical4u.com/diode-working-principle-and-types-of-diode/
2. https://www.allaboutcircuits.com/video-tutorials/transistors/
3. https://onlinelibrary.wiley.com/doi/full/10.1002/inf2.12016
4. https://nptel.ac.in/courses/117/106/117106091/
5. https://www.electronics-tutorials.ws/

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

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

U20ESP240	ELECTRICAL ENGINEERING LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To impart the basic knowledge of electrical quantities
- To provide an insight into the constructional details of DC machines
- To know the transformers characteristics for better understanding of their working principles
- To equip the students to test and evaluate the performance of various AC, DC machines and Single-phasetransformers by conducting appropriate experiments
- To Highlight the importance of transformers in real time applications

Course Outcomes

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

CO1 - Discuss the basic knowledge of Electrical machines **(K2)**
CO2 - Illustrate the constructional details of the DC machines by conducting various tests on dc machines **(K4).**
CO3 - Demonstrate the operations of various Transformers. **(K3)**
CO4 - Infer the performance of DC machine (shunt, series or compound) and transformer by conductingsuitable experiments**. (K4)**
CO5 - compare the various speed control techniques of DC motors **(K2).**

LIST OF EXPERIMENTS

1. Load test on single phase transformer.
2. OC and SC test on single phase transformer.
3. Load test on 3 phase transformers
4. Load test on DC shunt Generator.
5. OCC and Load test on separately exited DC generator.
6. Load test on DC shunt motor.
7. Swinburne ‘s test.
8. Speed control methods of DC motor.
9. Load test on single phase IM.
10. Load test on 3 phase induction motor.
11. Load test on 1 phase alternator

Reference Books

1. B.L. Theraja, “Electrical Technology Vol.- II AC/DC Machines”, S. Chand, 2008
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, Tata Mcgraw Hill Education Private Limited, 1st Edition, 2011.
3. G.C.Garg, “Utilisation of Electric power and electric traction”, Khanna Publications (p) Ltd, Delhi, 2006.
4. V. K. Mehta &RohitMehta, “Principle of Electrical Machines”, S. Chand Publishers, 2011.
5. D Kothari, I Nagrath, “Basic Electrical Engineering”, Tata Mcgraw Hill Education, 2009.

Web References

1. https://www.electrical4u.com/electric-machines/
2. https://www.javatpoint.com/electrical-machines-tutorial
3. https://www.coursera.org/lecture/linear-circuits-ac-analysis/5-1-transformers-dB0z9
4. https://www.elprocus.com/alternating-current-and-direct-current-and-its-applications/
5. https://www.electronicshub.org/electrical-systems-and-methods-of-electrical-wiring/

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

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

U20ECP201	ELECTRON DEVICES LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To provide a clear knowledge about various diodes
- To make the student to understand about BJT in different modes of Operation with its characteristics
- To enable the student to understand JFET and MOSFET Characteristics
- To study the characteristics of thyristor
- To Understand and study the applications of Diodes in real time

Course Outcomes

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

CO1 - Discover the VI characteristics of various semiconductor diodes **(K3)**
CO2 - Relate the Input -Output Characteristics of BJT. **(K4)**
CO3 - Differentiate the characteristics of JFET and MOSFET. **(K4)**
CO4 - Illustrate the electrical characteristics SCR, UJT and TRIAC. **(K4)**
CO5 - Predict of diodes used for Rectifiers, Voltage regulators, Clippers and Logic gates. **(K2)**

LIST OF EXPERIMENTS

1. V-I characteristics of semiconductor diodes
   a. PN Junction diode
   b. Point contact diode
   c. Zener diode
2. Characteristics of BJT in CB configuration
   a. Determination of input and output characteristics
   b. Determination of voltage gain, current gain, input and output resistances from the characteristics
3. Characteristics of BJT in CE configuration
   a. Determination of input and output characteristics
   b. Determination of voltage gain, current gain, input and output resistances from the characteristics
4. Characteristics of JFET
   a. Determination of output and transfer characteristics
   b. Determination of pinch off voltage, r_d, g_m and μ from the characteristics
5. Characteristics of MOSFET
   a. Determination of output and transfer characteristics
   b. Determination of pinch off voltage, rd, gm and μ from the characteristics
6. Characteristics of UJT, SCR and TRIAC
7. Characteristics of photonic devices
   a. Determination of V-I characteristics of LED
   b. Determination of V-I and intensity characteristics of phototransistor
8. Rectifier and Voltage Regulators
   a. Determination of ripple factor for different types of rectifiers with and without filters.
   b. Voltage regulation characteristics of shunt, series and IC regulators
9. i) Clipper circuits using diodes: Positive, negative, biased and combinational clippers
   ii) Switching circuit

10 a. AND and OR logic gates using diodes
   b. NOT gate using transistor

Reference Books

1. Robert L. Boylestad, “Electronic Devices and Circuit Theory”, Pearson, 11th edition 2015
2. L. K. Maheshwari, M. M. S. Anand, “Laboratory Manual for Introductory Electronics Experiments”, New Age International (P) Ltd, 2012
3. homas L.Floyd, “Electronic devices” Conventional current version, Pearson prentice hall, 10th Edition, 2017.
4. Balbir Kumar, Shail.B.Jain, “Electronic devices and circuits” PHI learning private limited, 2nd edition
5. Yang, “Fundamentals of Semiconductor devices”, McGraw Hill International Edition, 1978.

Web References

1. https://www.industrial-electronics.com/experiments_0.html
2. http://www2.ece.ohio-state.edu/ee327/
3. http://www.vlab.co.in/broad-area-electronics-and-communications.
4. https://www.electrical4u.com/diode-working-principle-and-types-of-diode/
5. https://www.allaboutcircuits.com/video-tutorials/transistors/

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

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

U20ECP202	ELECTRONICS ENGINEERING PRACTICES	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To identify the active and passive electronic components
- To get hands-on assembling, testing, dismantling and repairing systems experience by making use of the various tools and instruments
- To impart knowledge on various real time systems and troubleshooting of that systems
- To identify the subsystem of household electronic systems.
- To provide knowledge about basics of Robotics

Course Outcomes

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

CO1 - Identify the active and passive electronic components**. (K1)**
CO2 - Discuss with assembling, testing, dismantling and repairing systems by making use of the various toolsand instruments**. (K2)**
CO3 - Gain Knowledge on various real time systems with troubleshooting. **(K3)**
CO4 - Analyze the household electronic systems. **(K4)**
CO5 - Acquire knowledge on basics of robotics. **(K2)**

LIST OF EXPERIMENTS / EXERCISES:

1. Familiarization / Identification of electronic components with specification (Functionality, type, size, colour coding, package, symbol, cost etc. [Active, Passive, Electrical, Electronic, Electro-mechanical, Wires, Cables, Connectors, Fuses, Switches, Relays, Crystals, Displays, Fasteners, Heat sink etc.)
2. Drawing of electronic circuit diagrams using BIS / IEEE symbols and introduction to EDA tools, Interpret data sheets of discrete components and IC's, Estimation and costing.
3. Familiarization / Application of testing instruments and commonly used tools. [Multimeter, Function generator, Power supply, CRO etc.] [Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Screw drivers, Tweezers, Crimping tool, Hot air soldering and de- soldering station etc.]
4. Testing of electronic components [Resistor, Capacitor, Diode, Transistor, UJT and JFET using multimeter.]
5. Inter-connection methods and soldering practice. [Bread board, Wrapping, Crimping, Soldering -types - selection of materials and safety precautions, soldering practice in connectors and general-purpose PCB, Crimping.]
6. Printed circuit boards (PCB) [Types, Single sided, Double sided, PTH, Processing methods, Design and fabrication of a single sided PCB for a simple circuit with manual etching (Ferric chloride) and drilling.]

Assembling of electronic circuit / system on general purpose PCB, test and show the functioning

7. Fixed voltage power supply with transformer, rectifier diode, capacitor filter, zener/IC regulator.
8. LED blinking circuit using a stable multi-vibrator with transistor BC 107.
9. Square wave generation using IC 555 timer in IC base.
10. Sine wave generation using IC 741 OP-AMP in IC base.

Familiarization of Electronic Systems

11. Setting up of a PA system with different microphones, loudspeakers, mixer etc.
12. Assembling and dismantling of desktop computer / laptop / mobile phones.
13. Identify the subsystem of TV, DTH, CCTV, CRO and Function generator
14. Induction to Robotics – Familiarization of components (motors, sensors, battery etc.,) used in Robotics andassembling of simple robotics configurations

Reference Books

1. Navas, K. A., “Electronics Lab Manual Volume I”, Fifth Edition, PHI, 2015
2. Murtala Adamu Zungeru, “Handbook of Laboratory Experiments in Electronics Engineering Vol. 1“, Notion Press, 2016,
3. Robert L. Boylestad, “Electronic Devices and Circuit Theory”, Pearson, 11th edition 2015.
4. L. K. Maheshwari, M. M. S. Anand, “Laboratory Manual for Introductory Electronics Experiments”, New Age International (P) Ltd, 2012.
5. Thomas L.Floyd, “Electronic devices” Conventional current version, Pearson prentice hall, 10th Edition, 2017.

Web References

1. https://dronebotworkshop.com/tools-for-your-electronics-workbench/
2. https://nptel.ac.in/courses/122/106/122106025/
3. https://www.engineersgarage.com/tutorials/articles-beginners-guide-to-setup-electronics-lab/
4. https://www.electronics-tutorials.ws/
5. https://everycircuit.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
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2	3	3	3	2	3	-	-	-	-	-	-	1	3	2	-
3	3	3	3	2	3	-	-	-	-	-	-	1	3	2	-
4	3	2	3	2	3	-	-	-	-	-	-	1	3	2	-
5	3	2	3	2	3	-	-	-	-	-	-	1	3	2	-

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

U20ECC2XX	CERTIFICATION COURSE - II	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 Hrs 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 courseis mandatory for the award of degree.

U20ECM202	ENVIRONMENTAL SCIENCE	L	T	P	C	Hrs
		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 soseparate 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 directapplication 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 type of activities.

(a) Awareness Activities:

i) Small group meetings about water management, promotion of recycle use, generation ofless 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

SEMESTER – III										
Sl.No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST321	Numerical Methods and Optimization	BS	2	2	0	3	25	75	100
2	U20EST356	Data Structures	ES	3	0	0	3	25	75	100
3	U20ECT303	Analog Electronic Circuits	PC	3	0	0	3	25	75	100
4	U20ECT304	Digital Electronic Circuits	PC	3	0	0	3	25	75	100
5	U20ECT305	Signals and Systems	PC	2	2	0	3	25	75	100
6	U20ECT306	Electromagnetic Field Theory	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	U20ECP303	Analog Electronic Circuits Laboratory	PC	0	0	2	1	50	50	100
10	U20ECP304	Digital Electronic Circuits Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20ECC3XX	Certification Course -III**	EEC	0	0	4	-	100	-	100
12	U20ECS302	Skill Development Course - 2*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20ECM303	Physical Education	MC	0	0	2	-	100	-	100
							22	**650**	**650**	**1300**

U20BST321	NUMERICAL METHODS AND OPTIMIZATION	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To understand the numerical technique of solving linear simultaneous equations.
- To introduce the numerical techniques of interpolation in various intervals.
- To understand the knowledge of various optimization techniques and methods of solving various types of partial differential equations.
- To acquaint the knowledge of various methods of linear programming problems.

Course Outcomes

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

CO1 - Understand the basic concepts and numerical techniques of solving algebraic and transcendental equations. **(K2)**
CO2 - Solve linear simultaneous equations by various numerical techniques. **(K3)**
CO3 - Apply the numerical techniques of interpolation and error approximations in various Intervals. **(K3)**
CO4 - Apply the optimization techniques for various types of partial differential equations. **(K3)**
CO5 - Solve linear programming problems by using Optimization techniques. **(K3)**

UNIT – I SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS AND EIGEN VALUE PROBLEMS (12 Hrs)

Solution of algebraic and transcendental equations and Eigen value problem -Bisection method - Method of false position - Newton Raphson method - 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 and Gauss-Jordan methods - Iterative methods: Gauss Jacobi - Gauss Seidel.

UNIT- III INTERPOLATION (12 Hrs)

Interpolation: 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 - Integration by Trapezoidal and Simpson's rules (Single integration only).

UNIT- IV SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (12 Hrs)

Optimization Techniques: Jacobians and their properties - Taylor's series for functions of two variables - Maxima and minima - Lagrange's method of undetermined multipliers.

UNIT- V LINEAR PROGRAMMING PROBLEMS (12 Hrs)

Introduction to Linear Programming - Graphical Method - Simplex Method - Maximization and minimization.

Textbooks

1. Atul Goyal, Madhuchanda Rakshit, Suchet Kumar, "Numerical Methods", New India publishing Agency, 1st Edition, 2019.
2. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", McGraw Hill, 8th Edition 2020.
3. T. Veerarajan, "Operation Research", McGraw Hill, 1st Edition, 2018.

Reference Books

1. Sia, “Numerical Methods”, Sia Publishers and Distributors Pvt. Ltd., 1st Edition, 2018.
2. Rajesh Kumar Gupta, “Numerical Methods - Fundamental and Applications”, Cambridge University Press, 1st Edition, 2019.
3. A. Ravi Ravindran, “Operations Research Methodologies”, Taylor and Francis, 1st Edition, 2019.
4. Kevin J. Hastings, “Introduction to the Mathematics of Operations Research with Mathematica”, Taylor and Francis, 2nd Edition, 2019.
5. P. K. Gupta, D. S. Hira, “Operations Research”, S. Chand, 5th Edition, 2018

Web Resources

1. https://nptel.ac.in/courses/111106101/
2. https://www.geektonight.com/operation-research-notes-pdf/#.XrXzoP8za00
3. https://freecomputerbooks.com/Numerical-Methods-with-Applications.html
4. https://www.pphmj.com/journals/IJNMA.htm
5. https://nptel.ac.in/courses/106/108/106108056/

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

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

U20EST356	DATA STRUCTURES (Common to ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHTRONICS)	L	T	P	C	Hrs
		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 – 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 and its operations. Types of Queue: Simple Queue – Circular Queue – Priority Queue – Deque.

UNIT - III LINKED LIST OPERATIONS (9 Hrs)

Linked Lists: Singly linked list: Representation in memory. Algorithms of several operations: Traversing – Searching – Insertion – Deletion. 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.

Textbooks

1. Ellis Horowitz, Sartaj Sahni," Fundamentals of Data Structures", Computer Science Press, Second Edition, 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.

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

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

U20ECT303	ANALOG ELECTRONIC CIRCUITS	L	T	P	C	Hrs
		3	0	0	3	60

Course Objectives

- To analyze transistor biasing circuits and its stabilization techniques
- To analyze the amplifier using h-parameters and low frequency FET model.
- To familiarize the theory of multistage and feedback amplifiers
- To understand the fundamentals of feedback amplifiers and concepts of oscillators
- To understand the concepts of Large Signal Amplifiers

Course Outcomes

After completion of the course, the students can

CO1 - Design the biasing circuits **(K2)**
CO2 - Design and analyze the BJT and FET Amplifiers **in** both low and high frequency **(K3)**
CO3 - Illustrate the design and analyze multistage and feedback amplifiers **(K3)**
CO4 - Construct and analyze oscillators and multivibrators. **(K3)**
CO5 - Differentiate the power amplifiers based on their operation, efficiency and distortion **(K3)**

UNIT– I BIASING and Stabilization (9 Hrs)

Biasing and Stabilization: DC load line and Q-point – Need for biasing – Different types of BJT biasing – Fixed bias, Collector to base bias, Self-bias –Stability factor – Bias compensation: Diode, Thermistor and Sensistor compensation – FET biasing: Gate bias, Voltage divider bias and Self bias – MOSFET biasing.

UNIT– II LOW AND HIGH FREQUENCY ANALYSIS (9 Hrs)

Transistor Low Frequency Analysis: Definition of h–parameters – Small signal low frequency h-parameter model –Mid band analysis of CB, CE and CC amplifier to obtain gain, input impedance and output impedance – Analysis of CE amplifier with an emitter resistance – Low frequency FET model – CS, CD and CG amplifiers.

Transistor High Frequency Analysis: Hybrid pi CE transistor model – Hybrid pi conductance and capacitances – CE short circuit current gain using Hybrid pi model - Current gain with resistive load.

UNIT– III AMPLIFIERS (9 Hrs)

Multistage Amplifiers: Need for cascading – Cascade amplifier – Cascode amplifier – Darlington Pair – Basic emitter coupled differential amplifier – Tuned amplifiers – single tuned –double tuned –stagger tuned amplifiers.

Feedback Amplifiers: Concept of feedback- topological classification-voltage series, voltage shunt, current series, current shunt - effect of feedback on gain, stability, distortion, band width, input and output impedances – practical feedback amplifier circuits and their analysis.

UNIT– IV OSCILLATORS AND MULTIVIBRATORS (9 Hrs)

Oscillators: Barkhausen criterion for sustained oscillations - RC oscillators – RC phase shift oscillator and Wien bridge oscillator- LC oscillators - Hartley and Colpitts oscillators – crystal oscillators and frequency stability.

Multivibrators: Astable, monostable and bistable multivibrators using transistors–Schmitt trigger circuit. Time Base Generators: General features of time base signals – RC ramp generator –Constant current ramp generator, UJT saw tooth generator – Bootstrap ramp generator

UNIT– V LARGE SIGNAL AMPLIFIERS (9 Hrs)

Classification of power amplifiers - Class A power amplifier-direct and transformer coupled amplifiers; -Class B - Push-pull arrangements and complementary symmetry amplifiers; conversion efficiency calculations, cross over distortion – class AB amplifier - amplifier distortion – power transistor heat sinking – Class C and D amplifiers.

Textbooks:

1. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, 5th edition, 2008
2. Adel.S.Sedra, Kenneth C.Smith, Microelectronic Circuits Theory and Applications, 7th Edition, Oxford University, 2017
3. Millman J and Halkias C, “Integrated Electronics”, Tata McGraw Hill International Edition, 2007.

Reference Books:

1. R.L. Boylestad and L. Nashelsky, “Electronic Devices and Circuit Theory”, PHI Learning Pvt. Ltd, India, Ninth Edition, 2008
2. S. Salivahanan, N.SureshKumar and A. Vallavaraj, “Electronic Devices and Circuits”, 2nd Edition, TMH, 2007.
3. Thomas L.Floyd, Fundamentals of Analog Circuits, Pearson Publication, 2nd Edition,2012
4. Jacob Millman, Arvin Grabel, “Microelectronics”, 2nd edition, Tata McGraw Hill, New Delhi. 2003
5. Neamen, Donald A., “Electronic Circuit Analysis and Design”, 3rd edition, McGraw Hill, 2006

Web References

1. https://nptel.ac.in/courses/108102095/
2. https://lecturenotes.in/subject/7/analog-electronic-circuits-aec
3. https://gradeup.co/electronics-communication-exams/analog-circuits
4. http://www.electronics.teipir.gr/personalpages/papageorgas/download/2/shmeiwseis/ELECTRONIC_COMPONENTS/varistor/Analog_Electronics.pdf
5. https://sites.google.com/site/eeenotes2u/home/analog-electronic-circuits

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

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

U20ECT304	DIGITAL ELECTRONIC CIRCUITS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives
- To acquire the knowledge of digital logic levels to understand digital electronics
- To understand about Boolean theorem and they are by perform logic reduction
- To analyze design of combination logic circuits
- To analyze design of sequential logic circuits
- To explain about various memory devices

Course Outcomes
After completion of the course, the students are able to
CO1 - Infer the fundamental concepts of digital electronics **(K2)**
CO2 - Discuss the logic reduction using Boolean theorems **(K2)**
CO3 - Construct and illustrate combinational logic circuits **(K3)**
CO4 - Construct and illustrate sequential logic circuits **(K3)**
CO5 - Categorize and realize the memory devices. **(K3)**

UNIT- I NUMBER SYSTEMS AND CODE (9 Hrs)
Introduction to Digital Systems, Number Systems- Binary, Octal, Decimal and Hexadecimal, Methods of base conversions, Representation of signed numbers; Fixed and floating point numbers, Binary Arithmetic - Addition, Subtraction, Complementary numbering systems: 1s and 2s Complements, Codes- Binary coded decimal codes; Gray codes; Error detection and correction codes - parity check codes and Hamming code

UNIT- II BOOLEAN THEOREMS AND LOGIC REDUCTION (9 Hrs)
Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms-Sum of Products Form, Product of Sum Form, Gate level minimization - Karnaugh-Map Method, Logic expression simplification with grouping cells: Quine Mc Clusky Method; Prime implicants, Prime applicant chart, NAND and NOR Implementation.

UNIT- III COMBINATIONAL LOGIC CIRCUIT AND DESIGN (9 Hrs)
Binary adders- Half adder, Full adder, Binary Subtractor-Half subtractor, Full subtractor, Parallel Binary Adders, BCD Adders, Encoder, Decoder, Comparator, Code convertor, Multiplexers, Demultiplexers, Parity Generator and Checker

UNIT- IV SEQUENTIAL LOGIC CIRCUITS (9 Hrs)
Gated Latches & Flip Flops- Level triggered and Edge triggered Flip-Flops, Flip Flop Conversion. Shift registers, General model of sequential circuits- Mealy/Moore models -Excitation table- State table- State diagram, Design of Synchronous sequential circuits - Counters, Shift Registers, Ring counters, Johnson counters, Hazards logic circuits- Hazard free realization Logic

UNIT- V SEMICONDUCTOR MEMORY AND PROGRAMMABLE DEVICES (9 Hrs)
Semiconductor memories- Classification of memories, Programmable Logic Devices, Logic Implementation with Programmable Logic Array (PLA), Programmable Array Logic (PAL) – concept of Field Programmable Gate Arrays (FPGA).

Textbooks
1. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011.
2. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015.
3. Floyd and Jain, Digital Fundamentals, Pearsons Publication, 10th Edition, 2015

Reference Books
1. A.Anand Kumar, Fundamentals of Digital Circuits, 4th Edition PHI Learning Private Limited, 2016.
2. Donald P Leach, Albert Paul Malvino and GoutamSaha, “Digital Principles and Applications”, 6thedition, Tata McGraw Hill Publishing Company Ltd.,New Delhi,2008.
3. Tocci R J, “Digital systems: Principles and Applications”, PHI learning, New Delhi, Tenth Edition, 2006.
4. Fundamentals of Logic Design by Charles H. Roth Thomson, 2015.
5. R.P.Jain, “Modern Digital Electronics”, Fourth Edition, Tata McGraw-Hill Education, 2009.

Web References

1. https://nptel.ac.in/courses/108/105/108105132/
2. https://www.electronics-tutorials.ws/logic/logic_1.html
3. https://www.worldscientific.com/worldscibooks/10.1142/10998
4. https://www.classcentral.com/course/swayam-digital-electronic-circuits-12953
5. https://www.allaboutcircuits.com/video-tutorials/analog-and-digital-electronics/

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

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

U20ECT305	SIGNALS AND SYSTEMS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the Mathematical Representation of Signals and Systems
- To describe the concept of Fourier transform and Laplace transform
- To describe the concept of discrete time Fourier transform and Z transform
- To understand the behavior of continuous time systems
- To understand the behavior of discrete time systems

Course Outcomes

After completion of the course, the students are able to

CO1 - Describe the elementary signals and properties of the systems by mathematical representation **(K2)**
CO2 - Discuss the properties of continuous time signals using Fourier and Laplace Transforms **(K2)**
CO3 - Discuss the properties of discrete time signals using DTFT and Z - transform **(K2)**
CO4 - Demonstrate the behavior of continuous time systems **(K3)**
CO5 - Demonstrate the behavior of discrete time systems **(K3)**

UNIT I IINTRODUCTION TO SIGNALS AND SYSTEMS (12 Hrs)

Introduction to Signals and Systems, Classification of Signals based on Independent Variable, Elementary Signals - Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential signals, Amplitude and Time Operation on Signals, Classification of Systems, Properties of Systems.

UNIT II ANALYSIS OF CT SIGNALS (12 Hrs)

Fourier series, Properties of Continuous Time Fourier Series, Trigonometric and Exponential Fourier Series Fourier Transform, Properties of Continuous Time Fourier Transform, Gibbs Phenomena, Dirichlet Conditions, Laplace Transforms, Properties of Laplace Transforms-R.O.C -Inverse Laplace transform

UNIT III ANALYSIS OF DT SIGNALS (12 Hrs)

Discrete Time Fourier Transform, Properties of Discrete Time Fourier Transform, Inverse Discrete Fourier Transform, Z-Transform, Properties of Z-Transforms--R.O.C –Inverse Z transform

UNIT IV CONTINOUS TIME SYSTEMS (12 Hrs)

LTI continuous time systems- Differential equations, Transfer function and Impulse response, Convolution Integral- Block diagram representation - State variable techniques – State equations

UNIT V DISCRETE TIME SYSTEMS (12 Hrs)

Difference equations, System function and impulse response, Convolution Sum, Block diagram representation, Convolution Sum, State equations for discrete time systems, Frequency response of discrete time signals

Textbooks

1. Alan V. Oppenheim, Alan S. Willsky, Syed Hamid Nawab, “Signals and Systems”, 2nd Edition, Pearson, 2013
2. P. Ramesh Babu,” Signals and Systems”, Fifth Edition, Scitech Publishers, 2014.
3. A.Nagoor Kani, “Signals and Systems”, Tata McGraw Hill Education Private Limited,2010

Reference Books

1. B. P. Lathi, “Principles of Linear Systems and Signals”, 2nd Edition, Oxford University Press, 2009
2. Michael Corithios, “Signals, Systems, Transforms, and Digital Signal Processing with MATLAB”, CRC Press. 2018
3. Tarun Kumar Rawat, “Signals and Systems”, Oxford University Press, 2010Grewal B.S., Higher Engineering Mathematics, 40th Edition, Khanna Publishers, Delhi 2007
4. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems – Continuous and Discrete”, Pearson, 2007.
5. Charles L. Philips, J. M. Parr and E. A. Riskin, Signal, Systems and Transforms, Pearson Education.

Web References

1. https://nptel.ac.in/courses/108/104/108104100/
2. https://lecturenotes.in/subject/36/signals-and-systems-ss
3. http://signalsandsystems.wikidot.com/notes-signals-problems
4. http://signalsandsystems.wikidot.com/problems
5. http://home.npru.ac.th/sopapun/Solved_Problems.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	2	-	-	-	-	-	-	-	1	3	1	-
2	3	2	2	2	-	-	-	-	-	-	-	1	3	1	-
3	3	2	2	2	-	-	-	-	-	-	-	1	3	1	-
4	3	2	2	2	-	-	-	-	-	-	-	1	3	1	-
5	3	2	2	2	-	-	-	-	-	-	-	1	3	1	-

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

U20ECT306	ELECTROMAGNETIC FIELD THEORY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain knowledge on vector calculus
- To acquire knowledge of various static electric and magnetic fields
- To gain knowledge on different applications of electromagnetic fields
- To acquire knowledge on Electromagnetic Fields in various Materials
- To understand about Maxwell's equations in various forms

Course Outcomes

After completion of the course, the students are able to

CO1 - Relate vector calculus to electrostatic fields and infer the behavior of static electric field of various Geometries**. (K2)**

CO2 - Summarize the applications of Electrostatics **(K2)**

CO3 - Explore the knowledge in magneto statics fields and its applications. **(K2)**

CO4 - Infer knowledge about electromagnetic fields in various materials and Boundary conditions **(K2)**

CO5 - Extract the Maxwell's equation in different forms to determine field waves, potential waves, Energy and Charge conservation conditions. **(K2)**

UNIT- I ELECTROSTATIC FIELDS (9 Hrs)

Vector Calculus - Scalar and Vector fields - Coordinate Systems and Transformation, Del - Gradient of a Scalar-Divergence of a Vector and Divergence Theorem-Curl of a Vector and Stokes Theorem, Coulombs Law - Coulombs Law in Vector Form - Electric Field Intensity - Electric Field due to discrete charges. electric fields due to point, line, surface and volume charge distributions – Electric flux density – Gauss law – Electric potential – potential gradient – Divergence and divergence theorem – Poisson's and Laplace equations.

UNIT– II ELECTROSTATIC APPLICATIONS (9 Hrs)

Field due to dipoles – dipole moment – Current and current density – Conductors and Dielectrics - Boundary conditions – capacitance – Dielectric interface – Capacitance of system of conductors – Dielectric constant and Dielectric strength - Energy stored in capacitor – Energy density

UNIT- III MAGNETOSTATICS FIELDS (9 Hrs)

Biot - Savart Law and Field Intensity - Magnetic Field intensity due to a finite and infinite wire carrying a current - Magnetic field intensity on the axis of a circular loop carrying a current - Amperes Circuital Law - Applications - infinite line current-infinite sheet of current-infinitely long coaxial transmission line. Magnetic Potential-Magnetic Scalar and Vector Potentials - Magnetic Flux Density

UNIT- IV MAGNETIC FORCES, MATERIALS AND DEVICES (9Hrs)

Forces due to magnetic field- Lorentz force equation for a moving charge- Force on a Current Element-Force between Two Current Elements. Magnetic Torque and moment- Magnetic dipole - Magnetization in materials – Classification of Magnetic materials –- magnetic boundary conditions – Inductors - inductances – magnetic energy stored in inductors.

UNIT- V TIME VARYING ELECTROMAGNETIC FIELDS (9 Hrs)

Maxwell's Equations - Faradays Law - Displacement Current – Maxwell's Equations in integral form and differential form - Time-Varying Potentials. Wave Propagation-Helmholtz wave Equation-wave motion in free space- perfect dielectric - lossy dielectric and good conductor- Skin effect. Poynting vector and power considerations.

Textbooks

1. Matthew Sadiku, 'Elements of Electromagnetics', Oxford University Publication, 2018
2. Edward C. Jordon, Keith G. Balmain, "Electromagnetic Waves and Radiating Systems", Pearson Education, Prentice hall, 2015.
3. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.

Reference Books

1. Joseph A.Edminister, 'Theory and Problems of Electromagnetics-Schaum series'-TMH-2007.
2. J.D.Kraus and D.A Fleisch, Electromagnetics with applications,5/e-Tata McGraw-Hill- 2011.
3. Bhag Guru and Huseyin Hiziroglu," Electromagnetic Field Theory Fundamentals", Cambridge University Press, 2nd edition, 2004
4. S.P.Ghosh, Lipika Datta, "Electromagnetic Field Theory", 1stedition,McGrawHillEducation(India) Private Limited, 2012.
5. David K. Cheng, "Field and Wave Electromagnetics", 2nd edition, Pearson Education, 1989.

Web References

1. https://nptel.ac.in/courses/108/104/108104087/
2. https://www.scribd.com/lists/3218090/electromagnetics
3. https://ocw.mit.edu/resources/res-6-001-electromagnetic-fields-and-energy-spring-2008/
4. https://www.khanacademy.org/science/physics/magnetic-forces-and-magnetic-fields
5. http://www.transmission-line.net/search/label/Electromagnetics

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	1	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

U20HSP301	GENERAL PROFICIENCY–I (Common to all the branches)	L	T	P	C	Hrs
		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)

Lagunage Enchantement : Articles, Prépositions, 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, 2004.
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.

Web References

1. https://www.ielts-exam.net/grammar/
2. https://ieltsfocus.com/2017/08/02/collocations-ielts/
3. https://www.freshersliveonline-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)		
	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

U20ESP357	DATA STRUCTURES LABORATORY (Common to ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHTRONICS, CCE)	L	T	P	C	Hrs
		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 toper form 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) In order and
   c) Post order.
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", Oxford University, 2nd Edition, 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/
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	-	-	-	-	-	-	-	-	2	-	1
2	3	2	1	1	-	-	-	-	-	-	-	-	2	-	1
3	3	2	1	1	-	-	-	-	-	-	-	-	2	-	1
4	3	2	1	1	-	-	-	-	-	-	-	-	2	-	1
5	3	2	1	1	-	-	-	-	-	-	-	-	2	-	1

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

U20ECP303	ANALOG ELECTRONIC CIRCUITS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To design and measure frequency response of Amplifiers
- To design and construct Feedback Amplifiers
- To design and construct about various Multivibrators
- To design and construct low and high frequency Oscillators
- To learn and understand about Power amplifiers

Course Outcomes

After completion of the course, the students are able to

CO1 - Demonstrate and measure the frequency response of amplifiers (K3)
CO2 - Illustrate the characteristics of feedback amplifiers. **(**K2)
CO3 - Demonstrate and test the various types of oscillators (K3)
CO4 - Operate and test multivibrators and power amplifier (K3)
CO5 - Describe the concepts of electronic circuits using MULTISIM / PSPICE software (K2)

LIST OF EXPERIMENTS

1. Design and implement the Common Emitter Amplifier and test its performance with and without load. Plot the frequency response, determine the Gain and signal handling capacity.
2. Design a JFET amplifier in Common Source/Common Drain configuration to obtain the Voltage gain, plot the frequency response, determine the Gain and signal handling capacity.
3. Design and construct voltage series / voltage shunt feedback amplifiers. Study the frequency response with respect to feedback analogy.
4. Design and construct Current Series / Current shunt feedback amplifiers. Study the frequency response with respect to feedback analogy.
5. Design and construct RC phase shift oscillator and determine the frequency of oscillation. Verify the phase shift property using Barkhausen criterion.
6. Design and implement the Hartley / Colpitts oscillator for a particular frequency.
7. Design and construct the UJT relaxation oscillator and determine its intrinsic stand-off ratio.
8. Design and construct Astable / Monostable / Bistable multivibrator and validate its parameters.
9. Design and construct a power amplifier and obtain the frequency Vs. power and load Vs. power characteristics.
10. Design and construct the Schmitt trigger circuit and verify its property.

***Simulate all the experiments using Multisim / Pspice Software**

Reference Books

1. Donald A Neaman, Electronic Circuits Analysis and design, 7th Edition
2. Muhammad H. Rashid, Microelectronic Circuits: Analysis and Design, 3rd Edition, Cengage Learning
3. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 5th edition
4. Muhammad H. Rashid, Microelectronic Circuits: Analysis and Design, 3rd Edition, Cengage Learning.
5. David A Bell, Electronic Devices and Circuits Oxford University Press 5th Edition, 2008.

Web References

1. https://nptel.ac.in/courses/108102095/
2. https://www.docsity.com/en/exercises/engineering/analogue-ic-design/
3. http://www.owlnet.rice.edu/~dodds/Files331/analog_expt.
4. https://www.allaboutcircuits.com/worksheets/
5. https://www.electronics-tutorials.ws/

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

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

U20ECP304	DIGITAL ELECTRONIC CIRCUITS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To learn and understand the basics of digital circuits using logic gates
- To apply the knowledge of combinational circuits and analysis the results for adder, subtractor and comparator
- To apply the knowledge of combinational circuits and analysis the results for multiplexer, demultiplexer and encoder, decoder.
- To apply the knowledge of sequential circuits and analysis the results
- To implement and analysis of synchronous and asynchronous counter

Course Outcomes

After completion of the course, the students are able to

CO1 - Devise the function of logic gates **(K4)**
CO2 - Demonstrate various combinational circuits like adder, subtractor and comparator **(K3)**
CO3 - Demonstrate various combinational circuits like multiplexer, Demultiplexer and encoder, decoder **(K3)**
CO4 - Devise and categorize different sequential circuits **(K4)**
CO5 - Correlate synchronous and asynchronous counters **(K4)**

LIST OF EXPERIMENTS

1. Verify the logic gates
2. Design and implementation of Adders and Subtractors using Logic Gates
3. Design and implementation of the following Code convertors
   a) BCD to excess-3 code and vice versa
   b) Binary to gray code and vice-versa
4. Design and implementation of 4-bit binary Adder/ Subtractor and BCD adder using IC7483
5. Magnitude comparator
   a) Study of 4-bit magnitude comparator IC
   b) Realization of 8-bit magnitude comparator using 4-bit magnitude comparator ICs
6. Multiplexers and Encoders
   a) Study of an 8×1 multiplexer IC
   b) Realization of 16×1 multiplexer using 8×1 multiplexer ICs
   c) Realization of a combinational circuit using multiplexer
   d) Construction and study of a simple Priority Encoder
7. Decoders and Demultiplexers
   a) Study of a 3 to 8-line decoder IC
   b) Study of a 3 to 8-line decoder as Demultiplexer
   c) Study of the cascading arrangement of an 8×1 multiplexer IC and a corresponding Demultiplexer IC
   d) Realization of 4 to 16-line decoder using 3 to 8-line decoder ICs
   e) Realization of a combinational circuit using a decoder IC
8. Shift register
   a) Study of a universal shift register IC
   b) Construction of ring counter and Johnson counter using a shift register IC and study of their timing diagrams
   c) Designing a PN Sequence Generator using a shift register IC
9. Ripple Counters and their timing diagrams
   a) 3-bit binary counter
   b) 3-bit binary up/down counter
   c) A modulo-N-counter (where n is the no. of FFs used to construct the counter)
   d) BCD counter using mod-10 counter ICs
10. Design and implementation of Synchronous Counters and study of their timing diagrams
    a) Binary counter
    b) Non-sequential binary counter
    c) 3-bit binary up/down counter

Reference Books

1. A.Anand Kumar, Fundamentals of Digital Circuits, 4th Edition PHI Learning Private Limited, 2016
2. Donald P Leach, Albert Paul Malvino and GoutamSaha, "Digital Principles and Applications", 6thedition, Tata McGraw Hill Publishing Company Ltd. New Delhi, 2008.
3. Tocci R J, "Digital systems: Principles and Applications", PHI learning, New Delhi, 10th edition 2006.
4. Charles H. Roth, Fundamentals of Logic Design, Thomson 2015.
5. R.P.Jain, Modern Digital Electronics Fourth Edition, Tata McGraw-Hill Education, 2009.

Web References

1. https://nptel.ac.in/courses/108/105/108105132/
2. https://www.electronics-tutorials.ws/logic/logic_1.html
3. https://www.worldscientific.com/worldscibooks/10.1142/10998
4. https://www.classcentral.com/course/swayam-digital-electronic-circuits-12953
5. https://www.allaboutcircuits.com/video-tutorials/analog-and-digital-electronics/

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

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

U20ECC3XX	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 based on participation, attendance, performance and completion of the course. If a candidate fails, he/she must repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

SKILL DEVELOPMENT COURSE 2

(Choose anyone of the below three courses)

		L	T	P	C	Hrs
U20ECS302	**1. COMPUTER HARDWARE & TROUBLESHOOTING**	**0**	**0**	**2**	**-**	**30**

Course Objectives

- Learn and identification of standard desktop personal computer components
- To understand and troubleshooting system related problems
- To understand the components on the motherboard and system components
- To understand the Installation and configure computer drivers
- To develop the ability to Install of various operating systems, peripherals with antivirus and configure it

Course Outcomes

After completion of the course, the students are able to

CO1 - Infer the fundamental of standard desktop personal computer components **(K2)**
CO2 - Devise and troubleshoot system related problems. **(K4)**
CO3 - Manipulate and configure computer drivers **(K3)**
CO4 - Interpret the installation of software. **(K3)**
CO5 - Correlate the various operating systems, peripherals with antivirus and Configure it **(K4)**

LIST OF EXPERIMENTS

1. Study and identification of standard desktop personal computer.
2. Understanding of Motherboard and its interfacing component
3. Install and configure computer drivers and system components.
4. Disk formatting, partitioning and Disk operating system commands
5. Install, upgrade and configure Windows operating systems.
6. Remote desktop connections and file sharing.
7. Identify, install and manage network connections Configuring IP address and Domain name systems
8. Install, upgrade and configure Linux operating systems.
9. Installation Antivirus and configure the antivirus
10. Installation of printer and scanner software.
11. Disassembly and Reassembly of hardware.
12. Troubleshooting and Managing Systems

Reference Books:

1. Craig Zacker& John Rourke, “The complete Reference:PC hardware”, Tata McGrawHill, New Delhi, 2001
2. Mike Meyers, “Introduction to PC Hardware and Troubleshooting”, Tata McGrawHill, New Delhi, 2003.
3. B.Govindarajulu, “IBM PC and Clones hardware trouble shooting and maintenance”, Tata McGraw-Hill, New Delhi, 2002
4. B. Govindarajalu, PC AND CLONES Hardware, Troubleshooting and Maintenance, Tata Mc-graw-Hill Publication
5. Stephen J. Bigelow, PC Troubleshooting and Repair Dream tech Press, New Delhi

Web References

1. https://nptel.ac.in/courses/117101055/
2. https://www.hongkiat.com/blog/pc-hardware-problems-solutions/
3. https://edu.gcfglobal.org/en/computerbasics/basic-troubleshooting-techniques/1/
4. https://www.imperial.ac.uk/school-public-health/infectious-disease-epidemiology/it-support/basic-troubleshooting-guide/
5. https://www.computerhope.com/basic.htm

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

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

2. PCB DESIGN

L	T	P	C	Hrs
0	0	2	-	30

Course Objectives

- To understand the fundamental concepts in circuit design
- To know about the PCB design and construction along with its types
- To get a basic idea about Proteus software.
- To perform design synchronization with schematic tool
- To study about routing guidelines

Course Outcomes

After completion of the course, the students are able to

CO1 - Infer the fundamental of circuit design **(K2)**
CO2 - Describes PCB design and its types **(K2)**
CO3 - Demonstrate the Proteus PCB schematic **(K3)**
CO4 - Examines the design synchronization **(K4)**
CO5 - Tests the various routing guidelines **(K4)**

LIST OF EXPERIMENTS

1. **Introduction to Circuit Designing:** Fundamental of circuit design - Creating New Components - Introduction to Analog Circuit Design - Introduction to Digital Circuit Design - Placing Symbols and Ports - Labeling components - Circuit optimization
2. **Introduction to PCB Design** - Definition and Evolution of PCB - Purposes of a PCB - Types of PCBs - Creating the Blank PCB - Defining a sheet template - Printed Circuit Technology - PCB Construction (Power and Ground Plane) - PCB Printing & Etching process
3. **Proteus PCB Schematic** - Defining the Board Shape & Placement Boundary - Creating a board outline & placement / routing boundary - Basic concepts of PCB Designing - Schematic capture - From schematic to PCB - Placing, editing, and connecting parts and electrical symbols - Adding and editing graphics and text
4. **Proteus PCB Editor** - Creating and editing parts - Preparing to create a net list - Creating a net list - Exporting and importing schematic data - PCB Material. - Board Layers, Colors and Grids. - Defining the Electrical/Mechanical Layer - Defining PWR/GND layers.
5. **Design Transfer to the PCB and Design Rule Check** - Design synchronization with schematic tool. - Design transfer using a Net list. - Design rules concepts. - Design Rule Checking
6. **Component Placement & Shielding** - Placing components. - Finding components for placement. - Moving components. - Shielding Practices. - Copper Pour
7. **Routing PCB Layout Routing and Grounding** - Routing guidelines

Reference Books:

1. Bruce R. Archambeault , James Drewniak “PCB Design for Real-World EMI Control”, Springer-Verlag New York Inc., United States, 2002.
2. Kraig Mitzner, “Complete PCB Design Using OrCAD Capture and PCB Editor”, ELSEVIER SCIENCE & TECHNOLOGY, Oxford, United Kingdom, 2009.
3. Keng Tiong Ng , “PCB-RE: Real-World Examples”, Independently Published, 2019.
4. Roger Hu, “PCB Design and Layout Fundamentals for EMC”, Independently Published, 2019.
5. Matthew Scarpino, “Designing Circuit Boards with EAGLE: Make High-Quality PCBs at Low Cost”, Pearson Education, United States, 2014.

Web References

1. https://engineering.eckovation.com/learn-design-pcb/
2. https://www.tronicszone.com/blog/steps-pcb-design-manufacturing/
3. https://www.elprocus.com/what-is-printed-circuit-board-and-designing-process-of-pcb/
4. https://www.electronics-notes.com/articles/analogue_circuits/pcb-design/how-to-design-pcb-board-basics.php
5. https://resources.pcb.cadence.com/blog/2019-what-is-the-pcb-fabrication-process-an-introduction

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

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

3. DEMONSTRATION OF ELECTRONIC EQUIPMENTS

L	T	P	C	Hrs
0	0	2	-	30

Course Objectives

- To learn the basic working principles of different meters
- To understand and troubleshoot equipment related problems
- To test and identify the performance of various components and devices
- To understand the different types of signal analyzers
- To study the functions of PA system, DTH.

Course Outcomes

After completion of the course, the students are able to

CO1 - Explain the basic features of oscilloscope and different types of oscilloscopes **(K2)**
CO2 - Assess the working principle and its application of LCR Q meter and Function generator **(K5)**
CO3 - Illustrate basic meters such as voltmeters and ammeters **(K2)**
CO4 - Explain different types of signal analyzers **(K2)**
CO5 - Apply the complete knowledge of various electronics instruments/ transducers to measure the physical quantities in the field of science, engineering and technology **(K3)**

LIST OF EXPERIMENTS

1. Cathode Ray Oscilloscope: Working principle, Application of CRO and component testing using CRO
2. Digital Storage Oscilloscope: Working principle, various measurement and Application of DSO
3. Function Generator: Working principle, measurement and Application of Function Generator
4. Multi meter: Digital and Analog- Working principle, Application of Multi meter and component testing using Multi meter.
5. Regulated Power supply: Working principle, types and measurements.
6. LCR Q meter and LCR Q Bridge Network: Working principle and measurements.
7. Network Analyzer: Working principle, Applications and measurements.
8. Transmission line Analyzer: Working principle, Applications and measurements.
9. Spectrum Analyzer: Working principle, Applications and measurements.
10. GPS, GSM and Variable Antenna module: Working principle and Application.
11. Study and Demonstration of Television, DTH and CCTV.
12. Study and Demonstration of Public Addressing system.

Reference Books:

1. R S Khandpur, “Troubleshooting Electronic Equipment- Includes Repair & Maintenance”, Tata McGraw-Hill, Second Edition 2009.
2. Dan Tomal & Neal Widmer, “Electronic Troubleshooting”’, McGraw Hill, Third Edition 2004.
3. Jerry C. Whitaker, Blair Benson, “Standard Handbook of Video and Television Engineering”, McGraw-Hill, Fourth Edition 2003.
4. Witte Robert A, “Spectrum and Network Measurements”, SciTech Publishing Inc, Second Edition, 2014.
5. Sclater Neil, “Electronics Technology Handbook”, McGraw-Hill Education – Europe, Sixth Edition, 2015.

Web References:

1. https://www.youtube.com/watch?v=U1amW7S1fcI
2. https://www.circuitstoday.com/direct-to-home-dth-technology
3. https://www.electronics-tutorial.net/electronic-systems/public-address-system/
4. https://www.electronics-notes.com/articles/test-methods/lcr-meter-bridge/primer-basics.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	3	2	1	-	2	-	-	-	2	-	-	1	3	-	2
2	3	2	1	-	2	-	-	-	2	-	-	1	3	-	2
3	3	2	1	-	2	-	-	-	2	-	-	1	3	-	2
4	3	2	1	-	2	-	-	-	2	-	-	1	3	-	2
5	3	2	1	-	2	-	-	-	2	-	-	1	3	-	2

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

		L	T	P	C	Hrs
U20ECM303	**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.

SEMESTER –IV										
Sl.No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST431	Probability and Random Processes	BS	2	2	0	3	25	75	100
2	U20EST467	Programming in JAVA	ES	3	0	0	3	25	75	100
3	U20ECT407	Analog and Digital Communication Systems	PC	3	0	0	3	25	75	100
4	U20ECT408	Linear Integrated Circuits	PC	3	0	0	3	25	75	100
5	U20ECE4XX	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	U20ECP405	Communication Systems Laboratory	PC	0	0	2	1	50	50	100
10	U20ECP406	Linear Integrated Circuits Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20ECC4XX	Certification Course - IV**	EEC	0	0	4	-	100	-	100
12	U20ECS403	Skill Development Course 3[*]	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U20ECM404	NCC / NSS	MC	0	0	2	-	100	-	100
							22	650	650	1300

U20BST431	PROBABILITY AND RANDOM PROCESSES	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand concepts of probability.
- To acquire knowledge on Probability distributions.
- Gain knowledge about the random processes.
- Get exposed to discrete time Markov chain.
- Gain strong knowledge in principles of Queuing theory.

Course Outcomes

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

CO1 - Apply the specialized knowledge in probability theory. **(K3)**
CO2 - Understand the fundamental of interrelationship between discrete and continuous random variables. **(K2)**
CO3 - Apply the fundamentals of probability theory and random process. **(K3)**
CO4 - Determine theoretical solutions to the created models. **(K3)**
CO5 - Apply the knowledge of Queuing theory. **(K3)**

UNIT-I DISCRETE RANDOM VARIABLES (12 Hrs)

Random variables and their event spaces - The probability mass function - Distribution functions: Binomial- Geometric - Negative Binomial and Poisson.

UNIT- II CONTINUOUS RANDOM VARIABLES& APPLICATION OF DISTRIBUTION (12 Hrs)

Some important distributions: Exponential distribution - Gamma - Weibull and Gaussian distributions. Application of Distribution - Reliability - Failure density and Hazard function.

UNIT III RANDOM PROCESS (12Hrs)

Definition - Classification of Stochastic Process - Strictly Stationary process - Wide Sense Stationary - Poisson process. - Ergodic Process- Time Series Process.

UNIT- IV DISCRETE PARAMETER MARKOV CHAIN (12 Hrs)

Introduction - Computation of n-step transition Probabilities - Chapman - Kolmogorov equation State classification and limiting Probabilities - M/G/1 queuing system –Pollaczek Khinchine transform equation.

UNIT V CONTINUOUS PARAMETER MARKOV CHAIN (12 Hrs)

M/M/1 - M/M/C - M/M/1/N - M/M/C/N (C<N) - M/M/C/C - M/M/∞ models only - Derivation of mean number of customer in the system - in the queue and waiting time - Simple applications.

Textbooks

1. T. Veerarajan, “Probability and Statistics, Random Process and Queuing Theory”, McGraw Hill Education, 1st Edition, 2018.
2. P. Sivaramakrishna Das, **“**Probability and Random Process”, Pearson Education, 6th Edition, 2019.
3. M.B. K. Moorthy, K. Subramani. andA. Santha , “Probability & Random Process”, Scitech Publication Pvt. Ltd., 7th Edition, 2017.

Reference Books

1. P.Balaji, “Probability and Random Processes”, Balaji publishers, 5thEdition, 2018.
2. M. Bhatt and Ravish R. Singh, “Probability and Statistics”, McGraw Hill Education, 2nd Edition, 2017.
3. P.Kandasamy, Thilagavathi. K and Gunavathi.K., “Probability Random variable and Random Process”, S.Chand&Co. Pvt. Ltd, 2nd Edition, 2015
4. J.Ravichandran, “Probability& Random Process for Engineers”, I.K.International Publishing House Pvt. Ltd, 2014
5. J.Medhi, Stochastic Processes, New Age International (P)Ltd.,SecondEdition,1994.

Web References

1. https://nptel.ac.in/courses/117/105/117105085/
2. https://www.probabilitycourse.com/
3. https://people.eecs.berkeley.edu/~wlr/126notes.pdf
4. https://www.youtube.com/watch?v=AUth5ws75nk
5. https://www.youtube.com/watch?v=adfi2dHJw4o

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

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

U20EST467	PROGRAMMING IN JAVA (Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHTRONICS, CCE)	L	T	P	C	Hrs
		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, multi-threading 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, PACKAGESANDINTERFACES (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 EXCEPTIONHANDLING, MULTI THREADIN (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 – Sorted Set. 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.

Textbooks

1. Herbert Schildt, “Java: The Complete Reference”, TMH Publishing Company Ltd,11th 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. H.M.Dietel and P.J.Dietel, “Java How to Program”, 11th Edition, PearsonEducation/PHI, 2017.
2. Nageshvar rao, “Core Java and Integrated Approach”, 1st Edition, Dreamtech, 2016.
3. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, Prentice Hall,9th Edition, 2013.
4. P.J. Dietel and H.M Dietel, “Java for Programmers”, Pearson Education, 9th Edition, 2011.
5. Cay.S.Horstmann and Gary Cornell, “Core Java 2”, Pearson Education, 8th Edition,2008.

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 andJDBC.
4. https://www.edureka.co/blog
5. https://www.geeksforgeeks.org

CO-POs/PSOs Mapping (ECE)

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
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

U20ECT407	ANALOG AND DIGITAL COMMUNICATION SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To analyze techniques for the generation, transmission and reception of amplitude modulation, frequency modulation and phase modulation signals
- To gain knowledge of various pulse modulation techniques and the corresponding demodulation techniques
- To understand various digitization techniques, generation and reconstruction of PCM, DPCM and DM
- To gain knowledge in various band pass digital transmission
- To analyze the fundamental limits on the error free representation of information signals and the transmission of such signals over a noisy communication channel

Course Outcomes

After completion of the course, the students are able to

CO1 - Understand about fundamentals of Analog communication **(K2)**
CO2 - Explain Pulse modulation techniques **(K2)**
CO3 - Demonstrate all digitalization techniques **(K3)**
CO4 - Demonstrate digital modulation techniques **(K3)**
CO5 - Illustrate Channel coding Techniques **(K4)**

UNIT- I FUNDAMENTALS OF ANALOG COMMUNICATION SYSTEMS (9 Hrs)

Introduction to Communication Systems: Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM – FM – PM)Band Pass Signals and Systems, Band Pass Transmission, Bandwidth, Double Side Band Amplitude Modulation – AM Signals and Spectra, DSB Signals and Spectra, Suppressed Side Band Amplitude Modulation - Single Side Band Signals and Spectra, Single Side Band Generation, Vestigial Side Band Signals and Spectra, Illustrative Problems.

UNIT- II PULSE MODULATION TECHNIQUES (9 Hrs)

Pulse amplitude modulation – Flat top sampling and Pulse amplitude modulation (PAM), Pulse-Time Modulation – Pulse Duration and Pulse Position modulations, PPM spectral analysis, Illustrative Problems

UNIT- III DIGITIZATION TECHNIQUES (9 Hrs)

Pulse Code Modulation (PCM) - Generation and Reconstruction, Quantization Noise, Non-Uniform Quantization and Companding, PCM with Noise, Delta modulation, Adaptive Delta Modulation, Differential PCM systems (DPCM), Digital Multiplexing-Multiplexers and Hierarchies

UNIT- IV BAND PASS DIGITAL TRANSMISSION (9 Hrs)

Quadrature Carrier and M–ary Systems- Quadrature Carrier Systems, M–ary PSK Systems, M–ary QAM Systems, M–ary FSK Systems, BPSK and FSK, Timing and Synchronization, Interference, Non-Coherent Binary Systems, Non-Coherent FSK, Differentially Coherent PSK, Optimum Binary Detection, Coherent ASK (OOK (on-off keying)).

UNIT- V CHANNEL CODING (9 Hrs)

Error Detection & Correction - Repetition & Parity Check Codes, Interleaving, Code Vectors and Hamming Distance, Forward Error Correction (FEC) Systems, Automatic Retransmission Query (ARQ)Systems, Linear Block Codes – Matrix Representation of Block Codes, Convolutional Codes –Convolutional Encoding, Decoding Methods

Textbooks

1. Bruce Carlson, & Paul B. Crilly, “Communication Systems – An Introduction to Signals & Noise in Electrical Communication”, McGraw-Hill International Edition, 5th Edition, 2010
2. Simon Haykin, “Communication Systems”, Wiley-India edition, 3rd edition, 2010
3. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 4th Edition, Oxford University Press, 2011.

Reference Books

1. Sam Shanmugam, “Digital and Analog Communication Systems”, John Wiley, 2005
2. J. M. Wozencraft and I. M. Jacobs, Principles of Communication Engineering, Wiley, 1965.
3. J. R. Barry, E. A. Lee, and D. G. Messerschmitt, Digital Communication, 3rd Edition, Springer, 2004.
4. Taub and Schilling, “Principles of Communication Systems”, 2nd ed., Mc-Graw Hill
5. V Chandra Sekar, “Analog Communication”, Oxford University Press

Web References

1. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ee06/
2. http://www.ee.iitm.ac.in/~andrew/videolectures/EE419/index.html
3. https://new.siemens.com/global/en/company/about/history/technology/information-and-communications-technology/telephony.html
4. https://www.vedantu.com/revision-notes/cbse-class-12-physics-notes-chapter-15-communication-systems
5. https://learn.careers360.com/physics/communication-systems-chapter/

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

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

U20ECT408 LINEAR INTEGRATED CIRCUITS

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- Understand the classification of IC and basic building blocks of analog integrated circuits
- To understand the concepts, working principles and key applications of linear integrated circuits
- Design and analyze the linear and non-linear applications of operational amplifiers
- To Illustrate the operating principle of PLL, Data Converters and various special function ICs
- To design circuits and systems for specific applications using linear integrated circuits

Course Outcomes

After completion of the course, the students are able to

CO1 - Explain the internal structure of operational amplifiers and its characteristics. **(K2)**
CO2 - Demonstrate the applications of operational amplifiers. **(K3)**
CO3 - Construct the comparator and waveform generators using operational amplifier. **(K3)**
CO4 - Analyze the principle and operation of PLL and Data converters **(K4)**
CO5 - Use special function ICs and its application in modern electronic equipment. **(K3)**

UNIT I OPERATIONAL AMPLIFIER (9 Hrs)

Introduction to Integrated Circuits- Classification of ICs - Operational Amplifier: Basic Information of Op-Amp, Ideal Op Amp- Operational Amplifier Internal Circuit- Differential Amplifier – Characteristics of Op-Amp - DC Characteristics, AC Characteristics - Frequency Response- Frequency Compensation -Slew Rate.

UNIT II OPERATIONAL - AMPLIFIER APPLICATIONS (9 Hrs)

Closed Loop Op Amp Configuration - Inverting and Non inverting Amplifiers- Inverter- Voltage Follower- Summing Amplifier, Averaging Circuits – Subtractor -Differential Amplifier- Multiplier- Differentiator- Integrator- Instrumentation amplifier, Precision rectifier-log and antilog amplifiers- 1stOrder LPF, HPF and all pass filters.

UNIT III COMPARATORS AND WAVEFORM GENERATORS (9 Hrs)

Comparators: Open Loop Op Amp Configuration - Inverting, Non-Inverting Comparator- Applications of Comparator- Regenerative Comparator (Schmitt trigger) - Waveform Generators: Multivibrators -Astable, Monostable - Triangular wave generator- Principles of Sine wave Oscillator- RC Phase Shift,Wien Bridge Oscillator.

UNIT IV PHASE LOCKED LOOP AND DATA CONVERTER (9 Hrs)

Block Diagram of PLL- Principles-Types- Phase Detector- Voltage Controlled Oscillator-IC 566 and IC 565 Internal Block Diagram- PLL Applications - Data Converter and Applications- Sample and Hold circuits, D/A Techniques: Binary Weighted Resistor- R-2R and Inverted R-2R, Ladder DAC- A/D converter: Flash - Successive Approximation Converter - Dual Slope ADC.

UNIT V SPECIALIZED ICS (9 Hrs)

IC 555 Timer Internal Architecture- Astable and Monostable Multivibrator using 555 Timer - Applications- Voltage regulator, Fixed and Adjustable Voltage Regulators (Positive and Negative voltage regulators-78XX, 79XX, Adjustable Voltage Regulator LM317, LM340, LM723,) Dual Power supply – Switch Mode Power Supply (LM 1577/LM 2577) - Single power supply for op-Amp

Textbooks

1. Sergio Franco, Design with operational amplifiers and analog integrated circuits, McGraw-Hill,2002.
2. Ramakant A.Gayakwad, OP-AMP and Linear IC's , Prentice Hall of India, 2002.
3. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.

Reference Books

1. William D.Stanely, Operational Amplifiers with Linear Integrated Circuits. Pearson Education, 2004.
2. David L.Terrell,Op Amps-Design, Application, and Troubleshooting, Elsevier publications 2005.
3. S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, Tata McGraw Hill Publications, 2008.
4. B.S.Sonde, “System design using Integrated Circuits” , 2nd Edition, New Age Pub, 2001
5. Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.

Web References

1. http://www.nptelvideos.in/2012/11/analog-ics.html
2. https://www.intel.in/content/www/in/en/history/museum-making-silicon.html
3. https://developer.qualcomm.com/download/sd820e/qualcomm-snapdragon-820e-processor-apq8096sge
4. https://electrobian.files.wordpress.com/2016/07/linear-integrated-circuits-notes-arunkumar-pdf-apkart-com.pdf
5. https://learnengineering.in/ec6404-linear-integrated-circuits/

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

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

U20HSP402	GENERAL PROFICIENCY–II (Common to all the branches)	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 situation **(K2)**
CO3 - Develop language skills professionally to groom the overall personality through sensitizing various Etiquettes in real time situation **(K3)**
CO4 - Find 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 (Workplace 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.
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	-	1	1	-	-
2	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
3	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
4	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
5	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-

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

	PROGRAMMING IN JAVA LABORATORY	L	T	P	C	Hrs
U20ESP468	(Common to CSE, ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHTRONICS, 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, the 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 Exercises

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 data base.
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. Herbert Schil dt, “The Complete Reference JAVA 2”, TMH, Seventh Edition, 2006.
3. Cay.S.Horstmann and Gary Cornell, “Core Java 2”, Vol 2, Advanced Features, Pearson Education, Seventh Edition, 2010.
4. Sagayaraj, Denis, Karthik, Gajalakshmi, “JAVA Programming for core and advanced learners”, Universities Press Private Limited, 2018.

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 andJDBC.
4. https://www.edureka.co/blog.
5. https://www.geeksforgeeks.org.

CO-POs/PSOs Mapping (ECE)

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

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

U20ECP405	COMMUNICATION SYSTEMS LABORATORY	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To provide experience on design, testing and analysis of circuits used in communication engineering.
- Develop the ability to design and experimentally test RF circuits and hardware systems for analog communication systems.
- To understand the concepts of pre-emphasis and de-emphasis in communication transmitters and receivers.
- To understand the concepts of time division multiplexing and de-multiplexing techniques.
- Acquire the ability to design, implement and test modems for digital communication systems

Course Outcomes

After completion of the course, the students are able to

CO1 - Understand the basic concepts of circuits used in communication systems**. (K2)**
CO2 - Analyse the percentage of modulation AM and FM systems. **(K3)**
CO3 - Perform signal sampling by determining the sampling rates for baseband signals and reconstruct the signals. **(K3)**
CO4 - Compare PAM, PWM and PPM and perform their detection. **(K4)**
CO5 - Compare and analyse digital modulation techniques BPSK, DPSK and DEPSK and perform their detection **(K4)**

LIST OF EXPERIMENTS

CYCLE I (Six experiments are mandatory)

1. AM generation using discrete components
2. AM using multiplier IC AD534 or AD633.
3. AM detection using envelope detector.
4. IF tuned amplifier.
5. FM using 555 IC.
6. FM generation and demodulation using PLL.
7. Frequency multiplier using PLL
8. Pre-emphasis and de-emphasis circuits
9. Analog signal sampling & Reconstruction

CYCLE II (Six mandatory)

10. Generation of Pseudo Noise Binary sequence using Shift registers
11. Time Division Multiplexing and De-multiplexing
12. Generation & Detection of DM/SIGMA DELTA/ ADM
13. Generation & Detection of PAM/PWM/PPM
14. Generation & Detection of BPSK/DPSK/DEPSK
15. Generation & Detection of PCM
16. QPSK Modulation and Demodulation

Reference Books

1. Sam Shanmugam, “Digital and Analog Communication Systems”, John Wiley, 2005
2. J. M. Wozencraft and I. M. Jacobs, Principles of Communication Engineering, Wiley, 1965.
3. J. R. Barry, E. A. Lee, and D. G. Messerschmitt, Digital Communication, 3rd Edition, Springer, 2004.
4. Taub and Schilling, “Principles of Communication Systems”, 2nd ed., Mc-Graw Hill
5. V Chandra Sekar, “Analog Communication”, Oxford University Press, 2008

Web References

1. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ee06/
2. http://www.ee.iitm.ac.in/~andrew/videolectures/EE419/index.html
3. https://new.siemens.com/global/en/company/about/history/technology/information-and-communications-technology/telephony.html
4. https://www.vedantu.com/revision-notes/cbse-class-12-physics-notes-chapter-15-communication-systems
5. https://learn.careers360.com/physics/communication-systems-chapter/

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

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

U20ECP406 LINEAR INTEGRATED CIRCUITS LABORATORY	L	T	P	C	Hrs
	0	0	2	1	30

Course Objectives

- To expose the students to linear and integrated circuits
- To understand the basics of linear integrated circuits and available ICs
- To understand characteristics of operational amplifier
- To apply operational amplifiers in linear and nonlinear applications
- To acquire the basic knowledge of special function IC
- To understand the importance of op-amp in various applications like Precision Rectifiers, Filters, and DAC

Course Outcomes

After completion of the course, the students can

CO1 - Analyze the various linear and non-linear application of op-amp **(K4)**
CO2 - Examine and analyze filter circuits using op-amp **(K4)**
CO3 - Design and analyze oscillators and multi vibrator circuits using op-amp **(K4)**
CO4 - Distinguish the various applications of linear IC's like 741,555 timer and XR2240 **(K3)**
CO5 - Relate the use of OP- AMP as analog to digital and digital to analog converter. **(K3)**

LIST OF EXPERIMENTS

1. Applications of Op-amp: To study the application of Op-amp IC741 as
   a. Inverting amplifier
   b. Non-inverting amplifier
   c. Voltage follower
   d. Summer
   e. Subtractor

2. Differentiator and Integrator
   Design the op-amp as differentiator and integrator for various time constants

3. Comparator circuits
   (a) To study zero crossing detector, window detector
   (b) Design Schmitt trigger using op-amp 741

4. Signal converters
   To design and study the operation of op-amp as V to I and I to V converters

5. Active filters using Op-amp
   Design and test the performance of a 2^{nd} order LPF, HPF, BPF and BSF

6. Log, antilog and instrumentation amplifier
   To design and study (a) logarithmic and antilog amplifiers (b) Instrumentation amplifier

7. Multi vibrators using Op-Amp
   To design and study the working of
   (a). Astable Multi vibrator and (b). Monostable Multivibrator using IC 741.

8. Data converters
   Construction and study performance of
   (a). DAC circuits – R-2R and ladder type.
   (b). Successive approximation type ADC.

9. Multi vibrators using IC 555
   To design and study the working of
   (a). Astable multi vibrator
   (b). Monostable Multi vibrator using IC 555.

10. Frequency synthesizers
    To study performance of
    (a). Frequency multiplier using PLL IC 565
    (b). Frequency synthesizer using IC XR2240

11. Precision rectifiers - To study performance of half wave and full wave precision rectifiers using IC 741.
12. Fixed Voltage regulator (Using 78XX,79XX), Adjustable Voltage regulator (using LM317) and switched voltage regulator (using LM 1577 / LM 2577)

Reference Books

1. William D.Stanely, Operational Amplifiers with Linear Integrated Circuits. Pearson Education, 2004.
2. David L.Terrell,Op Amps-Design, Application, and Troubleshooting, Elsevier publications 2005.
3. S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, Tata McGraw Hill, 2008.
4. B.S.Sonde, “System design using Integrated Circuits” , 2nd Edition, New Age Pub, 2001
5. Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.

Web References

1. http://www.nptelvideos.in/2012/11/analog-ics.html
2. https://www.intel.in/content/www/in/en/history/museum-making-silicon.html
3. https://developer.qualcomm.com/download/sd820e/qualcomm-snapdragon-820e-processor-apq8096sge
4. https://electrobian.files.wordpress.com/2016/07/linear-integrated-circuits-notes-arunkumar-pdf-apkart-com.pdf
5. https://learnengineering.in/ec6404-linear-integrated-circuits/

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

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

U20ECC4XX	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.

SKILL DEVELOPMENT COURSE 3
(Choose anyone of the below three courses)

U20ECS403 **1. MOBILE SERVICING**

L	T	P	C	Hrs
0	0	2	-	30

Course Objectives
- Learn and identification of standard mobile components
- To understand and troubleshooting hardware and software related problems
- To study the various faults arising due to corrupt software
- To understand the various flasher boxes and Flashing software for various brands.
- To develop the ability to troubleshooting faults using advanced techniques

Course Outcomes
After completion of the course, the students can

CO1 - Infer the fundamental of standard mobile components. **(K2)**
CO2 - Examine and troubleshoot mobile hardware and software related problems. **(K4)**
CO3 - Inspect about various faults arising due to corrupt software **(K4)**
CO4 - Identify different flasher boxes and Flashing software for various brands **(K4)**
CO5 - Identify and troubleshooting faults using advanced techniques **(K4)**

MODULE I: HARDWARE BASED EXPERIMENTS
1. Study of various tools and equipment used for mobile phone repairs.
2. Introduction of various Circuit of the Motherboard and Various Components used in mobile phone
3. Assembling and disassembling of various models of mobile phones.
4. Identifying the fault and troubleshooting for repairing of various fault
5. Common repair procedure for hardware and software related faults.

MODULE II: SOFTWARE BASED EXPERIMENTS
1. Detailed study of various faults arising due to corrupt software
2. Introduction of various flasher boxes and Flashing software of various brands of hands.
3. Removing virus from infected phones and Unlocking of handsets through codes and/or software.
4. Common repair procedure for Water damaged repair techniques.
5. Use of internet for troubleshooting faults using advanced troubleshooting techniques.

Reference Books
1. Chukky Oparandu, “Mobile Phones and Tablets Repairs: A Complete Guide for Beginners and Professionals”, Mondraim Nig. Ltd, May 2016.
2. SanjibPandit, “Advance Mobile Repairing: Multicolour Circuits, Service Diagrams & Repairing”, Mondraim Nig. Ltd, December 2010.

Web References
1. https://www.youtube.com/watch?v=OjxCelVySi8
2. https://www.youtube.com/watch?v=jd8zBgwMfU0
3. https://in.pinterest.com/pin/862017184895958528/
4. https://fliphtml5.com/fgms/skao/basic
5. https://www.pinterest.com/smartphonesrepair/phone-repairing-manual-pdf-free-download/

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

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

2. AUTONOMOUS ROBOTS

L	T	P	C	Hrs
0	0	2	-	30

Course Objectives

- Describe properties of common types of robotic hardware, including sensors, actuators, and computational nodes
- Apply modern software development and deployment strategies connected with autonomous robots
- Set up and use equations of motion of wheeled autonomous robots
- Apply basic sensor fusion
- Set up and use computer simulations of autonomous robots

Course Outcomes

After completion of the course, the students can

CO1 - Apply global and local navigation of autonomous robots **(K3)**
CO2 - Apply the basics of behavior-based robotics and evolutionary robotics **(K3)**
CO3 - Apply methods for decision making in autonomous robots **(K3)**
CO4 - Discuss the potential role of autonomous robots in society, including social, ethical, and legal aspects **(K2)**
CO5 - Discuss technical challenges with autonomous robots in society **(K2)**

LIST OF EXPERIMENTS

1. Survey of robot related hardware
2. Modern software development for autonomous robots
3. Kinematics and dynamics for autonomous robots
4. Simulation of autonomous robots
5. Perception and sensor fusion for autonomous robots
6. Behavior modeling for autonomous robots
7. Practical work related to autonomous robots

Reference Books:

1. Roland Siegwart , Illah Reza Nourbakhsh , Davide Scaramuzza, “Introduction to Autonomous Mobile Robots ”, MIT Press Ltd , second edition, 2011
2. Cameron Hughes, Tracey Hughes, “Robot Programming : A Guide to Controlling Autonomous Robots”, Pearson Education (US), 2016.
3. Patrick Lin , George A. Bekey , Keith Abney , Colin Allen , Wendell Wallach , James J. Hughes , Selmer Bringsjord, “Robot Ethics : The Ethical and Social Implications of Robotics”, MIT Press Ltd, 2014
4. Eugene Kagan , Nir Shvalb , Irad Ben-Gal , “Autonomous Mobile Robots and Multi-Robot Systems : Motion-Planning, Communication, and Swarming”, John Wiley and Sons Ltd,2019

Web References

1. https://nptel.ac.in/courses/112/105/112105249/
2. https://nptel.ac.in/courses/112/101/112101098/
3. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-me74/
4. https://www.igdtuw.ac.in/6/stories/labmanuals-mae/Robotics%20lab%20Manuals%20Final.pdf
5. https://www.srmist.edu.in/mech-engg/robotics-lab

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

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

3. REPAIR AND MAINTENANCE OF ELECTRONIC EQUIPMENTS	L	T	P	C	Hrs
	0	0	2	-	30

Course Objectives

- Learn and identification of standards to Maintain domestic electronic devices
- To understand fault detection and rectification of home appliance
- To service the gadgets and Electronic equipment
- To understand the Installation and configure computer drivers
- To develop the ability to Install various real time systems.

Course Outcomes

After completion of the course, the students can

CO1 - Infer the Identification and testing of various active and passive components **(K2)**
CO2 - Devise and troubleshooting of electronic equipment. **(K4)**
CO3 - Manipulate and configure various analog and digital circuits **(K3)**
CO4 - Interpret the installation of various real time systems. **(K3)**
CO5 - Test and demonstrate the servicing of Cell phone, Computer, LED/ LCD TV and Computer **(K4)**

LIST OF EXPERIMENTS

1. Study of various handheld tools.
2. Test the performance of different passive electronic components
3. Test the performance of active electronic components like general purpose transistor/ FET/ MOSFET/ SCR/ DIAC/ TRIAC with DMM and CRO OR Components Tester
4. Test the performance of miscellaneous electronics components (transformers, Loudspeaker, microphone, Relays, Solenoid, Switches, DC Motors, Stepper Motor, sensors, opto electronics components
5. Verify the functionality of TTL and CMOS Digital IC's using IC tester
6. Explore datasheet of minimum any five electronics components and analog/ Digital IC's.
7. Test the given regulated power supply circuit/ SMPS (from any television/fridge/ computer system/ laboratory etc.) Test the voltage at different output points of SMPS of desktop and laptop computer system
8. Demonstrate steps of installation of online/ Offline UPS
9. Identify basic sections of a personal computer and List the technical specifications of various computer peripherals. (e.g. CPU, Monitor, Keyboard, Mouse, Speaker, Web cam, Printer, Scanner, microphone, speakers, modem, projector etc). Troubleshoot the booting process of computer system
10. Demonstrate troubleshooting steps of Laptop for the common fault
11. Explore circuit of any home theatre system and prepare its circuit diagram /wiring diagram
12. Practice steps for mobile troubleshooting

Reference Books:

1. Singh K. Sudeep. "Troubleshooting and Maintenance of Electronics Equipment", Katson Book, New Delhi, III edition, Reprint 2017
2. Khandpur R. S.," Troubleshooting Electronic Equipment: Includes Repair and Maintenance, Second Edition, Tata McGraw-Hill Education, New Delhi, India, latest edition
3. Manohar Lotia, "Mobile repairing Books ", BPB Publication, New Delhi, latest edition 2005
4. Stephen J. Bigelow, "PC Troubleshooting and Repair", Dream tech Press, New Delhi, 2008

Web References

1. https://nielit.gov.in/kohima/content/repairing-maintenance-electronics-products
2. http:// youtube.com (Repairing of various gazette)
3. http:// www.computerhope.com/basic.htm
4. http://computer.howstuffworks.com/computer-hardware-channel.htm
5. http://www.automationtechnology.de/cms/en/markets- solutions/electronics.htm
6. https://edu.gcfglobal.org/en/computerbasics/basic-troubleshooting-techniques/1/

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

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

U20ECM404	NCC / NSS	L	T	P	C	Hrs
		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 based on 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

SEMESTER– V										
Sl.No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20BST544	Statistical Methods for Engineers	BS	2	2	0	3	25	75	100
2	U20ECT509	Wireless Communication	PC	3	0	0	3	25	75	100
3	U20ECT510	Microcontroller	PC	3	0	0	3	25	75	100
4	U20ECT511	Digital Signal Processing	PC	2	2	0	3	25	75	100
5	U20ECE5XX	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 Methods Laboratory	BS	0	0	2	1	50	50	100
8	U20ECP507	Wireless Communication Laboratory	PC	0	0	2	1	50	50	100
9	U20ECP508	Microcontroller Laboratory	PC	0	0	2	1	50	50	100
10	U20ECP509	Digital Signal Processing Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
11	U20ECC5XX	Certification Course - V	EEC	0	0	4	-	100	-	100
12	U20ECS504	Skill Development Course 4: Foreign Language / IELTS-I / Career and Professional Skill Development Program - I	EEC	0	0	2	-	100	-	100
13	U20ECS505	Skill Development Course 5: Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
14	U20ECM505	Indian Constitution	MC	2	0	0	-	100	-	100
							22	750	650	1400

U20BST544	STATISTICAL METHODS FOR ENGINEERS	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To learn basic concepts of a few statistical and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- It is framed to address the issues and the principles of estimation theory.
- To learn the concept of testing of hypothesis using statistical analysis.
- Identify the direction and strength of a linear correlation between two factors.
- Analyze the data on agriculture field experiments using various types of designs they learned

Course Outcomes

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

CO1 - Solve the basic concepts of statistics. **(K3)**
CO2 - Understand the method of maximum likelihood estimation is an important way of estimating a parameter. **(K2)**
CO3 - Apply the concept of testing of hypothesis for small and large samples in real life problems. **(K3)**
CO4 - Solve the concept of linear regression, correlation, and its applications. **(K3)**
CO5 - Apply the designing experiments and recognize the key historical figures in Design of Experiments. **(K3)**

UNIT I MEASURES OF DISPERSION (12 Hrs)

Standard Deviation - Mean Deviation - Quartile Deviation - Range - Measures of skewness and Pearson's coefficient of skewness- Moments about the arbitrary origin and moments based on measures of skewness and kurtosis.

UNIT II ESTIMATION THEORY (12 Hrs)

Estimators: Unbiasedness – Consistency - Efficiency and sufficiency - Maximum likelihood estimation - Method of moments.

UNIT III TESTING OF HYPOTHESIS (12 Hrs)

Sampling distributions - Small and large samples - Tests based on Normal - t test - Chi square – F distributions for testing of means - variance and proportions - Contingency table (test for independent) Goodness of fit.

UNIT IV CORRELATION AND REGRESSION (12 Hrs)

Correlation-Rank correlation- Regression -Multiple and partial correlation - Method of least squares - Plane of regression - Coefficient of multiple correlation - Coefficient of partial correlation.

UNIT V DESIGN OF EXPERIMENTS (12 Hrs)

Analysis of variance - One way and two-way classifications - Completely randomized design -Randomized block design - Latin square design - 2^2 Factorial designs.

Textbooks

1. Richard A. Johnson, Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2018.
2. Murray R. Spegel, Larry J. Stephens, "Schaum's Outlines - Statistics" McGraw Hill Education, 6th Edition, 2017.
3. S. C.Gupta and V.K .Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, 11th Edition, 2002.

Reference Books

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, New Delhi,10th Edition, 2019.
2. B.S. Grewal and J.S.Grewal, “Numerical Methods in Engineering and Science “, Khanna Publishers, 10th Edition, New Delhi, 2015.
3. R.A Johnson,I. Miller and J. Freund , “Miller and Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, 8th Edition, 2015.
4. Dr.G.Balaji, “Statistics and Numerical methods” Balaji publication, 11th Edition, 2017.
5. R.A Johnson and D.W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Asia, 6th Edition, 2007.

Web References

1. https://nptel.ac.in/courses/110/105/110105087/
2. https://nptel.ac.in/courses/111/105/111105077/
3. https://www.coursera.org/learn/basic-statistics
4. https://www.youtube.com/watch?v=k3lUo0XYG3E
5. https://nptel.ac.in/courses/103/106/103106120/

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

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

U20ECT509	WIRELESS COMMUNICATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the characteristic of wireless channel
- To acquire knowledge about various digital signaling techniques
- To understand the design of a cellular system
- To know various wireless and Bluetooth technology
- To gain the knowledge about MIMO technology

Course Outcomes

Upon completion of the course, students will be able to

CO1 - Characterize a wireless channel and evolve the system design specifications **(K1)**
CO2 - Understand cellular system based on resource availability and traffic demands **(K2)**
CO3 - Identify suitable signaling and fading channels for wireless communication **(K3)**
CO4 - Learn about multipath mitigation techniques for the wireless channel **(K4)**
CO5 - Learn about the multiplexing and diversity techniques **(K4)**

UNIT – I BASICS OF WIRELESS COMMUNICATION (9 Hrs)

History of Wireless Communication - General Model of Wireless Communication Link - Types of Signals - Wireless Channel and Radio Communication - Free Space Propagation Model - Channel Noise and Losses – Fading - Multipath Fading - Fading Effects on Signal and Frequency – Shadowing - Wireless Channel Modelling: AWGN Channel, Rayleigh Channel, Rician Fading Channel.

UNIT –II MEDIUM ACCESS ALTERNATIVES FOR WIRELESS COMMUNICATION (9 Hrs)

Spread Spectrum Modulation - Pseudo-Noise Codes with Properties and Code Generation Mechanisms - DSSS and FHSS Systems - Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques - Zero Inter Symbol Interference Communication Techniques - Detection Strategies - Diversity Combining Techniques: Selection Combining - Threshold Combining - Equal Gain Combining - Maximum Ratio Combining.

UNIT – III CELLULAR SYSTEM DESIGN FUNDAMENTALS (9 Hrs)

Introduction to Cellular Communications - GSM system for mobile Telecommunication - Frequency reuse - Multiple Access Technologies - Cellular Processes - Call Setup, Handover -Tele traffic Theory - General Packet Radio Service – EDGE Technology - CDMA Based Standards: IS 95 to CDMA 2000 - Wireless Local Loop.

UNIT –IV WIRELESS LAN AND BLUETOOTH TECHNOLOGY (9 Hrs)

Introduction to Mobile Adhoc Networks – IEEE 802.11 Architecture and Services - Bluetooth – Bluetooth Protocol Stack - Wi-Fi Standards -WiMax Standards – WLAN Technology – Requirements of WLAN –Infrared Communication - Li-Fi Communication.

UNIT – V LTE AND MIMO TECHNOLOGIES (9 Hrs)

Ultra-Wideband Communication - Mobile data networks - Introduction to 4G and 5G concept of NGN - Long Term Evolution (LTE) - Mobile Satellite Communication - Introduction to MIMO - MIMO Channel Capacity - SVD and Eigen modes of the MIMO Channel - MIMO Spatial Multiplexing – MIMO Diversity – MIMO -OFDM.

Textbooks

1. T.S. Rappaport, “Wireless Communication-Principles and practice”, Pearson Publications,2nd Edition, 2010.
2. Steve Rackley, Wireless Networking Technology, From Principles to Successful Implementation, Newnes; 1st edition,2011
3. Gottapu Sasibhushana Rao, “Mobile Cellular Communication”, Pearson Education, 2012

Reference Books

1. UpenaDalal and Manoj K. Shukla, “Wireless and Mobile Communication”, Oxford Press Publications, 2016.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2012.
3. EzioBiglieri and Robert Calderbank, “MIMO Wireless Communications”, Cambridge University Press, 2015.
4. Kaveh Pah Laven and P. Krishna Murthy, “Principles of Wireless Networks”, Pearson Education, 2012
5. William Stallings, “Wireless Communication and Networking”, PHI, 2003.

Web References

1. http://nptel.ac.in/courses/117102062/
2. https://onlinecourses.nptel.ac.in/noc17_cs37/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-452-principles-of-wireless-communications-spring-2006/
4. https://jiscollege.ac.in/ece/Syllabus_MCNT_2018.pdf
5. https://learnengineering.in/ec8652-wireless-communication/

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

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

U20ECT510	MICROCONTROLLER	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand 8051 architecture and its memory organization
- To understand 8051 Assembly Language Programming
- To understand programming 8051 timers in embedded C
- To understand programming serial port and interrupts in embedded C
- To design various real time systems using 8051 microcontrollers.

Course Outcomes

After completion of the course, students will be able to

CO1 - Describe the architecture and explain the organization of memory in 8051 **(K2)**
CO2 - Classify and Apply 8051 instructions in Assembly Language Programming **(K3)**
CO3 - Explain the timer functions and Apply embedded C programming for controlling it**. (K3)**
CO4 - Explain serial ports and interrupts in 8051 and Apply embedded C programming for controlling it **(K3)**
CO5 - Understand and Develop 8051 based system by applying Assembly Language Programming. **(K5)**

UNIT – I 8051 MICROCONTROLLER (9 Hrs)

Microprocessors and Microcontrollers, 8051 Architecture: Introduction, 8051 Microcontroller hardware, Input/output pins, ports and circuits, External memory, Counters and timers, Serial data input/output, Interrupts

UNIT – II ASSEMBLY PROGRAMMING AND INSTRUCTION OF 8051 (9 Hrs)

Introduction to 8051 assembly programming, Assembling and running an 8051 program, Data types and Assembler directives, 8051 Addressing Modes, Arithmetic, logic instructions and programs, Jump, loop and call instructions, I/O port programming.

UNIT – III 8051 PROGRAMMING IN C (9 Hrs)

8051 programming in C: Data types and time delay in 8051C, I/O programming in 8051C, Logic operations in 8051 C, Data conversion program in 8051 C, accessing code ROM space in 8051C, Data serialization using 8051C.

8051 Timer programming in Assembly and C: Programming 8051 timers, counter programming, Programming timers 0 and 1 in 8051 C.

UNIT – IV SERIAL PORT AND INTERRUPT PROGRAMMING (9 Hrs)

8051 serial port programming in assembly and C: Basics of serial communication, 8051 connection to RS232, 8051 serial port programming in assembly, serial port programming in C.

8051 Interrupt programming in assembly and C: 8051 interrupts, Programming timer, external hardware, serial communication interrupt, Interrupt priority in 8051, Interrupt programming in C.

UNIT – V INTERFACING APPLICATIONS (9 Hrs)

Interfacing: LCD interfacing, Keyboard interfacing

ADC, DAC and sensor interfacing: Parallel and serial ADC DAC interfacing, Sensor interfacing and signal conditioning.

Motor control: Relay, PWM, DC and stepper motor: Relays and opt isolators, stepper motor interfacing, DC motor interfacing and PWM.

Textbooks

1 Mazidi Ali Muhammad, MazidiGillispie Janice, and McKinlay Rolin D, “The 8051 Microcontroller and Embedded Systems using Assembly and C”, Pearson Publication, 2nd edition, 2007
2 Kenneth J Ayala, “The 8051 Microcontroller – Architecture, Programming and Applications”, Penram International Publications, India, 2016
3 Uma Rathore Bhatt, “Assembly Language Programming with 8051 Microcontroller”, LAP Lambert Academic Publishing, 2016

Reference Books

1. Rajkamal, “Embedded Systems Architecture, Programming and Design”, TATA McGraw-Hill, 2nd edition 2015.
2. David E.Simon, “An Embedded Software Primer”, Pearson Education Asia, First Indian Reprint, 2012.
3. T Bezboruah, Embedded System Design Based on 8051 and PIC Family Microcontroller, LAP Lambert Academic Publishing, 2011
4. Dogan Ibrahim, “Microcontroller Projects In C for the 8051”, Elsevier Science, 2000
5. Thomas W Schultz, “C and the 8051” 4th edition, Wood Islands Prints, 2008

Web References

1. https://exploreembedded.com
2. https://www.elprocus.com/peripherals-interfacing-to-the-microcontroller-8051-in-electronics/
3. http://www.ti.com/microcontrollers/msp430-ultra-low-power-mcus/overview.html
4. https://developer.arm.com/products/architecture/cpu-architecture
5. https://www.udemy.com/course/8051-microcontroller-embedded-c-and-assembly-language/

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

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

U20ECT511	DIGITAL SIGNAL PROCESSING	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To Analyze the frequency domain behavior of the Discrete Time signal using Discrete Fourier Transform
- To design IIR filters for the given specifications by following the suitable design procedures
- To design FIR filters for the given specifications by following the suitable design procedures
- To analyze the finite word length effect in the design of digital signal processing systems
- To understand the architectural overview and addressing modes in DSP processors

Course Outcomes

After completion of the course, students will be able to

CO1 - Analyze the frequency domain behavior of a given Discrete Time signal using Discrete Fourier Transform. **(K4)**
CO2 - Construction of Realization structures and design for IIR filters **(K3)**
CO3 - Construction of Realization structures and design for FIR filters **(K3)**
CO4 - Analyze the effect of finite word length for fixed & floating-point number representation **(K4)**
CO5 - Develop an algorithm using TSM320C6X Processor for simple signal processing applications **(K3)**

UNIT - I DISCRETE FOURIER TRANSFORM: PROPERTIES, APPLICATIONS AND COMPUTATION (12 Hrs)

Review on DTFT- Spectrum limitations, The Discrete Fourier Transform- Need for DFT, DFT as a linear transformation. Properties of DFT- Periodicity, Linearity, Symmetry, Multiplication-Circular Convolution, Time Reversal Circular shifts in time and frequency, Inverse DFT. Efficient Computation of DFT-FFT Algorithm-Implementation of Radix 2 FFT algorithm (DIT and DIF)-Applications of FFT algorithm.

UNIT – II IIR FILTER DESIGN (12 Hrs)

IIR filters - advantages and disadvantages - Design of IIR filters from analog Butterworth and Chebyshev filters - Impulse invariance and bilinear transformation methods of IIR digital filter design – Realization of IIR filters – Direct form I, II, cascade, parallel and ladder realization

UNIT - III DESIGN OF FIR FILTERS (12 Hrs)

Linear phase FIR filters Design using Frequency sampling techniques using Windows- Hamming, Hanning, Blackman and Kaiser Window. Realization of FIR Filters-Direct, Linear phase realization structures

UNIT - IV FINITE WORD LENGTH EFFECT IN DIGITAL FILTERS (12 Hrs)

Number Representation-Fixed and Floating Point Quantization Noise-Finite Word Length Effects in Digital filters- Input Quantization, Product Quantization, Coefficient quantization error, Limit Cycle Oscillations, Overflow and Signal Scaling Introduction to Multirate Signal Processing-Interpolation, Decimation Applications - subband coding of speech signals, Digital filter bank - 2-channel Quadrature mirror filter bank.

UNIT - V DIGITAL SIGNAL PROCESSORS (12 Hrs)

Introduction to programmable DSP processors – Von- Neumann architecture- Harvard architecture- VLIW architecture – MAC unit- pipelining.- Special addressing modes in P-DSPs- On chip peripherals, PDSPs with RISC and CISC- Architecture and addressing modes of TMS320C5X

Textbooks

1. John G. Proakis and Dimitris K. Manolakis, “Digital Signal Processing”, 4th edition, Pearson, 2007
2. SanjitMitra, “Digital Signal Processing”, 4th edition, McGraw-Hill, New York, 2013(revised),
3. Chassaing,Rulph, “DSP applications using C and the TMS320C6x DSK”, Volume 13.John Wiley and Sons,2003

Reference Books

1 P.Ramesh Babu,"Digital Signal processing", Scitech Publications, 7th Edition, 2017
2 Alan V. Oppenheim and Ronald W. Schafer, "Discrete-Time Signal Processing", 3rd edition, Prentice Hall,2010.
3 Vinay K. Ingle and John G. Proakis, Digital Signal Processing using MATLAB, Cengage learning, Third Edition, 2011.
4 Ashok Ambardar, Digital Signal Processing: A modern introduction, Cengage Learning, First Edition, 2006.
5 B.Venkataramani and M.Bhaskar, "Digital Signal Processors- Architecture, programming and Applications", Tata McGraw Hill, Fourth Edition, 2005

Web References

1. https://engineering.purdue.edu/~bouman/ece438/lecture/module
2. http://freevideolectures.com/Course/2339/Digital-Signal-Processing-IITKharagpur
3. http://www.analog.com/en/content/beginners_guide_to_dsp/fca.html
4. https://onlinecourses.nptel.ac.in/noc21_ee20/preview
5. https://nptel.ac.in/content/storage2/courses/108105057/Pdf/Lesson-7.pdf

COs / POs / PSOs Mapping

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

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

U20BSP545	STATISTICAL METHODS LABORATORY (Common to ECE & BME)	L	T	P	C	Hrs
		0	0	2	1	30

Course Objectives

- To familiarize the concept of Univariate, 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

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 References

1. https://youtu.be/9pHi2vkz2_Y
2. https://youtu.be/4lAvbp-yVs8
3. https://youtu.be/B3pAD8ie3k0?list=PLoNoar1DlEikiPbM5cdpXOxDtQcrb4fQ5
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	2	1	-	-	-	1	-	-	-	-	-	1	2	3	-
2	2	1	-	-	-	1	-	-	-	-	-	1	2	3	-
3	3	2	1	1	-	1	-	-	-	-	-	1	2	3	-
4	3	2	1	1	-	1	-	-	-	-	-	1	2	3	-
5	2	1	-	-	-	1	-	-	-	-	-	1	2	3	-

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

U20ECP507	WIRELESS COMMUNICATION LABORATORY	L	T	P	C	Hrs
		0	0	3	1	45

Course Objectives

- To impart the fundamentals concepts of wireless communication systems
- To learn various technologies involved in wireless cellular communication
- To gain knowledge about various protocols involved in wireless cellular communication
- To acquire basics of BPSK/QPSK BER in Rayleigh and Racian fading channel
- To understand the concepts of signalling schemes and analyse its channel capacity

Course Outcomes

After completion of the course, students will be able to

CO1 - Assess and select the appropriate multiple accessing methods and propagation path loss model depending on channel model **(K2)**

CO2 - Apply the innovative ideas in the field of wireless communication, in particular how to communicate in wireless cellular communication **(K2)**

CO3 - Illustrating the concepts using examples from several modern wireless systems as well as new research developments **(K4)**

CO4 - Analyse the mathematical framework for design of wireless systems developed based on suitable equalization and diversity techniques **(K3)**

CO5 - Apply the innovative ideas to improve the existing technology in the field of digital communication through fading multipath channels and improving capacity in Wireless systems **(K4)**

LIST OF EXPERIMENTS

The following experiments are conducted using MATLAB

1. Simulation of Channel model for Free space propagation loss and log normal shadowing models
2. Simulation of Frequency Division Multiple access transmitter and receiver systems
3. BER simulation of OFDM system over multipath fading channel
4. Simulation of Frequency Division Multiple access techniques for communication systems
5. Simulation of CDMA transmitter and receiver
6. Simulation of Direct sequence spread spectrum modulation and demodulation
7. Analysis and comparison of BPSK/QPSK BER performance in Rayleigh and Racian fading channel
8. Generation of OFDM Transmitter and receiver systems using SDR kit
9. Study of Small-scale fading, large scale fading and link budgets using MATLAB
10. Study of diversity Concepts
    a. Receive diversity
    b. Selection diversity
    c. Maximum ratio combining
    d. Transmit diversity (Alamouti - STBC)
11. Implementation of MIMO including spatial multiplexing
12. Simulation study of Interference mitigation in MIMO
13. Implementation of IEEE 802.11n standard (PHY layer)

The following experiments are conducted using either QUALNET/OPNET Simulators.

1. Simulate a three nodes point-to-point network with duplex links between them. Set the queue size vary the bandwidth and find the number of packets dropped.
2. Simulate the different types of Internet traffic such as FTP a TELNET over a network and analyze the throughput.

Reference Books

1. Upena Dalal and Manoj K. Shukla, “Wireless and Mobile Communication”, Oxford Press Publications,2016.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2012.
3. EzioBiglieri and Robert Calderbank, “MIMO Wireless Communications”, Cambridge University Press,2015.
4. Vijay K. Garg, “Wireless Communications and Networks”, Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian reprint).
5. J. Schiller, “Mobile Communication” 2/e, Pearson Education, 2012.

Web References

1. http://nptel.ac.in/courses/117102062/
2. https://onlinecourses.nptel.ac.in/noc17_cs37/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-452-principles-of-wireless-communications-spring-2006
4. http://www.mnit.ac.in/dept_ece/download/Syllabus_Wireless_Optical.pdf
5. https://www.abebooks.com/book-search/title/wireless-communication-technology/author/blake/

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

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

U20ECP508	MICROCONTROLLER LABORATORY	L	T	P	C	Hrs
		0	0	3	1	45

Course Objectives

- To implement Arithmetic and Logical operations using 8051 ALP.
- To interface display and keyboard to 8051 using ALP.
- To interface ADC and DAC to 8051 using ALP.
- To interface stepper and DC motor using 8051 ALP.
- To Interface real time applications using IDE.

Course Outcomes

After completion of the course, students will be able to

CO1 - Explain and Implement 8051 instructions for solving mathematical problems **(K3)**
CO2 - Interface the 7 – segment / LCD Display using 8051 Trainer kit. **(K3)**
CO3 - Interface sensors to 8051 trainer kit using ADC and DAC**(K3)**
CO4 - Interface and control the operations of stepper and DC motor **(K3)**
CO5 - Interface and control the elevator using 8051**(K3)**

LIST OF EXPERIMENTS

PART –A (At least 6 experiments are mandatory)

Assembly Language Programming experiments using 8051 Trainer kit.

1. Data transfer/exchange between specified memory locations.
2. Find the Largest/smallest from a series.
3. Sorting (Ascending/Descending) of data.
4. Addition / subtraction / multiplication / division of 8/16 bit data.
5. Sum of a series of 8-bit data.
6. Multiplication by shift and add method.
7. Square / cube / square root of 8-bit data.
8. Matrix addition.
9. LCM and HCF of two 8-bit numbers.
10. Code conversion – Hex to Decimal/ASCII to Decimal and vice versa.

PART –B (At least 4 experiments are mandatory)

Interfacing experiments using 8051 Trainer kit and interfacing modules.

1. Time delay generation and relay interface.
2. Display (LED/Seven segments/LCD) and keyboard interface.
3. ADC interface.
4. DAC interface with waveform generation.
5. Stepper motor and DC motor interface.
6. Realization of Boolean expression through port.
7. Elevator interfacing.

Reference Books

1. Rajkamal, “Embedded Systems Architecture, Programming and Design”, TATA McGraw-Hill, 2nd edition 2015.
2. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram International, 2016.
3. David E.Simon, “An Embedded Software Primer”, Pearson Education Asia, First Indian Reprint, 2012.
4. Dogan Ibrahim, “Microcontroller Projects in C for the 8051”, Elsevier Science, 2000
5. Thomas W Schultz, “C and the 8051” 4th edition, Wood Islands Prints, 2008

Web References

1. https://exploreembedded.com
2. https://www.elprocus.com/peripherals-interfacing-to-the-microcontroller-8051-in-electronics/
3. http://www.ti.com/microcontrollers/msp430-ultra-low-power-mcus/overview.html
4. https://developer.arm.com/products/architecture/cpu-architecture
5. https://www.udemy.com/course/8051-microcontroller-embedded-c-and-assembly-language

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

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

U20ECP509	DIGITAL SIGNAL PROCESSING LABORATORY	L	T	P	C	Hrs
		0	0	3	1	45

Course Objectives

- To utilize MATLAB in various signal processing applications
- To Analyze the frequency domain behavior of a given Discrete Time signal using Discrete
- Fourier Transform
- To design IIR and FIR filters for the provided specifications by following the suitable design procedures
- To understand the architectural overview and addressing modes in DSP processors
- Identify suitable programs and Implementation of FFT algorithm using DSP trainer Kit

Course Outcomes

After completion of the course, students will be able to

CO1 - Analyze and implement digital signal processing systems in time domain **(K4)**
CO2 - Develop and implement digital systems using the DFT and the Fast Fourier Transform (FFT) **(K3)**
CO3 - Compute circular convolution, linear convolution and the discrete Fourier transform (DFT) of discrete time signals **(K3)**
CO4 - Construct the digital filters using windows**. (K3)**
CO5 - Develop an algorithm using TSM320C6X Processor for simple signal processing applications **(K3)**

LIST OF EXPERIMENTS

1. Introduction to MATLAB for Signal Processing
2. Write a Program for the generation of basic signals such as unit impulse, unit step, ramp, exponential, sinusoidal and cosine
3. Perform Sampling of Continuous time Signals with various sampling rates
4. Perform Linear and Circular Convolution (with and without functions)
5. Perform Computation of DFT of a signal, using basic equation and FFT algorithms
6. Design and Simulation of IIR and FIR filters using Filter Design Toolbox
7. Linear Convolution using Simulink
8. Study of Code composer studio
9. Perform Generation of Signals using DSP trainer Kit
10. Execute Manipulation of Matrix multiplication using DSP trainer kit
11. Perform Verification of Linear Convolution Operation using DSP trainer Kit
12. Verify Circular Convolution using DSP trainer kit
13. Implement FFT-DIT algorithms using DSP trainer Kit

Reference Books

1 Alan V. Oppenheim and Ronald W. Schafer, “Discrete-Time Signal Processing,” 3rd edition, Prentice Hall,2010.
2 Vinay K. Ingle and John G. Proakis, Digital Signal Processing using MATLAB, Cengage learning, Third Edition, 2011.
3 Ashok Ambardar, Digital Signal Processing: A modern introduction, Cengage Learning, First Edition, 2006.
4 Alan V. Oppenheim, Wilsky S. and Nawab S. H, Signals and Systems, Pearson, 2015
5 P.Ramesh Babu,”Digital Signal processing”, Scitech Publications, 7th Edition, 2017

Web References

1. https://engineering.purdue.edu/~bouman/ece438/lecture/module
2. http://freevideolectures.com/Course/2339/Digital-Signal-Processing-IITKharagpur
3. http://www.analog.com/en/content/beginners_guide_to_dsp/fca.html
4. https://onlinecourses.nptel.ac.in/noc21_ee20/preview
5. https://nptel.ac.in/content/storage2/courses/108105057/Pdf/Lesson-7.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	2	-	-	-	2	-	-	1	3	1	1
2	3	2	2	1	2	-	-	-	2	-	-	1	3	1	1
3	3	2	2	1	2	-	-	-	2	-	-	1	3	1	1
4	3	2	2	1	2	-	-	-	2	-	-	1	3	1	1
5	3	2	2	1	2	-	-	-	2	-	-	1	3	1	1

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

U20ECC5XX	CERTIFICATION COURSE - V	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, E-plan 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
U20ECS504	**SKILL DEVELOPMENT COURSE 4** (Foreign Language / IELTS – I/ Career and Professional Skill Development Program - 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

U20ECS505	SKILL DEVELOPMENT COURSE 5 (Presentation Skills using ICT)	L	T	P	C	Hrs
		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 ontheir 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.

U20ECM505	INDIAN CONSTITUTION	L	T	P	C	Hrs
		0	0	2	-	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
2. The scheme of the Fundamental Duties and its legal status
3. The Directive Principles of State Policy – Its importance and implementation
4. Federal structure and distribution of legislative and financial powers between the Union and the States
5. Parliamentary Form of Government in India – The constitution powers and status of the President of India
6. Amendment of the Constitutional Powers and Procedure
7. The historical perspectives of the constitutional amendments in India
8. Emergency Provisions: National Emergency, President Rule, Financial Emergency
9. Local Self Government – Constitutional Scheme in India
10. Scheme of the Fundamental Right to Equality
11. Scheme of the Fundamental Right to certain Freedom under Article 19
12. Scope of the Right to Life and Personal Liberty under Article 21.

SEMESTER – VI										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ECT612	Control System Engineering	PC	2	2	0	3	25	75	100
2	U20ECT613	Digital VLSI System Design	PC	3	0	0	3	25	75	100
3	U20ECCM03	Digital Image Processing	PC	3	0	0	3	25	75	100
4	U20ECT615	Transmission Lines & Antennas	PC	3	0	0	3	25	75	100
5	U20ECE6XX	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	U20ECP610	VLSI Design Laboratory	PC	0	0	2	1	50	50	100
8	U20ECP611	Digital Image Processing Laboratory	PC	0	0	2	1	50	50	100
9	U20ECP612	Electronic Design Workshop	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U20ECC6XX	Certification Course - VI**	EEC	0	0	4	-	100	-	100
11	U20ECS606	Skill Development Course 6: Foreign Language / IELTS-II / Career and Professional Skill Development Program - I	EEC	0	0	2	-	100	-	100
12	U20ECS607	Skill Development Course 7: Technical Seminar	EEC	0	0	2	-	100	-	100
13	U20ECS608	Skill Development Course 8: NPTEL/MOOC-I	EEC	0	0	0	-	100	-	100
Mandatory Course										
14	U20ECM606	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
Total							21	800	600	1400

U20ECT612	CONTROL SYSTEM ENGINEERING	L	T	P	C	Hrs
		2	2	0	3	60

Course Objectives

- To understand the fundamental concepts and mathematical modelling of control systems.
- To study the concept of time response and frequency response of the system
- Can able to learn stability analysis of system using Root locus, bode plot, polar plot, and Nyquist plot.
- Learn the features of different types of compensators and to design compensators using time-domain and frequency domain specification.
- To gain knowledge about digital control system and understand the concepts of state space analysis.

Course Outcomes

After completion of the course, the students can

CO1 - Describe various input/output models of dynamic system. **(K1)**
CO2 - Determine the time response of a control system for various test inputs **(K2)**
CO3 - Determine the frequency response using various plots. **(K2)**
CO4 - Examine the concept of stability using various stability criteria**. (K2)**
CO5 - Illustrate Bode plot to design phase lead-lag compensation. **(K3)**

UNIT- I SYSTEM REPRESENTATION (12 Hrs)

Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and rotational systems – Transfer function – Synchronous – AC and DC servo motors – Block diagram reduction techniques – Signal flow graphs.

UNIT- II TIME RESPONSE (12 Hrs)

Time response – Time domain specifications – Types of test input – I and II order system response –Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

UNIT-III FREQUENCY RESPONSE (12 Hrs)

Frequency response – Bode plot – Polar plot – Constant M and N circles, Nichols chart, Determination of closed loop response from open loop response – Correlation between frequency domain and time domain specifications.

UNIT- IV STABILITY OF CONTROL SYSTEM (12 Hrs)

Characteristics equation – Location of roots in S plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criteria.

UNIT -V COMPENSATOR DESIGN (12 Hrs)

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plot. Introduction to Digital Control Systems, Introduction to State Variable Analysis and Design -Advances in Control Systems.

Textbooks

1. I.J. Nagrath& M. Gopal, “Control Systems Engineering”, New Age International Publishers, Sixth edition, 2017.
2. Ogata.K, “Modern Control System Engineering” Fifth Edition, Pearsons, 2010.
3. B.C. Kuo “Automatic Control Systems”, Tenth Edition, McGraw-Hill Education, 2017.

Reference Books

1. M. Gopal, “Control Systems, Principles & Design,” Fourth edition, Tata McGraw Hill, New Delhi, 2012.
2. M.N. Bandyopadhyay, “Control Engineering Theory and Practice,” Prentice Hall of India, 2009
3. Norman S. Nise,“Control Systems Engineering: Analysis and Design ”, seventh edition, 2015,Wiley sons.
4. Jairath AK “Problems and Solutions of Control Systems: With Essential Theory”, fourth edition, 2007, CBS Publishers & Distributors
5. Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015. 2. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Pearson Education,2009.

Web References

1. https://nptel.ac.in/courses/107106081/
2. http://www.nptelvideos.com/control_systems/
3. http://www.ewh.ieee.org/sb/iiee/new/tutorials/feedback.pdf
4. https://upload.wikimedia.org/wikipedia/commons/e/e4/Control_Systems.pdf
5. https://ledin.com/control-systems-basics/

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

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

U20ECT613	DIGITAL VLSI SYSTEM DESIGN	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the introduction about design and implementation of digital circuits.
- To explain the various combinational and sequential logic blocks.
- To understand the terms and keywords in Verilog HDL.
- To understand about various levels of modelling.
- To demonstrate the various subsystem circuits using Verilog HDL.

Course Outcomes

After completion of the course, students will be able to

Understand the basic principles of design and implementation of digital circuits**. (K2)**
Discuss about the different combinational and sequential logic blocks**. (K3)**
Describe the terms and keywords in Verilog HDL. **(K2)**
Identify the various levels of modeling of Verilog HDL**. (K2)**
Implement the various subsystem using Verilog HDL**. (K2)**

UNIT - I HARDWARE DESIGN AND IMPLEMENTATION (9 Hrs)

Digital Hardware, The Design Process, Design of Digital Hardware, Standard Chips, Programmable Logic Devices, Custom Chips, Standard Cells, and Gate Arrays, Implementation Details for SPLDs, CPLDs, and FPGAs.

UNIT - II DIGITAL CIRCUITS DESIGN (9 Hrs)

Combinational Logic Design; Adders, Subtractor, Multiplier, Multiplexers, Demultiplexers, Decoders, Encoders, Code Converters. Sequential Logic Design- Flip-Flops, Registers, Counters, Finite State Machines- Mealy and Moore type, Serial Adder.

UNIT - III INTRODUCTION TO VERILOG HDL (9 Hrs)

Introduction to Verilog HDL: Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Functional Verification, System Tasks, Programming Language Interface (PLI), Module, Simulation and Synthesis Tools. Language Constructs and Conventions: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters,
Operators.

UNIT - IV LEVELS OF MODELING (9 Hrs)

Gate Level Modeling: Array of Instances of Primitives, Design of Flip-flops with Gate Primitives, Delays, Dataflow Level Modeling Continuous Assignment Structure, Delays and Continuous Assignments, Assignment to Vectors. Behavioral level Modeling: Initial and Always Construct, Assignments with Delays, Blocking and Non-Blocking Assignments, Procedural Statements, Assign-De-Assign construct, Parallel Blocks, Force-Release construct. Functions and Tasks, Design Examples.

UNIT - V SUBSYSTEM DESIGN USING VERILOG HDL (9 Hrs)

RTL coding for High speed adders, multipliers, divider,8-bit Counters, Finite state machines, Parallel to Serial Converter, sequence detector, memories, ALU, clock divider, traffic light controller, Sequence generator, Test bench for Combinational Circuits and Sequential Circuits.

Textbooks

1. Stephen. Brown and Zvonko Vranesic “Fundamentals of Digital Logic Design with Verilog Design,” TMH, 2nd Edition,2017.
2. Samir Palnitkar, Verilog HDL, Pearson Education, 2nd Edition, 2004.
3. M. Morris Mano Michael D Ciletti, Digital Design-Pearson Education, 5th Edition,2012.

Reference Books

1. Ion Grout, “Digital Systems Design with FPGAs and CPLDs”, Elsevier, 2008.
2. Bob Zeidman, “Designing with FPGAs and CPLDs”, Elsevier, CMP Books, 2002.
3. Ming-Bo Lin, “Digital System Designs and Practices using Verilog HDL and FPGAs”, Wiley,2012.
4. Sunggu Lee, “Advanced Digital Logic Design using Verilog, State Machine & Synthesis for FPGA”, Cengage Learning, 2012.
5. Michael D. Ciletti, “Advanced Digital Design with Verilog HDL”, PHI, 2009.

Web References

1. http://www.asic-world.com/verilog/veritut.html
2. https://www.coursera.org/courses?query=verilog
3. https://hackr.io/tutorials/learn-verilog
4. https://www.udemy.com/topic/verilog-hdl-programming/
5. https://www.maven-silicon.com/online-vlsi-design-verilog-hdl-course

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

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

U20ECCM03	DIGITAL IMAGE PROCESSING (Common to ECE and CCE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To become familiar with digital image fundamentals
- To get exposed to mathematical preliminaries and Image Transform used in Image Processing
- To learn concepts of Image Enhancement and restoration techniques.
- To study the image segmentation and colour Image processing techniques.
- To become familiar with image compression and recognition methods

Course Outcomes

After completion of the course, the students are able to

CO1 - Summarize the digital image fundamentals. **(K2)**
CO2 - Correlate the various image processing technique with the help of mathematical preliminaries. **(K4)**
CO3 - Apply different types of image enhancement and restoration techniques in various applications **(K3)**
CO4 - Illustrate the significance of Colour Image Processing and Image Segmentation techniques **(K4)**
CO5 - Connect Image compression and Recognition techniques in Image processing. **(K4)**

UNIT I DIGITAL IMAGE FUNDAMENTALS (9 Hrs)

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels., simple image formation model, Brightness, contrast, hue, saturation, Mach band effect

UNIT II IMAGE TRANSFORM: (9 Hrs)

Two-dimensional Fourier Transform- Properties – Fast Fourier Transform – Inverse FFT- Image transforms – 1D DFT, 2D DFT, Discrete Cosine transform, Discrete Sine transform, Hadamard transform, Haar transform, Slant transform, KL transform, SVD transform, Wavelet transform.

UNIT III IMAGE ENHANCEMENTAND IMAGE RESTORATION (9 Hrs)

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering – Frequency Domain: Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters. Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering.

UNIT IV COLOUR IMAGE PROCESSING AND IMAGE SEGMENTATION: (9 Hrs)

Colour fundamentals – Colour models – HIS to RGB and RGB to HIS. Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation- Morphological processing- erosion and dilation. Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm

UNIT V IMAGE COMPRESSION AND RECOGNITION (9 Hrs)

Need for compression – Coding Redundancy - Interpixel Redundancy - Psycho visual Redundancy - Bit plane coding - Variable length coding – Adaptive coding – Arithmetic coding – LZW coding – Hybrid coding – Wavelet – JPEG – MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching.

Textbooks

1. Rafael C. Gonzalez & Richard E. Woods, Digital Image Processing, 2017, 4th edition, Pearson Education, USA
2. Anil K. Jain, Fundamentals of Digital Image Processing, 2015, 1st edition, Pearson India, India
3. Kenneth R. Castleman, Digital Image Processing, Pearson, 2006.

Reference Books

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Willliam K Pratt, “Digital Image Processing”, John Willey, 2002.
3. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, First Edition, PHI Learning Pvt. Ltd., 2011.
4. John C. Russ, F. Brent Neal-The Image Processing Handbook, Seventh Edition, The Kindle edition (2016), CRC Press,Taylor & Francis Group.
5. P.Ramesh Babu, Digital Image Processing, Scitech Publications., 2003

Web References

1. http://eeweb.poly.edu/~onur/lectures/lectures.html
2. http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html
3. https://nptel.ac.in/courses/117/105/117105079/
4. https://nptel.ac.in/courses/117/105/117105135/
5. https://www.csie.nuk.edu.tw/

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

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

U20ECT615	TRANSMISSION LINES & ANTENNAS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the types of transmission lines and discuss the associated losses
- To use the Smith chart in solving transmission line problems
- To understand the concept of waveguides
- To understand antenna parameters and the radiation principles of wire antennas
- To understand the design and operation of array and aperture antennas.

Course Outcomes

After completion of the course, the students are able to

CO1 - Understanding the propagation of signals through transmission lines **(K2)**

CO2 - Knowledge to describe the fundamentals of transmission line theory and impedance matching in high frequency lines **(K3)**

CO3 - Understanding the principle of waveguides **(K2)**

CO4 - Analyze the various antenna parameters **(K3)**

CO5 - Knowledge to analyze the antennas and its radiation characteristics **(K3)**

UNIT- I TRANSMISSION LINE THEORY (9 Hrs)

Types of transmission lines, Primary and secondary constants. General solutions. Characteristic impedance, propagation constant, attenuation and phase constants. Open circuited and short-circuited lines. The telephone cable, Reflection of line not terminated in Z0- Reflection coefficient- Distortion in transmission lines- Distortion less line.

UNIT - II THE LINE AT RADIO FREQUENCIES (9 Hrs)

Standing waves and standing wave ratio on a line – One-eighth wave line – The quarter wave line and impedance matching – the half wave line. The circle diagram for the dissipation less line – The Smith Chart – Application of the Smith Chart – Conversion from impedance to reflection coefficient and vice-versa. Impedance to Admittance conversion and vice versa – Input impedance of a lossless line terminated by an impedance – single stub matching and double stub matching.

UNIT - III WAVE GUIDES (9 Hrs)

Transverse Magnetic waves, Transverse Electric waves and Transverse Electromagnetic waves between parallel plates, TM and TE waves in Rectangular wave guides, Impossibility of TEM in Rectangular wave guides, Bessel's differential equation and Bessel function, TM and TE waves in Circular wave guides.

UNIT – IV ANTENNA FUNDAMENTALS (9 Hrs)

Antenna parameters - Gain, Directivity, Effective aperture, Radiation Resistance, Bandwidth, Beam width; Impedance matching: BALUNS, Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, half wave dipole and folded dipole

UNIT - V APERTURE ANTENNAS AND SPECIAL ANTENNAS (9 Hrs)

Aperture Antennas: Horn antennas, Reflector antennas, Slot antennas. Microstrip patch antenna, Yagi array, Spiral antennas, helical antennas, log periodic antenna, Lens antennas, Fractal Antennas, Smart antennas and antenna beam forming. Antenna Arrays: N-element linear array, Pattern multiplication, Broadside and end fire array, Array synthesis: Binomial array

Textbooks

1. Jordan E.C and Balmain K.G, Electromagnetic Waves and Radiating Systems, Prentice Hall of India, Second Edition, 2011.
2. Umesh Sinha, “Transmission Lines and Network”, Satya Prakashan Publishing Company, New Delhi, 2012
3. William H Hayt and Jr John A Buck, “Engineering Electromagnetics”, Tata Mc Graw-Hill Publishing Company Ltd, New Delhi, 2008.

Reference Books

1. David K Cheng, “Field and Wave Electromagnetics”, Second Edition, Pearson Education Inc, Delhi, 2004.
2. Inan U S and Inan A S, Engineering Electromagnetics, Pearson Education, 2010. 4. Ulaby F.T, Michelson E and Ravaioli U, Fundamentals of Applied Electromagnetics, Pearson Education, Sixth Edition, 2015.
3. Balanis CA, Antenna Theory: Analysis and Design, A John Wiley & Sons Inc. publication, Third Edition, 2005.
4. I.J.Bahl and P.Bhartia, “Microstrip Antennas”, Artech house, Inc.,1980.
5. Simon R Saunders, “Antennas and Propagation for wireless communication system”, John Wiley Publications, 3rd Edition, 2001.

Web References

1. http://www.nptelvideos.in/2012/12/transmission-lines-and-em-waves.html
2. https://nptel.ac.in/courses/117101056
3. http://www.cdeep.iitb.ac.in/webpage_data/nptel/Electrical%20&%20Comm%20Engg/Transmission%20Line s%20and%20EM%20Waves/TOC.html
4. https://optiwave.com/optifdtd-overviw/
5. https://www.tutorialspoint.com/microwave_engineering/microwave_engineering_waveguides.htm

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

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

U20ECP610	VLSI DESIGN LABORATORY	L	T	P	C	Hrs
		0	0	2	1	45

Course Objectives

- To learn HDL programming for implementation of combinational circuits in FPGA.
- To learn HDL programming for implementation of sequential circuits in FPGA.
- To familiarize fusing of logical modules on FPGAs
- To synthesize the digital logic circuits using EDA tool.
- To examine the cost function using EDA Tool

Course Outcomes

After completion of the course, students will be able to

CO1 - Design and simulate combinational circuits using Verilog HDL **(K4)**
CO2 - Design and simulate sequential circuits using Verilog HDL**. (K4)**
CO3 - Implement the logic modules into FPGA Boards. **(K4)**
CO4 - Synthesize the Digital Logic using EDA tools. **(K3)**
CO5 - Analyze the cost function using EDA Tool. **(K3)**

LIST OF EXPERIMENTS

1. Study of Simulation and Implementation procedure of FPGA.
2. Design & Implement the following circuits using FPGA
   a. Basic logic gates.
   b. Half Subtractor and Full Subtractor
   c. 8-Bit Adders (Simple Adder & Ripple Carry Adder).
   d. 4 Bit Multiplier (Simple Multiplier & Array Multiplier).
   e. Decoder and Priority Encoder
   f. Code Converters
   g. Shift register (SISO, SIPO, and PIPO)
   h. 8 Bit Arithmetic logic unit.
   i. 4 Bit Up and Down Counters
   j. Finite State Machine (Moore Machine & Mealy machine)
   k. Memories using HDL.

Reference Books

1. Bob Zeidman, Designing with FPGAs and CPLDs, Elsevier, CMP Books, 2002.
2. Samir Palnitkar, “Verilog HDL”, Pearson Education, 2nd Edition, 2004.
3. Kevin Skahill, “VHDL for Programmable Logic”, PHI/Pearson education, 2006.
4. Michael D. Ciletti, “Advanced Digital Design with the Verilog HDL”, Pearson (Prentice Hall), Second edition.
5. Ming-Bo Lin, “Digital System Designs and Practices using Verilog HDL and FPGAs”, Wiley,2012.

Web References

1. http://www.asic-world.com/verilog/veritut.html
2. https://www.coursera.org/courses?query=verilog
3. https://hackr.io/tutorials/learn-verilog
4. https://www.udemy.com/topic/verilog-hdl-programming/
5. https://www.maven-silicon.com/online-vlsi-design-verilog-hdl-course

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

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

U20ECP611	DIGITAL IMAGE PROCESSING LABORATORY	L	T	P	C	Hrs
		0	0	2	1	45

Course Objectives

- To practice the basic image processing techniques.
- To compute magnitude and phasor representation of images.
- To design and analyse point processing and histogram processing using MATLAB
- To understand the concepts of image restoration and segmentation.
- To explore the applications of image processing techniques.
- To know de-noising, transforms, compression, and morphological processing.

Course Outcomes

After completion of the course, the students can

CO1- Summarize the fundamentals of a digital image processing system such as image acquisition, enhancement, segmentation, transforms, compression, morphology, representation and description. **(K2)**

CO2- Analyze images in the spatial domain. **(K4)**

CO3- Analyze images in the frequency domain through the Fourier transform. **(K4)**

CO4- Design and implement with MATLAB for digital image processing operations such as point processing, histogram processing, spatial and frequency domain filtering. **(K6)**

CO5- Design and implement with MATLAB for digital image processing for denoising, transforms, compression, and morphological processing. **(K6)**

LIST OF EXPERIMENTS

1. Point Processing techniques (At least 3 experiments).
2. Image sampling and quantization
3. Smoothing or averaging filter in spatial domain.
4. Histogram Processing (Histogram Stretching and Equalization).
5. Frequency Domain Filtering (Plotting 2D-DFT, Low pass and High Pass- Ideal, Butterworth and Gaussian Filters).
6. Morphology-Dilation Erosion.
7. Analysis of spatial and intensity resolution of images.
8. Intensity transformation of images.
9. Segmentation-Gradient operators.
10. Image Enhancement- Filtering in frequency domain
11. Image enhancement using Histogram Equalization
12. Identifying objects in an image based on their boundaries
13. Image segmentation – Edge detection, line detection and point detection.
14. Perform DFT for any given image and obtain its Fourier spectrum. Verify the symmetric property of DFT and compare the result with Discrete Cosine Transform.
15. Perform image enhancement, feature extraction studies and compression using DFT, DCT and DWT

Reference Books

1. A.K.Jain, Fundamentals of Digital Image Processing, Prentice-Hall, 1989.
2. Rafael C. Gonzalez, Digital Image Processing, Second Ed., Pearson Education,2004.
3. Bernd Jahne, Digital Image Processing, 5th revised and extended edition,2002.
4. Tinku Acharya, Image Processing Principles and Applications,2005.
5. Dwayne Phillips Image, Processing in C, Second Edition, 2000.

Web References

1. http://homepages.inf.ed.ac.uk/rbf/HIPR2/histgram.html
2. https://cse19-iiith.vlabs.ac.in/
3. http://www.marginalsoftware.com/HowtoScan/image_histograms
4. http://en.wikipedia.org/wiki/Mathematical_morphology
5. http://www.mathworks.com/access/helpdesk/help/pdf_doc/matlab/getstart.pdf
6. http://www.mathworks.com/help/toolbox/images/f18-12508.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	2	-	1	-	-	-	1	-	-	1	3	-	-
2	3	2	2	-	1	-	-	-	1	-	-	1	3	-	-
3	3	2	2	-	1	-	-	-	1	-	-	1	3	-	-
4	3	2	2	-	1	-	-	-	1	-	-	1	3	-	-
5	3	2	2	-	1	-	-	-	1	-	-	1	3	-	-

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

U20ECP612	ELECTRONIC DESIGN WORKSHOP	L	T	P	C	Hrs
		0	0	2	1	45

Course Objectives

- To provide the fundamentals knowledge on survey the literature to conceive a problem statement.
- To provide the solution to society-oriented problems
- To develop the prototype model in order to solve the conceived problem.
- To acquire knowledge on preparation of project report.
- To enhance the demonstration skill of proto-type model

Course Outcomes

At the end of the course, students will demonstrate the ability to:

CO1 - Conceive a problem statement either from rigorous literature survey **(K2)**
CO2 - Conceive the requirements raised from need analysis **(K2)**
CO3 - Design; implement prototype/algorithm in order to solve the conceived problem **(K3)**
CO4 - Write comprehensive report on mini project work. **(K2)**
CO5 - Enhance the demonstration skill of proto-type model. **(K2)**

Guidelines

1. The mini project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.
2. The mini project may be a complete hardware or a combination of hardware and software. The software part in mini project should be less than 50% of the total work.
3. Mini Project should cater to a small system required in laboratory or real life.
4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
5. After interactions with course coordinator and based on comprehensive literature survey/need analysis, the student shall identify the title and define the aim and objectives of mini project.
6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Artwork and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design.
9. Completed mini project and documentation in the form of mini project report is to be submitted at the end of semester.
10. The tutorial sessions should be used for discussion on standard practices used for electronic circuits/product design, converting the circuit design into a complete electronic product, PCB design using suitable simulation software, estimation of power budget analysis of the product, front panel design and mechanical aspects of the product, and guidelines for documentation /report writing.

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

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

U20ECC6XX	CERTIFICATION COURSE - VI	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 must repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

U20ECS606	SKILL DEVELOPMENT COURSE 6 (Foreign Language / IELTS – II/ Career and Professional Skill Development Program - II)	L	T	P	C	Hrs
		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

U20ECS607	SKILL DEVELOPMENT COURSE 7 (Technical Seminar)	L	T	P	C	Hrs
		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 overhead projectors, power point presentation 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 at least 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 are given based on the report.
- A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also.
- Evaluation is 100% internal. The marks attained for this course is not considered for CGPA calculation.

U20ECS608	SKILL DEVELOPMENT COURSE 8 (NPTEL / MOOC - I)	L	T	P	C	Hrs
		0	0	0	-	50

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.

U20ECM606	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 & 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

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

SEMESTER – VII										
Sl.No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ECT716	Millimeter and Optical Wave Communication	PC	3	0	0	3	25	75	100
2	U20ECCM04	Internet of Things	PC	3	0	0	3	25	75	100
3	U20ECE7XX	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	U20ECP713	High Frequency Communication Laboratory	PC	0	0	2	1	50	50	100
7	U20ECP714	Internet of Things Laboratory	PC	0	0	2	1	50	50	100
8	U20ECP715	Comprehensive Viva Voce	PC	0	0	2	1	50	50	100
Project Work										
9	U20ECW701	Project Phase – I	PW	0	0	4	2	50	50	100
10	U20ECW702	Internship / Inplant Training	PW	0	0	0	2	100	-	100
Mandatory Course										
11	U20ECM707	Professional Ethics	MC	2	0	0	-	100	-	100
							20	600	500	1100

U20ECT716	MILLIMETER AND OPTICAL WAVE COMMUNICATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientists, national/international policies with a futuristic vision along with socio-economic impact and issues
- To teach the principle of millimeter waves and millimeter transceivers
- To equip the student with concepts of light propagation through optical fibers and signal distortion
- To introduce the knowledge of optical transmitters and receivers for fiber and free-space links
- To equip the students with the concept of propagation of light in space

Course Outcomes

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

CO1- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world. (K3)

CO2- Insight about the fibers types characteristics and light propagation. (K2)

CO3- Ability to identify, understand and evaluate fiber transmission characteristics for real-time link design. (K3)

CO4- Thorough knowledge about transmitter and receiver types and design. (K4)

CO5- Optical networking concepts with components are explored and compared with conventional ideas. (K3)

UNIT - I MILLIMETER WAVES (9 Hrs)

Millimeter-wave characteristics- Channel performance at 60 GHz – Gigabit wireless communication – Development of millimeter-wave standards-coexistence with wireless backhaul – review of modulation for millimeter-wave – OOK, PSK, FSK, and QAM.

UNIT – II TRANSCEIVERS FOR MILLIMETER WAVES (9 Hrs)

Millimeter-wave link budget – Transceiver architecture – Transceiver without a mixer- Receiver without local oscillator – Millimeter-wave calibration – Millimeter-wave antennas – parameters – beam-steering antenna-Millimeter-wave design consideration.

UNIT – III OPTICAL FIBERS CHARACTERISTICS (9 Hrs)

Relevance of optical communication in backhaul/backbone networks and interconnects, fiber optics, optical fiber structure and parameters, ray and mode theory of light propagation in optical fibers, Optical signal attenuation- Optical signal distortion – Dispersion - fiber types, Standard Single mode and multimode Fibers, Principles of fiber nonlinearities.

UNIT – IV OPTICAL TRANSMITTERS AND RECEIVERS (9 Hrs)

Materials for optical sources, light-emitting diodes, semiconductor laser diodes, power-current characteristics, noise, direct and external modulation, Laser sources and transmitters for free-space communication – Receivers - Principles of optical detection, spectral responsivity, PIN, APD, preamplifier types, receiver noises.

UNIT –V FREE SPACE OPTICS (9 Hrs)

Overview of FSO Optical Transmitters – Receivers – Subsystems – Pointing, Acquisition and Tracking – Line of sight analysis- factors affecting FSO–selecting transmission wave integration of FSO in Optical networks – installation of FSO systems

Textbooks

1. Kao-Cheng Huang, Zhaocheng Wang, Millimeter Wave Communication Systems Wiley, 2011.
2. Gerd Kaiser, "Optical Fiber Communications", Tata McGraw Hill, New Delhi, 5th Edition, 2013.
3. Theodore Rappaport, Robert Heath. Robert Danielsthor, James Murdock, “Millimeter-wave wireless communications”, Pearson, 2015

Reference Books

1. Hemani Kaushal, V.K. Jain, SubratKar, "Free Space Optical Communication", Springer India, New Delhi, 2017.
2. Govind P. Agrawal, "Fiber-Optic Communication Systems", John Wiley & Sons, reprint, 3 rd Edition, 2012.
3. Sergey M. Smolskiy Author, Leonid A. Belov and Victor N. Kochemasov, “Handbook of RF, Microwave, and Millimeter-Wave Components”, Artech House Microwave Library, 2012.
4. Jonathan Rodriguez, Linglong Dai,”mmWave Massive MIMO: A Paradigm for 5G” Academic Press,2016
5. Su-Khng Yong, “60GHz Technology for Gbps WLAN and WPAN: From Theory to Practice”, Wiley, Ist Edition,2011

Web Resources

1. https://onlinecourses.nptel.ac.in/noc21_ee102/preview
2. https://onlinecourses.nptel.ac.in/noc20_ee71/preview
3. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ec04/
4. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470889886
5. https://assets.thalia.media/images-adb/8b/64/8b644a3e-cf4e-482f-882e-e14500f9f684.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	1	1	1	1		1							3		
2	3	3	3	3		1							3		
3	3	3	3	3		1							3		
4	3	3	3	2		1							3		
5	3	3	3	2		1							3		

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

U20ECCM04	INTERNET OF THINGS (Common to ECE, CCE and ICE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart necessary and practical knowledge of components of Internet of Things.
- To attain the knowledge about different types of architecture and their elements of IoT.
- To understand the concepts of integration of devices and data.
- To acquire the knowledge about remotely monitor data and control devices.
- To develop skills required to build real-time IoT based projects.

Course Outcomes

After completion of the course, students will be able to

CO1- Understand internet of Things and its hardware and software components. **(K2)**
CO2- Can learned about Interface I/O devices, sensors & communication modules. **(K2)**
CO3- Understand the concepts of remotely monitoring data and control devices. **(K2)**
CO4- Build and deploy various architecture with their elements. **(K3)**
CO5- Can develop real-time IoT based projects. **(K3)**

UNIT – I INTRODUCTION TO INTERNET OF THINGS (9 Hrs)

The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust.

UNIT - II ARCHITECTURE OF IoT (9 Hrs)

State of the Art – Introduction, Architecture Reference Model- IoT reference Model, IoT Reference Architecture, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT - III ELEMENTS OF IoT (9 Hrs)

Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces.

Software Components- Programming APIs (using Python/ Node.js/ Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.

UNIT - IV IoT DEVELOPMENT (9 Hrs)

Solution framework for IoT applications- Implementation of Device Integration, Data acquisition, and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices

UNIT - V IoT APPLICATIONS (9 Hrs)

IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in Business to Master IoT, IoT for Retailing Industry, IoT for Oil and Gas Industry.

Textbooks

1. Vijay Madisetti, Arshdeep Bahga, Internet of Things, “A Hands-on Approach”, University Press,3rd/e, Aug 2018.
2. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill ISBN: 9789352605224, 9789352605224,2nd edition, May 2017
3. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A Practical Approach”, ETI Labs 2014

Reference Books

1. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi, 2012
2. Adrian McEwen, “Designing the Internet of Things,” Wiley, 2007
3. Raj Kamal, “Internet of Things: Architecture and Design,” McGraw Hill, 2002
4. Cuno Pfister, “Getting Started with the Internet of Things,” O Reilly Media, 2015
5. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press

Web Resources

1. https://www.i-scoop.eu/internet-of-things-guide/
2. https://www.theinternetofthings.eu/
3. https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/
4. https://www.coursera.org/learn/iot
5. https://onlinecourses.nptel.ac.in/noc21_ee85/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	2	2	3	2	-	-	-	-	-	-	-	-	3	3	-
2	3	-	3	2	-	-	-	-	-	-	-	-	3	2	-
3	2	3	2	-	-	-	-	-	-	-	-	-	2	2	-
4	2	2	2	-	-	-	-	-	-	-	3	-	3	3	-
5	2	3	2	-	3	-	-	-	-	-	3	-	3	3	-

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

U20HSP703 BUSINESS BASICS FOR ENTREPRENEUR

L	T	P	C	Hrs
0	0	2	1	45

Course Objectives

- To develop a clear understanding on Business Plans and their significance.
- To be familiar with various forms of business appropriate for an individual entrepreneur
- To understand various ways of judging a successful opportunity for an entrepreneur
- To know the ways to formulate a successful Operation Plan
- To be aware of things to know to prepare effective financial and marketing plans

Course Outcomes

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

CO1- Impact comprehensive knowledge of an entrepreneurial ecosystem**. (K6)**
CO2- Understand the need and significance of Business Plan in the success of an Enterprise. **(K2)**
CO3- Understand the ways to judge the economic and business viability of proposed venture. **(K2)**
CO4- Utilize the elements of success of entrepreneurial ventures. **(K3)**
CO5- Evaluate the effectiveness of different entrepreneurial strategies. **(K5)**

UNIT I: THE ENTREPRENEURIAL PERSPECTIVE (6 Hrs)

Entrepreneurship and Family Business Management, Entrepreneurship theory and practice, The Nature and Importance of Entrepreneurs, The Entrepreneurial and Intrapreneurial Mind, The Individual Entrepreneur, International Entrepreneurship Opportunities

UNIT II: CREATING AND STARTING THE VENTURE (6 Hrs)

Creativity and the Business Idea, Legal Issues for the Entrepreneur, the Business Plan, the Marketing Plan, the Financial Plan, the Organizational Plan

UNIT III: FINANCING THE VENTURE (6 Hrs)

Raising Finance, scaling up the venture, NDA'S and term sheet, Sources of the Capital, Informal Risk Capital and Venture Capital

Report Submission:

- Grooming Entrepreneurial Mind-set
- Interaction with Business Leaders/Bankers/Venture Capitalists
- Finding and evaluating an idea
- Develop a business plan
- Financing for a company start-up
- Setting up a company-legal entity
- Entrepreneurial development and employment creation
- Effects of creativity and innovation on the entrepreneurial performance of family business

Textbooks

1. Friend, G., & Zehle, S. (2004). *Guide to business planning*. Profile Books Limited.
2. Lasher, W. (2010). *The Perfect Business Plan Made Simple: The best guide to writing a plan that will secure financial backing for your business*. Broadway Books.
3. Arjun Kakkar. (2009). *Small Business Management: Concepts and Techniques for improving Decisions*. Global India Publications.

Reference Books

1. Alexander Osterwalder and Yves Pigneur – Business Model Generation.
2. Arthur R. DeThomas – Writing a Convincing Business Plan.
3. Ben Horowitz – The Hard Thing About Hard Things.
4. Guy Kawasaki – The Art of Start 2.0
5. Hal Shelton – The Secrets to Writing a Successful Business Plan.

Web References

1. https://www.waveapps.com/blog/entrepreneurship/importance-of-a-business-plan
2. https://www.entrepreneur.com/article/200516
3. https://smallbusinessbc.ca/article/how-to-use-viability-to-test-if-you-should-invest-in-your-business/
4. https://www.infoentrepreneurs.org/en/guides/strategic-planning/
5. http://www.marketingmo.com/strategic-planning/marketing-plans-budgets/

COs/POs/PSOs Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2	1	2	1	1	3	3	2	3	1	2	1	2	1
2	1	2	2	2	2	2	3	3	3	2	1	2	2	2	1
3	1	2	2	1	2	2	3	3	3	3	2	3	1	2	3
4	1	3	2	2	2	2	3	3	3	3	2	3	1	2	2
5	1	3	2	2	2	2	3	3	3	2	2	3	1	3	2

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

U20ECP713	HIGH FREQUENCY COMMUNICATION LABORATORY	L	T	P	C	Hrs
		0	0	3	1	45

Course Objectives

- To enable the student to verify the basic principles and design aspects involved in
- High frequency band pass communication system components design and the performance parameters for the components and the overall system.
- To enable the student to gain insight into the practical aspects of radiation phenomena and thoroughly understand the radiation characteristics of different types of antennas. To enable the student to appreciate the practical aspects of band pass system design
- Understand the associated link power and rise time budgeting challenges and enable them to design and conduct experiments, as well as to analyze and interpret data to produce meaningful conclusions and match with theoretical concepts
- To enable the student to gain knowledge in optical devices

Course Outcomes

After completion of the course, students will be able to

CO1- The student would be able to design and conduct experiments to demonstrate the trade-offs involved in the design of high-frequency bandpass communication links and the associated components**. (K4)**

CO2- The student would be able to comprehensively record and report the measured data and would be capable of analyzing and interpreting the experimental measurement data and producing meaningful conclusions **(K4)**

CO3- The students will be able to acquire knowledge about the Spectral Characterization of Optical Sources **(K4)**

CO4- Acquiring practical skills to measure the microwave filter characteristics **(K4)**

CO5- Understanding the design and testing of Antennas **(K4**)

LIST OF EXPERIMENTS

1. Characterization of Glass and Plastic Optical Fibers - Measurement of Numerical Aperture and Attenuation, Coefficient OTDR Principle
2. DC Characteristics of LEDs and PIN Photodiodes - Determination of external power Efficiency and dark current of detecter Responsivity
3. P-I of LED Characteristics of Laser Diode Sources - Threshold Current Determination and Study of Temperature Effects
4. Gain Characteristics of APDs – Determination of Threshold Voltage and Average gain estimation
5. Analog Transmission Characteristics of a Fiber Optic Link – Determination of Operating Range of LED and System Bandwidth for Glass and Plastic fiber links and determination of device capacity of photodetection
6. Determination of Capacity of a Digital Fiber Optic Link – Maximum Bit Rate estimation for Glass and Plastic fiber links
7. Spectral Characterization of Optical Sources – Determination of Peak Emission Wavelength and Spectral Width
8. Study of WDM Link Components – WDM Mux / Demux, Isolator, Circulator, Fiber Bragg Grating, EDFA.
9. Gain and Radiation Pattern Measurement of an Antenna - Horn Antenna, Dipole Antenna, Array Antenna,
10. Log-Periodic Antenna, Loop Antenna
11. Determination of Mode Characteristics of a Reflex Klystron Oscillator
12. VSWR and Impedance Measurement and Impedance Matching
13. Dielectric Constant Measurement
14. Characterization of Directional Couplers and Multiport junctions
15. Gunn Diode Characteristics
16. Microwave IC – Filter Characteristics

Reference Books

1. Hemani Kaushal, V.K. Jain, SubratKar, "Free Space Optical Communication", Springer India, New Delhi, 2017.
2. Govind P. Agrawal, "Fiber-Optic Communication Systems", John Wiley & Sons, reprint, 3 rd Edition, 2012.
3. Sergey M. Smolskiy Author, Leonid A. Belov and Victor N. Kochemasov, “Handbook of RF, Microwave, and Millimeter-Wave Components”, Artech House Microwave Library, 2012.
4. Shahid Mumtaz , Jonathan Rodriguez, Linglong Dai,”mmWave Massive MIMO: A Paradigm for 5G” Academic Press,2016
5. Su-Khiong Yong, Pengfei Xia , Alberto Valdes-Garcia ,” 60GHz Technology for Gbps WLAN and WPAN: From Theory to Practice” ,Wiley, 1st Edition, 2011

Web Resources

1. https://onlinecourses.nptel.ac.in/noc21_ee102/preview
2. https://onlinecourses.nptel.ac.in/noc20_ee71/preview
3. https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ec04/
4. https://onlinelibrary.wiley.com/doi/book/10.1002/9780470889886
5. https://assets.thalia.media/images-adb/8b/64/8b644a3e-cf4e-482f-882e-e14500f9f684.pdf

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

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

U20ECP714	INTERNET OF THINGS LABORATORY	L	T	P	C	Hrs
		0	0	3	1	45

Course Objectives

- To impart necessary and practical knowledge of components of Internet of Things.
- To attain the knowledge about different types of architecture and their elements of IoT.
- To understand the concepts of integration of devices and data.
- To acquire the knowledge about remotely monitor data and control devices.
- To develop skills required to build real-time IoT based projects.

Course Outcomes

After completion of the course, students will be able to

CO1- Understand internet of Things and its hardware and software components.
CO2- Can learned about Interface I/O devices, sensors & communication modules.
CO3- Understand the concepts of remotely monitor data and control devices.
CO4- Build and deploy a various architecture with their elements.
CO5- Can develop real life IoT based projects.

LIST OF EXPERIMENTS

Cycle I - Sensor interfacing

1. Familiarization with Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface OLED with Raspberry Pi and write a program to print temperature and humidity readings using DHT11 sensor.
5. To interface DC motor using motor driver circuit with Raspberry Pi and write a program to rotate motor in clockwise and anticlockwise.
6. To interface Bluetooth with Raspberry Pi and write a program to turn Relay ON/OFF when '1'/'0' is received from smartphone using Bluetooth module.
7. Write a program on Raspberry Pi to upload temperature and humidity data to thingspeak cloud and retrieve data from thingspeak cloud.

Cycle II - Server Configuration

8. To install MySQL database on Raspberry Pi and perform basic SQL queries.
9. Write a program on Raspberry Pi to publish temperature data to MQTT broker.
10. Write a program on Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
11. Write a program to create a TCP server on Raspberry Pi and respond with humidity data to TCP client when requested.
12. Write a program to create a UDP server on Raspberry Pi and respond with humidity data to UDP client when requested.
13. LoRaWAN Configuration to share the data in the cloud.

Reference Books

1. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi, 2012
2. Adrian McEwen, "Designing the Internet of Things", Wiley, 2007
3. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill, 2002
4. CunoPfister, "Getting Started with the Internet of Things", O Reilly Media, 2015
5. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

Web Resources

1. https://www.i-scoop.eu/internet-of-things-guide/
2. https://www.theinternetofthings.eu/
3. https://www.udemy.com/course/complete-guide-to-build-iot-things-from-scratch-to-market/
4. https://www.coursera.org/learn/iot
5. https://onlinecourses.nptel.ac.in/noc21_ee85/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	2	1	-	-	3	-	-	-	-	-	-	-	3	2	2
2	2	1	-	-	3	-	-	-	-	-	-	-	3	3	2
3	3	2	1	1	3	-	-	-	-	-	-	-	3	2	2
4	3	2	1	1	3	-	-	-	-	-	-	-	3	3	3
5	3	2	1	1	3	-	-	-	-	-	-	-	3	3	3

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

U20ECP715	COMPREHENSIVE VIVA VOCE	L	T	P	C	Hrs
		0	0	3	1	45

The student will be tested for his understanding of the basic principles of the core engineering subjects. The internal assessment for a total of 50 marks will be made by a committee comprising of the faculty members of the department. The committee will conduct three written examinations of short questions type from the subjects

- Test1 - Analog and Digital Electronic Circuits, Electric Circuits, Microcontroller and VLSI
- Test 2 - Signal Processing, Electromagnetic Waves and Waveguides, Antennas Control Systems
- Test 3 - Analog and digital communication, advanced communication systems.

The external university examination, which carries a total of 50 marks, will be a Viva Voce examination conducted by a committee of one external examiner and one internal examiner appointed by the university.

U20ECW701	PROJECT PHASE - I	L	T	P	C	Hrs
		0	0	4	2	45

Each batch of 2 or 3 students will be assigned an experimental or a theoretical project to be carried out under the supervision of a guide. The project work has to be carried out in the 7th and 8th semesters and has to be completed by the end of the 8th semester.

In the phase I of the project work, the progress of the work carried out in the 7th semester will be monitored and assessed internally for a total of 50 marks. A committee of departmental faculty members comprising the project guide, the Head of the Department and one more faculty member will conduct the internal assessment.

U20ECW702	INTERNSHIP / INPLANT TRAINING	L	T	P	C	Hrs
		0	0	0	2	45

Students may undergo In-plant training or internship during summer / winter vacation at Industry/ Research organization for a period of three weeks to four weeks. Students are also permitted to undergo internships during their seventh semester after the theory classes are over. Each student must submit a detailed report on In-Plant Training Which He/ She has undergone.

U20ECM707	PROFESSIONAL ETHICS	L	T	P	C	Hrs
		2	0	0	-	30

The course should cover the following topics by way of Seminars, Expert Lectures and

Assignments

1. Engineering Ethics – Moral issues, Ethical theories and their uses
2. Engineering as Experimentation – Code of Ethics
3. Engineer ‘s responsibility for safety
4. Responsibilities and rights
5. Global issues of engineering ethics

Reference Book

1. Charles D. Fleddermann, –Engineering Ethics‖, Prentice Hall, New Mexico, 1999

SEMESTER – VIII										
Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U20ECT818	Cyber Physical System and Security	PC	3	0	0	3	25	75	100
2	U20ECE8XX	Professional Elective – V	PE	3	0	0	3	25	75	100
3	U20ECE8XX	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	U20ECW803	Project phase – II	PW	0	0	16	8	40	60	100
Employment Enhancement Course										
6	U20ECS809	Skill Development Course 9: NPTEL/MOOC-II	MC	0	0	0	-	100	-	100
							18	315	285	600

U20ECT818 CYBER PHYSICAL SYSTEM AND SECURITY

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives:

- To understand the overview of cyber-physical system and its different application domains
- To know the hardware and software platforms of cyber-physical system
- To gain knowledge about the synchronous and asynchronous models of CPS
- To learn about the cyber-physical system safety and security.
- To provide adequate knowledge about security in operating system and network.

Course Outcomes:

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

CO1 - Able to have understanding of the core principle behind the cyber-physical system **(K2)**
CO2 - Gain an overview of the hardware and software platform of cyber-physical system **(K2)**
CO3 - Identify and analyse the synchronous and asynchronous model of cyber-physical system **(K3)**
CO4 - Describe the cyber-physical system safety and security **(K3)**
CO5 - Acquire clear knowledge about security in operating system and network**(K4)**

UNIT-I INTRODUCTION TO CYBER-PHYSICAL SYSTEM (9 Hrs)

Introduction to Cyber-Physical Systems (CPS), Basic principles of design and validation of CPS, CPS requirements, Challenges in cyber-physical system, Industry standards, Key features of cyber-physical systems, Application of CPS- industry 4.0, AutoSAR, IIOT implications, Building automation, Medical CPS.

UNIT–II CPS HARDWARE AND SOFTWARE PLATFORM (9 Hrs)

CPS hardware platforms: Processors-Types of processor, Parallelism, Sensors- Model of sensor, Sensor types, Actuators, Memory architectures-Memory technologies, Memory hierarchy, Memory model, CPS network – Wireless Hart, CAN, Automotive Ethernet, CPS software stack – RTOS, Scheduling real-time control tasks.

UNIT-III SYNCHRONOUS AND ASYNCHRONOUS MODEL (9Hrs)

Synchronous model: Reactive components, Properties of components, Composing components, synchronous design, Synchronous circuits, Cruise control system, Synchronous networks, Asynchronous model: Asynchronous processes- Asynchronous design primitives, Coordination protocols- Leader election, Reliable transmission, Wait-fee consensus, Real-time scheduling: Scheduling concepts, EDF scheduling, Fixed – Priority scheduling.

UNIT–IV CYBER PHYSICAL SYSTEM SAFETY & SECURITY (9Hrs)

CPS Safety specification, verifying invariants, Enumerative Search, Symbolic search, Cyber Security requirement, Attack models, secure task mapping and partitioning, state estimation for attack detection, Advanced Techniques –System theoretic approaches, automotive case study vehicle ABS hacking, Power distribution case study, attacks on smart grids.

UNIT V SECURITY IN OPERATING SYSTEM & NETWORK (9Hrs)

Security in Operating Systems - Security in the Design of Operating Systems -Rootkit - Network security attack- Threats to Network Communications - Wireless Network Security - Denial of Service - Distributed Denial-of-Service.

Textbooks

1. E.A.Lee & S.A.Seshia, “Introduction to Embedded Systems: A Cyber-Physical Systems Approach”, PHI Learning Private Limited, 4th Edition, 2019.
2. Rajeev Alur, “Principles of Cyber-Physical Systems”, MIT Press, 2015.
3. Raj Rajkumar, “Cyber-Physical Systems”, Elsevier, 2nd Edition, 2015.
4. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition, Pearson Education, 2015

Reference Books

1. Houbing Song, Danda.B. Rawat & Sabina Jeschke, “Cyber physical system, Foundations, Principles and Application”, Todd Green, Elsevier, 2017.
2. Edward D Lamie, “Computing Fundamentals of Cyber Physical Systems”, Newnes Elsevier Publication, 2nd Edition, 2011.
3. Andrea Bondavalli, Sara Bouchnak & Hermann Kopetz, “Cyber-physical systems of systems: Foundations-A conceptual model and some derivations”, Springer Nature, 2016.
4. Andre Platzer, “Logical Foundations of Cyber-Physical System”, Springer, 2018.
5. Gaddadevara Matt Siddesh, Ganesh Chandra Deka, Krishnaraja nagar Gopalalyengar Srinivasa, Lait Mogan Patnaik, “Cyber-Physical systems-A Computational Perspective”, CRC Press, 2015.

Web Resources

1. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs24/
2. https://www.nist.gov/el/cyber-physical-systems
3. https://www.sciencedirect.com/topics/engineering/cyber-physical-systems
4. https://www.coursera.org/learn/cyber-physical-systems-1
5. https://www.elsevier.com/books/cyber-physical-systems/song/978-0-12-803801-7

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

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

U20HSP804	ENTREPRENEURSHIP MANAGEMENT	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To develop an ability to identify the critical challenges hindering growth of entrepreneurs
- To understand the significance of Finance Skills, Branding, and Sales Skills for an Entrepreneur
- To be aware of various Government Schemes and Subsidies available for Entrepreneurs

Course Outcomes

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

CO1 - Develop and demonstrate the business models. **(K2)**
CO2 - Practice cash management, brand building and enhancing turnover. **(K6)**
CO3 - Understand various schemes and subsidies that are offered by various Government agencies. **(K2)**
CO4 - Effectively tackle growth challenges of their venture. **(K5)**
CO5 - Manage and grow their business in terms of expansion and look for partnerships. **(K3)**

UNIT I: ENTREPRENEURIAL SKILLS 1 (6 Hrs)

Introduction to Business Model Generation, Developing Lean Business Model for the Business Idea, Developing Prototype and Evaluating assumptions in Business Model using prototype cheaply, Presentation of Business Model, Business Fair

UNIT II : ENTREPRENEURIAL SKILLS 2 (6 Hrs)

Financial Skills – Cash Management – Problems of Poor Cash Management – Learning to be Frugal. Branding – Building a 'niche' follower for your product/service – Developing and Establishing a Brand, Sales skills – KPI of Success of Entrepreneurship – Ensuring Growth in Turnover

UNIT III : ENTREPRENEURIAL OPPORTUNITIES (6 Hrs)

Awareness of Government Schemes and Subsidies for various Entrepreneurial Categories – Special Schemes for Women Entrepreneurs – Understanding the Procedure and Documentation Process for availing the Government Schemes – Venture Capital – Crowdfunding – Angel Investors.

Report Submission:

1. How can I get the first 100 customers to pay for my products/services?
2. Information technology as a resource
3. Marketing skill and promotion for entrepreneurs
4. Assessment of factors affecting the performance of women entrepreneurs
5. Entrepreneurship as a tool for sustainable employment
6. Examination of problems facing small scale business
7. Survival strategies in small business
8. The role of insurance in minimizing business risk

Textbooks

1. Storey, D. J., & Greene, F. J. (2010). Small business and entrepreneurship. Financial Times/Prentice Hall.
2. Scarborough, N. M. (2011). Essentials of entrepreneurship and small business management. Prentice-Hall.
3. Gupta C.B., & Srinivasan N.P. (2020). Entrepreneurial Development. Sultan Chand and Sons

Reference Books

1. Brian Tracy – The Psychology of Selling.
2. Dale Carnegie – How to Win Friends & Influence People.
3. Robert Kiyosaki and Sharon Lechter – Rich Dad, Poor Dad.
4. Reid Hoffman – The Startup of You: Adapt to the Future, Invest in Yourself, and Transform Your Career.
5. Michael E. Gerber – The E-Myth Revisited.

Web References

1. https://www.helpguide.org/articles/stress/stress-management.htm
2. https://bscdesigner.com/8-entrepreneurial-kpis.htm
3. https://www.inc.com/ilya-pozin/5-problems-most-entrepreneurs-face.html
4. https://www.inc.com/jessica-stillman/how-to-network-with-super-successful-people.html
5. https://www.entrepreneur.com/article/251603

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

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

U20ECW803	PROJECT PHASE - II	L	T	P	C
		0	0	16	8

The work on project extension and completion had begun in the previous semester. In the eighth semester, students will be authorized to perform project work in the industry for a maximum of 13 weeks. The students will be assigned an internal guide from the department as well as a mentor from the industry/research organization where the project will be completed. Both guides should discuss and agree on the scope of the project's work, as well as track its progress.

Internal guides should visit the industry at least three times per semester to monitor the progress of their students, and a concise report on the project should be sent to the HoD. At least twice a month, students should keep track of their progress and seek approval from both internal and external advisors, either in person or via email conversation. If the progress is not satisfactory for any reason, the Guide should take corrective action after speaking with the Dean Academics through the HoD for a longer project completion period.

The student must submit a progress report and a certificate of completion of the project work from the industry / research organization to the respective guide. The evaluation method will be the same as that used for students working on an in-house project. Students complete their in-house project in the Department after receiving formal approval from the HoD via the appropriate supervisor. Each student must produce a project report and submit it to the department once the project work is completed.

The project work and report will be reviewed by the internal evaluation committee in Phase II, which will perform two reviews and one demo for a total of 40 points. A committee of one external examiner and one internal examiner designated by the Controller of Examinations will conduct a report evaluation and viva voce examination for 50 marks during the end semester examination, which carries a total of 60 marks. Publication of papers, prototypes, and patents is worth ten points.

U20ECS809	SKILL DEVELOPMENT COURSE 9 (NPTEL / MOOC - II)	L	T	P	C	Hrs
		0	0	4	-	50

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.

PROFESSIONAL ELECTIVE COURSES

Professional Elective –I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U20ECE401	Computer Networks
2	U20ECE402	Sensors for Industrial Applications
3	U20ECE403	Computer Architecture
4	U20ECE404	PLC and SCADA Systems and its Applications
5	U20ECE405	Introduction to MEMS

U20ECE401	COMPUTER NETWORKS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the basics of computer network
- To gain the information about the application layer in computer network
- To understand the concepts of transport layer
- To know the importance of congestion control with its applications
- To develop the knowledge about network layer in computer network

Course Outcomes

After completion of the course, students will be able to

CO1 - Understand the concepts of application network layer **(K2)**
CO2 - Utilize a network for a particular application **(K2)**
CO3 - Acquire the knowledge about transport layer **(K3)**
CO4 - Illustrate the congestion control resource allocations **(K3)**
CO5 - Distinguish different types of routing protocols **(K3)**

UNIT- I INTRODUCTION TO COMPUTER NETWORKS AND THE INTERNET (9 Hrs)

Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic mail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.

UNIT- II SWITCHINGIN NETWORKS (9 Hrs)

Classificationandrequirementsofswitches,agenericswitch,CircuitSwitching,Time-divisionswitching,Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, blocking in packet switches, three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing.

UNIT- III TRANSPORT LAYER (9 Hrs)

Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call.

UNIT- IV CONGESTION CONTROL AND RESOURCE ALLOCATION (9 Hrs)

Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.

UNIT- V NETWORK LAYER (9 Hrs)

Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast Routing Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, and Switches.

Textbooks

1. J.F.Kuroseand K.W.Ross, “Computer Networking – A top down approach featuring the Internet”, Pearson Education, 5th Edition,2017
2. L. Peterson and B. Davie, “Computer Networks – A Systems Approach” Elsevier Morgan Kaufmann Publisher, 5th Edition,2011
3. S. Keshav, “An Engineering Approach to Computer Networking” , Pearson Education,2013

Reference books

1. B. A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 4th Edition,2017
2. Andrew Tanenbaum, “Computer networks”, Prentice Hall, 5th edition,2013
3. D. Comer, “Computer Networks and Internet/TCP-IP”, Prentice Hall ,2014
4. William Stallings, “Data and computer communications”, Prentice Hall,2016
5. T. Viswanathan, “Telecommunication Switching System and Networks”, Prentice Hall,2015

Web Reference

1. https://en.wikipedia.org/wiki/Computer_network
2. https://www.geeksforgeeks.org/basics-computer-networking/
3. https://www.javatpoint.com/types-of-computer-network
4. https://www.tutorialspoint.com/computer_fundamentals/computer_networking.htm
5. https://lecturenotes.in/subject/86/computer-network-cn

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

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

U20ECE402	SENSORS FOR INDUSTRIAL APPLICATIONS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study principles of sensor and calibration
- To understand different types of motion sensors
- To demonstrate force, magnetic and heading sensors with its application to the learners
- To enhance students to understand the concept of optical, pressure and temperature sensor
- To select suitable sensor for industrial application

Course Outcomes

After completion of the course, students will be able to

CO1 - Explain principles of sensor and illustrate the calibration **(K2)**
CO2 - Analyze different types of range and sensors **(K4)**
CO3 - Determine the principles of Force, magnetic and heading sensors **(K3)**
CO4 - Analyze different optical and thermal sensors **(K4)**
CO5 - Select suitable sensor for real time applications **(K4)**

UNIT-I INTRODUCTION (9 Hrs)

Principles of Physical and Chemical Sensors: Sensor classification, Sensing mechanism of Mechanical, Electrical, Thermal, Magnetic, Optical, Chemical and Biological Sensors.
Sensor Characterization and Calibration: Study of Static and Dynamic Characteristics, Sensor reliability, aging test, failure mechanisms and their evaluation and stability study.

UNIT- II MOTION, PROXIMITY AND RANGING SENSORS (9 Hrs)

Motion Sensors– Potentiometers, Resolver, Encoders–Optical, Magnetic, Inductive, Capacitive, LVDT–RVDT Synchro – Microsyn, Accelerometer– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT- III FORCE, MAGNETIC AND HEADING SENSORS (9 Hrs)

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT- IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS (9 Hrs)

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric–Tactile sensors, Temperature–IC, Thermistor, RTD, Thermocouple .Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT-V APPLICATIONS OF SENSORS (9 Hrs)

Applications and case studies of Sensors in Automobile Engineering, Aeronautics, Machine tools and Manufacturing processes.

Textbooks

1. Patranabis D.," Sensor and Transducers", Prentice Hall of India (Pvt) Ltd., second edition2005(revised).
2. Renganathan S.," Transducer Engineering", Allied Publishers (P) Ltd.,2005(revised).
3. Ernest O. Doebelin, "Measurement systems Application and Design", International Student Edition, VI Edition, Tata McGraw-Hill Book Company,2012.

Reference Books

1. Bradley D.A., and Dawson, Burd and Loader, "Mechatronics, Thomson Press India Ltd",2004.
2. Bolton W, "Mechatronics", Thomson Press, third edition,2004.
3. Ian R Sinclair, —Sensors and Transducersǁ, Third Edition, Newnes publishers,2001.
4. Rober tB.Northrop, "Introduction to Instrumentation and Measurement", 3rdEdition", CRC Press Taylor and Francis Group,2005
5. Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice Hall International Edition,2015.

Web References

1. https://www.first-sensor.com/en/applications/industrial/
2. https://www.finoit.com/blog/top-15-sensor-types-used-iot/
3. https://www.iaasiaonline.com/smart-sensors-for-industrial-applications-2/
4. https://www.plantautomation-technology.com/articles/types-of-sensors-used-in-industrial-automation
5. https://www.thomasnet.com/articles/instruments-controls/sensors/

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

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

U20ECE403	COMPUTER ARCHITECTURE	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain knowledge about the basic concepts in computer organization
- To learn the various Organization of memories
- To explore the input - output organization of an architecture
- To acquire knowledge in 16- and 32-bit microprocessors
- To study the various instructions used in pipelining

Course Outcomes

After completion of the course, students will be able to

CO1 - Infer the concepts of functional units of computer Organization. **(K2)**
CO2 - Distinguish various memory organization. **(K2)**
CO3 - Relate the functionality of input-output Organization **(K3)**
CO4 - Illustrate various Architecture of advanced microprocessors (K3)
CO5 - Relate processing of computer organization and DSP Architecture **(K3)**

UNIT-I INTRODUCTION TO COMPUTER ORGANIZATION (9 Hrs)

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.

UNIT- II MEMORY ORGANIZATION (9 Hrs)

System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

UNIT- III INPUT –OUTPUT ORGANIZATION (9 Hrs)

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

UNIT- IV 16 AND 32 MICROPROCESSORS (9 Hrs)

80x86 Architecture, IA–32 and IA–64, Programming model, Concurrent operation of EU and BIU, Realmode addressing, Segmentation, addressing modes of 80x86, Instruction set of 80x86, I/O addressing in80x86

UNIT-V PIPELINING (9 Hrs)

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set.
Different Architectures: VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming

Textbooks

1. W. Stallings, “Computer organization”, PHI,2016.
2. John P Hays, “Computer architecture and organization”, 2015
3. J. L. Hennessy and D. A. Patterson, “Computer Architecture A Quantitative Approach”, Morgan Kauffman,2011.

Reference Books

1. Morris Mano, “Computer System Architecture”, 3rd edition, Prentice Hall India, 2016
2. N. Mathivanan, “Microprocessors, PC Hardware and Interfacing”, Prentice Hall,2004.
3. AICTE Model Curriculum for Undergraduate degree in Electrical Engineering (Engineering & Technology)
4. Y.C.LieuandG.A.Gibson, “Microcomputer Systems :The 8086/8088 Family”,Prentice Hall India,1986.
5. J. Uffenbeck, “The 8086/8088 Design, Programming, Interfacing”, Prentice Hall,1987.

Web Reference

1. https://www.computersciencedegreehub.com/faq/what-is-computer-architecture/
2. https://www.geeksforgeeks.org/computer-organization-and-architecture-tutorials/
3. https://www.oreilly.com/library/view/designing-embedded-hardware/0596007558/ch01.html
4. https://www.researchgate.net/publication/329191354_Lecture_Notes_on_Computer_Architecture
5. http://www.cs.iit.edu/~virgil/cs470/Book/

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

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

U20ECE404	PLC AND SCADA SYSTEMS AND ITS APPLICATIONS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide basic knowledge in PLC programming
- To understand the concept of interfacing between devices and PLC input / output modules
- To understand the working of SCADA systems
- To gain knowledge about SCADA system components
- To design any application based on SCADA systems

Course Outcomes

After completion of the course, students will be able to

CO1 - Interpret the fundamentals of Programmable Logic Controllers **(K2)**
CO2 - Extract the ladder diagrams from process control descriptions**. (K2)**
CO3 - Distinguish the SCADA communication, various industrial communication technologies, open standard communication protocols **(K2)**
CO4 - Illustrate SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server **(K3)**
CO5 - Demonstrate the SCADA applications in transmission and distribution sector, industries **(K2)**

UNIT- I PLC FUNDAMENTALS (9 Hrs)

Block diagram of PLC's Applications and Types of Transformers Selection of PLC components (Power supply, CPU, I/Os List, Communication bus Various ranges available in PLC's) Open-Circuit and Short-Circuit Tests Architectural Evolution of PLC-Need of PLC for Industrial Automation Types and working of field devices

UNIT- II PROGRAMMING INSTRUCTIONS ARITHMETICAND LOGICAL (9 Hrs)

Logical function done by ladder program in software, interfacing the field component to PLC, need of push button for industrial automation, Memory concept, Types of counters Example for automation using counters. Jump and subroutine, Automation using Jump and Subroutine.

UNIT-III SCADA (9 Hrs)

SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850 SCADA Communication: various industrial communication technologies -wired and wireless methods and fiber optics, Open standard communication protocols

UNIT- IV SCADA SYSTEM COMPONENTS (9 Hrs)

SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems

UNIT- V SCADA APPLICATIONS (9 Hrs)

SCADA Applications: Utility Applications-Transmission and Distribution sector - operations, monitoring, analysis and improvement. Industries - oil, gas and water. Case studies, Implementation, Simulation Exercises

Textbooks

1. Rajesh Mehra and Vikrant Vij, "PLCs and SCADA: Theory and Practice" Laxmi Publications, 2015.
2. Ayman Aly El-Naggar, "Fundamentals of Automation and Industrial Control Systems Using PLC",2008
3. Madhuchhanda Mitra and Samarjt Semgupta, "Programmable Logic Controllers and Industrial Automation:An Introduction", 2nd Edition"2008

Reference Books

1. Kevin Collins, "PLC Programming for Industrial Automation", Exposure Publishing,2007
2. Mini S Thomas and John Douglas McDonald, "Power System SCADA and Smart Grids", CRC Press,2015
3. Gordon Clarke, Deon Reynders, "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK,2004
4. L.A. Bryan, E. A. Bryan, "Programmable Controllers Theory and Implementation" Industrial Text Company Publication, Second Edition. 1997
5. Stuart A. Boyer, "SCADA-Supervisory Control and Data Acquisition, Instrument" Society of America Publications, USA,2004

Web Reference

1. https://www.udemy.com/topic/scada/
2. https://bin95.com/certificate_program_online/control-systems-technology.htm
3. https://electrical-engineering-portal.com/resources/plc-programming-training
4. https://www.electrical4u.com/scada-system/
5. https://www.elprocus.com/scada-systems-work/

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

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

U20ECE405	INTRODUCTION TO MEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To provide basic knowledge about MEMS
- To get clear idea about MEMS sensor and actuators
- To understand the basic level of MEMS switch
- To acquire depth knowledge about RFMEMS
- To learn information about MEMS applications

Course Outcomes

After completion of the course, students will be able to

CO1 - Explain the working principles of MEMS and NEMS devices. **(K2)**
CO2 - Extract the Design and model MEM devices**. (K2)**
CO3 - Summarize the application of MEMS switch **(K2)**
CO4 - Predict the idea about RF MEMS **(K2)**
CO5 - Explain the various applications of MEMS **(K2)**

UNIT-I INTRODUCTION (9 Hrs)

History of Micro-Electro Mechanical Systems (MEMS), market for MEMS, Introduction and origin of MEMS, driving force for MEMS development, fabrication process, MEMS fabrication technologies: Conventional IC fabrication processes, bulk micro machining, surface micro machining, LIGA process, anodic and fusion bonding, packaging techniques for MEMS.

UNIT- II MEMS SENSOR AND ACTUATORS (9 Hrs)

Sensors, Classification and terminology of sensors, evolution of semiconductor sensors, sensor characterization basic concept of acoustic, mechanical, magnetic, radiation, thermal sensors and integrated sensors. Actuation in MEMS devices, electrostatic actuation, parallel plate capacitor-cantilever beam-based movement, comb-drive structures.

UNIT- III MEMS SWITCH (9 Hrs)

MEM switch; Cantilever based MEM switch, Membrane based switch design microwave material and mechanical considerations. The MEMS switch; cantilever-based MEMS switch, membrane-based switch design.

UNIT- IV RF MEMS (9 Hrs)

Introduction to RF MEMS technologies: Need for RF MEMS components in communications, space and defense applications, Materials and fabrication technologies, Actuation methods in MEMS, Special considerations in RF MEMS design.

UNIT- V MEMS APPLICATIONS (9 Hrs)

Examples of RF MEMS components and case studies: Micro-switches, Planar, on-chip components, Transmission lines and other components, Micro machined and reconfigurable antennas, Micro machined phase shifters.

Textbooks

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India,2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano - and Micro engineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers,2001.

Reference Books

1. M. Madou, Fundamentals of Micro fabrication, CRC Press,1997.
2. G. Kovacs, Micro machined Transducers Sourcebook, McGraw-Hill, Boston,1998.
3. M.H. Bao, “Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes”, Elsevier, New York, 2000.
4. G.Kovacs, “Micro machined Transducers Sourcebook”, Science Open, 2005
5. S.D.Senturia, Microsystems Design, Springer, 2001

Web Reference

1. https://en.wikipedia.org/wiki/Microelectromechanical_systems
2. https://internetofthingsagenda.techtarget.com/definition/micro-electromechanical-systems-MEMS
3. https://www.allaboutcircuits.com/technical-articles/introduction-to-mems-microelectromechanical-systems/
4. https://engineeringproductdesign.com/mems-micro-electro-mechanical-system/
5. https://www.lboro.ac.uk/microsites/mechman/research/ipm-ktn/pdf/Technology_review/an-introduction-to-mems.pdf

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

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

Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U20ECE506	Hardware Description Languages
2	U20ECCM01	Vehicular Communication
3	U20ECE508	Industry 4.0 Technology
4	U20ECE509	Information Theory and Coding
5	U20ECCM02	Robotics and Automation

U20ECE506	HARDWARE DESCRIPTION LANGUAGES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basic conventions of Verilog Hardware Description Language
- To understand the various modelling of Verilog HDL
- To model the digital logics using Verilog HDL.
- To learn the basics of VHDL
- To understand the synthesis of VHDL

Course Outcomes

Upon completion of the course, students will be able to

CO1 - Explain the various basic conventions of Verilog HDL **(K2)**
CO2 - Describe the modeling of Verilog HDL **(K2)**
CO3 - Analyze code for digital circuits using Verilog modeling styles **(K3)**
CO4 - Comprehends the basic concepts of VHDL **(K2)**
CO5 - Illustrate the design of digital circuits implementation using VHDL **(K3)**

UNIT I VERILOG HDL (9 Hrs)

Introduction to HDL - Lexical Conventions - Ports and Modules - Data Types – operators- hierarchy procedures and assignments- timing controls and delays-tasks and functions-control statements

UNIT II MODELING OF VERILOG HDL (9 Hrs)

Data Flow Modeling - Gate Level Modeling- Behavioral level Modelling - Synthesis of Finite State Machines- Switch Level Modelling- System Tasks & Compiler Directives - Test benches

UNIT III SYSTEM DESIGN USING VERILOG HDL (9 Hrs)

Design of Combinational circuits -Multiplexers / Demultiplexers, Magnitude comparators, Adders - Multiplier-Divider. Design of Sequential circuits - Flip-flops, Registers / Shift registers, counters – State machines: synthesis of explicit and implicit state machines- Synthesis of gated clocks and clock enables -synthesis of Loops

UNIT IV VHDL OVERVIEW (9 Hrs)

VHDL Libraries– Data Types – Data Operators – Entities – Concurrent Statements– Component Declarations- Component Instantiation –Test Benches –Process – Delays – Basic Sequential Statements – Attributes – File Concepts - Packages – Functions & Procedures – Predefined & User Defined Library Implementations

UNIT V VHDL SYNTHESIS (9 Hrs)

Synthesis basics-modeling combinational logic- modeling sequential logic- Modeling Flip-flop with Synchronous/ Asynchronous Preset and clear modeling a latch

Textbooks

1. Samir Palnitkar," Verilog HDL: A Guide to Digital Design and Synthesis" Prentice Hall, Second Edition, 2009
2. M. D. Ciletti, "Advanced VLSI Design with the Verilog HDL", Prentice-Hall of India, 2008
3. Douglas L. Perry, "VHDL Programming by Examples", McGraw-Hill, 2002

Reference Books

1. James M. Lee, “Verilog Quickstart”, Kluwer Academic Publishers, 2002
2. Kevin Skahill, “VHDL for PROGRAMMABLE LOGIC” Pearson Publications,2004
3. Sudhakar Yalamanchili, “Introductory VHDL From Simulation to Synthesis”, Prentice Hall, 2001
4. J. Bhaskar, “A VHDL Synthesis Primer”, BS Publications, 2nd Edition, 2001
5. Stephen Brown, Zvonkoc Vranesic, “Fundamentals of Digital Logic with Verilog Design”, 2nd Edition, Tata McGraw Hill, 2010

Web References

1. http://www.asic-world.com/verilog/veritut.html
2. https://www.chipverify.com/verilog/verilog-tutorial
3. https://onlinecourses.nptel.ac.in/noc18_cs48/preview
4. https://www.coursera.org/lecture/build-a-computer/unit-1-4-hardware-description-language-8VOXT
5. https://www.inspirenignite.com/jntuh/jntuh-m-tech-2017-2018-r17-detailed-syllabus-verilog-hardware-description-language/

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	1	-	-	-	-	-	-	-	-	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

		L	T	P	C	Hrs
U20ECCM01	**VEHICULAR COMMUNICATION** (Common to ECE and CCE)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To introduce the emerging technologies in vehicular communication systems
- To study the design considerations and challenges of vehicular communication
- To analyze the vehicular mobility modelling, and vehicular technologies
- To introduce the standards from the physical to network layers
- To study about various emerging applications of vehicular communications

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 - Describe the emerging technologies in vehicular communication systems. **(K2)**
CO2 - Infer technologies and system architecture of vehicular ad-hoc networks (VANET) or inter-vehicle communication networks**. (K2)**
CO3 - Examine the vehicular mobility modelling, and vehicular technologies **(K4)**
CO4 - Infer standards from the physical layers to network layers **(K2)**
CO5 - Illustrate vehicular communication platforms for various kinds of safety and infotainment applications. **(K3)**

UNIT- I BASICS OF VEHICULAR COMMUNICATION (9 Hrs)

Introduction to Vehicular Communication- Basic principles and challenges, Inter and intra vehicular sensor communications for various functions such as collision control and vehicle localization. Sensors deployed for inter and intra vehicular communications- Ultra Wide Band sensors, GPS sensors. Various algorithms developed for collisions.

UNIT- II SYSTEM ARCHITECTURE OF VANET (9 Hrs)

Cooperative Vehicular Safety Applications Enabling technologies, cooperative system architecture, safety applications. Infrastructure-based vs. infrastructure-less technologies

UNIT - III VEHICULAR MOBILITY MODELS (9 Hrs)

Vehicular Mobility Modelling Random models, flow and traffic models, behavioral models, trace and survey-based models, joint transport and communication simulations

UNIT - IV STANDARDS IN VARIOUS LAYERS (9 Hrs)

Physical Layer Considerations for Vehicular Communications Signal propagation, Doppler spread and its impact on OFDM systems. MAC Layer of Vehicular Communication Networks Proposed MAC approaches and standards, IEEE 802.11pVANET Routing protocols Opportunistic packet forwarding, topology-based routing, geographic routing

UNIT - V EMERGING APPLICATIONS (9 Hrs)

Bus Systems–Classification, Applications in the vehicle- Coupling of networks- Networked vehicles -Buses - CAN Bus- LIN Bus- MOST Bus- Bluetooth- FlexRay- Diagnostic Interfaces. DSRC Protocol Stack, Cellular V2X

Textbooks

1. H. Hartenstein and K. P. Laberteaux, “VANET: Vehicular Applications and Inter Networking Technologies”, Wiley, 2010.
2. H. Moustafa, Y. Zhang, “Vehicular Networks: Techniques, Standards, and Applications”, CRC Press, 2009.
3. Anand Paul, Naveen Chilamkurti, Seungmin Rho, Alfred Daniel, “Intelligent Vehicular Networks and Communications: Fundamentals, Architectures and Solutions”, Elsevier, 2016.

Reference Books

1. P. H.-J. Chong, I. W.-H. Ho, Vehicular Networks: Applications, Performance Analysis and Challenges, Nova Science Publishers, 2019.
2. C. Sommer, F. Dressler, “Vehicular Networking”, Cambridge University Press, 2015.
3. M. Emmelmann, B. Bochow and C. C. Kellum, “Vehicular Networking: Automotive Applications and Beyond”, Wiley, 2010.
4. M. Watfa, “Advances in Vehicular Ad-Hoc Networks: Development and Challenges”, Information Science Reference, 2010.
5. Wai Chen, “Vehicular Communications and Networks: Architectures, Protocols, Operation and Deployment”, Elsevier, - Technology & Engineering, 2015

Web References

1. https://arxiv.org/pdf/1704.05746
2. https://www.springerprofessional.de/en/5g-enabled-vehicular-communications-and- networking/16262476
3. http://publications.lib.chalmers.se/records/fulltext/174782/174782.pdf
4. https://www.sciencedirect.com/science/article/pii/S221420961930261X

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

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

U20ECE508	INDUSTRY 4.0 TECHNOLOGY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the integration of modern technologies such as sensors, communication, and computational processing
- To understand basic industrial processes and its reference architecture
- To perceive the knowledge of networks and programming of IIOT
- To master security in IIOT
- To study application of IIOT in various fields

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 - Comprehend to the modern technologies need for IIOT **(K2)**
CO2 - Interpret basic industrial processes and its reference architecture **(K2)**
CO3 - Illustrate the programming of IIOT **(K3)**
CO4 - Handle real time security issues in IIOT **(K2)**
CO5 - Analyse the various industrial IOT applications **(K3)**

UNIT-I FUNDAMENTALS OF INDUSTRY 4.0 (9 Hrs)

Introduction: Sensing & actuation, Communication, Networking- Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories. Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis

UNIT-II INDUSTRIAL INTERNET OF THINGS (9 Hrs)

Cybersecurity in Industry 4.0, Basics of Industrial IoT: Industrial Processes, Industrial Sensing & Actuation, Industrial Internet Systems. IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, IIoT Reference Architecture.

UNIT-III NETWORK AND PROGRAMMING OF IIOT (9 Hrs)

Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication. Industrial IoT- Layers: IIoT Communication, IIoT Networking. Industrial IoT: IIoT Analytics - Introduction, Machine Learning and Data Science, R and Julia Programming, Data Management with Hadoop

UNIT-IV COMPUTATION IN IIOT AND SECURITY (9 Hrs)

Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT, Data Center Networks, Industrial IoT: Security and Fog Computing- Cloud Computing in IIoT.Industrial IoT: Security and Fog Computing- Fog Computing in IIoT, Security in IIoT, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry

UNIT-V INDUSTRIAL IOT APPLICATION (9 Hrs)

Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security: AR and VR safety applications, Facility Management. Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Case studies. Self-Referential Structures and Introduction to Lists; Advanced Topics

Textbooks

1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2017
2. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B.Rawart(Springer)
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.

Reference Books

1. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”,1st Edition, VPT, 2014
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013
3. CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1- 4493-9357-1
4. Olivier Hersent, David Boswarthick, Omar Elloumi “The Internet of Things – Key• applications and Protocols”, Wiley, 2012
5. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press,2012.

Web References

1. https://nptel.ac.in/courses/106/105/106105195/
2. https://global.hitachi-solutions.com/blog/industry-4-0-technologies
3. https://www.i-scoop.eu/industry-4-0/
4. https://ottomotors.com/blog/5-industry-4-0-technologies
5. https://www.machinemetrics.com/blog/industry-4-0-technologies

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

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

U20ECE509	INFORMATION THEORY AND CODING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To define and apply the basic concepts of information theory.
- To Understand encoding and decoding of digital data streams.
- To be familiar with the Source Coding techniques.
- To be aware of compression and decompression techniques.
- To Learn the concepts of multimedia communication.

Course Outcomes

After completion of the course, students will be able to

CO1 – Explain the fundamentals of Information Theory such as Entropy and Channel capacity **(K2)**
CO2 – Describe the Data and Voice Modulation techniques **(K2)**
CO3 - Demonstrate the Source Coding Techniques **(K3)**
CO4 - Describe the Text and Image compression techniques **(K2)**
CO5 - Explain the Audio and Video Coding techniques **(K2)**

UNIT - I INFORMATION THEORY (9 Hrs)

Concept of amount of information, information units Entropy: marginal, conditional, joint and relative entropies, relation among entropies Mutual information, information rate, channel capacity, redundancy and efficiency of channels Discrete channels – Symmetric channels, Binary Symmetric Channel, Binary Erasure Channel, Noise-Free Channel, Channel with independent I/O, Cascaded channels, repetition of symbols, Binary asymmetric channel- Shannon theorem.

UNIT - II DATA AND VOICE CODING (9 Hrs)

Differential Pulse code Modulation – Adaptive Differential Pulse Code Modulation – Adaptive sub-band coding – Delta Modulation – Adaptive Delta Modulation – Coding of speech signal at low bit rates -Vocoders, LPC.

UNIT - III SOURCE CODING TECHNIQUES (9 Hrs)

Purpose of encoding, Instantaneous codes, Construction of instantaneous codes, Kraft's inequality, Coding efficiency and redundancy, Source coding theorem. Construction of basic source codes – Shannon Fano coding, Shannon Fano Elias coding, Huffman coding, Minimum variance Huffman coding, Adaptive Huffman coding, Arithmetic coding, Channel coding theorem for DMC.

UNIT - IV COMPRESSION TECHNIQUES (9 Hrs)

Principles – Text compression – Static Huffman Coding – Dynamic Huffman coding – Arithmetic coding – Image Compression – Graphics Interchange format – Tagged Image File Format – Digitized documents – Introduction to JPEG standards.

UNIT - V AUDIO AND VIDEO CODING (9 Hrs)

Linear Predictive coding – code excited LPC – Perceptual coding, MPEG audio coders – Dolby audio coders – Video compression – Principles – Introduction to H.261 & MPEG Video standards.

Textbooks

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley and Sons, 2007.
2. Fred Halsall, "Multimedia Communications, Applications Networks Protocols and Standards", Pearson Education, Asia 2002
3. R. Togneri, C.J.S deSilva, Fundamentals of Information Theory and Coding Design, Taylor and Francis, 2006

Reference Books

1 Mark Nelson, "Data Compression Book", BPB Publication 1992.
2 Watkinson J, "Compression in Video and Audio", Focal Press, London, 1995.
3 R. J. McEliece, The Theory of Information and Coding, Cambridge University Press, 2004
4 R. Bose, Information Theory Coding and Cryptography, Tata McGraw Hill, 2008
5 T. M. Cover, J. A. Thomas, Elements of Information Theory, 2nd edition, Wiley, 2006

Web References

1. https://nptel.ac.in/courses/117/101/117101053/
2. https://web.stanford.edu/class/ee376a/files/scribes/
3. https://people.montefiore.uliege.be/lwh/Info/Transp2000/introduction.pdf
4. http://link.springer.com/content/pdf/bfm%3A978-1-4757-2319-9%2F1.pdf
5. https://nptel.ac.in/content/storage2/courses/117108097/Learning%20Material%20-%20ITC.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	1	-	-	-	-	-	-	-	-	1	3	-	-
2	3	2	1	-	-	-	-	-	-	-	-	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

U20ECCM02	ROBOTICS AND AUTOMATION (Common to ECE, EEE and ICE)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To introduce basic components required for Robot
- To analyze different control mechanism applied for Robotics
- To understand the concept of path planning in Robotics
- To Manipulate forward and inverse kinematics
- To understand application of robots in various fields

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 – Describe the components required for robotics **(K2)**

CO2 - Demonstrate control mechanism required for Robotics**(K3)**

CO3 - Explain path planning of Robotics **(K2)**

CO4 - Demonstrate forward and inverse kinematics**(K3)**

CO5 - Demonstrate application of Robots in industrial and other application**(K3)**

UNIT- I INTRODUCTION (9 Hrs)

Robotics – Basic components – Classification – Performance characteristics – Actuators- Electric actuator- DC motor horsepower calculation, magneto strictive hydraulic and pneumatic actuators. Sensors and vision systems: Different types of robot transducers and sensors – Tactile sensors – Proximity and range sensors – ultrasonic sensor-touch sensors-slip sensors-sensor calibration- vision systems – Image processing and analysis – image data reduction – segmentation feature extraction – Object recognition.

UNIT - II ROBOT CONTROL (9 Hrs)

Control of robot manipulators- state equations-constant solutions-linear feedback systems-single axis PID control- PD gravity control- computed torque control- variable structure control- Impedance control.

UNIT - III END EFFECTORS (9 Hrs)

End effectors and tools– types – Mechanical grippers – Vacuum cups – Magnetic grippers – Robot end effectors interface, workspace analysis work envelope-workspace fixtures-pick and place operation-continuous path motion interpolated motion- straight line motion.

UNIT - IV ROBOT MOTION ANALYSIS (9 Hrs)

Robot motion analysis and control: Manipulator kinematics –forward and inverse kinematics- arm equation-link coordinates- Homogeneous transformations and rotations and Robot dynamics.

UNIT - V ROBOT APPLICATIONS (9 Hrs)

Industrial and Nonindustrial robots, Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants – Industrial automation – Typical examples of automated industries.

Textbooks

1. Mikel P. Grover, 'Industrial Robots – Technology Programming and Applications', second edition, McGraw Hill, 2012
2. Robert J.Schilling 'Fundamentals of Robotics-Analysis and Control', PHI, 2015,
3 R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.

Reference Books

1. K.S.Fu,R.C.Gonzalez, CSG. Lee, "Robotics, Control sensing vision and Intelligence", Tata Mcgraw-Hill, Indian edition, 2008.
2. JohnJ.Craig, "Introduction to Robotics Mechanics and Control", Third edition, Pearson Education 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, "Industrial Robotics", McGraw-Hill, Singapore, 2007
4. Ashitava Ghoshal, "Robotics-Fundamental Concepts and Analysis", Oxford University Press, Sixth impression, 2010
5. B.K.Ghosh, "Control in Robotics and Automation: Sensor Based Integration", Allied Publishers, Chennai,

Web References

1. https://robotics.nasa.gov/links/resources.php
2. https://hackernoon.com/16-best-resources-to-learn-robotics-and-iot-development-in-2019- 847bb93c9bd9
3. https://www.robotics.org/Online-Store
4. https://nptel.ac.in/courses/112/107/112107289/
5. https://www.mheducation.co.in/robotics-and-control-9780070482937-india

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

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

Professional Elective – III (Offered in Semester VI)	
Course Code	**Course Title**
U20ECE611	Low Power VLSI Design
U20ECE612	Aircraft communication and Navigation Systems
U20ECE613	Nano-electronics and Devices
U20ECE614	Speech and Audio Signal Processing
U20ECE615	Soft Computing

U20ECE611	LOW POWER VLSI DESIGN	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand different sources of power dissipation in CMOS.
- To perform power modelling and estimation of VLSI circuits at various levels of design abstractions.
- To compare the tradeoffs of CMOS circuits and devices based on leakage power.
- To design low power random access memories and arithmetic circuits.
- To understand the energy recovery techniques used in low power design.

Course Outcomes

After completion of the course, students will be able to

CO1 - Describe the different sources of power dissipation in VLSI circuits**. (K2)**
CO2 - Recognize the different power analysis mechanisms in VLSI circuits. **(K2)**
CO3 - Interpret the techniques for low power design circuits. **(K3)**
CO4 - Classify the various architectures of low power SRAM. **(K2)**
CO5 - Explain advanced and special techniques for reducing power consumption in memories. **(K2)**

UNIT - I POWER DISSIPATION IN CMOS (9 Hrs)

Introduction to low power CMOS VLSI design-Need for low power VLSI chips-Charging and discharging capacitance-Short circuit current in CMOS circuit- Short circuit current of an inverter-short circuit current variation with output load-short circuit variation with input signal slope- CMOS leakage current-Static current-Basic principles of low power design-Low power figure of merits.

UNIT -II SIMULATION AND PROBABILISTIC POWER ANALYSIS (9 Hrs)

SPICE circuit simulation- Gate level logic simulation - Architecture level analysis-Random logic signals Characterization of logic signals-continuous and discrete random signals-Probability and Frequency Static Probability and frequency-conditional probability and frequency-word level and bit level statistics Probabilistic power analysis techniques-Signal entropy

UNIT-III DESIGN OF LOW POWER CMOS CIRCUIT (9 Hrs)

Transistor and gate sizing-Sizing an inverter chain-transistor and gate sizing for dynamic power reduction-Equivalent pin ordering-Network reconstructing and reorganization-Special Latches and Flipflops-Low power digital cell library-Gate Reorganization-Signal Gating-Logic Encoding

UNIT-IV LOW POWER STATIC RAM ARCHITECTURES (9 Hrs)

Introduction to SRAM-Organization of a static RAM-MOS static RAM memory cell-4T SRAM Architecture-6T SRAM Architecture- SRAM cell operation-Banked organization of SRAMs-Reducing voltage swings on bit lines-Reducing power in the write diver circuits-Reducing power in sense amplifier circuits

UNIT -V LOW POWER ARCHITECTURE AND ADVANCED TECHNIQUES (9 Hrs)

Power and performance management -Microprocessor sleep modes-performance management-adaptive filtering-Switching activity reduction-Parallel architecture with voltage reduction-Adiabatic computation Pass transistor logic synthesis-Asynchronous circuits

Textbooks

1. Gary Yeap, Practical Low Power Digital VLSI Design, Kluwer, 2012
2. K.Roy and S.C. Prasad, Low Power CMOS VLSI Circuit Design, Wiley, 2000
3. Angsuman Sarkar, Swapnadip De, Manash Chanda and Chandan Kumar Sarkar, “Low Power VLSI Design”, De Gruyter Oldenbourg, 2016

Reference Books

1. K.S. Yeo and K.Roy, “Low-Voltage, Low-Power VLSI Subsystems”, Tata McGraw-Hill, 2004.
2. Dimitrios Soudris, Chirstian Pignet and Costas Goutis, “Designing CMOS Circuits for Low Power,” Kluwer, 2009
3. James B. Kuo and Shin Chia Lin, “Low voltage SOI CMOS VLSI Devices and Circuits,” John Wiley and Sons, 2008
4. J.B Kuo and J.H Lou, Low voltage CMOS VLSI Circuits, Wiley, 2008
5. Gary K. Yeap, “Practical Low Power Digital VLSI Design,” KAP, 2002

Web References

1. https://nptel.ac.in/courses
2. http://www.cmosvlsi.com/lect18.pdf
3. https://www.slideshare.net/AnilYadav55/low-power-vlsi-design-ppt
4. https://www.intechopen.com/books/very-large-scale-integration/low-power-design-methodology
5. https://ieeexplore.ieee.org/document/8073688

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

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

U20ECE612	AIRCRAFT COMMUNICATION AND NAVIGATION SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn about layers in atmosphere and special receivers
- Study about VHF and HF communications ranges and ELT
- Analyze the aircraft navigation
- Analyze about various radio navigation systems
- To study about air traffic control, alert and collision avoidance

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 - Understand various receivers used in aircrafts **(K2)**
CO2 - Describe VHF and HF communication **(K2)**
CO3 - Comprehend to aircraft navigation and direction finding **(K2)**
CO4 - Describe different radio navigation techniques **(K3)**
CO5 - Analyze traffic in aircraft communication **(K3)**

UNIT- I INTRODUCTION (9 Hrs)

Radio frequency spectrum, the ionosphere, silent zone and skip distance, Antennas, isotropic radiators, SWR, transmitters and receivers, TRF, Super heterodyne receivers, Double super heterodyne receivers, design examples

UNIT- II VHF AND HF COMMUNICATION AND EMERGENCY LOCATION TRANSMITTERS (9 Hrs)

VHF range and propagation, DSB modulation, channel spacing, depth of modulation, compression, squelch, data modes, ACARS, VHF radio equipments, HF range and propagation, SSB modulation, SELCAL, HF data link, HF radio equipment, HF antenna and coupling unit Emergency location transmitters: Types of ELT, Maintenance and testing of ELT,ELT mounting requirements, typical ELT, Cospas-Sarsat satellites

UNIT - III AIRCRAFT NAVIGATION AND AUTOMATIC DIRECTION FINDER (9 Hrs)

The earth and navigation, Dead reckoning, Position fixing, Maps and charts, ADF principles, ADF equipment, Operational aspects of ADF

UNIT - IV RADIO NAVIGATION (9 Hrs)

Hyperbolic radio navigation, Hyperbolic position fixing, Loran overview, Doppler navigation, The Doppler effect, Doppler navigation principles, Area navigation, RNAV overview, Inertial navigation systems, Inertial navigation principles, Global navigation satellite system, GPS overview

UNIT - V AIR TRAFFIC CONTROL SYSTEM AND TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEM (9 Hrs)

ATC overview, ATC transponder modes, Airborne equipment System operation, Automatic dependent surveillance-broadcast, Communications, navigation and surveillance/air traffic management Airborne collision avoidance systems, TCAS overview, TCAS equipment System operation.

Textbooks

1. Mike Tooley and David Wyatt, “Aircraft Communications and Navigation Systems” 2nd Edition, Elsevier, 2007
2. Chris Binns, “Aircraft Systems: Instruments, Communications, Navigation, and Control”, Wiley, 2006
3. Dale Stacey, “Aeronautical Radio Communication Systems and Networks” 2nd Edition, 2009

Reference Books

1. Donald S. Bond, “Radio direction finders”, McGraw-Hill Book Company, 2004
2. M.I. Skolnik: Introduction to Radar Systems, Tata McGraw-Hill, 2007.
3. M. Kayton and W. Fried: Avionics Navigation System, Wiley Inter science, second edition, 2008
4. Pallett, and Abolfazl Mazloomi Aircraft Electrical Systems, Pitman Publishing Limited, 2017.

Web References

1. https://nptel.ac.in/courses/101108056/
2. https://doi.org/10.1201/9781315858982
3. https://www.sciencedirect.com/book/9780128154052/short-range-wireless-communication
4. https://www.routledge.com/Aircraft-Communications-and-Navigation-Systems/Tooley-Wyatt/p/book/9780415827751
5. http://infocom.uniroma1.it/rrsn/wiki/uploads/TelecomunicazioniPerLAerospazio/testi/acnsprelims.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	-	-	-	-	-	-	-	-	-	1	3	-	-
2	3	2	-	-	-	-	-	-	-	-	-	1	3	-	-
3	3	2	-	-	-	-	-	-	-	-	-	1	3	-	-
4	3	2	-	-	-	-	-	-	-	-	-	1	3	-	-
5	3	2	-	-	-	-	-	-	-	-	-	1	3	-	-

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

U20ECE613	NANO - ELECTRONICS AND DEVICES	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basic concepts of Nanotechnology
- To obtain a broad idea on fundamentals of Nano electronics
- To study the channel and gate effect of MOS system
- To analyze the process involved in carbon nanotubes
- To study the recent trends of Nano devices in the industry

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 - Defines the basic concepts of nanotechnology **(K1)**
CO2 - Explains the conceptual ideas behind Nano electronics **(K2)**
CO3 - Describes the concepts of Silicon MOSFET and quantum transport devices **(K2)**
CO4 - Get a clear idea on process involved in carbon nanotubes and their properties **(K2)**
CO5 - Be familiar with molecular electronics and future applications **(K3)**

UNIT –I INTRODUCTION TO NANOTECHNOLOGY (9 Hrs)

Background to nanotechnology: Types of nanotechnology and nano machines; Molecular, Nanotechnology: Electron microscope-scanning electron microscope-atomic force microscope- scanning tunneling microscope-nano manipulator-nano tweezers-atom manipulation-nano dots; Top down and bottom up approaches: self-assembly-dip pen nano lithography. Nanomaterials: preparation-plasma arcing-chemical vapor deposition-sol-gels-electrode position ball milling

UNIT –II FUNDAMENTALS OF NANOELECTRONICS (9 Hrs)

Fundamentals of logic devices:-Requirements-dynamic properties-threshold gates; physical limits to computations; concepts of logic devices:-classifications-two terminal devices-field effect devices-coulomb blockade devices-spintronics-quantum dot cellular automata-quantum computing-DNA computer, Ultimate computation:-power dissipation limit-dissipation in reversible computation.

UNIT –III SILICON MOSFETS (9 Hrs)

Silicon MOSFETS-Novel materials and alternate concepts: -fundamentals of MOSFET Devices-scaling rules-silicon-dioxide based gate dielectrics-metal gates-junctions & contacts-advanced MOSFET concepts. Quantum transport devices based on resonant tunneling: -Electron tunneling-resonant tunneling diodes-resonant tunneling devices; Single electron devices for logic applications: -Single electron devices

UNIT-IV CARBON NANOTUBES (9 Hrs)

Fullerenes-types of nanotubes-formation of nanotubes-assemblies-purification of carbon nanotubes-electronic properties-synthesis of carbon nanotubes-carbon nanotube interconnects carbon nanotube FETs-Nanotube for memory applications.

UNIT -V MOLECULAR ELECTRONICS (9 Hrs)

Electrodes & contacts-functions-molecular electronic devices-first test systems-simulation and circuit design-fabrication; Future applications.

Textbooks

1. Michael Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse, Chapman & Hall ‘Nanotechnology: Basic Science and Emerging Technologies’, CRC,2002
2. T.Pradeep, “NANO: The Essentials-Understanding Nanoscience and Nanotechnology’ TMH,2007
3. Prof. Marc Baldo, “Introduction to Nanoelectronics”, TMH,2010

Reference Books

1. Rainer Waser (Ed.), “Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices”, Wiley-VCH,2012
2. George W. Hanson, “Fundamentals of Nano Electronics”, Prentice Hall,2008
3. Vladimir V. Mitin,,Viatcheslav A. Kochelap, Michael A. Stroscio, “Introduction to Nano Electronics”, Cambridge University Press, 2012
4. Manoj Kumar Majumder , Vijay Rao Kumbhare, Brajesh Kumar Kaushik, “Introduction to Microelectronics to Nano Electronics - Design and Technology”, CRC Press,2020
5. Vladimir V Mitin, Viatcheslav A Kochelap, Introduction to Nanoelectronics, applications, Cambridge University Press, 2018

Web References

1. https://nptel.ac.in/courses/117108047/
2. https://www.nptel.ac.in/courses/118104008/
3. https://www.mitre.org/sites/default/files/pdf/nano_overview.pdf
4. https://www.mouser.in/blog/introduction-to-nanoelectronics
5. https://www.springer.com/gp/book/9783030325718

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

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

U20ECE614 SPEECH AND AUDIO SIGNAL PROCESSING

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To understand basic concepts of speech and audio signals processing
- To study the time domain speech processing methods
- To study the frequency domain speech processing methods
- To understand the predictive analysis of speech signal
- To understand the time and frequency analysis for audio signal

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 - Describe the mechanics of speech and audio **(K2)**
CO2 - Infer the time domain parameters of speech processing **(K2)**
CO3 - Demonstrate the frequency domain parameters of speech processing **(K3)**
CO4 - Outline the linear prediction in speech analysis **(K4)**
CO5 - Relate the various filter banks and their transforms in time domain **(K4)**

UNIT - I MECHANICS OF SPEECH AND AUDIO (9 Hrs)

Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry and the Spread of Masking- Non simultaneous Masking - Perceptual Entropy - Basic measuring philosophy - Subjective versus objective perceptual testing - The perceptual audio quality measure.

UNIT - II TIME DOMAIN METHODS FOR SPEECH PROCESSING (9 Hrs)

Time domain parameters of Speech signal – Time dependent processing of speech – Methods for extracting the parameters Energy, Average Magnitude – Zero crossing Rate – Short Time Auto Correlation Function – Pitch period estimation using Auto Correlation Function.

UNIT - III FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING (9 Hrs)

Short Time Fourier analysis – Filter bank analysis – Formant extraction – Pitch Detection – Analysis by Synthesis– Pitch synchronous spectrum Analysis – Pitch synchronous estimation of the glottal wave – Analysis synthesis systems – Phase vocoder – Channel Vocoder.

UNIT- IV LINEAR PREDICTIVE ANALYSIS OF SPEECH (9 Hrs)

Basic Principles of Linear Predictive Analysis – The Auto correlation method – The Covariance method – Solution of LPC equations – Cholesky Decomposition solution – Durbin's Recursive solution Comparison of solutions – LPC Vocoder quantization considerations – Voice Excited LPC Vocoders.

UNIT -V TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS (9 Hrs)

Introduction - Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters - Tree-Structured QMF and CQF M-band Banks - Cosine Modulated "Pseudo QMF" M-band Banks -Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT) - Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion- Pre-echo Control Strategies.

Textbooks

1. Ben Gold and Nelson Morgan, “Speech and Audio Signal Processing”, John Wiley and Sons Inc.2011
2. Rabiner L R and Schaffer R W, "Digital Processing of Speech Signals, Pearson Education - India, New Delhi, 2010.
3. Ben Gold, Nelson Morgan, “Speech and Audio Signal Processing: Processing and Perception of Speech and Music”, Wiley 2011.

Reference Books

1. Owens FJ, “Signal Processing of Speech”, Macmillan, New York, 2013.
2. Thomas F Quatieri, “Discrete –Time Speech Signal Processing”, Pearson Education - India, New Delhi, 2011
3. John R DellerJr and John H L Hansen, John G Proakis, “Discrete Time Processing of Speech Signal”, IEEE press, 2010.
4. Mark Kahrs, Karlheinz Brandenburg, Kluwer, “Applications of Digital Signal Processing to Audio and Acoustics”, Academic Publishers,
5. UdoZölzer, "Digital Audio Signal Processing", Second Edition A John Wiley& sons Ltd.2008

Web References

1. https://online.stanford.edu/courses/sohs-ymusic0001-audio-signal-processing
2. https://signalprocessingsociety.org/get-involved/audio-and-acoustic-signal-processing
3. https://www.ruhrunibochum.de/ika/forschung/forschungsbereich_martin/speech_audio_processing/speech_audio_processing_eng.htm

COs / POs / PSOs Mapping

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

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

U20BMCM01	SOFT COMPUTING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objective

- To analyze the basic concepts of fuzzy systems
- To understand the architecture of neural networks
- To analyze the binary and real parameter genetic algorithm
- To understand the structure and operation of genetic algorithm
- To analyze the applications of genetic algorithm in various fields

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 - Understand the basic concepts of fuzzy **(K2)**
CO2 - Infer the different architecture of neural networks **(K2)**
CO3 - Determine the binary and real parameter genetic algorithm **(K3)**
CO4 - Explain the structure and operation of genetic algorithm **(K2)**
CO5 - Analyze the applications of genetic algorithm in various fields **(K4)**

UNIT - I FUZZY SYSTEMS (9 Hrs)

Crisp sets – Fuzzy sets – Operation and properties. Fuzzy relations – Equivalence and tolerance relations. Fuzzy membership function- Types and definitions. Membership value assignments – Rule based systems. Type of fuzzy inference. Structure and parameters of a Fuzzy system- Computer assignment.

UNIT - II NEURAL NETWORKS (9 Hrs)

Biological inspiration–Neuron model and Network architectures perception–Architecture, learning rule. Limitations of multiplayer perception- Back propagation algorithm – Learning rule – Computer assignments.

UNIT - III GENETIC ALGORITHM (9 Hrs)

Goals of optimization –Introduction to GA –Terminologies. Simple GA - Data structure. Genetic operation – Crossover, mutation, fitness scaling, Inversion- A Multi parameter mapped fixed point coding – Computer assignments.

UNIT - IV EVOLUTIONARY PROGRAMMING (9 Hrs)

Single and multi-objective Optimization-General Algorithm - Binary GA, Real parameter GA, constraint handling in GA Evolution strategies general programming – Computer assignments.

UNIT - V APPLICATIONS (9 Hrs)

Applications to various branches of Engineering and science- Application off fuzzy, neural, GA and EP in computer science, electrical, communication, instrumentation and control, mechanical and civil engineering.

Textbooks:

1. S, Rajasekaran and G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis and Applications," PHI Publication, 1st edition, 2009.
2. S.N. Sivanandam and S.N. Deepa, "Principles of Soft Computing," Wiley Publications, 2nd Edition, 2011.
3. Bart Kosko, Neural Network & Fuzzy System, PHI Publication, 1stEdition, 2009

Reference Books

1. Timothy J. Ross, "Fuzzy logic with Engineer Application," McGraw Hill, 1997.
2. Martin T.Hagam Howard B. Deruth and Mark Beale, "Neural Network Design", Thompson Learning, 2002.
3. David E.Gold Berg "Genetic Algorithm", Pearson Education 2002.
4. Kalyanmoy Deb. John, "Multi-objective optimization using Evolutionary Algorithm," Wiley and sons, 2002
5. N.K.Bose, Ping Liang, Neural Network fundamental with Graph, Algorithms & Applications, TMH, 1st Edition, 1998.

Web References

1. www.geneticengg.com
2. www.neuralnetworks.org
3. http://www.myreaders.info/html/soft_computing.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	2	-	2
2	3	2	1	1	-	-	-	-	-	-	-	1	2	-	2
3	3	2	1	1	-	-	-	-	-	-	-	1	2	-	2
4	3	2	1	1	-	-	-	-	-	-	-	1	2	-	2
5	3	2	1	1	-	-	-	-	-	-	-	1	2	-	2

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

Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U20ECE716	CAD for VLSI Circuits
2	U20ECCM05	Satellite Communication
3	U20ICCM01	Fuzzy logic and Neural Network
4	U20ECE719	Biomedical Signal Processing
5	U20ECE720	Wireless Sensor Networks

U20ECE716	CAD FOR VLSI CIRCUITS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study various physical design methods in VLSI
- To illustrate the concepts behind layout compaction, placement and partitioning techniques
- To understand the concepts of various algorithms used for floor planning and routing techniques.
- To impart knowledge on the simulation and synthesis of systems.
- To use the various modeling and scheduling algorithms for VLSI system design.

Course Outcomes

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

CO1 - Understand various physical design methods and VLSI design flow. **(K2)**
CO2 - Understand methods of combinational optimization. **(K2)**
CO3 - Interpret the design rule set to achieve optimization in layout compaction, placement and Partitioning techniques. **(K4)**
CO4 - Analyze and apply various automation algorithms for floor planning and routing. **(K4)**
CO5 - Analyze different levels of simulation and synthesis in VLSI circuits and about scheduling
CO6 - algorithms, Assignment and High-level transformation. **(K4)**

UNIT - I INTRODUCTION TO VLSI DESIGN FLOW (9 Hrs)

Introduction to VLSI Design methodologies, Basics of VLSI design automation tools, Algorithmic Graph Theory and Computational Complexity, Tractable and Intractable problems, General purpose methods for combinatorial optimization.

UNIT - II LAYOUT, PLACEMENT AND PARTITIONING (9 Hrs)

Layout Compaction, Design rules, Problem formulation, Algorithms for constraint graph compaction, Placement and partitioning, Circuit representation, Placement algorithms, Partitioning

UNIT - III FLOOR PLANNING AND ROUTING (9 Hrs)

Floor planning concepts, Shape functions and floor plan sizing, Types of local routing problems, Area routing, Channel routing, Global routing, Algorithms for global routing.

UNIT - IV SIMULATION AND LOGIC SYNTHESIS (9 Hrs)

Simulation, Gate-level modeling and simulation, Switch-level modeling and simulation, Combinational Logic Synthesis, Binary Decision Diagrams, Two Level Logic Synthesis.

UNIT - V HIGH LEVEL SYNTHESIS (9 Hrs)

Hardware models for high level synthesis, internal representation, allocation, assignment and scheduling, scheduling algorithms, Assignment problem, High level transformations.

Textbooks

1 S.H.Gerez, "Algorithms for VLSI Design Automation",JohnWiley&Sons,2008
2 N.A.Sherwani, ”Algorithms for VLSI Physical Design Automation”, Kluwer, 2013
3 SadiqM.Sait, Habibyoussef,” VLSI Physical design automation: Theory and practice”, World scientific 2010
4 Andrew B. Kahng, Jens Lienig, Igor L. Markov and Jin Hu “VLSI Physical Design: From Graph Partitioning to Timing Closure”, 2011.
5 Naveed A. Sherwani “Algorithm for VLSI Physical Design Automation”, 3rd Edition, Springer, 1998.

Reference Books

1 N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.
2 Steven M.Rubin, “Computer Aids for VLSI Design”, Addison Wesley Publishing 31 Dec 1997
3 Sung Kyu Lim, Practical Problems in VLSI Physical Design Automation, Springer, 2008
4 Dimitrios Soudris, Christian Pignet, Costas Goutis, “Designing CMOS Circuits for Low Power”, Kluwer, 2011.
5 Kaushik Roy and S.C.Prasad, “Low power CMOS VLSI circuit design”, Wiley, 2000.

Web Resources

1 http://www.vlsi-expert.com/p/vlsi-basic.html
2 https://www.engineersgarage.com/articles/vlsi-design-future
3 https://nptel.ac.in/courses/106106089/
4 www.cadvlsi.com
5 http://www.ee.ncu.edu.tw/~jfli/vlsi21/lecture

COs/POs/PSOs Mapping

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

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

U20ECCM05	SATELLITE COMMUNICATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To give exposure on the basics of satellite orbits.
- To understand satellite segment and earth segment
- To learn about the various methods of satellite access
- To study the applications of satellites
- To recognize the concepts of the basics of satellite Networks

Course Outcomes

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

CO1 - Explain the basics of satellite orbits. (**K2**)
CO2 - Summarize the satellite segment and earth segment. (**K2**)
CO3 - Analyze the satellite Link design (**K3**)
CO4 - Interpret the working principle of various methods of satellite access. (**K2**)
CO5 - Discuss the various satellite applications. (**K2**)

UNIT - I SATELLITE ORBITS (9Hrs)

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geostationary and non-Geo-stationary orbits – Look Angle Determination- Limits of visibility –Eclipse -Sub satellite point –Sun transit Outage-Launching Procedures - launch vehicles and propulsion

UNIT - II SPACE SEGMENT AND EARTH SEGMENT (9Hrs)

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and Command-Transponders-The Antenna Subsystem - earth segment- Transmit-Receive Earth Station.

UNIT - III SATELLITE LINK DESIGN (9Hrs)

The space link, Equivalent Isotropic Radiated Power, transmission losses, the link power budget equation, system noise, carrier-to-noise ratio (C/N), the uplink, the downlink, effects of rain, combined uplink and downlink C/N ratio, intermodulation noise, inter satellite links. interference between satellite

UNIT - IV SATELLITE ACCESS AND CODING METHODS (9Hrs)

Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods, compression – encryption, Coding Schemes

UNIT - V SATELLITE APPLICATIONS (9Hrs)

INTELSAT Series, INSAT, VSAT, Mobile satellite services : GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH). Recent trends – Macro and Nano satellites.

Textbooks

1 Dennis Roddy, Satellite Communication, 4th Edition, Mc Graw Hill International, 2006.
2 Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communications, 2nd Edition, Wiley India Pvt. Ltd, 2017, ISBN: 978-81-265-0833-4
3 M.Richharia, Satellite Communication Systems-Design Principles, Macmillan 2003

Reference Books

1. Anil K. Maini, Varsha Agrawal, Satellite Communications, Wiley India Pvt. Ltd., 2015, ISBN: 978-81-265-2071-8.
2. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, Satellite Communication Systems Engineering, Prentice Hall/Pearson, 2007.
3. Tri T. Ha, Digital Satellite Communication, second edition, 2017.
4. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, Satellite Communication Systems Engineering, Prentice Hall/Pearson, 2007.
5. Gerard Maral, Michel Bousquet, Zhili Sun, Satellite Communications Systems: Systems, Techniques and Technology, 5th Edition, Wiley India Pvt. Ltd., 2020

Web Resources

1. https://nptel.ac.in/courses/117/105/117105131/
2. https://www.managementstudyguide.com/satellite-communication-system.htm
3. https://www.tutorialspoint.com/satellite_communication/satellite_communication_introduction.htm
4. https://www.intelsat.com/resources/tools/satellite-101/
5. https://www.sciencedirect.com/topics/engineering/satellite-communication-system

COs/POs/PSOs Mapping

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

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

		L	T	P	C	Hrs
U20ICCM01	**FUZZY LOGIC AND NEURAL NETWORK** (Common to ICE, EEE, ECE, CCE, CSE, IT, CIVIL, BME, AI&DS)	**3**	**0**	**0**	**3**	**45**

Course Objectives
- To acquaint the students with the basics of fuzzy logic.
- To impart knowledge about fuzzy logic control system.
- To familiarize the basics of neural networks
- To inculcate knowledge on neural network-based computation.
- To make the students understand the concept of hybrid Neuro-fuzzy logic controller schemes.

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

CO1 - Illustrate the fuzzy sets and the properties of fuzzy logic **(K2)**

CO2 - Comprehend fuzzy logic controllers and its applications. **(K2)**

CO3 - Familiarize in the neural network architecture. **(K2)**

CO4 - Impart knowledge on various training algorithm of neural network and its application. **(K3)**

CO5 - Recognize the hybrid Neuro-fuzzy logic controllers. **(K2)**

UNIT I INTRODUCTION TO FUZZY LOGIC (9 Hrs)
Classical sets - Fuzzy sets – properties of fuzzy sets – operations on fuzzy sets, Cartesian Product, Fuzzy relations linguistic variables – Linguistic approximation. Fuzzy statements: Assignments, Conditional and Unconditional statements.

UNIT II FUZZY LOGIC CONTROL SYSTEM (9 Hrs)
Introduction to Fuzzy logic controller: Architecture – Fuzzification, Membership functions: Triangular, Trapezoidal, Gaussian. Inference Mechanism, knowledge base, fuzzy rule base, Inference method: Mamdani, Sugeno and TSK models, Defuzzification - Applications of Fuzzy logic controller.

UNIT III INTRODUCTION TO NEURAL NETWORK (9 Hrs)
Introduction to neural networks – Biological neural networks, Artificial Neural network: Single and Multi-layer feed forward network- Activation function, types (step and sigmoid function), threshold function- Classification of learning: Supervised, Unsupervised and Reinforced. McCulloh Pitts neuron: architecture, algorithm and applications.

UNIT IV NEURAL NETWORKS CONTROL (9 Hrs)
Back propagation neural net: standard architecture, algorithm -Hopfield net: architecture and algorithm- Kohonnen's Self Organizing map- Adaptive Resonance Theory ART 1: Architecture and operation- Neural networks for control: Schemes of neuro control - Applications of neuro controller.

UNIT V HYBRID CONTROL SCHEMES (9 Hrs)
Adaptive Neuro-Fuzzy Inference Systems (ANFIS), Hybrid system: Types of Hybrid Systems: Neuro-Fuzzy Hybrid systems, Neuro Genetic Hybrid systems, Fuzzy Genetic Hybrid systems- Applications of fuzzy logic and neural network.

Textbooks
1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw- Hill International Editions,2010
2. Laurene Fausett, "Fundamentals of Neural Networks", Pearson Education, 2008
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, 2001.
5. S. N. Sivanandam, S. Sumathi, S. N. Deepa, “Introduction to Neural Networks using MATLAB 6.0”, Tata McGraw Hill Education, 1st Edition, 2017.

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

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

U20ECE719	BIOMEDICAL SIGNAL PROCESSING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basics of Biomedical Signal Processing
- To gain knowledge on the signal processing techniques used for ECG and EEG in cardio
- To gain knowledge on the signal processing techniques used for ECG and EEG in neuro
- To understand the wavelet concepts
- To understand the signal processing steps involved in Brain-Computer Interface.

Course Outcomes

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

CO1 - Infer knowledge in basics of biomedical signal Processing **(K2)**
CO2 - Make use of various Signal Processing techniques to identify ECG parameters **(K3)**
CO3 - Select Various Signal Processing techniques for analysis of EEG **(K3)**
CO4 - Apply wavelet analysis to identify different features of biological signals. **(K3)**
CO5 - Understand the concept of Brain Computer Interface **(K2)**

UNIT – I INTRODUCTION TO BIOSIGNAL PROCESSING (9Hrs)

The nature of biomedical signals, example of biomedical Signal, the action potential of a cardiac myocyte and neuron, objective of signal analysis and its difficulties. Sampling and Conversion requirements for biomedical signals, Time domain filtering - Synchronized averaging, Moving Average, Frequency Domain Filtering - Notch Filter

UNIT - II CARDIOLOGICAL SIGNAL PROCESSING (9Hrs)

Basic electrocardiography, ECG lead systems, ECG signal characteristics, Analog filters, ECG amplifier and QRS detector - Differentiation-based and template-based rhythm analysis and Arrhythmia detection algorithms, automated ECG analysis. Data compression techniques: Turning Point algorithm, AZTEC, CORTES, and KL transform. Adaptive filters, Weiner filter principles, LMS & RLS.

UNIT - III NEUROLOGICAL SIGNAL PROCESSING (9Hrs)

Stochastic process, linear prediction, Yule-Walker equations, Autoregressive Modeling of EEG signal. Detection of EEG Rhythms, Template matching for EEG spike-and-wave detection, detection of its 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.

UNIT - IV WAVELETS IN MEDICINE (9Hrs)

Need for wavelets, types of wavelets, Selection of a wavelet for different applications, Statistical Analysis of Image difference by Decomposition and reconstruction of signals using wavelets, Wavelet denoising for various medical applications.

UNIT - V BRAIN-COMPUTER INTERFACE (9Hrs)

Brain signals for BCIs, Neuronal activity in motor cortex, electric and magnetic fields produced by the brain, signals reflecting brain metabolic activity, feature extraction and feature translation involved in BCIs - BCI hardware and software, its applications.

Textbooks

1. Rangaraj M. Rangayyan, "Biomedical Signal Analysis:", second edition John Wiley & Sons, 2015
2. Willis J.Tompkins, "Biomedical Digital Signal Processing", Prentice-Hall of India Pvt. Ltd.,2012
3. Akram Aldroubi, Michael Unser, "Wavelets in Medicine and Biology", CRC Press, 1996.

Reference Books

1. Monson H.Hayes, “Statistical Digital Signal Processing and Modeling”, Wiley-India, 2009.
2. Stephane Mallat, “Wavelet Tour of Signal Processing: The Sparse Way”, 3rd ed. Academic Press, 2009.
3. Jonathan Wolpaw and Elizabeth Winter Wolpaw, “Brain-Computer Interfaces: Principles and Practice”, Oxford University Press, 2012.
4. Fabian J. Theis and Anke Meyer-Bäse, “Biomedical Signal Analysis - Contemporary Methods and Applications” MIT Press, March 2010
5. Johnny R Johnson, “Introduction to Digital Signal Processing Paperback,” Prentice Hall India, January 1992

Web Resources

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://www.coursera.org/lecture/computational-neuroscience/3-1-neural-decoding-and-signal-detection-theory-67uWp

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

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

U20ECE720	WIRELESS SENSOR NETWORKS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To obtain a broad idea of various challenges involved to design wireless sensor networks.
- To focus on network architecture and protocols of wireless sensor networks.
- To obtain a clear idea on wireless channel and communication fundamentals
- To Understand the different routing protocols
- To obtain a broad understanding of the technologies and applications for the emerging and exciting domain of wireless sensor networks.

Course Outcomes

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

CO1 - Obtain the basic and advanced concepts knowledge in sensor networking architectures **(K2)**
CO2 - Obtain the basic idea on architecture and various parameters in sensor nodes **(K2)**
CO3 - Get an idea on MAC protocols for wireless sensor networks. **(K2)**
CO4 - Obtain an idea on routing protocols for wireless sensor networks. **(K2)**
CO5 - Be familiar with the existing and ongoing research in WSN on real time applications **(K2)**

UNIT – I INTRODUCTION (9 Hrs)

Introduction – Challenges for wireless sensor networks, Characteristic requirements and required mechanisms- Comparison of Mobile ad hoc network and wireless sensor networks, Fieldbuses and wireless sensor networks - Enabling Technologies for Wireless Sensor Networks- Advantages of Sensor Networks- Applications of WSN

UNIT - II ARCHITECTURES (9 Hrs)

Single node architecture- Hardware components, Energy consumption of sensor nodes, Operating systems and execution environment- Case study of Tiny OS and nesC- Examples of Sensor nodes. Network architecture**-** Sensor network scenarios, Optimization goals and figures of merit, Design principles for WSNs, Gateway concepts.

UNIT - III WIRELESS CHANNEL CONCEPTS AND PROTOCOLS (9 Hrs)

Wireless channel and communication fundamentals- Frequency allocation, Modulation and demodulation, Wave propagation effects and noise, Channel models- Physical layer and transceiver design considerations in WSNs- Fundamentals of (wireless) MAC protocols- Low duty cycle protocols and wakeup concepts- Contention-based protocols- Schedule-based protocols- IEEE 802.15.4 MAC protocol

UNIT - IV ROUTING PROTOCOLS (9 Hrs)

Gossiping and agent-based unicast forwarding- Multipath unicast routing- Energy-efficient unicast- Broadcast and multicast, Source-based tree protocols, Shared core-based tree protocols, Mesh-based protocols- Geographic routing- Mobile nodes, Mobile sinks, Mobile data collectors, Mobile regions.

UNIT - V APPLICATIONS OF WIRELESS SENSOR NETWORKS (9 Hrs)

Range of Applications - WSN Applications Home Control, Building Automation, Industrial Automation, Medical Applications, Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring, Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat Monitoring, Nanoscopic Sensor Applications.

Textbooks

1. Feng Zhao, Leonidas Guibas “Wireless Sensor Networks: An Information Processing Approach” Elsevier 2007.
2. Holger Karl, Andreas Willi g, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley, 2005
3. Kazem Sohraby, Daniel Minoli, Taieb Znati, “Wireless Sensor Networks-Technology”, Protocols, And Applications, John Wiley, 2007.

Reference Books

1. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
2. Bhaskar Krishnamachari, “Networking Wireless Sensors”, Cambridge Press, 2005.
3. Sitharama Iyengar S, Nandan Parmeshwaran, Balkrishnan N and Chuka D, “Fundaments of Sensor Network Programming, Applications and Technology”, John Wiley & Sons, 2011.
4. Fei Hu and Xiaojun Cao, “Wireless Sensor Networks Principles and Practice”, CRC Press, 2010.
5. C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education 2008.

Web Resources

1. https://nptel.ac.in/courses/106/105/106105160/
2. www.tfb.edu.mk/amarkoski/WSN/Kniga-w02
3. http://profsite.um.ac.ir/~hyaghmae/ACN/WSNbook.pdf
4. http://ceng.usc.edu/~bkrishna/research/talks/WSN_Tutorial_Krishnamachari_ICISIP05.pdf
5. http://ijcttjournal.org/Volume4/issue-8/IJCTT-V4I8P194.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	1	-	-	-	-	-	-	-	-	-	1	2	2	-
2	3	1	-	-	1	-	-	-	-	-	-	1	2	2	-
3	3	1	-	-	1	-	-	-	-	-	-	1	2	2	-
4	3	1	-	-	1	-	-	-	-	-	-	1	2	2	-
5	3	1	-	-	1	-	-	-	-	-	-	1	2	2	-

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

Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20ECE821	High Speed Electronics
2	U20ECE822	Machine Learning for Wireless Communication
3	U20ECE823	Virtual and Augmented Reality
4	U20ECE824	Adaptive Signal Processing
5	U20ECE825	Real Time Systems

U20ECE821	HIGH SPEED ELECTRONICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To give exposure on the band diagram of Semiconductor Material.
- To understand the characteristics of homo-junction devices and fabrication techniques.
- To understand the characteristics of hetero-junction devices and fabrication techniques.
- To apply knowledge of Advanced Devices in High Speed Application.
- To create awareness about Fabrication and Characterization Techniques.

Course Outcomes

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

CO1 – Understand the concept of Semiconductor Material with its Characteristics. (K2)
CO2 – To explain about homo junction and its characteristics in FET, BJT. (K2)
CO3 – Differentiate homo-junction and hetero-junction Devices. (K2)
CO4 – Apply knowledge of Advanced Devices in High Speed Application. (K2)
CO5 – Understand various process of Fabrication and Characterization Techniques. (K2)

UNIT - I SEMICONDUCTOR MATERIAL CHARACTERISTICS (9 Hrs)

Review of Crystal Structure: Crystal structure of important semiconductors (Si, GaAs, InP) - electrons in periodic lattices - energy band diagram - carrier concentration and carrier transport phenomenon - electrical - optical - thermal and high field properties of semiconductors.

UNIT - II HOMOJUNCTION DEVICES (9 Hrs)

Homojunction Devices (BJT and FET): Structure - band diagram - operation - I–V and C–V characteristics (analytical expressions) - small signal switching models.

UNIT - III MOS DEVICES (9 Hrs)

MOS Diode: Structure - band diagram - operation - C–V characteristics - effects of oxide charges - avalanche injection - high field effects and breakdown; Heterojunction Based MOSFET: Band diagram - structure - operation - I–V and C–V characteristics (analytical expressions) - MOSFET breakdown and punch through – sub-threshold current -scaling down; Alternate High k-dielectric Materials: HF–MOSFETs - SOI MOSFET - buried channel MOSFET - charge coupled devices.

UNIT - IV ADVANCED DEVICES (9 Hrs)

HBT and HEMT Devices: AlGaAs/ GaAs, InP and SiGe based HBT and HEMT structure - band diagram - operation - I–V and C–V characteristics (analytical expressions) - small signal switching models - benefits of hetero-junction transistor for high speed applications.

UNIT - V FABRICATION AND CHARACTERIZATION TECHNIQUES (9 Hrs)

Crystal Growth and Wafer Preparation: Epitaxy - diffusion - ion implantation - dielectric film deposition and oxidization techniques - masking and lithography techniques (optical, e-beam and other advanced lithography techniques) - metallization - bipolar and MOS integration techniques - interface passivation techniques; Characterization Techniques: Four probe and hall effect measurement - I–V and C–V for dopant profile characterization and DLTS.

Textbooks

1 Nandita Das Gupta and Amitava Das Gupta, “Semiconductor Devices: Modeling and Technology”, Prentice Hall of India,2012.
2 M. S. Tyagi, “Introduction to Semiconductor Materials and Devices”, John Wiley and Sons, 2008.
3 M. J. Madou, Fundamentals of Microfabrication, 2nd Edition, CRC Press, 2011.
4 P. Bhattacharya, Semiconductor Optoelectronics Devices, 2nd Edition, PHI, 2009.

Reference Books

1 S. M. Sze, “Physics of Semiconductor Devices”, 3rd edition, John Wiley and Sons,2007.
2 J. Singh, “Semiconductor Devices: Basic Principles”, John Wiley and Sons,2007.
3 J. P. McKelvey, Introduction to Solid State and Semiconductor Physics, Harper and Row and John Weathe Hill.
4 Cheng T. Wang, Ed., Introduction to Semiconductor Technology: GaAs and Related Compounds, John Wiley & Sons, 1990.
5 Donald A Neamen, Semiconductor Physics and Devices: Basic Principles, McGraw-Hill (1997) ISBN 0-256-24214-3

Web Resources

1 https://nptel.ac.in/courses/117104071/
2 https://cosmolearning.org/courses/high-speed-devices-circuits/
3 https://www.docsity.com/en/lecture-notes/subjects/high-speed-electron-devices/
4 https://www.researchgate.net/journal/International-Journal-of-High-Speed-Electronics-and-Systems-0129-1564
5 https://ieeexplore.ieee.org/document/6647520

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

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

U20ECE822	MACHINE LEARNING FOR WIRELESS COMMUNICATION	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Understand the principles of machine learning and apply the fundamental principles Data acquisition, pre-processing
- Apply machine learning principles based on supervised learning
- Understand optimization and dimensionality reduction using unsupervised learning
- To learn neural and deep neural networks for parallel processing
- To develop intelligent applications by applying the principles of machine learning

Course Outcomes

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

CO1 – Know the basic principles of machine learning **(K2)**
CO2 – Understand supervised learning and it basic classifications **(K2)**
CO3 – Optimize the performance using clustering algorithms **(K3)**
CO4 - Compare neural and deep neural networks for parallel processing **(K3)**
CO5 – Develop applications based on the concepts of machine learning **(K4)**

UNIT - I INTRODUCTION (9 Hrs)

Data acquisition, pre-processing, feature extraction and processing, feature ranking/selection, feature reduction, model learning, evaluation, deployment. Matrix algebra Feature Scaling, Learning Rate, Normal Equation, Features and Polynomial Regression, Logistic Regression-classification, hypothesis representation, decision boundary, cost function, optimization, multiclass classification.

UNIT – II SUPERVISED LEARNING (9Hrs)

Decision trees, Inductive bias, Classification, Regression, Perceptron, Tree learning algorithms. Model Selection and Generalization. Dimensions of a Supervised Machine Learning Algorithm

UNIT - III UNSUPERVISED LEARNING (9Hrs)

Introduction, k-means algorithm, optimization, random initialization, clustering. Dimensionality Reduction: Data compression, visualization, principal component analysis algorithm, reconstruction from compressed representation.

UNIT – IV NEURAL NETWORKS (9Hrs)

Artificial neurons, Neural Networks as a Paradigm for Parallel Processing. The Perceptron Gradients and back propagation, Gradient decent, Convolution neural networks: continuous convolution, discrete convolution, pooling. Recurrent neural networks. Deep neural networks.

UNIT - V APPLICATIONS (9Hrs)

Development of an application of machine learning; for example, Optical Character Recognition, Email spam identification, etc Machine Learning for communication: signal processing, adaptive filtering, modulation, spectrum sensing.

Textbooks

1 Ethem Alpaydin, “Introduction to Machine Learning”, 3e, MIT Press, 2014
2 Kevin P. Murphy, Machine Learning A probabilistic Perspective, MIT press, 2012
3 Machine Learning and Deep Learning Techniques in Wireless and Mobile Networking Systems (Big Data for Industry 4.0) by by K. Suganthi, R. Karthik, G. Rajesh, CRC Press; 1st edition, 2021.

Reference Books

1 Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006
2 T. Hastie, R.Tibshirani, J. H. Friedman, “The Elements of Statistical Learning”, Springer; 1st edition, 2001.
3 Luo, Fa-Long, ed. "Machine learning for future wireless communications." (2020).
4 Machine Learning and Cognitive Computing for Mobile Communications and Wireless Networks by Krishna Kant Singh, Akansha Singh, Wiley-Scrivener; 1st edition, 2020.
5 Applications of Machine Learning in Wireless Communications (Telecommunications) by by Ruisi He and Zhiguo Ding, Institution of Engineering and Technology,2019.

Web Resources

1. https://onlinecourses.nptel.ac.in/noc16_cs18/
2. http://freevideolectures.com/Course/2257/Machine-Learning Online courses: 1 2
3. https://www.coursera.org/learn/machine-learning
4. https://www.edx.org/course/machine-learning-data-science-analyticscolumbiax-ds102x-0#
5. http://scikit-learn.org/stable/modules/clustering.html
6. https://towardsdatascience.com/k-means-clustering-algorithm-applications-evaluation-methods-and-drawbacks-aa03e644b48a

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

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

U20ECE823	VIRTUAL AND AUGMENTED REALITY	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn basic virtual Reality systems functions(operations)
- To design Virtual Reality considerations.
- To give knowledge of virtual Reality systems
- To integration hardware and software in virtual Reality applications.
- To identify the concept of virtual reality systems with its applications.

Course Outcomes

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

CO1 - Understand the basic functioning of virtual Reality systems**. (K2)**
CO2 - Visualize the concepts of Geometric modeling and Geometrical Transformations**. (K2)**
CO3 - Learn Animated Virtual Environment**. (K2)**
CO4 - Understand various types of Hardware's and software's in virtual Reality systems**. (K2)**
CO5 - Describe the applications of Virtual Environment**. (K2)**

UNIT - I INTRODUCTION (9Hrs)

Virtual Reality & Virtual Environment: Introduction – Computer graphics – Real time computer graphics – Flight Simulation – Virtual environments –requirement – benefits of virtual reality- 3D Computer Graphics : Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – Human vision – stereo perspective projection – 3D clipping – Color theory – Simple 3D modeling – Illumination models – Reflection models – Shading algorithms.

UNIT - II GEOMETRIC MODELING GEOMETRICAL TRANSFORMATIONS (9Hrs)

Geometric Modeling: Introduction – From 2D to 3D – 3D space curves – 3D boundary representation - Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances – Picking – Flying – Scaling the VE – Collision detection - A Generic VR system: Introduction – The virtual environment- the Computer environment- VR Technology – Model of interaction- VR System.

UNIT - III VIRTUAL ENVIRONMENT (9Hrs)

Animating the Virtual Environment: Introduction – The dynamics of numbers – Linear and Non-linear interpolation - The animation of objects – linear and non-linear translation - shape & object in between – freeform deformation – particle system- Physical Simulation : Introduction – Objects falling in a graphical field –Rotating wheels – Elastic collisions – projectiles – simple pendulum – springs – Flight dynamics of an aircraft.

UNIT - IV VR HARDWARES & SOFTWARES (9Hrs)

Human factors : Introduction – the age- the ear- the somatic senses - VR Hardware : Introduction – sensor hardware – Head-coupled displays –Aquatic hardware – Integrated VR systems-VR Software: Introduction – Modeling virtual world –Physical simulation- VR toolkits – Introduction to VRML

UNIT - V VR APPLICATION (9Hrs)

Introduction – Engineering- Architecture, Education, Medicine, Entertainment, Science, Training.

Textbooks

1. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
2. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Inter science, India, 2003.
3. M. LaValle, "Virtual Reality, Steven", Cambridge University Press, 2016

Reference Books

1 Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, 2005.
2 Oliver Bimber and Ramesh Raskar, “Spatial Augmented Reality: Merging Real and Virtual Worlds”, 2005.
3 John Vince, “Virtual Reality Systems”, Addison Wesley, 2012.
4 William R Sherman and Alan B Craig, “Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics)”. Morgan Kaufmann Publishers, San Francisco, CA, 2002.
5 Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, “3D User Interfaces, Theory and Practice”, Addison Wesley, USA, 2005

Web Resources

1. https://digitaldefynd.com/best-augmented-reality-courses/
2. https://www.edx.org/learn/augmented-reality
3. https://www.classcentral.com/course/augmented-reality-virtual-reality-mixed--10508
4. https://nptel.ac.in/courses/106/106/106106138/
5. https://www.coursera.org/learn/introduction-virtual-reality

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

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

U20ECE824	ADAPTIVE SIGNAL PROCESSING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To review the basics of statistical signal processing
- Understand about the need for adaptive filters and learn the design of it.
- To acquire knowledge on **Steepest Descent Algorithms** and constraints associated with it.
- To gain knowledge on design of variants of LMS algorithm and lattice structures
- To understand the RLS Algorithm in the filtering processing and designing the adaptive filters

Course Outcomes

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

CO1 – Infer the basics of statistical signal processing **(K2)**
CO2 - Summarize the Development of Adaptive Filter Theory & Searching the Performance surface **(K2)**
CO3 – Illustrate Steepest Descent Algorithms **(K2)**
CO4 - Demonstrate Variants of LMS Algorithm and Lattice Structures **(K2)**
CO5 - Understanding the need and design of adaptive filters using different algorithms **(K2)**

UNIT- I INTRODUCTION TO ADAPTIVE SYSTEMS (9 Hrs)

Adaptive Systems: Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner – Description, Weight Vectors, Desired Response Performance function – Gradient & Mean Square Error

UNIT- II DEVELOPMENT OF ADAPTIVE FILTER THEORY & SEARCHING THE PERFORMANCE SURFACE (9 Hrs)

Introduction to Filtering – Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonality – Minimum Mean Square Error, Wiener- Hopf equations, Error Performance – Minimum Mean Square Error, Estimation of phase shift between two narrow band signals using Orthogonal Decomposer.

UNIT- III STEEPEST DESCENT ALGORITHMS (9 Hrs)

Searching the performance surface – Methods & Ideas of Gradient Search methods – Gradient Searching Algorithm & its Solution – Stability & Rate of convergence – Learning Curves Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves**.**

UNIT- IV VARIANTS OF LMS ALGORITHM AND LATTICE STRUCTURES (9 Hrs)

Overview – LMS Adaptation algorithms, Stability & Performance analysis of LMS Algorithms – LMS Gradient & Stochastic algorithms – Convergence of LMS algorithm. Applications: Adaptive BFSK, BPSK, ASK demodulators and delay estimation. Adaptive Beam forming, concept of IQ channels, Adaptive filter implementation of Hilbert Transform. Introduction to MUSIC.

UNIT- V RECURSIVE LEAST SQUARE ALGORITHM (9 Hrs)

Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process- Expression of Kalman Gain, Filtering Example estimation of state from observations of noisy observed narrow band signals. Target tracking using only DOA.

Textbooks

1. Bernard Widrow, Samuel D.Strearns, "Adaptive Signal Processing", 2005, PE.
2. Simon Haykin, "Adaptive Filter Theory", 4th Edition. 2002, PE Asia.
3. Tulay Adali; Simon Haykin ,Adaptive Signal Processing: Next Generation Solutions., John Wiley & Sons, 2010

Reference Books

1. Kaluri V. Rangarao, Ranjan K. Mallik, "Digital Signal Processing: A Practitioner's Approach", ISBN: 978-0-470-01769-2, 210 pages, November 2006, John Wiley (UK)
2. Sophocles. J. Orfamadis, "Optimum signal processing: An introduction", 2nd Edition, 1988, McGraw-Hill, Newyork
3. Thomas S. Alexander, "Adaptive signal processing-Theory and Applications -1986, Springer New York
4. Benesty, Jacob, Huang, Yiteng (Eds.), "Adaptive Signal Processing - Applications to Real-World Problems,2003
5. James V. Candy - Signal Processing: A Modern Approach, McGraw-Hill, International Edition, 1988.

Web Resources

1. http://www.nptelvideos.in/2012/12/adaptive-signal-processing.html
2. https://www.isip.piconepress.com/courses/msstate/ece_8423/index.html
3. https://nptel.ac.in/courses/117/105/117105075/
4. https://ece.iisc.ac.in/~spchepuri/e9211.html
5. https://www.intechopen.com/about-intechopen

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

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

U20ECE825	REAL TIME SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand application of real time system and importance of task scheduling
- To understand about desired language and tools for real-time systems
- To understand about databases available for real-time systems
- To understand about the protocols used for real-time systems
- To understand about the fault tolerance and reliability techniques used for real-time system

Course Outcomes

After completion of the course, students will be able to

CO1 – To understand and classify the task scheduling needed for real-time system **(K2)**
CO2 – To explain programming language concepts required for real-time systems **(K2)**
CO3 – To categorize and explain the databases used in real-time systems **(K2)**
CO4 - To explain about communication protocols used in real-time systems **(K2)**
CO5 – To explain about troubleshooting functions in real-time systems **(K2)**

UNIT – I INTRODUCTION AND REAL TIME TASK SCHEDULING (9 Hrs)

Real time – Applications – Basic Model of real-time system – Characteristics – Safety and reliability – Types of real-time tasks and their characteristics – Task scheduling – Clock driven scheduling - Hybrid schedulers – Event driven scheduling – Earliest Deadline First scheduling – Rate Monotonic Algorithm - Issues in RMA

UNIT – II PROGRAMMING LANGUAGES AND TOOLS (9 Hrs)

Desired language characteristics – Data typing – Control structures – Facilitating hierarchical decomposition – Packages – Run time error handling – Overloading and Generics – Multitasking – Low level programming – Task scheduling – Timing specification – Some experimental languages – Programming environments – Run time support

UNIT – III REAL-TIME DATABASES (9 Hrs)

Real time Vs General purpose databases – Main memory databases – Transaction priorities – Transaction aborts – Concurrency control issues – Disk scheduling algorithm – A two phase approach to improve predictability – Maintaining serialization consistency – databases for hard real-time systems

UNIT – IV REAL-TIME COMMUNICATION (9 Hrs)

Basic concepts – Real-time communication in LAN - Soft real-time communication in LAN – Hard real-time communication in LAN – Bounded access protocols for LAN – Performance comparison – Real-time communication over packet switched networks – QoS framework – Routing – Resource reservation – rate control – Qos models

UNIT – V FAULT TOLERANCE AND RELIABILITY EVALUATION (9 Hrs)

Fault Tolerance: Fault types – Fault detection – Fault and error containment – Redundancy – data diversity – Reversal checks – Malicious or Byzantine failures – Integrated failure handling- Reliability Evaluation: Obtaining parameter values – Reliability model for hardware redundancy – Software error models – Taking time into account

Textbooks

1 Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson Education India, 2009.
2 C.M. Krishna, K.G. Shin, “Real Time Systems”, McGraw Hill Education India, 2017.
3 Alur, Rajeev. *Principles of Cyber-Physical Systems.* MIT Press, 2015

Reference Books

1. Jane W. S. Liu, “Real Time Systems”, Pearson, 2000.
2. Maryline Chetto, “Real-time Systems Scheduling 1: Fundamentals”, ISTE Ltd and John Wiley & Sons Inc, 2014.
3. Roman Gumzej, “Real-time Systems' Quality of ServiceSpringer London Ltd, 2014
4. Phillip A. Laplante, Seppo J. Ovaska, “Real-Time Systems Design and Analysis: Tools for the Practitioner”, Wiley India Pvt. Ltd, 2013
5. Sriram Iyer, Pankaj Gupta, “Embedded Realtime Systems Programming”, McGraw Hill Education India,2003

Web Resources

1. https://www.coursera.org/learn/real-time-systems
2. https://users.ece.cmu.edu/~koopman/des_s99/real_time/
3. https://www.arm.com/resources/education/online-courses/real-time-operating-systems
4. https://developer.arm.com/products/architecture/cpu-architecture
5. https://nptel.ac.in/courses/106/105/106105036/

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

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

Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U20ECE826	VLSI for Communication Systems
2	U20ECE827	5G Wireless Communication Systems
3	U20ECE828	Biomedical Electronics
4	U20ECE829	Advanced Digital Image and Video Processing
5	U20ECE830	Hardware Software Co-design

U20ECE826	VLSI FOR COMMUNICATION SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To study the design concepts of low noise amplifiers.
- To learn various types of mixers designed for wireless communication.
- To design PLL and VCO.
- To acquire knowledge about various sub systems in wireless communication.
- To understand the concepts of CDMA in wireless communication.

Course Outcomes

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

CO1 - Analyze the design concepts of low noise amplifiers. **(K4)**
CO2 - Differentiate various types of mixers designed for wireless Communication. **(K4)**
CO3 - Able to design PLL and VCO. **(K3)**
CO4 - Recognize various sub systems in wireless communication. **(K3)**
CO5 - Understand the concepts of CDMA in wireless communication. **(K2)**

UNIT - I COMPONENTS AND DEVICES (9 Hrs)

Introduction of wireless system -Integrated inductors, resistors, MOSFET and BJT Amplifier Design: Low Noise Amplifier Design - Wideband LNA - Design Narrowband LNA - Impedance Matching - Automatic Gain Control Amplifiers – Power Amplifiers

UNIT - II MIXERS (9 Hrs)

Balancing Mixer - Qualitative Description of the Gilbert Mixer - Conversion Gain – Distortion - Low Frequency Case: Analysis of Gilbert Mixer – Distortion - High-Frequency Case – Noise - A Complete Active Mixer. Switching Mixer - Distortion in Unbalanced Switching Mixer - Conversion Gain in Unbalanced Switching Mixer.

UNIT - III FREQUENCY SYNTHESIZERS (9 Hrs)

Phase Locked Loops - Voltage Controlled Oscillators - Phase Detector – Analog Phase Detectors – Digital Phase Detectors - Frequency Dividers - LC Oscillators - Ring Oscillators - Phase Noise - A Complete Synthesizer Design Example (DECT Application).

UNIT - IV SUB SYSTEMS (9 Hrs)

Data converters in communications, adaptive filters, equalizers and transceivers

UNIT - V IMPLEMENTATIONS (9 Hrs)

VLSI architecture for Multitier Wireless System - Hardware Design Issues for Next generation CDMA System

Textbooks

1. B.Razavi ,"RF Microelectronics" , Prentice-Hall ,2012 second edition2015
2. Bosco H Leung "VLSI for Wireless Communication", Pearson Education, 2014.
3. Thomas H.Lee, "The Design of CMOS Radio –Frequency Integrated Circuits', Cambridge University Press ,2008. 2003
4. S.H.Gerez, "Algorithms for VLSI Design Automation",JohnWiley&Sons,2016 1998
5. David Tse and PramodViswanath, "Fundamentals of Wireless Communication", Cambridge Press, 2005.

Reference Books

1. Emad N Farag and Mohamed I Elmasry, "Mixed Signal VLSI Wireless Design - Circuits and Systems", Kluwer Academic Publishers, 2000. (Paperback format 2013)
2. Behzad Razavi, "Design of Analog CMOS Integrated Circuits" McGraw-Hill, 2012. (2nd edition 2016)
3. DALAL & UPENA, Wireless Communication, Oxford University Press, New Delhi, 2014.
4. U. Meyer – Baese, "Digital Signal Processing with Field Programmable Gate Arrays", Springer, Second Edition, 2007
5. Andreas Antoniou "Digital Filters" McGraw-Hill Science, 2000.

Web Resources

1. http://www.wirelesscommunication.nl/reference/contents.htm
2. https://www.tutorialspoint.com/wireless_communication.html
3. http://www.nptelvideos.in/2012/12/wireless-communication.html
4. http://www.dsptechnologie.com/products/specialist-semiconductors/high-reliability-integrated-circuits
5. ece.ut.ac.ir/silab/research/vlsi_comm.htm

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

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

U20ECE827	5G WIRELESS COMMUNICATION SYSTEMS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Learning the Basics of 5G and about 5G regulation protocol stack and its architecture.
- To understand the key technologies and enablers of 5G hardware technologies in 5G systems.
- To incorporate MIMO designs in 5G wireless systems analyze 5G wireless propagation channel models.
- To understand coordinated multi-point network architecture in 5G.
- To learn the new challenges in 5G modelling.

Course Outcomes

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

CO1 - Map latest 5G Technology and its benefits with past technologies **(K2)**
CO2 - Learn the fundamentals of baseband and RF implementations in 5G using massive MIMO **(K2)**
CO3 - Attain knowledge about 5GRadio Access Technologies and its channel models **(K3)**
CO4 - Understand about 5G network architecture (**K3)**
CO5 - Implementation and evaluation of 5G and its applications **(K4)**

UNIT - I INTRODUCTION AND ROADMAP TO 5G (9 Hrs)

Evolution of mobile technologies from 1G to 4G (LTE, LTEA, LTEA Pro) , An Overview of 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G. Historical trend and evolution of LTE technology to beyond 4G – Key building blocks of 5G – 5G use cases and system concepts – The 5G Architecture – IoT: relation to 5G.

UNIT - II RF FRONT END FOR 5G (9 Hrs)

Millimetre Wave Communications: Hardware technologies for mmW systems – Architecture and Mobility – Massive MIMO: Resource allocation and transceiver algorithms for massive MIMO - Fundamentals of baseband and RF implementations in massive MIMO - Beamforming.

UNIT - III 5G WAVEFORMS AND CHANNEL MODELS (9 Hrs)

5G Radio Access Technologies: Design principles - Multi-carrier with filtering - Non-orthogonal Multiple Access - Radio access for dense deployments – Radio Access for V2X Communication - Radio access for massive machine-type communication - 5G wireless propagation channel models: Modelling requirements and scenarios - The METIS channel models

UNIT - IV NETWORKING IN 5G (9 Hrs)

Coordinated multi-point transmission in 5G: Joint Transmission CoMP enablers - Distributed cooperative transmission - JT CoMP with advanced receivers - Relaying and network coding in 5G: Multi-flow wireless backhauling - Buffer-aided relaying.

UNIT - V EVALUATION OF 5G AND 5G APPLICATIONS (9 Hrs)

Machine-type communications: Fundamental techniques for MTC - Massive MTC - Ultra-reliable low-latency MTC - Device-to-device (D2D) communications - Multi-hop D2D communications - Multi-operator D2D communication - Simulation methodology: Evaluation methodology – Calibration - New challenges in the 5G modelling.

Textbooks

1. Wei Xiang, Kan Zheng, Xuemin (Sherman) Shen, - 5G Mobile Communications, Springer, 2017.
2. Afif Osseiran, Jose F. Monserrat and Patrick Marsch, - 5G Mobile and Wireless Communications Technology, Cambridge University Press, 2016. (Hardback format, 2019)
3. Athanasios G.Kanatos, Konstantina S.Nikita, Panagiotis Mathiopoulos, “New Directionsin Wireless Communication Systems from Mobile to 5G”, Taylor & Francis Inc, 2017

Reference Books

1 Jonathan rodriguez, - Fundamentals of 5G mobile networks, John Wiley & Sons, Ltd, 2015.
2 Amitabha Ghosh and Rapeepat Ratasuk “Essentials of LTE and LTE-A”, Cambridge,2011
3 University Press.D.R. Kamilo Feher Wireless Digital Communications, Prentice Hall of India, New Delhi.
4 Theodore S.Rappaport, Robert W.Heath, Robert C.Danials, James N.Murdock “Millimeter Wave Wireless Communications”, Prentice Hall Communications., 2014
5 Wong, Vincent WS, Robert Schober, Derrick Wing Kwan Ng, and Li-Chun Wang, eds. *Key technologies for 5G wireless systems*. Cambridge university press, 2017.

Web Resources

1. https://www.engineersgarage.com/article_page/5g-technology/
2. https://www.techspot.com/guides/272-everything-about-5g/
3. https://pubmed.ncbi.nlm.nih.gov/27076701/
4. https://www.gsma.com › uploads › 2019/04 › The-5g
5. https://www.engpaper.com/5g-2018.htm

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

Correlation L1evel: 1-Low, 2-Medium, 3-High

U20ECE828	BIOMEDICAL ELECTRONICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To know about basic of biomedical signal and its characteristics
- To learn about various signal conditioning circuits used in biomedical field
- To gain knowledge about basic measuring instruments in biomedical
- To study about the various assist devices used in the hospitals
- To understand recent trends in medical electronics

Course Outcomes

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

CO1 - Acquire the knowledge of basic of biomedical signal and various medical electrodes **(K2)**

CO2 - Gain the knowledge about various biomedical signal conditioning circuits **(K3)**

CO3 - Understand the working mechanism of basic bio signal measuring electronics instruments **(K3)**

CO4 - Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and Ventilators **(K3)**

CO5 - Know about recent trends in medical electronics **(K2)**

UNT-I FUNDAMENTALS OF BIOMEDICAL ELECTRONICS (9 Hrs)

Sources of biomedical signals, Generalized medical instrumentation block diagram, Origin of bio potentials - characteristics – Frequency and amplitude ranges , Bio-potential electrodes, Types of electrodes - Surface; needle and micro electrodes, Medical electrode - ECG system, EEG electrode system, EMG, EOG, ERG-typical waveforms and signal characteristics.

UNIT-II BIO 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-III BASIC MEASURING ELECTRONICS INSTRUMENTS (9 Hrs)

Multimeters – analog and digital multimeters. Frequency and time measurement – analog CRO and digital storage oscilloscope. Medical display systems – single and multichannel displays, nonfade displays, LED and LCD displays.

UNIT-IV ASSIST DEVICES (9 Hrs)

Blood pressure monitors – Electrocardioscope - Pulse Oximeter - pH meter - Auto analyzer – Pacemakers – Defibrillator - Heart lung machine - Nerve and muscle stimulators - Dialysis machines - Surgical diathermy equipments – Nebulizer; inhalator - Aspirator – Humidifier - Ventilator and spirometry.

UNIT-V RECENT TRENDS IN MEDICAL ELECTRONICS (9 Hrs)

Basics of diagnostic radiology -Nature and properties of X-rays - X-ray machine - Block diagram - Digital radiography – CT - Basic Principle - Block diagram – Radioisotopes in medical diagnosis – Physics of radioactivity – Gamma Camera. Block diagram – SPECT Scanner – PET Scanner - Principles of NMR Imaging systems - Block diagram of NMR Imaging System – Ultrasonic Imaging Systems – Magnetic Resonance Imaging Systems.

Textbooks

1. Leslie Cromwell, ‘Biomedical Instrumentation and Measurement’, Prentice Hall of India, New Delhi, 2007
2. R S Khandpur, “Handbook of Biomedical Instrumentation”, 1st ed., Tata McGraw Hill Publishing Company Limited, 2004
3. Erich A. Pfeiffer, Fred J Weibell and Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice-Hall of India Pvt.Ltd, 2011

Reference Books

1. Khandpur, R.Stata, “Handbook of Biomedical Instrumentation”, McGraw-Hill, New Delhi, 3rd edition 2014
2. John G.Webster, ‘Medical Instrumentation Application and Design’, 4rd edition, Wiley India Edition, 2015
3. Joseph J.Carr and John M.Brown John, “Introduction to Biomedical Equipment Technology”, Wiley and Sons, New York, 4th edition, 2001
4. Shakthi Chatterjee & Aubert Miller, “Biomedical Instrumentation”, CENGAGE Learning, 2010
5. Chanderlekha Goswami, “Handbook of Biomedical Instrumentation”, Manglam Publications, 2010

Web Resources

1. https://en.wikipedia.org/wiki/Biomedical_engineering
2. https://guides.lib.uh.edu/biomedical
3. https://www.google.co.in/books/edition/Handbook_of_Biomedical_Instrumentation
4. https://nptel.ac.in/courses/108/108/108108180/
5. https://nptel.ac.in/courses/102/105/102105090/

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

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

U20ECE829	ADVANCED DIGITAL IMAGE AND VIDEO PROCESSING	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain knowledge about fundamentals of image processing.
- To understand the various image segmentation techniques.
- To extract features for image analysis.
- To introduce the concepts of image registration and image fusion.
- To illustrate 3D image visualization.

Course Outcomes

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

CO1 - Explain the fundamentals of image processing **(K2)**
CO2 - Learn and Analyze various image segmentation techniques **(K2)**
CO3 - Understand extract features for image analysis. **(K2)**
CO4 - Develop knowledge about the concepts of image registration and image fusion. **(K3)**
CO5 - Identify 3D image visualization. **(K3)**

UNIT - I FUNDAMENTALS OF DIGITAL IMAGE PROCESSING (9 Hrs)

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, and SVD. Image enhancement in spatial and frequency domain, Review of morphological image processing

UNIT - II SEGMENTATION (9 Hrs)

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour methods, Texture feature-based segmentation, Model based segmentation, Atlas based segmentation, Wavelet based Segmentation methods.

UNIT - III FEATURE EXTRACTION (9 Hrs)

First and second order edge detection operators, Phase congruency, Localized feature extraction detecting image curvature, shape features Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Run length features, Fractal model based features, Gabor filter, wavelet features.

UNIT - IV LINEAR PREDICTIVE ANALYSIS OF SPEECH (9 Hrs)

Registration- Preprocessing, Feature selection-points, lines, regions and templates Feature Correspondence-Point pattern matching, Line matching, and region matching Template matching. Transformation functions-Similarity transformation and Affine Transformation. Resampling Nearest Neighbor and Cubic Splines Image Fusion-Overview of image fusion, pixel fusion, Multiresolution based fusion discrete wavelet transform, Curvelet transform. Region based fusion.

UNIT - V 3D IMAGE VISUALIZATION (9 Hrs)

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D, Measurements on 3D images.

Textbooks

1 Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2015
2 Ardeshir Goshtas by, “2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications”, John Wiley and Sons, 2005.
3 John C.Russ, “The Image Processing Handbook”, CRC Press7th edition, Taylor & Francis Inc , 2015

Reference Books

1 Mark Nixon, Alberto Aguado, “Feature Extraction and Image Processing”,2nd edition Academic Press, 2008.
2 R.C.Gonzalez and R.E. Woods, ”Digital Image Processing “, 4th edition, Pearson, 2018
3 Rick S.Blum, Zheng Liu, “Multisensor image fusion and its Applications“, Taylor& Francis,2006.
4. Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing, Analysis, and Machine Vision, Thomson Learning, 2008.
5. S Jayaraman, S Esakkirajan and T Veerakumar, Digital Image Processing, McGraw Hill Education, 2009.

Web Resources

1 http://eeweb.poly.edu/~onur/lectures/lectures.html.
2 http://www.caen.uiowa.edu/~dip/lecture/lecture.html
3 https://nptel.ac.in/courses/117105079/
4 https://nptel.ac.in/courses/108101113/
5 https://www.youtube.com/watch?v=GlL-h4IMgFk

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	1	2	-	-	-	-	-	-	-	-	-	3	-	1
2	3	1	2	-	-	-	-	-	-	-	-	-	3	-	1
3	3	1	2	-	-	-	-	-	-	-	-	-	3	-	1
4	3	1	2	-	-	-	-	-	-	-	-	-	3	-	1
5	3	1	2	-	-	-	-	-	-	-	-	-	3	-	1

Correlation L1evel: 1-Low, 2-Medium, 3-High

U20ECE830	HARDWARE SOFTWARE CO-DESIGN	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain knowledge about system specification and modeling.
- To understand the formulation of partitioning the hardware and software.
- To explore the hardware and software integration.
- To identify unified model representation.
- To understand the design specification and module creation.

Course Outcomes

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

CO1 - Describe the knowledge about system specification and modeling. (K2)
CO2 - Learn the formulation of partitioning the hardware and software. (K2)
CO3 – Discuss about the hardware and software integration. (K2)
CO4 – Illustrate the hardware design languages and its Components. (K3)
CO5 – Interpret the design specification and module creation. (K3)

UNIT I – CO-DESIGN CONCEPTS (9Hrs)

Nature of hardware & software, quest for energy efficiency, driving factors for hardware-software co design, design space, system specification and modelling- Embedded Systems-Functional decomposition, Hardware Software tradeoffs- Comparison of Co-Design Approaches, Models of Computation, Requirements for Embedded System Specification.

UNIT II– METHODOLOGY FOR CO-DESIGN (9Hrs)

Partitioning source description into different implementation domains, Dataflow modeling and transformation, Dataflow implementation in Hardware and Software, Analysis of Control flow and Dataflow, hardware-software co-synthesis, Distributed System Co-Synthesis.

UNIT III– HARDWARE-SOFTWARE INTEGRATION (9Hrs)

Prototyping and Emulation Techniques, Target Architectures-Micro Programmed Architectures, General-Purpose Embedded Cores, System-on-Chip, Hardware-Software Interfaces, Principles of Hardware/Software Communication, Microprocessor Interfaces, Hardware Interfaces.

UNIT IV– OBJECTED ORIENTED HARDWARE DESIGN (9Hrs)

Motivation for object-oriented techniques, object-oriented design strategies, modelling hardware components as classes, designing specialized components, data decomposition, and Processor example.

UNIT V – SYSTEM C PROGRAMMING (9Hrs)

Design Methodology, Modules and Hierarchy, Processes, Ports and signals, Data types, Simulation using System C. CASE STUDY: Processor/Coprocessor design using System C.

Textbooks

1. Vahid and Frank, “Embedded System Design: A Unified Hardware/Software –Introduction”, Wiley, 2002.
2. Alex Jantsch, “Modeling Embedded Systems and SOC’s. Concurrency and Time in Models of Computation”, MK, 2004.
3. Giovanni De Micheli, Rolf Ernst Morgon,” Reading in Hardware/Software Co-Design “Kaufmann Publishers,2001.

Reference Books

1. Patrick Schaumont “A Practical Introduction to Hardware/Software Co-design”, Patrick Schaumont, Springer, 2012.
2. Wolf and Wayne, “Computers as Components: Principles of Embedded Computing System Design”, MK, 2001.
3. Grotker T, Liao S, Martin G and Swan S, “System design with System C”, Kluwer Academic Publishers, 2002.
4. Frank Vahid, Tony Givargis, “Embedded System Design”, John Wiley. 4th Edition 2010.
5. David E. Simon, “An Embedded Software Primer” Pearson Education, 4th Edition 2010

Web Resources

1. http://embedded.eecs.berkeley.edu/research/hsc/class.F04/index.html
2. http://www.tik.ee.ethz.ch/tik/education/lectures/ES/
3. http://www1.cs.columbia.edu/~sedwards/classes/2004/4840/
4. http://courses.cs.tamu.edu/rabi/cpsc489/resources.shtml
5. http://ptolemy.eecs.berkeley.edu/ptolemyII/ptII10.0/ptII10.0.1_20141217/ptolemy/domains/continuous/doc/index.htm

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

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