SRI MANAKULA VINAYAGAR ENGINEERING COLLEGE

(An Autonomous Institution)

Puducherry - 605 107

B.Tech - Electronics and Communication Engineering

(REGULATIONS-2019)

CURRICULUM & SYLLABI

Recommended by Board of Studies	28th August 2021
Approved by Academic Council	3rd Academic Council Meeting (Date:16th December 2021)

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 in collaboration with industries and institutions globally for creating intellectuals with new avenues

M3: Employability and Entrepreneurship: To inculcate the employability and entrepreneurial skills through value and skill-based training

M4 : Ethical Values : To instill deep sense of human values by blending societal righteousness with academic professionalism for the growth of society

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 field of 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 intra personal skills among students to make them employable and entrepreneurs

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

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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 and environmental 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 community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance:

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

PO12: Life-long learning:

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

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 adaptto 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 welfareof 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)	09
2	Basic Sciences (BS)	34
3	Engineering Sciences (ES)	36
4	Professional Core (PC)	64
5	Professional Electives (PE)	18
6	Open Electives (OE)	09
7	Project Work (PW) and Internship	12
8	Employability Enhancement Courses (EEC)	-
9	Mandatory courses (MC)	-
	Total Credits	**182**

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)	4	-	-	-	3	-	1	1	09
2	Basic Science (BS)	16	12	3	-	3	-	-	-	34
3	Engineering Sciences (ES)	10	18	8	-	-	-	-	-	36
4	Professional Core (PC)	-	-	10	15	12	15	9	3	64
5	Professional Electives (PE)	-	-	-	3	3	3	3	6	18
6	Open Electives (OE)	-	-	-	3	-	3	3	-	09
7	Project Work (PW)	-	-	-	-	-	-	2	8	10
8	Internship (PW)	-	-	-	-	-	-	2	-	2
9	Employability Enhancement Courses (EEC*)	-	-	-	-	-	-	-	-	-
10	Mandatory courses (MC*)	-	-	-	-	-	-	-	-	-
	Total	**30**	**30**	**21**	**21**	**21**	**21**	**20**	**18**	**182**

** EEC and MC are not included for CGPA calculation*

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

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

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

SEMESTER – III							21	700	600	1300
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U19ECT31	Numerical Methods and Optimization	BS	2	2	0	3	25	75	100
2	U19ECT32	Data Structures	ES	3	0	0	3	25	75	100
3	U19ECT33	Electron Devices	PC	3	0	0	3	25	75	100
4	U19ECT34	Electrical Engineering	ES	3	0	0	3	25	75	100
5	U19ECT35	Circuits and Networks	PC	2	2	0	3	25	75	100
6	U19ECT36	Electromagnetic Field Theory	PC	3	0	0	3	25	75	100
Practical										
7	U19ECP31	Data Structures Laboratory	ES	0	0	2	1	50	50	100
8	U19ECP32	Electrical Engineering Laboratory	ES	0	0	2	1	50	50	100
9	U19ECP33	Electron Devices Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19ECC3X	Certification Course -I**	EEC	0	0	4	-	100	-	100
11	U19ECS31	Skill Development Course 1: General Proficiency –I	EEC	0	0	2	-	100	-	100
12	U19ECS32	Skill Development Course 2*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19ECM31	Physical Education	MC	0	0	2	-	100	-	100

SEMESTER – IV										
Sl. No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U19ECT41	Signals and Systems	PC	2	2	0	3	25	75	100
2	U19ECT42	Analog Electronic Circuits	PC	3	0	0	3	25	75	100
3	U19ECT43	Digital Electronic Circuits	PC	3	0	0	3	25	75	100
4	U19ECT44	Communication Systems	PC	3	0	0	3	25	75	100
5	U19ECE4X	Professional Elective – I#	PE	3	0	0	3	25	75	100
6	U19XXO4X	Open Elective – I$	OE	3	0	0	3	25	75	100
Practical										
7	U19ECP41	Analog Electronic Circuits Laboratory	PC	0	0	2	1	50	50	100
8	U19ECP42	Digital Electronic Circuits Laboratory	PC	0	0	2	1	50	50	100
9	U19ECP43	Communication Systems Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19ECC4X	Certification Course -II**	EEC	0	0	4	-	100	-	100
11	U19ECS41	Skill Development Course 3: General Proficiency – II	EEC	0	0	2	-	100	-	100
12	U19ECS42	Skill Development Course 4*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19ECM41	Indian Constitution	MC	2	-	-	-	100	-	100
							21	700	600	1300

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

SEMESTER – V										
Sl.No.	**Course code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U19ECT51	Probability and Random Processes	BS	2	2	0	3	25	75	100
2	U19ECT52	Linear Integrated Circuits	PC	3	0	0	3	25	75	100
3	U19ECT53	Microcontroller	PC	3	0	0	3	25	75	100
4	U19ECT54	Digital Signal Processing	PC	2	2	0	3	25	75	100
5	U19ECE5X	Professional Elective - II#	PE	3	0	0	3	25	75	100
6	U19XXO5X	Open Elective-II$	HS	3	0	0	3	25	75	100
Practical										
7	U19ECP51	Linear Integrated Circuits Laboratory	PC	0	0	2	1	50	50	100
8	U19ECP52	Microcontroller Laboratory	PC	0	0	2	1	50	50	100
9	U19ECP53	Digital Signal Processing Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19ECC5X	Certification Course -III**	EEC	0	0	4	-	100	-	100
11	U19ECS51	Skill Development Course 5: Foreign Language/ IELTS- I	EEC	0	0	2	-	100	-	100
12	U19ECS52	Skill Development Course 6:Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19ECM51	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	700	600	1300

SEMESTER – VI										
Sl. No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U19ECT61	Control Systems	PC	2	2	0	3	25	75	100
2	U19ECT62	Digital VLSI System Design	PC	3	0	0	3	25	75	100
3	U19ECT63	Wireless Communication	PC	3	0	0	3	25	75	100
4	U19ECT64	Transmission Lines and Antennas	PC	3	0	0	3	25	75	100
5	U19ECE6X	Professional Elective - III#	PE	3	0	0	3	25	75	100
6	U19XXO6X	Open Elective-III$	OE	3	0	0	3	25	75	100
Practical										
7	U19ECP61	VLSI Design Laboratory	PC	0	0	2	1	50	50	100
8	U19ECP62	Wireless Communication Laboratory	PC	0	0	2	1	50	50	100
9	U19ECP63	Electronic Design Workshop	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19ECC6X	Certification Course -IV**	EEC	0	0	4	-	100	-	100
11	U19ECS61	Skill Development Course 7: Foreign Language/IELTS - II	MC	0	0	2	-	100	-	100
12	U19ECS62	Skill Development Course 8: Technical Seminar	MC	2	0	0	-	100	-	100
13	U19ECS63	Skill Development Course 9: NPTEL/MOOC-I	MC	0	0	0	-	100	-	100
Mandatory Course										
14	U19ECM61	Professional Ethics	MC	2	0	0	-	100	-	100
							21	800	600	1400

 # Professional Electives are to be selected from the list given in Annexure I
$Open electives are to be selected from the list given in Annexure II

*** Certification courses are to be selected from the list given in Annexure III*

SEMESTER – VII										
Sl. No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U19ECT71	Millimeter and Optical Wave Communication	PC	3	0	0	3	25	75	100
2	U19ECT72	Internet of Things	PC	3	0	0	3	25	75	100
3	U19ECE7X	Professional Elective – IV#	PE	3	0	0	3	25	75	100
4	U19XXO7X	Open Elective – IV$	OE	3	0	0	3	25	75	100
Practical										
5	U19ECP71	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U19ECP72	High Frequency Communication Laboratory	PC	0	0	2	1	50	50	100
7	U19ECP73	Internet of Things Laboratory	PC	0	0	2	1	50	50	100
8	U19ECP74	Comprehensive Viva Voce	PC	0	0	2	1	50	50	100
Project Work										
9	U19ECW71	Project Phase – I	PW	0	0	4	2	50	50	100
10	U19ECW72	Internship / Inplant Training	PW	0	0	0	2	100	-	100
							20	500	500	1000

SEMESTER – VIII										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U19ECT81	Cyber Physical System and Security	PC	3	0	0	3	25	75	100
2	U19ECE8X	Professional Elective – V#	PE	3	0	0	3	25	75	100
3	U19ECE8X	Professional Elective – VI#	PE	3	0	0	3	25	75	100
Practical										
4	U19ECP81	Entrepreneurship Management	HS	0	0	2	1	100	-	100
Project Work										
5	U19ECW81	Project phase – II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U19ECS81	Skill Development Course10: NPTEL/MOOC-II	MC	0	0	0	-	100	-	100
							18	315	285	600

 # Professional Electives are to be selected from the list given in Annexure I

$ Open electives are to be selected from the list given in Annexure II

*** Certification courses are to be selected from the list given in Annexure III*

Annexure – I

1

PROFESSIONAL ELECTIVE COURSES

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U19ECE41	Computer Networks
2	U19ECE42	Sensors for Industrial Applications
3	U19ECE43	Computer Architecture
4	U19ECE44	PLC and SCADA Systems and its Applications
5	U19ECE45	Introduction to MEMS
Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U19ECE51	Hardware Description Languages
2	U19ECE52	Vehicular Communication
3	U19ECE53	Industry 4.O Technology
4	U19ECE54	Information Theory and Coding
5	U19ECE55	Robotics and Control
Professional Elective – III (Offered in Semester VI)		
Sl. No.	**Course Code**	**Course Title**
1	U19ECE61	Low Power VLSI Design
2	U19ECE62	Aircraft communication and Navigation Systems
3	U19ECE63	Nano Electronics and Devices
4	U19ECE64	Speech and Audio Signal Processing
5	U19ECE65	Soft Computing
Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U19ECE71	CAD for VLSI Circuits
2	U19ECE72	Satellite Communication
3	U19ECE73	Fuzzy logic and Neural Network
4	U19ECE74	Biomedical Signal Processing
5	U19ECE75	Wireless Sensor Networks
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U19ECE80	VLSI for Communication Systems
2	U19ECE81	Machine Learning for Wireless Communication
3	U19ECE82	Virtual and Augmented Reality
4	U19ECE83	Adaptive Signal Processing
5	U19ECE84	Real Time Systems
Professional Elective – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U19ECE85	High Speed Electronics
2	U19ECE86	5G Wireless Communication Systems
3	U19ECE87	Biomedical Electronics
4	U19ECE88	Advanced Digital Image and Video Processing
5	U19ECE89	Hardware Software Co-design

Annexure – II
OPEN ELECTIVE COURSES

Sl.No	Course Code	Course Title	Offering Department	Permitted Departments
Open Elective – I (Offered in Semester IV)				
1	U19EEO41	Solar Photovoltaic Fundamentals andApplications	EEE	ECE, ICE, MECH, CIVIL, Mechatronics
2	U19EEO42	Electrical Safety	EEE	ECE, ICE, MECH, CIVIL, Mechatronics, BME, IT, CSE
3	U19ECO41	Engineering Computation with MATLAB	ECE	ICE, EEE, MECH, CIVIL, BME, Mechatronics
4	U19ECO42	Consumer Electronics	ECE	EEE, ICE, CSE, MECH, IT, CIVIL, BME, Mechatronics
5	U19CSO41	Web Development	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
6	U19CSO42	Analysis of Algorithms	CSE	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
7	U19CSO43	Programming in JAVA	CSE	ECE, MECH, Mechatronics
8	U19ITO41	Database System: Design &Development	IT	EEE, ECE, ICE, BME
9	U19ITO42	R programming	IT	EEE, ECE, ICE, BME, MECH, Mechatronics
10	U19ICO41	Sensors and Transducers	ICE	ECE, CSE, IT, MECH, CIVIL
11	U19ICO42	Control System Engineering	ICE	CSE, IT, MECH
12	U19MEO41	Rapid Prototyping	MECH	EEE, ECE, ICE, CIVIL, BME
13	U19MEO42	Material Handling System	MECH	EEE, ICE, CIVIL, Mechatronics
14	U19MEO43	Power Plants for Electrical Engineering	MECH	EEE
15	U19CEO41	Energy and Environment	CIVIL	EEE, ECE, MECH, BME, IT, Mechatronics
16	U19CEO42	Building Science and Engineering	CIVIL	EEE, MECH, BME
17	U19BMO41	Medical Electronics	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
18	U19BMO42	Telemedicine	BME	EEE, ECE, CSE, IT, ICE
19	U19CCO41	Basic DBMS	CCE	EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME
20	U19CCO42	Introduction to Communication Systems	CCE	EEE, CSE, IT, MECH, CIVIL, ICE, Mechatronics
Open Elective – II / Open Elective – III				
1	U19HSO51 / U19HSO61	Product Development and Design	MBA	**Common to B. Tech** (Offered in Semester V for **EEE,ECE, ICE, CIVIL, BME**) (Offered in Semester VI for **CSE,IT, MECH, Mechatronics**)
2	U19HSO52 / U19HSO62	Intellectual Property and Rights	MBA	
3	U19HSO53 / U19HSO63	Marketing Management and Research	MBA	
4	U19HSO54 / U19HSO64	Project Management for Engineers	MBA	
5	U19HSO55 / U19HSO65	Finance for Engineers	MBA	

Open Elective – II / Open Elective – III (Offered in Semester V for **CSE, IT, MECH, Mechatronics**) (Offered in Semester VI for **EEE, ECE, ICE, CIVIL, BME**)				
1	U19EEO53 / U19EEO63	Conventional and Non-Conventional Energy Sources	EEE	ECE, ICE, MECH, CIVIL, BME, Mechatronics
2	U19EEO54 / U19EEO64	Industrial Drives and Control	EEE	ECE, ICE, MECH, Mechatronics
3	U19ECO53 / U19ECO63	Electronic Product Design and Packaging	ECE	EEE, CSE, IT, ICE, BME, MECH, Mechatronics
4	U19ECO54 / U19ECO64	Automotive Electronics	ECE	EEE, ICE, MECH
5	U19CSO54 / U19CSO64	Platform Technology	CSE	EEE, ECE, ICE, MECH, CIVIL,BME
6	U19CSO55 / U19CSO65	Graphics Designing	CSE	EEE, ECE, ICE, MECH, CIVIL,BME
7	U19ITO53 / U19ITO63	Essentials of Data Science	IT	EEE, ECE, ICE, MECH, CIVIL,BME
8	U19ITO54 / U19ITO64	Mobile App Development	IT	EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics
9	U19ITO55 / U19ITO65	Data Structures	IT	MECH
10	U19ICO53 / U19ICO63	Fuzzy logic and neural networks	ICE	CSE, IT, CIVIL, BME
11	U19ICO54 / U19ICO64	Measurement and Instrumentation	ICE	ECE, Mechatronics
12	U19MEO54 / U19MEO64	Heating, ventilation and air conditioning system (HVAC)	MECH	EEE, ECE, ICE, CIVIL
13	U19MEO55 / U19MEO65	Creativity Innovation and New Product Development	MECH	EEE, ECE, ICE, CIVIL, BME, Mechatronics
14	U19CEO53 / U19CEO63	Disaster Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH,BME
15	U19CEO54 / U19CEO64	Air Pollution and Solid Waste Management	CIVIL	EEE, ECE, CSE, IT, ICE, MECH,BME
16	U19BMO53 / U19BMO63	Biometric Systems	BME	EEE, ECE, CSE, IT, ICE, MECH, Mechatronics
17	U19BMO54 / U19BMO64	Medical Robotics	BME	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, Mechatronics
18	U19CCO53 / U19CCO63	Network Essentials	CCE	EEE, MECH, CIVIL, ICE, Mechatronics, BME
19	U19CCO54 / U19CCO64	Web Programming	CCE	EEE, ECE, MECH, CIVIL, ICE, BME Mechatronics,
20	U19ADO51 / U19ADO61	Principle of Artificial Intelligence and Machine Learning	AI&DS	EEE, ECE, CSE, IT, ICE, MECH,CIVIL
21	U19ADO52 / U19ADO62	Data science Application of Vision	AI&DS	EEE, ECE, CSE, IT, ICE, MECH, CIVIL, BME, Mechatronics

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

Annexure - III

EMPLOYABILITY ENHANCEMENT COURSES – (A) CERTIFICATION COURSES

Sl. No	Course Code	Course Title
1	U19ECCX1	Introduction to C++ Programming
2	U19ECCX2	Python Programming
3	U19ECCX3	Embedded System Using C
4	U19ECCX4	Data Science using R
5	U19ECCX5	CCNA
6	U19ECCX6	VLSI Design
7	U19ECCX7	Embedded System Design using Arduino
8	U19ECCX8	Digital Signal Processing Development System
9	U19ECCX9	Internet of Things

Annexure – IV

EMPLOYABILITY ENHANCEMENT COURSES – (B) SKILL DEVELOPMENT COURSES

Sl. No	Course Code	Course Title
1	U19ECS31	Skill Development Course 1 : General Proficiency - I
2	U19ECS32	Skill Development Course 2*
		1) Computer Hardware and Troubleshooting
		2) PCB Design
		3) Demonstration of Electronic Equipments
3	U19ECS41	Skill Development Course 3 : General Proficiency - II
4	U19ECS42	Skill Development Course 4 *
		1) Mobile Servicing
		2) Autonomous Robot
		3) Repair and Maintenance of Electronic Equipments
5	U19ECS51	Skill Development Course 5 : Foreign Language/ IELTS -I
6	U19ECS52	Skill Development Course 6 : Presentation Skills using ICT
7	U19ECS61	Skill Development Course 7 : Foreign Language/ IELTS - II
8	U19ECS62	Skill Development Course 8 : Technical Seminar
9	U19ECS63	Skill Development Course 9 : NPTEL/MOOC - I
10	U19ECS81	Skill Development Course 10 : 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	T101	Mathematics – I	BS	3	1	0	4	25	75	100
2	T102	Physics	BS	4	0	0	4	25	75	100
3	T103	Chemistry	BS	4	0	0	4	25	75	100
4	T110	Basic Civil and Mechanical Engineering	ES	4	0	0	4	25	75	100
5	T111	Engineering Mechanics	ES	3	1	0	4	25	75	100
6	T112	Communicative English	HS	4	0	0	4	25	75	100
Practical										
7	P104	Physics lab	BS	0	0	3	2	50	50	100
8	P105	Chemistry lab	BS	0	0	3	2	50	50	100
9	P106	Workshop Practice	ES	0	0	3	2	50	50	100
							30	300	600	900

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

Course Objectives

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

Course Outcomes

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

CO1 – Understand the concept of curvature. **(K2)**
CO2 –Solve different types of partial differential equation. **(K3)**
CO3 – Understand the concept of double and triple integrals. **(K2)**
CO4 – Solve differential equations**. (K3)**
CO5 – Solve higher order differential equations. **(K3)**

UNIT I CALCULUS (12Hrs)

Curvature, radius of curvature, evolutes and involutes. Beta and Gamma functions and their properties.

UNIT II FUNCTIONS OF SEVERAL VARIABLES (12Hrs)

Partial derivatives, Total derivatives, Differentiation of implicit functions, Change of Variables, Jacobians and their properties, Taylor’s series for functions of two variables, Maxima and minima, Lagrange’s method of undetermined multipliers.

UNIT III MULTIPLE INTEGRALS AND APPLICATIONS (12Hrs)

Multiple Integrals, change of order of integration and change of variables in double integrals (Cartesian to polar). Applications: Areas by double integration and volumes by triple integration (Cartesian and polar).

UNIT IV DIFFERENTIAL EQUATIONS (12Hrs)

Exact equations, First order linear equations, Bernoulli’s equation, orthogonal Trajectories, growth, decay and geometrical applications. Equations not of first degree: Equations solvable for p, equations solvable for y, equations solvable for x and Clairaut’s type.

UNIT V DIFFERENTIAL EQUATIONS (Higher order) (12Hrs)

Linear differential equations of higher order - with constant coefficients, the operator D, Euler’s linear equation of higher order with variable coefficients, simultaneous linear Differential equations, solution by Variation of parameters method simple application to Electric circuits.

Text Books

1.Venkataraman M.K, Engineering Mathematics-First year, National Publishing Company, Chennai, 2010
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41stEdition, 2011.
3. Dr. A. Singaravelu, “Engineering Mathematics - I”, Meenakshi publications, Tamil Nadu, 2011.

Reference Books

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

Web Resources

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

COs/POs/PSOs Mapping

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

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

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

Course Objectives

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

Course Outcomes

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

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

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

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

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

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

UNIT I ACOUSTICS & NDT (9 Hrs)

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

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

UNIT II OPTICS (9 Hrs)

Interference - Air Wedge – Michelson's Interferometer - Wavelength Determination – Interference Filter – Antireflection Coatings

Diffraction - Diffraction Grating – Dispersive power of grating - Resolving Power of Grating & Prism

Polarisation Basic concepts of Double Refraction - Huygens Theory of Double Refraction- Quarter and Half Wave Plates – Specific Rotary Power – Laurent Half Shade Polarimeter

UNIT III LASERS & FIBER OPTICS (9 Hrs)

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

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

UNIT IV WAVE MECHANICS (9 Hrs)

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

UNIT V NUCLEAR ENERGY SOURCE (9 Hrs)

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

Text Books

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

2. Arthur Beiser, Concepts of Modern Physics, 6th Edition, TMH, New Delhi 2008.

Reference Books

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

Web References

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

COs/POs/PSOs Mapping

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

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

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

Course Objectives

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

Course Outcomes

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

CO1 – Understand the basic concept of hardness of water, the chemicals responsible for it, measurement of hardness, its disadvantages and its removal. **(K2)**
CO2 – Understand the synthesis of various organic and inorganic polymer **(K3)**
CO3 – Understand the application of the concept of oxidation and reduction reaction to various cells **(K2)**
CO4 – Understand the application of electrochemistry in corrosion of metals and also about different types of corrosion control methods **(K3)**
CO5 – Understand the concept of phase equilibrium and its application to different types of heterogeneous equilibrium system like eutectic alloys.**(K3)**

UNIT I – WATER (9 Hrs)

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

UNIT II – POLYMER (9 Hrs)

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

UNIT III – ELECTROCHEMICAL CELLS (9 Hrs)

Galvanic cells, single electrode potential, standard electrode potential, electromotive series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes–hydrogen, calomel, Ag/AgCl& glass electrodes. Batteries– primary and secondary cells, Leclanche cell, Lead acids to rage cell, Ni-Cd battery& alkaline battery. Fuel cells–H2-O2 fuel cell

UNIT IV – CORROSION ANDITSCONTROL (9 Hrs)

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

UNIT V – PHASE RULE (9 Hrs)

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

Text Books

1. P.C. Jain and Monika Jain, Engineering Chemistry, DhanpatRai and Sons, New Delhi 15th Ed,2010.
2. B.Sivasankar (2008) , "Engineering Chemistry ", Tata McGraw Hill , India
3. Shaley Oberoi & Monica Malik (2009), "Engineering Chemistry made easy", Cengage Learning, Delhi.

4. Engineering Chemistry by Rama Devi, Venkata Ramana Reddy and Rath, Cengage learning, New Delhi. (2016)
5. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi (2015)

Reference Books

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

Web References

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

COs/POs/PSOs Mapping

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

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

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

Course Objectives

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

Course Outcomes

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

CO1 - Understand the basic concepts of different types of buildings and building materials. **(K3)**
CO2 - Learn various types of building components and their functions. **(K3)**
CO3 - Describe the importance of the basic infrastructure. **(K3)**
CO4 - Understand the classification of engines, low pressure Steam generators, its mounting and accessories**.** **(K2)**
CO5 - Apply the knowledge of thermal systems and equipment's in power plants and analyze the way of harnessing the renewable energies and its utilization. **(K3)**
CO6 - Understand the basic principles of machining, manufacturing and metal joining processes such as Lathe machine, Drilling, Grinding, Welding, green sand moulding foundry process. **(K2)**

PART – A CIVIL ENGINEERING

UNIT I BUILDINGS, BUILDING MATERIALS (8 Hrs)
Buildings-Definition-Classification according to NBC-plinth area, Floor area, carpet area, floor space index-construction materials-stone, brick , cement, cement-mortar, concrete, steel-their properties and uses.

UNIT II BUILDINGS AND THEIR COMPONENTS (8 Hrs)
Buildings: Various Components and their functions. Soils and their classification. Foundation: function and types. Masonry-function and types. Floors: definition and types of floors. Roofs: definition and types.

UNIT III BASIC INFRASTRUCTURE (7 Hrs)
Surveying: classification, general principles, types, Uses, instruments used. Roads- types: components, types and their advantage and disadvantages. Bridges: components and types of bridges. Dams: purpose, types of dams. Water supply- sources and quality requirements, need and principles of rainwater harvesting.

PART- B MECHANICAL ENGINEERING

UNIT IV INTERNAL AND EXTERNAL COMBUSTION SYSTEMS (7 Hrs)
IC engines – Classification – Working principles – Diesel and petrol engines: two stroke and four stroke engines – Merits and demerits.
Steam generators (Boilers) – Classification – Constructional features (of only low pressure boilers) – Boiler mountings and accessories – Merits and demerits – Applications.

UNIT V POWER GENERATION SYSTEMS (7 Hrs)
Conventional and Non-Conventional: Hydraulic – Thermal – Nuclear Power plants – Schemes and layouts (Description only)
Solar – Wind – Geothermal – Wave – Tidal and Ocean Thermal Energy Conversion systems – Basic power plant schemes and layouts (Description only).

UNIT VI MANUFACTURING PROCESS (8 Hrs)
Machines – Lathe – Drilling – Bending – Grinding – Shearing (Description only) Machine Process – Turning – Planning – Facing – Blanking – Drilling – Punching – Shearing – Bending – Drawing – Filling – Sawing – Grinding. Moulding and Metal Joining – Pattern making – Green and dry sand moulding – Arc and Gas welding – Brazing – Soldering (process description only).

Text Books

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

Reference Books

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

Web References

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

COs/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	1	1	2	1	-	1	2	1	3	-	-	-
2	3	1	3	1	1	2	1	-	1	2	1	3	-	-	-
3	3	1	3	1	1	2	1	-	1	2	1	3	-	-	-
4	3	2	1	-	-	1	2	-	-	-	-	3	1	1	-
5	3	2	2	2	2	2	2	-	-	-	-	3	1	1	-
6	3	2	2	2	2	2	2	-	-	-	-	3	1	1	-

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

T111

ENGINEERING MECHANICS

(Common to all branches)

L	T	P	C	Hrs
3	1	0	4	60

Course Objectives

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

Course Outcomes

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

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

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

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

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

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

UNIT I FUNDAMENTAL OF MECHANICS (12 Hrs)

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

UNIT II PRACTICAL APPLICATION OF FORCE SYSTEM (12 Hrs)

Structural member: Definition, degree of freedom, concept of free body diagrams, types of supports and reactions, types of loads, Analysis of trusses-method of joints, method of sections.

Friction: Introduction, Static dry friction, simple contact friction problems, ladders, wedges.

UNIT III PROPERTIES OF SURFACES (12 Hrs)

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

UNIT IV KINEMATICS AND KINETICS OF PARTICLES (12 Hrs)

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

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

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

Text Books

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

Reference Books

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

5. D.P.Sharma “Engineering Mechanics”, Dorling Kindersley India Pvt. Ltd, New Delhi, 2010.

Web References

1. http://nptel.iitm.ac.in/video.php?subjectId=112103108
2. http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR / Engineering mechanics / Table of Contents.html
3. https://nptel.ac.in/courses/112/106/112106286/
4. https://www.coursera.org/learn/engineering-mechanics-statics
5. https://nptel.ac.in/courses/122/104/122104014/

COs/POs/PSOs Mapping

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

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

		L	T	P	C	Hrs
T112	**COMMUNICATIVE ENGLISH** (Common to all the branches)	**4**	**0**	**0**	**4**	**45**

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

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

CO1 - Procure holistic development of LSRW skills **(K2)**

CO2 - Gain efficacies to compete confidently in the interviews **(K3)**

CO3 - Effectively enhances the oral communication skills **(K3)**

CO4 - Select compile and synthesize information for written mode of communication **(K2)**

CO5 - Familiarize and Excels in different business correspondence in work place **(K3)**

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

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

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

UNIT IV BUSINESS WRITING / CORRESPONDENCE (9Hrs)
Report writing – Memoranda – Notice – Instruction– Letters – Resumes – Job applications

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

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

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

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

COs/POs/PSOs Mapping

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

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

P104

PHYSICS LAB

(Common to all the branches)

L	T	P	C	Hrs
0	0	3	2	30

Course Objectives

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

Course Outcomes

On successful completion of the course, students will be able to

CO1 - Ability to operate optical equipments like Spectrometer, Polarimeter to find the optical properties like dispersive power, Resolving power and specific rotatory power. **(K2)**

CO2 - Capable of handling screw gauge, venire caliper and travelling microscope to calculate the required parameters. **(K4)**

CO3 - Acquired basic knowledge about Thermal conduction and magnetic field due to a current carrying coil. **(K3)**

CO4 - Ability to prepare formal laboratory reports describing the results of experiments and to interpret the data from the experiments. **(K5)**

List of experiments (Any 10 Experiments)

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

COs/POs/PSOs Mapping

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

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

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

Course Objectives

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

Course Outcomes

On successful completion of the course, students will be able to

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

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

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

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

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

List of experiments

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

Demonstration Experiments

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

Reference Books

1. Vogel's Text book of Macro and Semimicro Qualitative Analysis G. Svehla, Longman Inc., Newyork. 1997
2. Basic Principles of Practical Chemistry, Venkateswaran. V, Veeraswmay. R, Kulandaivelu. A.R., Pearson Education. 1989.
3. Vogel's Text book of Quantitative Analysis, Mendham. J, Denney. R.C, Bames. J.D, and Thomas, M. Pearson Education. 1989.
4. Practical Chemistry, D. N Bajpai, S. Giri and O P Pandey, Chand Publishing 2013
5. Allied Practical Chemsitry, A R Kulandaivelu , V Venkateswaran & R Veeraswamy, Chand Publications, 2001

Web References

1. https://edu.rsc.org/resources/titration-screen-experiment/2077.article
2. https://edu.rsc.org/resources/aspirin-screen-experiment/1644.article
3. https://www.stem.org.uk/resources/collection/3959/practical-chemistry
4. https://www.scienceinschool.org/2010/issue14/practical
5. http://www.chemlabs.bris.ac.uk/outreach/resources/Teachers_Websites.html

COs/POs/PSOs Mapping

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

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

P106 **WORKSHOP PRACTICE**
(Common to all the branches)

L	T	P	C	Hrs
0	0	3	2	30

Course Objectives

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

Course Outcomes

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

CO1 - Understand the functioning and usage of basic hand tools of fitting, welding and carpentry. **(K2)**
CO2 - Apply the knowledge of fitting tools and machineries to perform the exercise on fitting joints like symmetric asymmetric and angular fitting. **(K3)**
CO3 - Apply the knowledge of gas and Arc welding principles to perform to join the metal with joints like Lap and V- Butt joints. **(K3)**
CO4 - Apply the knowledge of metal joining process using sheet metals and to perform to make tray and frustum. **(K3)**
CO5 - Apply the knowledge of carpentry tools and equipment's to perform the joints like mortise and half lap joint. **(K3)**

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

LIST OF EXERCISES

I - FITTING

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

II - WELDING

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

III - SHEET METAL WORK

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

IV - CARPENTRY

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

Reference Books

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

Web References

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

COs/POs/PSOs Mapping

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

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

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

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

Course Objectives

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

Course Outcomes

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

CO 1 – Understand the concept of Eigen values and Eigen vectors, Diagonalization of a matrix. **(K2)**
CO 2 – Understand the use of vector calculus. **(K2)**
CO 3 – Apply Laplace transform of simple function. **(K3)**
CO 4 – Apply inverse Laplace transform of simple functions**. (K3)**
CO 5 – Compute Fourier transforms of various functions. **(K3)**

UNIT I MATRICES (12 Hrs)

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

UNIT II VECTOR CALCULUS (12 Hrs)

Gradient, divergence and curl, their properties and relations.Gauss divergence theorem and Stoke’s theorem (without proof).Simple application problems.

UNIT III LAPLACE TRANSFORMS (12 Hrs)

Definition, Transforms of elementary functions, properties. Transform ofderivatives and Integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and Final value theorems.

UNIT IV APPLICATIONS OF LAPLACE TRANSFORM (12 Hrs)

Methods for determining inverse Laplace Transforms, convolution theorem, Application to differential equations and integral equations. Evaluation of integrals by Laplace transforms.

UNIT V FOURIER TRANSFORMS (12 Hrs)

Fourier Integral theorem (statement only), Fourier transform and its inverse, properties. Fourier sine and cosine transforms their properties, convolution and Parseval’s identity.

Text Books

1.Venkataraman M.K., Engineering Mathematics, National Publishing Company, Chennai, 2012
2. Kandasamy P. et al, Engineering Mathematics, Vol.2 & 3, S. Chand & Co., New Delhi.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

Reference Books

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 1^{st} Edition, 2011.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11^{th} Reprint, 2010.
3. Erwin Kreyszig Advanced Engineering Mathematics, John Wiley & Sons, New Delhi.
4. Bali N. and Goyal M., Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7^{th} Edition, 2010.
5. Balaji.G, Engineering Mathematics – II, Balaji Publication, 4^{th} edition, 2010.

Web Resources

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

COs/POs/PSOs Mapping

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

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

T108

MATERIAL SCIENCE
(Common to all branches)

L	T	P	C	Hrs
4	**0**	**0**	**3**	**45**

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

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

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

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

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

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

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

UNIT I - CRYSTAL STRUCTURE AND LATTICE DEFECTS (12 Hrs)
Crystal structure - Bravais Lattices, Crystal Systems –– Coordination Number, Atomic Radius, Packing Factor for FCC & HCP structures – Miller Indices- Powder X Ray Diffraction Method
Lattice defects – Qualitative ideas of point, line, surface and volume defects

UNIT II – DIELECTRIC PROPERTIES (12 Hrs)
Dielectric Polarization and Mechanism –Temperature dependence of polarization, Internal or local Field-Clausius-Mossotti relation. Basic ideas of Dielectric loss - frequency dependence of dielectric constant – Measurement of Dielectric constant and loss using Scherring bridge – Elementary ideas of Piezoelectrics, Ferroelectrics and Pyroelectric materials and Applications

UNIT III – MAGNETIC PROPERTIES (12 Hrs)
Origin of atomic magnetic moment – Bohr magneton-Elementary Ideas of classification of magnetic materials (Dia, Para, Ferro, antiferro & Ferri). – Quantum theory of Para & Ferro Magnetism – Domain Theory of Hysteresis – Heisenberg Theory of Exchange Interaction (without derivation) – Qualitative ideas of Anti ferromagnetic Ordering – Structure and Properties of Ferrites – Properties of Soft & Hard Magnetic Materials – Applications. Magnetic data storage – Magnetic tapes, Hard disks, Magneto optical recording

UNIT IV – SEMICONDUCTORS AND SUPERCONDUCTORS (12 Hrs)
Semiconductors -Derivation of Carrier concentration in intrinsic Semiconductors –Basic ideas of Electrical conductivity in intrinsic and extrinsic semiconductors (without derivations) -temperature dependence of carrier concentration and electrical conductivity in semiconductors (qualitative ideas), Hall effect in Semiconductors -- Application of Hall Effect, Basic Ideas of Compound Semiconductors (II-VI & III-V)
Superconductivity - Basic concepts – transition temperature – Meissener effect – Type I and II superconductors – high temperature superconductors – 123 superconductor – Applications of superconductors.

UNIT V – ADVANCED MATERIALS (12 Hrs)
Liquid Crystals – Types – Application as Display Devices

Metallic Glasses – preparation by melt spinning. Twin roller system, properties and applications
Shape Memory alloys (SMA), Shape memory effect, Properties and applications of SMA
Nanomaterials- Nano materials (one, Two & three Dimensional) –Methods of synthesis (PVD, CVD, Laser Ablation, Solgel, Ball-milling Techniques), Properties and applications of nanomaterials. carbon nanotubes– Properties and applications.

Text books

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

Reference Books

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

Web References

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

COs/POs/PSOs Mapping

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

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

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

Course Objectives

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

Course Outcomes

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

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

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

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

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

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

UNIT I ENVIRONMENT AND ENERGY RESOURCES (12 Hrs)

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

UNIT II ECOSYSTEM AND BIODIVERSITY (12 Hrs)

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

UNIT III AIR POLLUTION (12 Hrs)

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

UNIT IV WATER AND LAND POLLUTION (12 Hrs)

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

UNIT V POLLUTION CONTROL AND MONITORING (12 Hrs)

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

Text Books

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

Reference Books

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

Web Resources

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

COs/POs/PSOs Mapping

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

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

T104

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to all branches)

L	T	P	C	Hrs
3	1	0	4	60

Course Objectives

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

Course Outcomes

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

CO1 - Analyze the basic concepts, various laws and theorems used in DC circuits. **(K3)**
CO2 - Analyze and solve the AC circuits and develop resonance circuits for transmitter and receiver. **(K4)**
CO3 - Gain the knowledge of power production in power system and application of transformers and motors in real time. **(K2)**
CO4 - Understand the operations of semiconductor diode, BJT, FET and its applications. **(K2)**
CO5 - Summarize the digital electronics concepts for sequential and combinational circuits. **(K2)**
CO6 - Explain and Relate different Communication Systems. **(K2)**

PART A – ELECTRICAL

UNIT I DC CIRCUITS (10 Hrs)

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

UNIT II AC CIRCUITS (10 Hrs)

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

UNIT III ELECTRICAL MACHINES AND POWER PLANTS (10 Hrs)

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

PART B – ELECTRONICS

UNIT IV ELECTRONIC CIRCUITS (10 Hrs)

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

UNIT V DIGITAL ELECTRONICS (10 Hrs)

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

UNIT VI COMMUNICATION AND COMPUTER SYSTEMS (10 Hrs)

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

Text Books

1. Kothari D P and Nagrath I J , Basic Electrical Engineering, Tata McGraw Hill,2009.
2. Rajendra Prasad, “Fundamentals of Electronic Engineering”, Cengage learning, New Delhi, First Edition, 2011.
3. Morris Mano, “Digital design”, PHI Learning, Fourth Edition, 2008.
4. Wayne Tomasi, “Electronic Communication Systems- Fundamentals Theory Advanced”, Sixth Edition, Pearson Education, 2004.

Reference Books

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

Web References

1. https://nptel.ac.in/courses/108/108/108108076/
2. https://www.electrical4u.com/
3. https://nptel.ac.in/courses/108/102/108102146/
4. http://electrical-engineering-portal.com/
5. http://www.electronics-tutorials.ws
6. https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/
7. https://nptel.ac.in/courses/117/102/117102059/

COs/POs/PSOs Mapping

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

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

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

Course Objectives

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

Course Outcomes

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

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

UNIT I BASIC CONCEPTS AND DEFINITIONS (12 Hrs)

Energy conversion and efficiencies - system, property and state – Thermal equilibrium – Temperature – Zeroth law of Thermodynamics – Pure substance – P, V and T diagrams – Thermodynamic diagrams.

UNIT II FIRST LAW OF THERMODYNAMICS (12 Hrs)

The concept of work and adiabatic process – First law of thermodynamics – conservation of Energy Principle for closed and open systems – Calculation of work for different processes of expansion of gases

UNIT III SECOND LAW OF THERMODYNAMICS (12 Hrs)

Equilibrium and the second law – Heat engines – Kelvin-Plank statement of second law of thermodynamics – Reversible and irreversible processes – Carnot principle – Clausius inequality – Entropy

UNIT IV GAS POWER CYCLES (12 Hrs)

Air standard cycles: The air standard carnot cycle – Air standard Otto cycle, Diesel cycle, Dual cycle and Brayton cycles and their efficiencies

UNIT V REFRIGERATION CYCLES AND SYSTEMS (12 Hrs)

Reverse Carnot cycle – COP – Vapor compression refrigeration cycle and systems (only theory) – Gas refrigeration cycle – Absorption refrigeration system – Liquefaction – Solidification (only theory).

Text Books

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

Reference Books

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

Web References

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

COs/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	-	-	-	-	-	-	-	1	-	-
2	3	2	2	2	2	-	-	-	-	-	-	-	-	-	-
3	3	2	3	3	2	-	-	-	-	-	-	-	-	-	-
4	3	2	3	3	-	-	-	-	-	-	-	-	-	-	-
5	3	2	3	3	-	-	-	-	-	-	-	-	-	-	-

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

T106 **COMPUTER PROGRAMMING** (Common to all branches)

L	T	P	C	Hrs
3	1	0	4	60

Course Objectives

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

Course Outcomes

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

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

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

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

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

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

UNIT I INTRODUCTION TO COMPUTERS (12 Hrs)

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

UNIT II INTRODUCTION TO C (12 Hrs)

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

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

UNIT III DECISION MAKING AND ARRAYS (12 Hrs)

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

UNIT IV STRUCTURES AND POINTERS (12 Hrs)

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

UNIT V FILE MANAGEMENT AND PREPROCESSORS (12 Hrs)

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

Text Books

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

Reference Book

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

Web References

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

COs/POs/PSOs Mapping (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	-	-	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

P101	COMPUTER PROGRAMMING LABORATORY	L	T	P	C	Hrs
	(Common to all branches)	0	0	3	2	30

Course Objectives

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

Course Outcomes

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

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

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

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

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

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

List of Exercises

1. Study of OS Commands
2. Write a simple C program to find the Area of the triangle.
3. Write a simple C program to find the total and average percentage obtained by a student for 6 subjects.
4. Write a simple C program to read a three-digit number and produce output like
   1 hundreds
   7 tens
   2 units
   for an input of 172.
5. Write a simple C program to check whether a given character is vowel or not using Switch – Case statement.
6. Write a simple C program to print the numbers from 1 to 10 along with their squares.
7. Write a simple C program to find the sum of ‘n’ numbers using for, do – while statements.
8. Write a simple C program to find the factorial of a given number using Functions.
9. Write a simple C program to swap two numbers using call by value and call by reference.
10. Write a simple C program to find the smallest and largest element in an array.
11. Write a simple C program to perform matrix multiplication.
12. Write a simple C program to demonstrate the usage of Local and Global variables.
13. Write a simple C program to perform various string handling functions: strlen, strcpy, strcat, strcmp.
14. Write a simple C program to remove all characters in a string except alphabets.
15. Write a simple C program to find the sum of an integer array using pointers.
16. Write a simple C program to find the Maximum element in an integer array using pointers.
17. Write a simple C program to create student details using Structures.
18. Write a simple C program to display the contents of the file on the monitor screen.
19. Create a File by getting the input from the keyboard and retrieve the contents of the file using file operation commands.
20. Write a simple C program to pass the parameter using command line arguments.

Text Books

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

Reference Book

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

Web References

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

COs/POs/PSOs Mapping (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	-	-	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

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

Course Objectives

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

Course Outcomes

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

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

UNIT I **(12 Hrs)**

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

UNIT II **(12 Hrs)**

Projection of Solids and Sections of solids.

UNIT III **(12 Hrs)**

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

UNIT IV **(12 Hrs)**

Isometric projections and Orthographic projections

UNIT V **(12 Hrs)**

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

Text Books

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

Reference Books

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

Web References

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

COs/POs/PSOs Mapping

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

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

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

Course Objectives

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

Course Outcomes

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

CO1 - Follow the safety procedures when working with electricity and various tools. **(K4)**
CO2 - Do line diagram and wiring practices for domestic application. **(K5)**
CO3 - Use the protection circuits for electrical networks**. (K3)**
CO4 - Design and verify the kirchoff's law. **(K4)**
CO5 - Analyze the characteristics of PN diode and use it for rectifier applications. **(K4)**
CO6 - Gain knowledge on digital electronics to solve problems related to boolean algebra. **(K4)**

ELECTRICAL LAB

List of Experiments

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

ELECTRONICS LAB

List of Experiments

1. Study of CRO
   (a) Measurement of AC and DC voltages
   (b) Frequency and phase measurements (using Lissajou's figures)
2. Verification of Kirchoff's Voltage and Current Laws
   Determine the voltage and current in given circuits using Kirchoff"s laws theoretically and verify the laws experimentally.
3. Characteristics and applications of PN junction diode.
   Forward and Reverse characteristics of PN junction diode.
   Application of Diode as Half wave Rectifier – Measurement of ripple factor with and without capacitor filter
4. Frequency Response of RC Coupled Amplifiers
   Determination of frequency response of given RC coupled amplifier - Calculation of bandwidth.

5. Study of Logic Gates
   (a) Verification of Demorgan's theorems
   (b) Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR, EX-NOR gates and Flipflops - JK, RS, T and D
   (c) Implementation of digital functions using logic gates and Universal gates.

Reference Books

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

Web References

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

COs/POs/PSOs Mapping

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

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

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

NCC/NSS training is compulsory for all the Undergraduate students

1. The above activities will include Practical/field activities/Extension lectures.
2. The above activities shall be carried out outside class hours.
3. In the above activities, the student participation shall be for a minimum period of 30 hours.
4. The above activities will be monitored by the respective faculty in-charge.
5. Pass /Fail will be determined on the basis of participation, attendance, performance and behavior. If a candidate Fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree

SEMESTER – III										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U19ECT31	Numerical Methods and Optimization	BS	2	2	0	3	25	75	100
2	U19ECT32	Data Structures	ES	3	0	0	3	25	75	100
3	U19ECT33	Electron Devices	PC	3	0	0	3	25	75	100
4	U19ECT34	Electrical Engineering	ES	3	0	0	3	25	75	100
5	U19ECT35	Circuits and Networks	PC	2	2	0	3	25	75	100
6	U19ECT36	Electromagnetic Field Theory	PC	3	0	0	3	25	75	100
Practical										
7	U19ECP31	Data Structures Laboratory	ES	0	0	2	1	50	50	100
8	U19ECP32	Electrical Engineering Laboratory	ES	0	0	2	1	50	50	100
9	U19ECP33	Electron Devices Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19ECC3X	Certification Course -I**	EEC	0	0	4	-	100	-	100
11	U19ECS31	Skill Development Course 1: General Proficiency –I	EEC	0	0	2	-	100	-	100
12	U19ECS32	Skill Development Course 2*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19ECM31	Physical Education	MC	0	0	2	-	100	-	100
							21	700	600	1300

		L	T	P	C	Hrs
U19ECT31	**NUMERICAL METHODS AND OPTIMIZATION**	**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.

Text Books

1. AtulGoyal, MadhuchandaRakshit, 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 Mapping with POs and PSOs

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

U19ECT32 **DATA STRUCTURES**

L	T	P	C	Hrs
3	0	0	3	45

(Common to ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHTRONICS)

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 OFDATASTRUCTURES (9Hrs)

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 ANDQUEUEOPERATIONS (9Hrs)

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 LINKEDLISTOPERATIONS (9Hrs)

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.

UNITIVTREES (9Hrs)

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 ANDGRAPHS (9Hrs)

Sorting: Bubble Sort – Selection Sort – Insertion Sort – Heap Sort – Shell Sort and Radix Sort. Performance and Comparison among the sorting methods. Hashing: Hash Table – Hash Function and its characteristics. Graph: Basic Terminologies and Representations – Graph traversal algorithms.

Text Books

1. Ellis Horowitz, Sartaj Sahni,"Fundamentals of Data Structures", 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

U19ECT33	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. (K2)
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. (K2)
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.

Text Books

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, 5thedition 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 Private Ltd., 2011.
3. homasL.Floyd, “Electronic devices” Conventional current version, Pearson prentice hall, 10thEdition, 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

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

		L	T	P	C	Hrs
U19ECT34	**ELECTRICAL ENGINEERING**	**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. (K2)
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. (K4)

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.

Text 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. 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”, DhanpatRai 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	2	2	-
2	3	3	3	2	2	-	-	-	-	-	-	1	2	2	-
3	3	3	3	2	2	-	-	-	-	-	-	1	3	2	-
4	3	3	3	1	2	-	-	-	-	-	-	1	3	2	-
5	3	3	3	1	2	-	-	-	-	-	-	1	3	2	-

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

U19ECT35	CIRCUITS AND NETWORKS	L	T	P	C	Hrs
		2	**2**	**0**	**3**	**60**

Course Objectives
- To understand the need for various theorems to solve complicated Electrical circuits
- To explore the use of Resonant circuits and coupled circuits
- To analyze the transient behaviour of Electrical circuits
- To understand the concept of network functions and network parameters
- To understand the use of passive filters

Course Outcomes
After completion of the course, the students are able to
CO1 - Analyze Electric circuits using network theorems(K4)
CO2 - Understand the resonance phenomenon and its significance. (K2)
CO3 - Analyze electric circuits for transient response using Laplace transform(K4)
CO4 - Understand the concepts network function and network parameters. (K2)
CO5 - Construct passive filters for the given application. (K3)

UNIT – I NETWORK THEOREMS FOR DC AND AC CIRCUITS (12 Hrs)
Review of loop and nodal methods of analysis, Source transformation, Superposition theorem, Thevenin’s theorem, Norton’s theorem, reciprocity theorem, compensation theorem, Maximum power transfer theorem, Millman’s Theorem and Tellegen’s theorem applied to dc and ac circuits

UNIT - II RESONANCE AND COUPLED CIRCUITS (12 Hrs)
Resonance – Series and parallel resonance circuits- Concept of band width and Q factor. Coupled Circuits: Faraday’s laws of electromagnetic induction – Concept of self and mutual inductance – dot convention – coefficient of coupling.

UNIT III NETWORK FUNCTIONS AND NETWORKPARAMETERS (12 Hrs)
Network functions: The concept of complex frequency- concept of transformed network- driving point impedance and admittance-transfer function- Properties of driving point impedance -poles and zeros. Z, Y, ABCD, hybrid parameters and their relations– 2-port network parameters using transformed variables.

Unit - IV TRANSIENT ANALYSIS (12 Hrs)
Initial conditions in elements, Transient response of R-L, R-C, R-L-C circuits (Series combinations only) for step and sinusoidal excitations -Solution using Laplace transform

UNIT V FILTERS (12 Hrs)
Classification of filters - Analysis of a proto type low pass filter and High pass filters- Analysis of a proto type Band pass and Band stop filters- constant K filters - m-derived filters – BPF and BSF

Text Books

1. Sudhakar. A., Shyammohan, S. P.; “Circuits and Network”; Tata McGraw-Hill New Delhi, 2017
2. P. Ramesh Babu, Circuit theory, Second Edition, Scitech Publications Pvt. Ltd, 2017.

Reference Books

1. John. D. Ryder, “Network lines and fields”, PHI Learning, Second Edition, 2015
2. William Hayt and Jack E. Kimmerly, Engineering circuit analysis, McGraw Hill Company, 8th edition, 2013.
3. A William Hayt, “Engineering Circuit Analysis” 8th Edition, McGraw-Hill Education, 2016
4. Franklin Fa-Kun. Kuo, “Network Analysis & Synthesis”, John Wiley & Sons.
5. M. L. Soni, J. C. Gupta, “A Course in Electrical Circuits and Analysis”,

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

U19ECT36	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 staticsfields 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 ELECTROSTATICFIELDS (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.

Text Books

1. Matthew Sadiku, ‘Elements of Electromagnetics’, Oxford University 7/e Press, 2009
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. William H Hayt, John A Buck, Engineering Electromagnetics, McGraw-Hill Higher Education, 8th edition, 2011
3. J.D.Kraus and D.A Fleisch, Electromagnetics with applications,5/e-Tata McGraw-Hill- 2011.
4. Bhag Guru and HuseyinHiziroglu,” Electromagnetic Field Theory Fundamentals”, Cambridge University Press, 2nd edition, 2004
5. S.P.Ghosh, LipikaDatta, ”ElectromagneticFieldTheory”, 1stedition,McGrawHillEducation(India) Private Limited, 2012.

Web References

1. https://nptel.ac.in/courses/108106073/
2. https://lecturenotes.in/subject/77/electromagnetic-theory-emt
3. https://engineering.purdue.edu/wcchew/ece604f19/EMFTAll20191204
4. http://pcwww.liv.ac.uk/~awolski/Teaching/Cockcroft/EMTheory/Electromagnetism-Lecture
5. https://courses.cit.cornell.edu/ece303/Lectures/Lectures.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	-	-	-	-	-	-	1	-	3	-	-
2	3	2	2	1	-	-	-	-	-	-	1	-	3	-	-
3	3	2	2	1	-	-	-	-	-	-	1	-	3	-	-
4	3	2	2	1	-	-	-	-	-	-	1	-	3	-	-
5	3	2	2	1	-	-	-	-	-	-	1	-	3	-	-

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

		L	T	P	C	Hrs
U19ECP31	**DATA STRUCTURES LABORATORY** (Common to ECE, EEE, IT, ICE, MECH, CIVIL, BME, MECHTRONICS, CCE)	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) BinarySearch.
2. Write a C program to implement i) Bubble sort ii) Selection sort iii) Insertion sort iv) Shell sort v) Heapsort.
3. Write a C program to implement the following using an array. a) Stack ADT b) QueueADT
4. WriteaCprogramtoimplementlistADTtoperformfollowingoperationsa)Insertanelementintoalist.
   a)Delete an element from list c) Search for a key element in list d) count number of nodes inlist.
5. Write a C program to implement the following using a singly linked list. a) Stack ADT b) QueueADT.
6. Write a C program to implement the dequeue (double ended queue) ADT using adoubly linked list and an array.
7. Write a C program to perform the following operations:
   a) Insert an element into a binary searchtree.
   b) Delete an element from a binary search tree.
   c) Search for a key element in a binary searchtree.
8. Write a C program that use recursive functions to traverse the given binary treein
   a) Preorder b) Inorderand c) Postorder.
9. Write a C program to perform the AVL tree operations.
10. Write a C program to implement Graph TraversalTechniques.

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

U19ECP32	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-phase transformers 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. (K2)

CO4– Infer the performance of DC machine (shunt, series or compound) and transformer by conducting suitable 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 transformer
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

U19ECP33 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 withits 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. (K2)
CO3–Differentiate the characteristics of JFET and MOSFET. (K4)
CO4–Illustrate the electrical characteristics SCR, UJT and TRIAC. (K3)
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. ThomasL.Floyd, “Electronic devices” Conventional current version, Pearson prentice hall, 10thEdition, 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

		L	T	P	C	Hrs
U19ECC3X	**CERTIFICATION COURSE - I**	**0**	**0**	**4**	**-**	**50**

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

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

U19ECS31	**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 (6Hrs)
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 (6Hrs)
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 (6Hrs)
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 (6Hrs)
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 (6Hrs)
Language Enhancement: Articles**,** Preposition, Tenses
Verbal Ability Enhancement: Blood Relation, Completing Statements- Cloze test, Spotting Errors –Sentence Improvement, One Word Substitution, Word Analogy, Word Groups (**GATE**)

Reference Books

1. Jeff Butterfield, “Soft Skills for Everyone”, Cengage Learning, New Delhi, 2012.
2. Mn,Taylor, and Grant Taylor. “English Conversation Practice”. Tata McGraw-Hill Education, 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.fresherslive.com/online-test/blood-relations-questions-and-answers
4. https://www.toppr.com/guides/english-language/reading-comprehension/cloze-test/
5. https://www.examsbook.com/word-analogy-test-questions-with-answers

COs/POs/PSOs Mapping

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

U19ECS32

SKILL DEVELOPMENT COURSE 2
(Choose anyone of the below three courses)

1.COMPUTER HARDWARE & TROUBLESHOOTING	L	T	P	C	Hrs
	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. PC AND CLONES Hardware, Troubleshooting and Maintenance B. Govindarajalu, Tata Mc-graw-Hill Publication
5. PC Troubleshooting and Repair Stephen J. Bigelow 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 AND CIRCUIT 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)

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	2	2	1	3	-	-	-	3	2	2	-	3	3	1
2	3	2	2	1	3	-	-	-	3	2	2	-	3	3	1
3	3	2	2	1	3	-	-	-	3	2	2	-	3	3	1
4	3	2	2	1	3	-	-	-	3	2	2	-	3	3	1
5	3	2	2	1	3	-	-	-	3	2	2	-	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. Multimeter: Digital and Analog- Working principle, Application of Multimeter and component testing using Multimeter.
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, 3rd Edition 2004.

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

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

		L	T	P	C	Hrs
U19ECM31	**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	U19ECT41	Signals and Systems	PC	2	2	0	3	25	75	100
2	U19ECT42	Analog Electronic Circuits	PC	3	0	0	3	25	75	100
3	U19ECT43	Digital Electronic Circuits	PC	3	0	0	3	25	75	100
4	U19ECT44	Communication Systems	PC	3	0	0	3	25	75	100
5	U19ECE4X	Professional Elective – I#	PE	3	0	0	3	25	75	100
6	U19XXO4X	Open Elective – I$	OE	3	0	0	3	25	75	100
Practical										
7	U19ECP41	Analog Electronic Circuits Laboratory	PC	0	0	2	1	50	50	100
8	U19ECP42	Digital Electronic Circuits Laboratory	PC	0	0	2	1	50	50	100
9	U19ECP43	Communication Systems Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19ECC4X	Certification Course -II**	EEC	0	0	4	-	100	-	100
11	U19ECS41	Skill Development Course 3: General Proficiency – II	EEC	0	0	2	-	100	-	100
12	U19ECS42	Skill Development Course 4*	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19ECM41	Indian Constitution	MC	2	-	-	-	100	-	100
							21	700	600	1300

		L	T	P	C	Hrs
U19ECT41	**SIGNALS AND SYSTEMS**	**2**	**2**	**0**	**3**	**60**

Course Objectives

- To understand the Mathematical Representation of Signals and Systems
- To describe the concept of Linear Time Invariant Systems and the Convolution property
- To represent a given Continuous Time signal in frequency domain using Fourier Series and Fourier Transform
- To illustrate a given Discrete Time signal in frequency domain using Fourier Series and Fourier Transform
- To understand Spectrum Analysis of Continuous Time signals and sampled version of the CT signal

Course Outcomes

After completion of the course, the students are able to

CO1- Categorize the Signals and Systems with mathematical representation **(K4)**
CO2- Employ the concept of Convolution to predict the behavior of a given Linear Time Invariant System **(K3)**
CO3- Illustrate the frequency domain behavior of a given Continuous Time signal using Fourier analysis andLaplace Analysis **(K4)**
CO4- Relate the frequency domain behavior of a given Discrete Time signal using Discrete Time and Z Transform Analysis **(K4)**
CO5- Relate the Spectrum of Continuous Time Signals and its sampled versions **(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, Types of Systems, Properties of Systems.

UNIT II ANALYSIS OF LINEAR TIME INVARIANT SYSTEMS (12 Hrs)

Concept of Impulse Response, Convolution Integral and Convolution Sum, Causality and Stability of LTI systems, Interconnection of LTI Systems, Correlation of Signals, Orthogonality of Signals

UNIT III FREQUENCY DOMAIN REPRESENTATION 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 IV FREQUENCY DOMAIN REPRESENTATION OF DT SIGNALS (12 Hrs)

Discrete Time Fourier series, Properties of Discrete Time Fourier series, 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 V SPECTRUM ANALYSIS OF LTI SYSTEMS (12 Hrs)

Spectrum Analysis of Continuous-Time Systems, Spectrum Analysis of Discrete-Time Systems, Sampling Theorem with Proof, Sampling and Reconstruction of Band-Limited Signals, Aliasing.

Text Books

1. Alan V. Oppenheim, Alan S. Willsky, Syed Hamid Nawab, “Signals and Systems”, 2nd Edition, Pearson, 2013
2. Simon Haykin, Barry Van Veen, “Signals and Systems”, 2nd Edition, John Wiley & Sons, 2007
3. R.E.Zeimer, W.H.Tranter and R.D.Fannin, ―Signals & Systems – Continuous and Discrete‖, Pearson, 2007.

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. John Alan Stuller, ―An Introduction to Signals and Systems‖, Thomson, 2007.

5. Signal, Systems and Transforms by Charles L. Philips, J. M. Parr and E. A. Riskin, Pearson Education.

Web References

1. https://nptel.ac.in/courses/117101055/
2. https://lecturenotes.in/subject/36/signals-and-systems-ss
3. http://www.eng.ucy.ac.cy/cpitris/courses/ece623/notes/SignalsAndSystems.pdf
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	-	-	-	-	-	-	-	-	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

U19ECT42	ANALOG ELECTRONIC CIRCUITS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To learn the fundamental concepts behind transistor biasing and to differentiate small signal & large signal circuit models
- To understand the small signal low frequency model of BJT and FET
- To understand the small signal high frequency model of BJT and FET
- To study the performance metrics of Multistage and Power amplifiers
- To understand the working of signal generating and wave shaping circuits

Course Outcomes

After completion of the course, the students are able to

CO1 - Analyze different biasing methods for Bipolar Junction Transistors and Field Effect Transistors (K4)
CO2-Compare and model different Transistor configurations for Bipolar Junction Transistors and Field Effect Transistors (K4)
CO3- Analyze the behavior of Bipolar Junction Transistors and Field Effect Transistors at different FrequencyConditions (K4)
CO4- Construct multistage and feedback amplifier circuits using Bipolar Junction Transistors and Field Effect Transistors (K3)
CO5- Construct the Oscillator and Multivibrator circuits using Bipolar Junction Transistors (K3)

UNIT I TRANSISTOR BIASING (9 Hrs)

BJT: Bias Stability, Bias Compensation- Thermistor, Sensistor, and Diode compensation-Thermal Runaway, Mobility and Lifetime of electrons and holes in BJT, FET: Biasing by Fixing VGS, Biasing by connecting Resistance, Biasing by Drain to Gate Feedback Resistor, and Biasing using Constant Current Source.

UNIT II SMALL SIGNAL LOW FREQUENCY MODEL AND CURRENT MIRROR (9 Hrs)

BJT: Analysis of transistor amplifier CE,CC&CB Configuration using h parameters , Simplified Hybrid Model for CB, CE & CC configurations, Comparison of transistor amplifier configurations, Darlington Pair. FET: Voltage Gain, Small Signal Equivalent Circuit model.

UNIT III SMALL SIGNAL HIGH FREQUENCY MODELS AND DIFFERENTIAL PAIR (9 Hrs)

BJT: Behavior of Transistor at High Frequency, The High Frequency T Model, The Hybrid pi Common Emitter Transistor Model, - CB & CE Short Circuit Current Frequency response, Frequency Response of the CE Amplifier.

UNIT IV MULTI STAGE AND FEEDBACK AMPLIFIERS (9 Hrs)

BJT: CE-CC Amplifier, Cascade Amplifier, RC coupled amplifier, Millers Theorem, High input resistance transistor circuits, Difference Amplifier- Step response and Frequency Response of Multistage Amplifiers.

Feedback amplifiers - Current Series, Voltage Shunt, Current shunt and Voltage Series. Power Amplifiers: Class A, Class B, Class C, Class AB and Class D Power Amplifiers, Distortion in Amplifier.

UNIT V SIGNAL GENERATORS AND WAVE SHAPING CIRCUITS (9 Hrs)

Basic Principles of Sinusoidal Oscillators, Classification of Oscillator- Barkhausen Criterion- RC Phase Shift ,Wien Bridge , General Form of LC- Hartley, Colpitts, Clapp Tuned Collector and Crystal Oscillators. Monostable, Astable and Bistable Multivibrators.

Text Books

1. Adel. S. Sedra , Kenneth C. Smith, Microelectronic Circuits Theory an Applications ,7th Edition, Oxford University, 2017.
2. Jacob Millman, C. Halkias and SatyabrataJit Electronic Devices and Circuits, 4th Edition, Tata McGraw-Hill, 2015
3. Fundamentals of Analog Circuits Thomas L Floyd Pearson 2nd Edition, 2012

Reference Books

1. Electronic Circuits Analysis and design, Donald A Neaman, 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. Electronic Devices and Circuits David A Bell Oxford University Press 5th Edition, 2008.
5. Electronic Devices and Circuit Theory Robert L Boylestad Louis Nashelsky Pearson 11th Edition, 2015.

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

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

U19ECT43	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 their 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 the synchronous and asynchronous logic circuits and realize the memory devices. (K4)

UNIT I NUMBER SYSTEMS AND CODE (9Hrs)

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 (9Hrs)

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 (Up to 4 variable); Prime implicants, Prime applicant chart, NAND And NOR Implementation.

UNITIII COMBINATIONAL LOGIC CIRCUIT AND DESIGN (9Hrs)

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 (9Hrs)

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 Asynchronous & Synchronous sequential circuits - Binary Counter, Ring counters, Johnson counters, Up/Down counter, Asynchronous counter- Hazards logic circuits- Hazard free realization Logic

UNIT V SEMICONDUCTOR MEMORY AND PROGRAMMABLE DEVICES (9Hrs)

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).

Text Books

1. M.Morris Mano, Michael D Ciletti Digital Design 4^{th} edition Pearson, 2011.
2. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11^{th} Edition, 2015.
3. Digital Fundamentals by FLOYD & JAIN, Pearsons Pub, 10^{th} Edition, 2015.

Reference Books

1. A.Anand Kumar, Fundamentals of Digital Circuits, 4^{th} Edition PHI Learning Private Limited, 2016.
2. Donald P Leach, Albert Paul Malvino and GoutamSaha, “Digital Principles and Applications”, 6^{th}edition, 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. Modern Digital Electronics by R.P.Jain, 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	2
2	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2
3	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2
4	3	2	2	1	1	-	-	-	-	-	-	-	2	2	2
5	3	2	2	1	-	-	-	-	-	-	-	-	2	2	2

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

U19ECT44	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 - Describe all digitalization techniques (K2)
CO4 - Explain digital modulation techniques (K2)
CO5 - Illustrate error detecting and correcting codes (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

Text Books

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

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

		L	T	P	C	Hrs
U19ECP41	**ANALOG ELECTRONIC CIRCUITS LABORATORY**	**0**	**0**	**2**	**1**	**30**

Course Objectives

- To design and measure frequency response, signal handling capacity, input and output impedances of various types ofamplifiers
- To design and construct about various Multivibrators
- To design and construct circuits using PSPICE
- To learn and understand aboutMiller integrator and Bootstrap ramp generator
- To learn and understand about power amplifiers

Course Outcomes

After completion of the course, the students are able to

CO1–Demonstrate and test different types of amplifiers (K2)
CO2 –Interpret the parameter from the characteristics of integrator, differentiator, clampers and voltage Multipliers (K2)
CO3 –Demonstrate and test various types of oscillators(K2).
CO4–Describe the concepts of electronic circuits using PSPICE (K2)
CO5–Operate and test a power amplifier(K3).

LIST OF EXPERIMENTS

1. a) Design and measurement of frequency response, signal handling capacity, input and output impedances of CE amplifier.
   b) Differential amplifier.
2. Design and measurement of frequency response, signal handling capacity, input and output impedances of common source and common drain FET amplifier.
3. Design and measurement of frequency response, signal handling capacity, input and output impedances of cascade amplifier and cascade amplifier.
4. To design, construct and measure the frequency response, input impedance and output impedance of (i) voltage shunt (ii) voltage series negative feedback amplifiers with and without feedback.
5. To design, construct and study the low frequency and high frequency oscillators.
   i. To design, construct and study the RC Integrator, RC Differentiator, Clampers and Voltage Multipliers
   ii. To design, construct and study the UJT relaxation oscillator
6. a) To design, construct and study the BJT based Astablemultivibrator and Monostablemultivibrator
   b) To design, construct and study the BJT based Bistablemultivibrator and Schmitt trigger circuits.
7. a) To design, construct and study the Miller integrator and Bootstrap ramp generator
   b) To simulate the Bootstrap ramp generator circuit using PSPICE
8. To obtain the frequency Vs. power and load Vs. power characteristics of Class A power amplifier
9. To obtain the frequency Vs. power and load Vs. power characteristics of Class B complementary symmetry amplifier

Reference Books

1. Electronic Circuits Analysis and design, Donald A Neaman, 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. Electronic Devices and Circuits David A Bell 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	2	2	1	2	-	-	-	-	-	3	-	2	2	-
2	3	2	2	1	2	-	-	-	-	-	3	-	2	2	-
3	3	2	2	1	2	-	-	-	-	-	3	-	2	2	-
4	3	2	2	1	3	-	-	-	-	-	3	-	2	2	-
5	3	2	2	1	2	-	-	-	-	-	3	-	2	2	-

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

U19ECP42	DIGITAL ELECTRONIC CIRCUITSLABORATORY	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 (K2)
CO3 - Demonstrate various combinational circuits like multiplexer, Demultiplexer and encoder, decoder (K2)
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 the following Code convertors
   a) BCD to excess-3 code and vice versa
   b) Binary to gray code and vice-versa
3. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC7483
4. Magnitude comparator
   a) Study of 4-bit magnitude comparator IC
   b) Realization of 8-bit magnitude comparator using 4-bit magnitude comparator ICs
5. 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
6. 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
7. 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
8. 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

9. Design and implementation of Synchronous Counters and study of their timing diagrams
   a) Binary counter
   b) b)Non-sequential binary counter
   c) 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. Fundamentals of Logic Design by Charles H. Roth Thomson, 2015.
5. Modern Digital Electronics byR.P.Jain, 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	3	-	-	-	2	3	3	-	2	2	2
2	3	2	2	1	3	-	-	-	2	3	3	-	2	2	2
3	3	2	2	1	3	-	-	-	2	3	3	-	2	2	2
4	3	2	2	1	3	-	-	-	2	3	3	-	2	2	2
5	3	2	2	1	3	-	-	-	2	3	3	-	2	2	2

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

		L	T	P	C	Hrs
U19ECP43	**COMMUNICATION SYSTEMS LABORATORY**	**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

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

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

		L	T	P	C	Hrs
U19ECC4X	**CERTIFICATION COURSE - II**	**0**	**0**	**4**	**-**	**50**

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

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

		L	T	P	C	Hrs
U19ECS41	**GENERAL PROFICIENCY–II** (Common to all the branches)	**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 thetypes of writing in different state of affairs (K2)
CO3-Develop language skills professionally to groom the overall personality through sensitizing various Etiquettes in real time situation (K3)
CO4-Identify the rules of grammar in academic discourse settings (K3)
CO5-Extend the skills to compete in various competitive exams like GATE, GRE, CAT, UPSC, etc.(K2)

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

UNIT III - FUNCTIONAL SKILLS (6Hrs)
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 (6Hrs)
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 (6Hrs)
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	-	-	-	-	-	-	-	-	3	-	1	1	-	-
4	1	-	-	-	-	-	-	1	-	3	-	1	1	-	-
5	1	-	-	-	-	-	-	-	-	3	-	1	1	-	-

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

U19ECS42

SKILL DEVELOPMENT COURSE 4
(Choose anyone of the below three courses)

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 are able to
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	-	-	-	1	3	-
2	3	2	2	1	2	-	-	-	1	-	-	-	1	3	-
3	3	2	2	1	2	-	-	-	1	-	-	-	1	3	-
4	3	2	2	1	2	-	-	-	1	-	-	-	1	3	-
5	3	2	2	1	2	-	-	-	1	-	-	-	1	3	-

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 are able to

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. Behaviour 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	-	-	-	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	-	-	2	3	3	3	-	2	3	3
5	3	2	2	1	3	-	-	2	3	3	3	-	2	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 are able to

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 hand held 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
4. Data Books - National semiconductor , National semiconductor Publication
5. PC Troubleshooting and Repair Stephen J. Bigelow Dream tech Press, New Delhi

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

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

		L	T	P	C	Hrs
U19ECM41	**INDIAN CONSTITUTION**	**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 been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

Course content

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

Professional Elective – I (Offered in Semester IV)		
Sl. No.	**Course Code**	**Course Title**
1	U19ECE41	Computer Networks
2	U19ECE42	Sensors for Industrial Applications
3	U19ECE43	Computer Architecture
4	U19ECE44	PLC and SCADA Systems and its Applications
5	U19ECE45	Introduction to MEMS

		L	T	P	C	Hrs
U19ECE41	**COMPUTER NETWORKS**	**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 (K4)

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 SWITCHING IN NETWORKS (9 Hrs)

Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, 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.

UNITIII 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, Switches.

Text books

1. J.F. Kurose and 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. T. Viswanathan, “Telecommunication Switching System and Networks”, Prentice Hall, 2015

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. S. Keshav, “An Engineering Approach to Computer Networking” , Pearson Education, 2013

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

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

		L	T	P	C	Hrs
U19ECE42	**SENSORS FOR INDUSTRIAL APPLICATIONS**	**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 IVOPTICAL, 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.

UNITV APPLICATIONS OF SENSORS (9 Hrs)

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

Text Books

1. Patranabis D.,” Sensor and Actuators”, Prentice Hall of India (Pvt) Ltd., second edition 2005(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 Transducers‖, Third Edition, Newnes publishers, 2001.
4. Robert B. Northrop, “Introduction to Instrumentation and Measurement”, 3rd Edition”, 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	3	1	1	-	-	-	-	-	-	-	-	1	3	-	-
2	3	-	3	-	-	-	-	-	-	-	-	1	-	-	-
3	2	2	3	-	-	-	1	-	-	-	-	-	2	-	-
4	2	2	3	-	-	-	1	-	-	-	-	1	2	-	-
5	2	2	3	-	-	-	1	-	-	-	-	1	3	-	-

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

U19ECE43 **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 –Illustratevarious Architecture of advanced microprocessors **(**K3)
CO5- . Relate processing of computer organization and DSP Architecture (K3)

UNITI 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, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

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

Text Books

1. B. Brey and C. R. Sarma, “The Intel microprocessors”, Pearson Education, 2000.
2. J. L. Hennessy and D. A. Patterson, “Computer Architecture A Quantitative Approach”, Morgan Kauffman, 2011.
3. W. Stallings, “Computer organization”, PHI, 1987.

Reference Books

1. N. Mathivanan, “Microprocessors, PC Hardware and Interfacing”, Prentice Hall, 2004.
2. AICTE Model Curriculum for Undergraduate degree in Electrical Engineering (Engineering &Technology)
3. Y. C. Lieu and G. A. Gibson, “Microcomputer Systems: The 8086/8088 Family”, Prentice Hall India, 1986.
4. J. Uffenbeck, “The 8086/8088 Design, Programming, Interfacing”, Prentice Hall, 1987.
5. B. Govindarajalu, “IBM PC and Clones”, Tata McGraw Hill, 1991.

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

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

U19ECE44	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 ARITHMETIC AND 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

Text Books

1. AymanAly El-Naggar, “Fundamentals of Automation and Industrial Control Systems Using PLC”, 2008
2. Madhuchhanda Mitra and Samarjt Semgupta, “Programmable Logic Controllers and Industrial Automation: An Introduction”, 2nd Edition” 2008
3. Stuart A. Boyer, “SCADA-Supervisory Control and Data Acquisition, Instrument” Society of America Publications, USA, 2004

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. Rajesh Mehra and Vikrant Vij, "PLCs and SCADA: Theory and Practice" Laxmi Publications, 2015.
4. Gordon Clarke, Deon Reynders, "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes Publications, Oxford, UK,2004
5. L.A. Bryan, E. A. Bryan, "Programmable Controllers Theory and Implementation" Industrial Text Company Publication, Second Edition.

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

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

U19ECE45 **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 RF MEMS
- 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, Micromachined and reconfigurable antennas, Micromachined phase shifters.

Text Books
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 Microfabrication, CRC Press, 1997.
2. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.
3. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.
4. Micromachined Transducers Sourcebook, G. Kovacs
5. Microsystems Design, S.D. Senturia

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/

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

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

Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U19ECE51	Hardware Description Languages
2	U19ECE52	Vehicular Communication
3	U19ECE53	Industry 4.0 Technology
4	U19ECE54	Information Theory and Coding
5	U19ECE55	Robotics and Control

U19ECE51	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

Text Books

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
U19ECE52	**VEHICULAR COMMUNICATION**	**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 802.11p VANET 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

Text Books

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

U19ECE53	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

Text Books

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

		L	T	P	C	Hrs
U19ECE54	**INFORMATION THEORY AND CODING**	**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.

Text Books

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

U19ECE55	ROBOTICS AND CONTROL	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 horse power calculation, magnetostrictive 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, work space 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 Non industrial robots, Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants – Industrial automation – Typical examples of automated industries.

Text Books
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**
U19ECE61	Low Power VLSI Design
U19ECE62	Aircraft communication and Navigation Systems
U19ECE63	Nano-electronics and Devices
U19ECE64	Speech and Audio Signal Processing
U19ECE65	Soft Computing

		L	T	P	C	Hrs
U19ECE61	**LOW POWER VLSI DESIGN**	**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

Text Books

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. DimitriosSoudris, ChirstianPignet 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**
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

		L	T	P	C	Hrs
U19ECE62	**AIRCRAFT COMMUNICATIONS AND NAVIGATION SYSTEMS**	**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.

Text Books

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

U19ECE63	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.

Text Books

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

		L	T	P	C	Hrs
U19ECE64	**SPEECH AND AUDIO SIGNAL PROCESSING**	**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.

Text Books

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)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

U19ECE65	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.

Text Books:

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, 1st Edition, 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

OPEN ELECTIVES
UNDER REGULATIONS 2019

OPEN ELECTIVES OFFERED IN SEMESTER – IV

Course Code	Course Title
U19EEO41	Solar Photovoltaic Fundamentaland applications
U19EEO42	Electrical Safety
U19CSO41	Web Development
U19CSO42	Analysis of Algorithms
U19CSO43	Programming in JAVA
U19ITO41	Database System: Design &Development
U19ITO42	R programming
U19ICO41	Sensors and Transducers
U19MEO41	Rapid Prototyping
U19CEO41	Energy and Environment
U19BMO41	Medical Electronics
U19BMO42	Telemedicine
U19CCO41	Basic DBMS

U19EEO41	SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS (Common to ECE, ICE, MECH, CIVIL, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To impart fundamental knowledge of solar cell formation and its properties.
- To understand the various technologies used to improve solar cells.
- To discuss the various components in On-grid connected systems.
- To gain knowledge on components in Off-grid connected systems using Solar PV.
- To design the PV systems for various real load applications with cost benefits.

Course Outcomes

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

CO1 -Explain the fundamentals of solar cells. **(K2)**
CO2 -Recognize the various solar PV technologies and their up gradations along with their benefits. **(K2)**
CO3 -Design and analyze on–grid PV applications. **(K4)**
CO4 -Design and analyze off–grid PV applications. **(K4)**
CO5 -Realize cost benefit analysis of PV installations. **(K4)**

UNIT I ESSENTIAL BASICS OF SOLAR CELL (9 Hrs)

Solar cell – physics – Photovoltaics in Global Energy Scenario – Fundamentals of Semiconductors, Energy band, Charge carriers – Motion, PN Junction diode, Solar cells – Design characteristics, Solar radiation.

UNIT II COMMERCIAL AND DEVELOPING TECHNOLOGIES (9 Hrs)

Commercial technologies – Mono crystalline and Multi crystalline, Silicon – Wafer based Solar cell, Thin film solar cells – A–Si, Cd–Te and CIGS, Concentrated PV cells, Developing technologies – Organic cells, Dye sensitized cells.

UNIT III SOLAR PV FOR ON-GRID APPLICATIONS (9 Hrs)

Solar cells to solar array – On–Grid PV system – With and Without storage – Balance of system – DC–DC converters – Inverters – Net Metering – Design and analysis – Performance evaluation and monitoring – Field visit – Grid tied PV power plant.

UNIT IV SOLAR PV FOR OFF–GRID APPLICATIONS (9 Hrs)

Off–Grid stand alone PV system – System sizing – Module and Battery – Storage – Batteries for PV systems – Sun Tracking mechanism – Types of tracking – One–axis, Two–axis – Maximum power point tracking – Design and analysis – Performance evaluation and monitoring – Field visit – Off–grid PV system

UNIT V COST BENEFIT ANALYSIS FOR SOLAR PV INSTALLATIONS (9 Hrs)

Cost and manufacturability – Manufacturing economics – Scaling – Pricing – Trends in retail pricing – Energy economics – Grid tied power plant – Solar street lighting system

Text Books

1. C.S. Solanki, “Solar Photovoltaics – Fundamentals, Technologies and Applications”, PHI Learning Pvt. Ltd., 2nd Edition, 2011.
2. Martin A. Green, “Solar Cells Operating Principles, Technology, and System Applications”, Prentice - Hall, 1st Edition, 2008.

Reference Books

1. J. Nelson, “The Physics of Solar Cells”, Imperial College Press, 1st Edition, 2003.
2. Thomas Markvart, “Solar Electricity”, John Wiley and Sons, 2nd Edition, 2000.
3. Stuart R. Wenham, Martin A. Green, Muriel E. Watt, Richard Corkish , “Applied Photovoltaics”, Earthscan, 3rd Edition, 2011.
4. Michael Boxwell, “The Solar Electricity Handbook”, Green stream Publishing, 10th Edition, 2016.
5. RikDe Gunther, “Solar Power-Your Home for Dummies”, Wiley Publishing Inc, 2nd Edition, 2010.

Web References

1. https://swayam.gov.in/nd1_noc20_ph21/preview
2. https://swayam.gov.in/nd2_nou20_ag13/preview
3. https://www.studentenergy.org/topics/solar-pv

4. https://www.eia.gov/energyexplained/solar/photovoltaics-and-electricity.php
5. https://www.energysage.com/solar/
6. https://www.bca.gov.sg/publications/others/handbook_for_solar_pv_systems.pdf
7. http://www.oas.org/dsd/publications/unit/oea79e/ch05.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	3	3	2	-	3	-	-	-	-	3	3	2	-
2	3	3	3	3	2	-	3	-	-	-	-	3	3	2	-
3	3	3	3	3	2	-	3	-	-	-	-	3	3	2	2
4	3	3	3	3	2	-	3	-	-	-	-	3	2	2	2
5	3	3	3	3	2	-	3	-	-	-	-	3	2	2	-

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

		L	T	P	C	Hrs
U19EEO42	**ELECTRICAL SAFETY** (Common to ECE, ICE, MECH, CIVIL, Mechatronics, BME, IT, CSE)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To familiarize the Indian Electricity Rules and Act related with electrical safety.
- To provide a knowledge about electrical shocks and safety precautions.
- To create awareness of the electrical safety associated with installation of electrical equipment.
- To analyze different Hazardous areas for electrical safety.
- To expose knowledge about necessity of safety policy and safety management.

Course Outcomes

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

CO1 - Describe the Indian Electricity (IE) acts and various rules for electrical safety.**(K2)**
CO2 - Expose safety measures to prevent electrical shock in handling of domestic electrical appliances**. (K3)**
CO3 - Evaluate the safety aspects during installation of plant and equipment**. (K3)**
CO4 - Describe the various hazardous area and application of electrical safety in various places**. (K3)**
CO5 - Acquire knowledge about importance of electrical safety training to improve quality management in electrical systems**. (K3)**

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS (9 Hrs)

Objective and scope of electrical safety - National electrical Safety code - Statutory requirements – Indian Electricity acts related to electrical Safety - Safety electrical one line diagram - International standards on electrical safety safe limits of current and voltage - Grounding of electrical equipment of low voltage and high voltage systems - Safety policy - Electrical safety certificate requirement

UNIT II ELECTRICAL SHOCKS AND THEIR PREVENTION (9 Hrs)

Primary and secondary electrical shocks - Possibilities of getting electrical shock and its severity - Effect of electrical shock of human being - Shocks due to flash/ Spark over's - Firing shock - Multi storied building - Prevention of shocks - Safety precautions - Safe guards for operators - Do's and Don'ts for safety in the use of domestic electrical appliances - Case studies on electrical causes of fire and explosion

UNIT III SAFETY DURING INSTALLATION, TESTING AND COMMISSIONING, OPERATION AND MAINTENANCE (9 Hrs)

Need for inspection and maintenance - Preliminary preparations - Field quality and safety - Personal protective equipment - Safe guards for operators - Safety equipment - Risks during installation of electrical plant and equipment - Effect of lightning current on installation and buildings - Safety aspects during installation -Safety during installation of electrical rotating machines - Importance of earthing in installation– Agricultural pump installation

UNIT IV HAZARDOUS ZONES (9 Hrs)

Primary and secondary hazards - Hazardous area classification and of electrical equipments (IS, NFPA, API and OSHA standards) - Explosive gas area classifications: Class I(Division 1) - Zone 0, Zone 1, zone 2 classified locations, Design Philosophy for Equipment and installations-Classification of equipment enclosure for various hazardous gases and vapors - flash hazard calculation and approach distances- calculating the required level of arc protection

UNIT V SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS (9 Hrs)

Principles of Safety Management - Occupational safety and health administration standards - Safety organization - Safety auditing - Employee electrical safety teams - Electrical safety training to improve Quality management - Total quality control and management – Importance of high load factor - Causes of low power factor - Disadvantages of low power factor - Power factor improvement - Importance of P.F. improvement - Case studies of electrical workplace safety practices.

Text books

1. John Cadick, Mary CapelliSchellpfeffer, Dennis Neitzel, Al Winfield, "Electrical Safety Handbook", McGraw-Hill Education, 4th Edition, 2012.
2. Madden, M. John, "Electrical Safety and the Law: A Guide to Compliance", Wiley publications, 4th Edition, 2002.
3. Mohamed A. El-Sharkawi, "Electric Safety: Practice and Standards", CRC Press; 1st Edition, 2013.

Reference books

1. Rob Zachariason, "Electrical Safety", Delmar Cengage Learning, 1st Edition, 2011.
2. Peter E. Sutherland,"Principles of Electrical Safety", Wiley-IEEE Press; 1st Edition, 2014.

Web References

1. https://www.apeasternpower.com/downloads/elecact2003.pdf
2. https://safetyculture.com/topics/electrical-hazards/
3. https://www.jove.com/science-education/10114/electrical-safety-precautions-and-basic-equipment
4. https://electrical-engineering-portal.com/21-safety-rules-for-working-with-electrical-equipment
5. https://www.electrical4u.com/safety-precautions-for-electrical-system/
6. https://www.constellation.com/energy-101/electrical-safety-tips.html

COs /POs/PSOs Mapping

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

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

		L	T	P	C	Hrs
U19CSO41	**WEB DEVELOPMENT** (Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To study the fundamentals of web application development
- To understand the design components and tools using CSS
- To learn the concepts JavaScript and programming fundamentals.
- To study about advance scripting and Ajax applications.
- To understand the working procedure of XML

Course Outcomes

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

CO1 -Develop basic web applications. **(K5)**
CO2 - Design the web applications using CSS. **(K5)**
CO3 -Validate the web pages using javascripts functions. **(K5)**
CO4 - Demonstrate the web 2.0 application to advance scripts. **(K3)**
CO5 - Update the knowledge of XML Data. **(K4)**

UNIT I INTRODUCTION TO WWW & HTML (9Hrs)

Protocols – Secure Connections – Application and development tools – Web browser – Server definition – Dynamic IP.Web Design: Web site design principles – Planning the site and navigation. HTML: Development process – Html tags and simple HTML forms – Web site structure.

UNIT II STYLE SHEETS (9 Hrs)

Introduction to CSS: Need for CSS – Basic syntax and structure using CSS – Background images – Colors and properties – Manipulating texts using fonts, borders and boxes – Margins, padding lists, positioning using CSS – CSS2.

UNIT III JAVASCRIPTS (9 Hrs)

Client side scripting: Basic JavaScript – Variables – Functions – Conditions – Loops. Applications: Page Validation – Reporting.

UNIT IV ADVANCE SCRIPT (9 Hrs)

JavaScript and objects – DOM and Web browser environments – Forms and Validations – DHTML. AJAX: Introduction – Web applications – Alternatives of AJAX.

UNIT V XML (9 Hrs)

Introduction to XML – Uses of XML – Simple XML – XML key components – DTD and Schemas – Well-formed XML document – Applications of XML – XSL and XSLT.

Text Books

1. Keith Wald, Jason Lengstorf,” Pro PHP and jQuery”, Paperback, 2016.
2. Semmy Purewal, “Learning Web App Development”, O’Reilly Media, 2014.
3. P.J. Deitel AND H.M. Deitel,” Internet and World Wide Web - How to Program”, Pearson Education, 2009.

Reference Books

1. Yakov Fain, Victor Rasputnis, Anatole Tartakovsky and Viktor Gamov, “Enterprise Web Development “, O’Reilly Media, 2014.
2. Steven Suehring, Janet Valade, “PHP, MySQL, JavaScript & HTML5 All-in-One”, John Wiley & Sons, Inc, 2013.

3. UttamK.Roy, “Web Technologies”, Oxford University Press, 2010.
4. Rajkamal, “Web Technology”, Tata McGraw-Hill, 2009.
5. Shklar, Leon, Rosen, Rich, “Web Application Architecture: Principles, Protocols and Practices”, Wiley Publication, 2009.

Web References

1. https://www.w3schools.com
2. https://www.geeksforgeeks.org/web-technology/
3. https://www.guru99.com/cakephp-tutorial.html
4. https://www.ithands.com/blog/cms-or-php-framework-which-technology-is-better-for-my-business
5. http://Oriel.ly/learning-web-app

COs /POs/PSOs Mapping

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

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

		L	T	P	C	Hrs
U19CSO42	**ANALYSIS OF ALGORITHMS** (Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To analyze the performance of algorithms in terms of time and space complexity.
- To understand the performance of the algorithms such as divide and conquer, greedy method
- To solve problems using Dynamic Programming and derive the time complexity.
- To solve problems using Backtracking technique and derive the time complexity.
- To solve problems using Branch and Bound technique and derive the time complexity.

Course Outcomes

Upon completion of the course, students shall have ability to

CO1 -Choose the appropriate data structure and algorithm design method for a specified application.**(K2)**

CO2 - Ability to understand the design technique such as divide and conquer, greedy method applied to realistic problems and analyse them. **(K3)**

CO3 -Ability to understand the dynamic programming design technique and how it is applied to realistic problems and analyze them. **(K3)**

CO4 - Ability to understand the backtracking design technique and how it is applied to realistic problems and analyze them. **(K3)**

CO5 - Ability to understand Branch and Bound design technique and how it is applied to realistic problems and analyze them. **(K2)**

UNIT I INTRODUCTION (9 Hrs)

Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis – Time complexity, Space complexity, Asymptotic Notation – Big oh notation, Omega notation, Theta notation and Little oh notation.

UNIT II DIVIDE AND CONQUER METHOD AND GREEDY METHOD (9 Hrs)

Divide and Conquer method: Applications – Binary search, Merge sort, Quick sort. Greedy method: General method, applications – Knapsack problem, Minimum cost spanning trees, Single source shortest path problem.

UNIT III DYNAMIC PROGRAMMING (9 Hrs)

Dynamic Programming: Applications - Multistage graphs, 0/1 knapsack problem, All pairs shortest path problem, Traveling salesperson problem, Reliability design.

UNIT IV BACKTRACKING (9 Hrs)

Backtracking: General method, Applications – N-queen problem, Sum of subsets problem, Graph Coloring – Hamiltonian Cycles.

UNIT V BRANCH AND BOUND (9 Hrs)

Branch and Bound**:** General method, Applications – Traveling sales person problem, 0/1 Knapsack problem, LC Branch and Bound solution, FIFO Branch and Bound solution.

Text Books

1. E. Horowitz and S.Sahni, "Fundamentals of Algorithms", Galgotia Publications, 2nd Edition, 2010.
2. T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein, "Introduction to Algorithms", PHI/Pearson Education, 3rdEdition, 2009.
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Pearson Education, Third Edition, 2012.

Reference Books

1. Michael T. Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet

Examples", Wiley India, 2006.
2. Sara Baase and Allen Van Gelder, "Computer Algorithms Introduction to Design and Analysis", Pearson Education Asia, 3rd Edition, 2010.
3. Donald E Knuth, "The Art of Computer Programming, Volume I & II", Addison Wessely, Third Edition, 2011.
4. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 2006.
5. Harsh Bhasin, "Algorithms Design and Analysis", Oxford university press, 2016.

Web References

1. https://swayam.gov.in/nd1_noc20_cs71/preview
2. https://www.tutorialspoint.com/design_and_analysis_of_algorithms/
3. https://www.javatpoint.com/daa-tutorial
4. https://www.guru99.com/design-analysis-algorithms-tutorial.html
5. https://www.geeksforgeeks.org/fundame

COs /POs/PSOs Mapping

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

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

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

U19CS043	PROGRAMMING IN JAVA (Common to ECE, MECH, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To gain and explore the knowledge of Javaprogramming.
- To know the principles of inheritances and packages.
- To learn about the usage of interfaces in Java.
- To gain and explore the event handling inJava.
- To get familiarized to the interfaces generic programming, multithreadingconcepts.

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 and package in relevant applications. **(K3)**

CO3 – Construct Java programs using interfaces. **(K3)**

CO4 – Build Java applications using Event Handling. **(K3)**

CO5 – Create Java applications using multithreading and generic programming. **(K3)**

UNIT I INTRODUCTIONTO 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 – Objects and classes in Java – Defining classes – Methods - Access specifiers – Static members – Constructors – Finalize method.

UNIT II INHERITANCE AND PACKAGES (9Hrs)

Arrays – Strings - Packages – Java-Doc comments –- Inheritance – Class hierarchy – Polymorphism – Dynamic binding – Final keyword – Abstract classes.

UNIT III INTERFACES (9Hrs)

The Object class – Reflection – Interfaces – Object cloning – Inner classes – Proxies - I/O Streams - Graphics programming – Frame – Components – Working with 2D shapes.

UNIT IV EVENT HANDLING (9Hrs)

Basics of event handling – Event handlers – Adapter classes – Actions – Mouse events – AWT event hierarchy – Introduction to Swing – Model-View-Controller design pattern – Buttons – Layout Management – Swing Components – Exception handling – Exception hierarchy – Throwing And catching exceptions.

UNIT V GENERIC PROGRAMMINGANDMULTITHREADING (9Hrs)

Motivation for generic programming – Generic classes – Generic methods – Generic code and virtual machine – Inheritance and generics – Reflection and generics - Multi-threaded programming – Interrupting threads – Thread States – Thread properties – Thread synchronization – Executors – Synchronizers. Enumeration – Autoboxing – Generics.

Text Books

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. Cay S. Horstmann and Gary Cornell, “Core Java: Volume I – Fundamentals”, Sun Microsystems Press, Eighth Edition, 2008.
4. Herbert Schildt, “The Complete Reference JAVA 2”, TMH, Seventh Edition, 2006.

Reference Books

1. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, 9th Edition, Prentice Hall,2013.
2. H.M.Dietel and P.J.Dietel, “Java How to Program”, PearsonEducation/PHI, 11th Edition, 2017.
3. Cay.S.Horstmann and Gary Cornell, “Core Java 2”, Vol 2, Advanced Features, Pearson Education,8th Edition,2008.
4. Java for Programmers, P.J. Dietel and H.M Dietel, Pearson Education (OR) JAVA:

5. Programming in Java, S.Malhotra and S.Choudary, Oxford Univ. Press.

Web References

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

COs /POs/PSOs Mapping

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

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

		L	T	P	C	Hrs
U19ITO41	**DATABASE SYSTEM: DESIGN & DEVELOPMENT** (Common to EEE, ECE, ICE, BME)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To gain and explore the knowledge of Javaprogramming.
- To know the principles of inheritances and packages.
- To learn about the usage of interfaces in Java.
- To gain and explore the event handling inJava.
- To get familiarized to the interfaces generic programming, multithreadingconcepts.

Course Outcomes

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

CO1 - Explain the concepts of Database Management System and develop Entity Relationship model and Relational Models for a given application **(K2)**
CO2 - Manipulate and build database queries using Structured Query Language and relational algebra **(K2)**
CO3 - Apply data normalization principles to develop a normalized database for a given application. **(K3)**
CO4 - Explain various storage & indexing techniques, transactions and recovery techniques **(K2)**
CO5 - Apply tools like NoSQL, MongoDB, Cassandra on real time applications**(K3)**

UNIT I INTRODUCTION (9 Hrs)

Database Systems– Data Models – Database System Architecture - Entity-Relationship Model - ER Diagram-Extended ER Model –ER into Relational Model - **Relational Model**: Structure of Relational Databases, Database Schema, Keys, Tables

UNIT II DATABASE LANGUAGES (9 Hrs)

Relational Algebra – Extended-Relational Algebra Operations –**SQL**: Introduction – DDL – DML –Integrity Constraints-Set Operations-Joins – Nested Queries -View- Trigger - Stored Procedures

UNIT III RELATIONAL-DATABASE DESIGN (9 Hrs)

Introduction to Schema Refinement – Decomposition – Lossless Decomposition – Functional Dependencies – Normal Forms - First Normal Form, Second Normal Form, Third Normal Form, Boyce-Codd Normal Form, Fourth Normal Form.

UNIT IV DATA STORAGE (9 Hrs)

RAID - File Organization - Indexing, Ordered Index, Index files, Hashing - Static and dynamic hashing.
Transactions: Transaction concepts and states– Concurrent Execution-Serializability-Concurrency Control: Lock based Protocol - Timestamp based Protocol - **Recovery System**: – Log-Based Recovery – Shadow Paging

UNIT V CASE STUDY (9 Hrs)

NoSQL – Document Database : MongoDB - Multi-dimensional: Cassandra

Text Books

1. Silberschatz, Korth, Sudarshan, *Database System Concepts*, 7th Edition – McGraw-Hill Higher Education, International Edition, 2019.
2. Ramez Elmasri, and Shamkant B. Navathe, Fundamentals of Database Systems (7th edition), Publisher: Pearson,2016

Reference Books

1. Raghu Ramakrishnan, —Database Management Systems, Fourth Edition, McGraw-Hill College Publications, 2015.
2. Date C J, Kannan A and Swamynathan S, —An Introduction to Database Systems‖, 8th Edition, Pearson Education, New Delhi, 2006.
3. Alan Beaulieu, Mastering SQL Fundamentals, Second Edition, O'Reilly,2009
4. Kristina Chodorow; Shannon Bradshaw MongoDB: The Definitive Guide, 3rd Edition, O'Reilly Media, Inc., 2018.
5. Pramod J. Sadalage (Author), Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of

Polyglot Persistence 1st Edition, Kindle Edition

Web References

1. http://www.database.com/
2. http://cassandra.apache.org/
3. 3.https://www.mongodb.com/

COs /POs/PSOs Mapping

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

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

		L	T	P	C	Hrs
U19ITO42	**R PROGRAMMING** (Common to EEE, **ECE,** ICE, BME, MECH, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the basics in R programming in terms of constructs, control statements, string functions
- To learn to apply R programming for Text processing
- To understand the use of data frames and tables
- To able to appreciate and apply the R programming from a statistical perspective
- To understand the interface model.

Course Outcomes

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

CO1 - Create artful graphs to visualize complex data sets and functions.**(K3)**
CO2 - Write more efficient code using parallel R and vectorization.**(K3)**
CO3 - Create data frames and working with tables.**(K3)**
CO4- Interface R with C/C++ and Python for increased speed or functionality.**(K2)**
CO5 - Find new packages for text analysis, image manipulation &perform statistical analysis.**(K4)**

UNIT I INTRODUCTION (9 Hrs)

Introducing to R – R Data Structures – Help functions in R – Vectors – Scalars – Declarations – recycling – Common Vector operations – Using all and any – Vectorized operations – NA and NULL values – Filtering – Vectorised if-then else – Vector Equality – Vector Element names

UNIT II MATRICES AND ARRAYS (9 Hrs)

Matrices, Arrays And Lists Creating matrices – Matrix operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns – Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists.

UNIT III DATA FRAMES (9 Hrs)

Data Frames Creating Data Frames – Matrix-like operations in frames – Merging Data Frames – Applying functions to Data frames – Factors and Tables – factors and levels – Common functions used with factors – Working with tables - Other factors and table related functions

UNIT IV FUNCTIONS AND ARGUMENTS (9 Hrs)

Control statements – Arithmetic and Boolean operators and values – Default values for arguments - Returning Boolean values – functions are objects – Environment and Scope issues – Writing Upstairs - Recursion – Replacement functions – Tools for composing function code – Math and Simulations in R Creating Graphs – Customizing Graphs – Saving graphs to files – Creating three-dimensional plots.

UNIT V INTERFACING (9 Hrs)

Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized.

Linear models – Non-linear models – Time Series and Auto-correlation – Clustering.

Text Books

1. Norman Matloff, “The Art of R Programming: A Tour of Statistical Software Design”, No Starch Press, 2011.
2. Jared P. Lander, “R for Everyone: Advanced Analytics and Graphics”, Addison-Wesley Data & Analytics Series, 2013.

Reference books

1. Mark Gardener, “ Beginning R – The Statistical Programming Language”, Wiley, 2013
2. Robert Knell, “Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and Programming in R”, Amazon Digital South Asia Services Inc, 2013.

Web References

1. https://www.coursera.org/learn/r-programming
2. https://www.r-project.org/

COs /POs/PSOs Mapping

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

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

U19ICO41	SENSORS AND TRANSDUCERS (Common to ECE, CSE, IT, MECH, CIVIL)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- Get to know the methods of measurement, classification of transducers and to analyze error.
- Get exposed to different types of resistive transducers and their application areas
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers
- To introduce about advancements in sensor technology.

Course Outcomes

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

CO1 - Understand the concepts of classification of Transducers. **(K2)**
CO2 - Familiar with the working of resistance Transducer. **(K3)**
CO3 - Familiar with the principle and working of various Inductive and Capacitive transducer **(K1)**
CO4 - Able to design signal conditioning circuit for various transducers **(K3)**
CO5 - Able to identify or choose a transducer for a specific measurement application **(K4)**

UNIT I CLASSIFICATION OF TRANSDUCERS (9 Hrs)

General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data.

UNIT II RESISTANCE TRANSDUCERS (9 Hrs)

Resistive transducers: Potentiometers, metal and semiconductor strain gauges and signal conditioning circuits, strain gauge applications: Load and torque measurement, Digital displacement sensors.

UNIT III INDUCTIVE AND CAPACITIVE TRANSDUCERS (9 Hrs)

Transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details, characteristics of capacitive transducers – Different types & Signal Conditioning – Applications:- Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

UNIT IV OTHER TRANSDUCERS (9 Hrs)

Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Magnetostrictive transducers. Eddy current transducers. Hall effect transducers – Optical sensors, IC sensor for temperature – signal conditioning circuits, Introduction to Fiber optic sensors – Temperature, pressure, flow and level measurement using fiber optic sensors

UNIT V SMART TRANSDUCER (9 Hrs)

Introduction to semiconductor sensor, materials, scaling issues and basics of micro fabrication. Smart sensors, Intelligent sensor, Mems Sensor, Nano-sensors, SQUID Sensors,- Environmental Monitoring sensors

Text Books

1. Doebelin E.O. and Manik D.N., “Measurement Systems”, 6th Edition, McGraw-Hill Education Pvt. Ltd.,2011.
2. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge,2003
3. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design Clarendon, Oxford2nd editionJacob Fraden - 2010
4. DoeblinE..O. “Measurement System Applications and Design”, TMH, 5th Edition, 2004

Reference Books

1. BelaG. Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol.1 ISA/CRC Press,2003.

2. BelaG. Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th edition, Vol.2 ASME PTC ,2018
3. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A.
4. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education,2000.

Web References

1. www.electrical4u.com
2. https://nptel.ac.in/courses/108108147/
3. https://www.youtube.com/watch?v=1uPTyjxZzyo

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

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

		L	T	P	C	Hrs
U19MEO41	**RAPID PROTOYPING** (Common to EEE, ECE, ICE, CIVIL, BME)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the development of RP systems
- To learn the classification of liquid based and solid based rapid prototyping systems
- To understand the powder based rapid prototyping systems
- To learn about the materials for rapid prototyping systems
- To discuss about the reverse engineering and new technologies

Course Outcomes

On successful completion of the course, students will be able to

CO1 - Acquire knowledge about the product development **(K1)**
CO2 - Analyze the classification of liquid based and solid based rapid prototyping systems **(K4)**
CO3 - Analyze the powder based rapid prototyping systems **(K4)**
CO4 - Acquire knowledge about the materials for rapid prototyping systems **(K1)**
CO5 - Acquire knowledge about reverse engineering and new technologies **(K1)**

UNIT I INTRODUCTION (9 Hrs)

History – Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle – Fundamental – File format – Other translators – medical applications of RP - On demand manufacturing – Direct material deposition - Shape Deposition Manufacturing.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS (9 Hrs)

Classification – Liquid based system - Stereolithography Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system - Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing.

UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS (9 Hrs)

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sintering materials, products, advantages, limitations, applications and uses. Three Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, e-manufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing - Laser Engineered Net Shaping (LENS).

UNIT IV MATERIALS FOR RAPID PROTOTYPING SYSTEMS (9 Hrs)

Nature of material – type of material – polymers, metals, ceramics and composites liquid based materials, photo polymer development – solid based materials, powder based materials - case study.

UNIT V REVERSE ENGINEERING AND NEW TECHNOLOGIES (9 Hrs)

Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds-preprocessing, point clouds to surface model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, other applications - Case study.

Text Books

1. Rafiq I. Noorani, Rapid Prototyping – Principles and Applications, Wiley & Sons, 2006.
2. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping: Principles and Applications, second edition, World Scientific, 2003.
3. Amitav Ghosh Introduction to Rapid Prototyping, North West Publication, New Delhi, 2008.

Reference Books

1. Hopkinson N, R.J.M, Hauge, P M, Dickens, “Rapid Manufacturing – An Industrial revolution for the digital age”, Wiley, 2006
2. Ian gibson, “Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototying”, Wiley, 2006

3. Paul F.Jacobs, Rapid Prototyping and Manufacturing, "Fundamentals of Stereolithography", McGraw Hill 1993.
4. Pham D.T and Dimov, "Rapid Manufacturing", Springer Verlog 2001.
5. Liou W.Liou, Frank W.Liou ,"Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.

Web References

1. https://nptel.ac.in/courses/112/104/112104265/
2. https://www.digimat.in/nptel/courses/video/112104265/L01.html
3. https://nptel.ac.in/courses/112/107/112107078/
4. https://www.youtube.com/watch?v=oDdOqLblmVQ
5. https://www.youtube.com/watch?v=OhNnKTaciVI

COs /POs/PSOs Mapping

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

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

		L	T	P	C	Hrs
U19CEO41	**ENERGY AND ENVIRONMENT** (Common to EEE, ECE, MECH, BME, IT, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- Explain the importance of energy, classifications of energy sources and energy demand scenario
- Analyze the impacts of energy on environment & sustainability energy options
- Outline the harness of hydropower and geothermal energy sources
- Discuss the aspects of solar and wind energy
- To study the importance of biomass energy and its applications

Course Outcomes

At the end of Course students will be able to.

CO1 - Apply the knowledge of science & engineering to the contemporary issues of Energy for better humankind & environment **(K3)**

CO2 - Identify, review & analyze the complex problems of Energy crises in environment **(K4)**

CO3 - Designing solutions for the energy crises in the form of renewable energy systems to meet the needs by understanding the limitations **(K4)**

CO4 - Understanding the impact of energy on environment and providing solutions for sustainable development. **(K5)**

CO5 – Apply biomass energy under relevant technologies **(K3)**

UNIT I ENERGY (9 Hrs)

Introduction, Importance of energy, role of energy consumption in economic and social transformation, Energy needs and crisis. Energy production and utilization. Types and classification of energy sources, Conventional & unconventional energy, Renewable sources & Nonrenewable sources of energy advantages, limitations, comparisons

UNIT II ENVIRONMENT (9 Hrs)

Impact of energy on economy &environment. Regional impacts of temperature change - Global warming, Greenhouse effect, Acid rain, Ozone layer depletion. Indian environment degradation, Environmental laws - Water Act-1974 (Prevention & control of pollution), The environment protection act 1986, Air act.

UNIT III HYDROPOWER & GEOTHERMAL ENERGY (9 Hrs)

Hydropower Energy – Introduction, Site selection, layout of hydro power plant, components & working, classifications, power station, structure and control. Geothermal Energy - Introduction, Site selection, layout of power plant, components & working, Advantages and disadvantages.

UNIT IV SOLAR & WIND ENERGY (9 Hrs)

Sun as source of energy - Introduction, Site selection, layout of power plant components & working, classifications, Types of collectors, collection systems efficiency, Solar cells. Wind Energy - Introduction, advantages/limitations, Site selection, layout of power plant, components &working, classification.

UNIT V BIOMASS ENERGY (9 Hrs)

Introduction, advantages/limitations, Photosynthesis, biomass fuel, biomass gasification, biogas from waste biomass, factors affecting biogas generation, types of biogas plant, Biomass programme in India,

Text Books

1. Trivedi R.R. and Jalka K.R, “Energy Management”, Commonwealth Publication, 20177.
2. Diamant R.M.E., “Total Energy”, Pergamon, OxfordPublishers, 2017.
3. N.G. AJJANNA “ Energy auditing & demand side management” first edition, Gouthami Publications, Shimoga
4. Chakrabarti, M.L.Soni, P.V. Gupta,U.S. Bhatnagar “ Power system Engineering” 2001, DhanpatRai&Co, New Delhi.
5. D.P.Kothari, K.C Singal, Rajesh Ranjan, “Renewable Energy sources and Emerging Technologies” second edition , PHI , India

Reference Books

1. Boyle G, Everett B and Ramett J, “Energy systems and sustainability”, Oxford University Press, 2018
2. "Pollution Control Acts, Rules and Notifications", CPCB, Pollution Control series, PC/2/2014, Vol.I,2014
3. Peavy.H, Rowe.D, and Tchobanoglous, G., Environmental Engineering, Tata McGraw-Hill, 2013
4. S.Rao, Dr. BB Parulekar “Energy Technologies” Khanna Publications , New Delhi
5. David M Buchla, Thomas E Kissel, Thomas L Floyd “Renewable Energy systems” Pearson, India
6. Godfrey Boyle “Renewable Energy power for sustainable future” oxford Publications , New Delhi

Web References

1. https://onlinecourses.nptel.ac.in/noc20_ce23/announcements
2. https://swayam.gov.in/nd1_noc20_ce23/preview
3. www.iucn.org
4. www.cites.org
5. www.thesummitbali.com/
6. http://engineering geology.gov.in/

COs /POs/PSOs Mapping

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

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

		L	T	P	C	Hrs
U19BMO41	**MEDICAL ELECTRONICS** (Common to EEE, ECE, CSE, IT, ICE, MECH, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To gain knowledge about the various physiological parameters measurements
- To understand the various biochemical and nonelectrical sensors
- To study about the assist devices
- To gain knowledge on surgical equipments and telemetry in healthcare
- To understand the concepts of recent advancements in healthcare

Course Outcomes

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

CO1 - Explain the electro- physiological parameters and bio-potentials recording **(K2)**
CO2 - Measure the biochemical and non-electrical physiological parameters **(K2)**
CO3- Interpret the various assist devices used in the hospitals **(K3)**
CO4 - Identify physical medicine methods and biotelemetry **(K3)**
CO5 - Analyse recent trends in medical instrumentation **(K3)**

UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING (9 Hrs)

Sources of bio medical signals, Bio-potentials, Bio potential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT (9 Hrs)

pH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

UNIT III ASSIST DEVICES (9 Hrs)

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters, Heart-Lung Machine.

UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY (9 Hrs)

Diathermies - Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry - Single Channel and Multiple Channel.

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION (9 Hrs)

Telemedicine, Insulin Pumps, Radio pill, Endo-microscopy, Brain machine interface, Lab on a chip, Cryogenic Technique.

Text Books

1. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 2011.
2. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TATA McGraw-Hill, New Delhi, 2017.
3. John G.Webster, “Medical Instrumentation Application and Design”, Third Edition, Wiley India , 2012.

Reference Books

1. Joseph J.Carr and John M.Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and Sons, New York, 2011.
2. R.Anandanatarajan, “Biomedical Instrumentation and Measurements”, Second Edition, PHI Learning, 2016.
3. Mandeep singh, “Introduction to Biomedical Instrumentation”, Second Edition, Prentice Hall of India, New Delhi,2014
4. Shakti Chatterjee, Aubert Miller, “Biomedical Instrumentation Systems”, Cengage Learning, 2012
5. C.Raja Rao, Sujoy K.Guha, “ Principles of Medical Electronics and Biomedical Instrumentation”, Universities Press, 2010

Web References

1. https://www.nap.edu/read/21794/chapter/7
2. https://www.embs.org/about-biomedical-engineering/our-areas-of-research/diagnostic-therapetic systems
3. https://nptel.ac.in/courses/127/106/127106136/
4. medicinenet.com/script/main/art.asp?articlekey=6414
5. https://www.verywellhealth.com/cardiopulmonary-bypass-machine-used-for-surgery-3157220

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

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

		L	T	P	C	Hrs
U19BMO42	**TELEMEDICINE** (Common to EEE, ECE, CSE, IT, ICE)	**3**	**0**	**0**	**3**	**45**

Course Objectives:
- To understand the classification of telemetry.
- To gain knowledge about biotelemetry principles
- To know about the applications of telemetry in various fields
- To provide the idea about the value of telemedicine
- To know the various applications in telemedicine.

Course Outcomes:

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

CO1- Categorize the telemetry systems **(K2)**
CO2- Understand the principles of biotelemetry in transmission of biological signals **(K3)**
CO3 - Apply the various Biotelemetry applications for diagnostics **(K3)**
CO4- Acquire clear idea about the fundamentals of telemedicine **(K2)**
CO5 - Know about various applications of telemedicine **(K3)**

UNIT I INTRODUCTION TO TELEMETRY (9 Hrs)

Basic system, Classification, Non electrical telemetry systems, Mechanical and Pneumatic type, Voltage and Current telemetry systems, Local transmitters and Converters, Frequency telemetry system, Power Line carrier communication (PLCC).

UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT (9 Hrs)

pH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

UNIT III APPLICATION OF BIOTELEMETRY (9 Hrs)

Wireless Telemetry - Single Channel and Multi-channel Telemetry systems, Multi Patient Telemetry, Implantable Telemetry Systems, Ambulatory patient monitoring.

UNIT IV FUNDAMENTALS OF TELEMEDICINE (9 Hrs)

History and advancements in telemedicine, Benefits of telemedicine, Functional Block of a telemedicine system, Use of computers in distance mode of healthcare delivery, Familiarizing with technology of telemedicine, scanner, electro stethoscope, data reception equipment, Scope for telemedicine, Limitations of telemedicine.

UNIT V APPLICATIONS OF TELEMEDICINE (9 Hrs)

Telemedicine in Neuroscience, Telecardiology, Telepathology, Telepediatrics, Telepharmacy, Telepsychiatry and mental health, Veterinary

Text Books

1. Marilyn J. Field , "A Guide to Assessing Telecommunications in Health Care", Fourth Edition, Academy Press,2011.
2. Bashshur , R. L. , Sanders, J. H and Shannon, G, "Telemedicine: Theory and Practice", Eight Edition, Springer,2014.
3. Olga (EDT), Ferre Roca, M. Sosa, "Handbook of Telemedicine", Third Edition, IOS press 2009.

Reference Books

1. Bemmel, J.H. van, Musen, M.A. (Eds.), "Handbook of Medical Informatics", Second Edition, Springer, 2010.
2. Simpson, W, "Video over IP. A practical guide to technology and applications'", Ninth Edition, Focal Press, Elsevier, 2009.
3. Ferrer-Roca, O., Sosa-Iudicissa, , "Handbook of Telemedicine", IOS Press, 2012
4. Norris, A.C, "Essentials of Telemedicine and Telecare", Eight Edition, Wiley, 2017
5. Wotton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine", Fifth Edition, Royal Society of Medicine Press Ltd., 2014.

Web References

1. https://en.wikipedia.org/wiki/Biotelemetry
2. https://www.who.int/goe/publications/goe_telemedicine_2010.pdf
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5927731

COs /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	-	-	3	-	-
2	3	2	-	-	2	1	-	1	-	2	-	-	3	-	-
3	3	2	3	2	2	1	-	1	-	2	-	-	3	1	-
4	3	2	-	2	2	1	-	1	-	2	-	-	3	1	-
5	3	2	3	2	2	1	-	1	-	2	-	-	3	-	-

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

		L	T	P	C	Hrs
U19CCO41	**BASIC DBMS** (Common to EEE, ECE, MECH, CIVIL, ICE, Mechatronics, BME)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand about basics of Database Management System.
- To provide a general introduction to relational model and relational algebra.
- To study about normalization and SQL.
- To acquire knowledge about storage indexing and transaction management.
- To gain knowledge about the backup and recovery in database.

Course Outcomes

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

CO1 – Explain the concept of database management system.(**K2**)
CO2 – Create conceptual data model using entity relationship diagram.(**K2**)
CO3 – Analyze the various normalization.(**K4**)
CO4 – Describe the concept of storage indexing and transactions.(**K2**)
CO5 – Explain the database recovery and security.(**K2**)

UNIT - I INTRODUCTION TO DATABASE MANAGEMENT (9 Hrs)

Introduction to Database Management systems – History - Characteristics – Users- three-level architecture- Entity-- relationship data model.

UNIT – II - THE RELATIONAL DATA MODEL AND RELATIONAL ALGEBRA (9 Hrs)

Data structures – Mapping E-R Model to Relational model – data manipulation – integrity – advantages – rules for fully relational systems – relational algebra – relational algebra queries.

UNIT - III - STRUCTURED QUERY LANGUAGE AND NORMALIZATION (9 Hrs)

SQL – Data definition – manipulation – views SQL in procedural programming – data integrity and constraints – triggers – data control – database security.Normalization – Undesirable properties – single-valued normalization – desirable properties of decompositions – multivalued dependencies

UNIT –IV STORAGE INDEXING AND TRANSACTIONS MANAGEMENT (9 Hrs)

Different types of memories – secondary storage – buffer management – file structures – heap files – sorted files – index and types – indexed sequential file – B-tree – B+ tree.Transaction management – concepts – examples – schedules – serializability – concurrency control – deadlocks – lock and multiple granularity – nonlocking techniques.

UNIT –V DATABASE BACKUP, RECOVERY AND SECURITY (9 Hrs)

Database system failure – backup – recovery and concept of log – log-based recovery techniques – types of recovery – log-based immediate update recovery technique. Database Security – violations – identifications and authentication – authorization / access control – security of statistical databases – audit policy – internet applications and encryption

Text Books

1. Gupta.G.K, “Database Management Systems”, Tata McGraw Hill, 2011
2. Abraham Silberschatz, Henry F Korth, S Sudharshan, Database System Concepts 7th Edition, McGraw-Hill International Edition, 2019.
3. Ramez Elmasri and Shamkant Navathe, Durvasula V L N Somayajulu, Shyam K Gupta, “Fundamentals of Database Systems”, Pearson Education, United States of America, 2018.

Reference Books

1. Silberschatz, Korth.H and Sudarshan.S, “Database System Concepts”, 6th Edition, McGraw-HillInternational, 2011.
2. Hector Garcia-Molina, Jeffrey D.Ullman, Jennifer Widom, “Database System The Complete Book, 1st Edition, Pearson 2002.
3. Date CJ, Kannan A, Swamynathan S, An Introduction to Database System, 8th Edition, Pearson Education-2006.
4. Raghu Ramakrishna, Johannes Gehrke, Database Management Systems, 3rd Edition, McGraw Hill, 2014.

5. Ramez Elmasri, Durvasul VLN Somyazulu, Shamkant B Navathe, Shyam K Gupta, Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016.

Web References

1. https://docs.oracle.com/cd/E11882_01/server.112/e41084/toc.htm MySQL Online Documentation
2. http://dev.mysql.com/doc/
3. http://www.rjspm.com/PDF/BCA-428%20Oracle.pdf
4. http://www.w3schools.com/
5. https://www.codecademy.com/learn/learn-

COs /POs/PSOs Mapping

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

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

OPEN ELECTIVE
UNDER REGULATIONS 2019

OPEN ELECTIVES OFFERED IN SEMESTER – V

Common to B. Tech (Offered in Semester V for **EEE, ECE, ICE, CIVIL, BME**) and (Offered in Semester VI for **CSE, IT, MECH, Mechatronics**)

Course Code	Course Name
U19HSO51/ U19HSO61	Product Development and Design
U19HSO52 U19HSO62	Intellectual Property and Rights
U19HSO53/ U19HSO63	Marketing Management and Research
U19HSO54/ U19HSO64	Project Management for Engineers
U19HSO55/ U19HSO65	Finance for Engineers

U19HSO51/ U19HSO61	PRODUCT DEVELOPMENT AND DESIGN	L	T	P	C	Hrs
		3	1	0	3	45

Course Objectives

- To provide the basic concepts of product design, product features and its architecture.
- To have a basic knowledge in the common features a product has and how to incorporate them suitably in product.
- To enhance team working skills.
- To design some products for the given set of applications.
- To compete with a set of tools and methods for product design and development.

Course Outcomes

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

CO1 - Apply the concept for new product development. **(K3)**
CO2 - Validate knowledge on the concepts of product specification. **(K5)**
CO3 - Describe the principles of industrial design and prototyping. **(K2)**
CO4 - Apply knowledge on product architecture. **(K3)**
CO5 - Review the concept of product development and customer needs. **(K5)**

UNIT I: INTRODUCTION TO PRODUCT DEVELOPMENT (9 Hrs)

Product development versus design, product development process, and product cost analysis, cost models, reverse engineering and redesign product development process, new product development, tear down method.

UNIT II: PRODUCT SPECIFICATIONS (9 Hrs)

Establishing the product specifications–, Target specifications – Refining specifications, concept generation-Clarify the problem – Search internally – Search externally – Explore systematically - Reflect on the Results and the Process.

UNIT III: PRODUCT CONCEPTS (9 Hrs)

A: Concept generation, product configuration, concept evaluation and selection, product embodiments.
B: Quality function deployment, product design specification, physical prototypes-types and technique, dimensional analysis, design of experiments.

UNIT IV: PRODUCT ARCHITECTURE (9 Hrs)

Concept selection- Screening – scoring, Product architecture – Implication of architecture - Establishing the architecture – Related system level design issues.

UNIT V: PROTOTYPING (9 Hrs)

Reliability, failure identification techniques, Poka-Yoke, Design for the environment, design for maintainability, product safety, liability and design, design for packaging.

Text Books

1. Kari T.Ulrich and Steven D.Eppinger,"Product Design and Development", McGraw-Hill International Edns.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood,
3. Otto, K. N. Product design: techniques in reverse engineering and new product development.

Reference Books

1. Ashby, M. F., & Johnson, K... *Materials and design: the art and science of material selection in product design*. Butterworth-Heinemann.
2. Kevin Otto and Kristin Wood, "Techniques in Reverse Engineering and New Product Development", Pearson Education, Chennai, Edition III.
3. Chitale A.V. and Gupta R.C., "Product Design and Manufacturing", 6th Edition, PHI.
4. Taurt Pugh,"Tool Design – Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY

5. Kumar, A., Jain, P. K., & Pathak, P. M. Reverse engineering in product manufacturing: an overview. DAAAM international scientific book,

Web References

1. http://www.worldcat.org/title/product-design-and-development/oclc/904505863
2. https://www.pdfdrive.com/product-design-and-development-e38289913.html
3. https://www.smashingmagazine.com/2018/01/comprehensive-guide-product-design/
4. https://www.smashingmagazine.com/2018/01/comprehensive-guide-product-design/
5. https://ocw.mit.edu/courses/sloan-school-of-management/15-783j-product-design-and-development-spring-2006/lecture-notes/clas1_int_crse_6.pdf
6. https://swayam.gov.in/nd1_noc20_de05/preview

COs/POs/PSOs Mapping

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

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

U19HSO52 U19HSO62	INTELLECTUAL PROPERTY RIGHTS	L 3	T 0	P 0	C 3	Hrs 45

Course Objectives

- To introduce fundamental aspects of Intellectual Property Rights to students who are going to play a major role in development and management of innovative projects in industries.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights and its related rights and registration aspects
- To disseminate knowledge on trademarks and registration aspects
- Awareness about current trends in IPR and Government steps in fostering IPR

Course Outcomes

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

CO1: Complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works **(K2)**

CO2: Presenting useful insight on novelty of their idea from state-of-the art search during their project work period. **(K3)**

CO3: Posting Intellectual Property as a career option like R&D IP Counsel, Government Jobs – Patent Examiner, Private Jobs, Patent agent and/or Trademark agent and Entrepreneur **(K5)**

CO4: To disseminate knowledge on Design, Geographical Indication, Plant Variety and Layout Design Protection and their registration aspects **(K1)**

CO5: Organizing their idea or innovations and analyse ethical and professional issues which arise in the intellectual property law context. **(K4)**

UNIT I OVERVIEW OF INTELLECTUAL PROPERTY (9 Hrs)

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994

UNIT II PATENTS (9 Hrs)

Patents - Elements of Patentability: Novelty, Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board

UNIT III COPYRIGHTS (9 Hrs)

Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights

UNIT IV TRADEMARKS (9 Hrs)

Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks - Infringement, Remedies & Penalties - Trademarks registry and appellate board

UNIT V OTHER FORMS OF IP (9 Hrs)

Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection Geographical Indication (GI) Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection.

Text Books

1. Nithyananda, K V. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited, 2019
2. Neeraj, P., & Khusdeep, D. Intellectual Property Rights. India, IN: PHI learning Private Limited. 2014

Reference Books

1. Ahuja, V K. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis, 2017.
2. Deborah E. Bouchoux, Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets, Cengage Learning, Third Edition, 2012.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.
4. Prabuddha Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, McGraw Hill Education, 2011.
5. S.V. Satakar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.
6. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012.

Web References

1. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf
3. Cell for IPR Promotion and Management (http://cipam.gov.in/)
4. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
5. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)
6. Journal of Intellectual Property Rights (JIPR): NISCAIR

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	1	-	3	-	2	-	1	2	-	-	-	2	2	2	-
2	1	-	3	-	2	-	2	2	-	-	-	2	2	2	-
3	-	-	2	-	1	-	3	3	-	-	-	2	2	2	-
4	2	-	3	-	2	-	2	2	-	-	-	2	2	2	-
5	1	-	1	-	2	-	1	2	-	-	-	2	2	2	-

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

		L	T	P	C	Hrs
U19HSO53/ U19HSO63	**MARKETING MANAGEMENT AND RESEARCH**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To facilitate understanding of the conceptual framework of marketing in engineering.
- To understand the concepts of product and market segmentation for engineering services and technological products.
- Analyzing the various pricing concepts and promotional strategies for engineering and technology markets.
- Learn to focus on a research problem using scientific methods in engineering and technological enterprises.
- To be able to design and execute a basic survey research reports in in engineering and technological enterprises

Course Outcomes

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

CO1 - Analyze the fundamental principles involved in managing engineering and technological markets **(K3)**
CO2 - Understand and develop product, and Market Segmentation for engineering services and technological Products **(K4)**
CO3 - Develop pricing and promotional strategies for engineering and technology markets **(K6)**
CO4 - Analyze market problems and be capable of applying relevant models to generate appropriate solutions to meet challenges in engineering and technological enterprises **(K3)**
CO5 - Identify the interrelationships between market trends, innovation, sustainability and communication in engineering and technological enterprises **(K5)**

UNIT I MARKETING – AN OVERVIEW (9 Hrs)

Definition, Marketing Process, Dynamics, Needs, Wants and Demands, Marketing Concepts, Environment, Mix, Types, Philosophies, Selling vs Marketing, Consumer Goods, Industrial Goods.

UNIT II PRODUCT AND MARKET SEGMENTATION (9 Hrs)

Product, Classifications of product, Product Life Cycle, New product development, Branding, Segmentation factors, Demographic, Psycho graphic and Geographic Segmentation, Process, Patterns. Services marketing and Industrial marketing.

UNIT III PRICING AND PROMOTIONAL STRATEGIES (9 Hrs)

Price: Objectives, Pricing Decisions and Pricing Methods, Pricing Management. Advertising-Characteristics, Impact, Goals, Types, Sales Promotion – Point of purchase, Unique Selling Propositions, Characteristics, Wholesaling, Retailing, Channel Design, Logistics.

UNIT IV RESEARCH AND ITS FUNDAMENTALS (9 Hrs)

Research: Meaning, Objectives of Research, Types of Research, Significance of Research - Methods Vs Methodology - Research Process – Components of Research Problem, Literature Survey – Primary Data and Secondary Data, Questionnaire design, Measurement and Scaling Techniques.

UNIT V BASIC STATISTICAL ANALYSIS AND REPORT WRITING (9 Hrs)

Fundamentals of Statistical Analysis and Inference- Measures of Central Tendency -Measures of Dispersion -Measures of Asymmetry - Report Writing: Types of research reports, Techniques of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different Steps in Report Writing, Layout of Research Report, Mechanics of Writing Research Report, Ethics in Research

Text Books

1. Philip Kolter & Keller, “Marketing Management”, Prentice Hall of India, 14th edition, 2012.
2. Lilien, Gary l., and Arvind Rangaswamy. “Marketing managers make ongoing decisions about product features, prices, distribution options”, The Handbook of Marketing Research: Uses, Misuses, and Future Advances (2006).

Reference Books

1. Chandrasekar. K.S., “Marketing Management Text and Cases”, 1st Edition, Tata McGraw Hill - Vijaynicole, 2010.
2. Kothari, C. “Research Methodology Methods and Techniques”, New Age International (P) Ltd., 2017
3. RajanSexena. Marketing Management: Text cases in Indian Context.(3rd edition) New Delhi, Tata McGraw hill, 2006
4. Moisander J, Valtonen A, “Qualitative marketing research: A cultural approach”, Sage Publisher, 2006.
5. Malhotra NK, Satyabhushan Dash, “Marketing Research: An Applied Orientation”, 7th ed, Pearson Education, 2019

Web References

1. https://swayam.gov.in/nd1_noc20_mg26/preview
2. https://swayam.gov.in/nd1_noc20_mg26/preview
3. https://www.entrepreneur.com/encyclopedia/market-research

COs/POs/PSOs Mapping

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

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

U19HSO54/ U19HSO64	PROJECT MANAGEMENT FOR ENGINEERS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the various concepts and steps in project management.
- To familiarize the students with the project feasibility studies and project life cycle
- To enable the students to prepare a project schedule
- To understand the risk management and project Control process.
- To learn about the closure of a project and strategies to be an effective project manager.

Course Outcomes

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

CO1 - Interpret the different concepts and the various steps in defining a project. **(K2)**
CO2 - Examining the feasibility of a project. **(K3)**
CO3 - Build a schedule for a Project. **(K6)**
CO4 - Predict the risk associated with a project and demonstrate the project audit. **(K2)**
CO5 - Analyse the project team and outline the Project closure. **(K4)**

UNIT I PROJECT MANAGEMENT CONCEPTS (9 Hrs)

Project: Meaning, Attributes of a project, Project Life cycle, Project Stakeholders, Classification, Importance of project management, Project Portfolio Management System, Different Project Management Structure, Steps in Defining the Project, Project Rollup – Process breakdown structure – Responsibility Matrices – External causes of delay and internal constraints

UNIT II PROJECT FEASIBILITY ANALYSIS (9 Hrs)

Opportunity Studies, Pre-Feasibility studies, and Feasibility Study: Market Feasibility, Technical Feasibility, Financial Feasibility and Economic Feasibility. Financial and Economic Appraisal of a project, Social Cost Benefit Analysis in India and Project Life Cycle.

UNIT III PROJECT SCHEDULING & NETWORK TECHNIQUES (9 Hrs)

Scheduling Resources and reducing Project duration: Types of project constraints, classification of scheduling problem, Resources allocation methods, Splitting, Multitasking, Benefits of scheduling resources, Rationale for reducing project duration, Options for accelerating Project completion
Developing and Constructing the Project Network (Problems), PERT, CPM; Crashing of Project Network,

UNIT IV PROJECT RISK MANAGEMENT AND PROJECT CONTROL (9 Hrs)

Project Risk management; Risk concept, Risk identification, Risk assessment, Risk response development, Contingency planning, Contingency funding and time buffers, Risk response control, and Change control management
Budgeting and Project Control Process, Control issues, Tendering and Contract Administration. Steps in Project Appraisal Process and Project Audits

UNIT V PROJECT CLOSURE AND MANAGING PROJECT (9 Hrs)

Project Closure: Team, Team Member and Project Manager Evaluations. Managing versus Leading a Project: Qualities of an Effective Project Manager, Managing Project Stakeholders, Managing Project Teams: Five Stage Team Development Model, Situational factors affecting team development and project team pitfalls.

Text Books

1. Erik Larson and Clifford Gray. “Project Management: The Managerial Process”. 6th Edn. McGraw Hill Education; 2017.
2. Harold Kerzner. “Project Management: A systems approach to Planning, Scheduling and Controlling. 12th Edn. John Wiley & Sons; 2017

Reference Books

1. Meredith, J.R. & Mantel, S. J. "Project Management- A Managerial Approach". John Wiley.:2017
2. Prasanna Chandra. "Projects: Planning, Analysis, Selection, Financing, Implementation, and Review". 9th Edn. McGraw Hill Education; 2019.
3. B C Punmia by K K Khandelwal. "Project Planning and Control with PERT and CPM". 4th Edn. Laxmi Publications Private Limited; 2016.
4. Hira N Ahuja, S.P.Dozzi, S.M.Abourizk. "Project Management". 2nd Edn. Wiley India Pvt Ltd; 2013.
5. "A guide to Project Management Body of Knowledge". 6th Edn. Project Management Institute; 2017

Web Resources
1. www.pmi.org
2. www.projectmanagement.com
3. https://www.sciencedirect.com/journal/international-journal-of-project-management
4. https://nptel.ac.in/courses/110/107/110107081/
5. https://nptel.ac.in/courses/110/104/110104073/

COs/POs/PSOs Mapping

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

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

U19HSO55/ U19HSO65	FINANCE FOR ENGINEERS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To develop a deeper understanding of the fundamentals of Accounting and Finance
- To learn how to apply mathematical principles in Finance and the concepts of Risk and Return
- To understand the need and procedure for conducting Financial Analysis for better decision-making
- To be familiar with the modes of generating funds for business and their implications
- To understand the scientific ways to determine deployment of funds in business

Course Outcomes

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

CO1: Understand basic concepts in accounting and finance and their importance for engineers **(K2)**
CO2: Demonstrate knowledge and understanding of the applications of mathematics in finance **(K3)**
CO3: Conduct Financial Analysis and use the outcome in making informed decisions in investing **(K4)**
CO4: Identify and appreciate various sources of procurement of funds in business and their critical evaluation **(K2)**
CO5: Know how to scientifically determine the investing in long-term and short-term assets in business **(K3)**

UNIT I: UNDERSTANDING THE FUNDAMENTALS (9 Hrs)

Assets – Need and Functions of Assets – Types of Assets – Factors determining Investments in Assets. Liabilities – Meaning and Functions of Liabilities – Types of Liabilities – Capital as a Liability: Why and How –– Concept and Meaning of Finance – Distinction between Accounting and Finance – Significance of Accounting and Finance for Engineers.

UNIT II: MATHEMATICS OF FINANCE (9 Hrs)

Time Value of Money – Computation of Present Value and Future Value – Implications of TVM in Financial Decisions – Concept of Risk and Return – Measuring Risk and Return – Concept of Required Rate of Return and its significance in Investment Decisions.

UNIT III: FINANCIAL ANALYSIS (9 Hrs)

Meaning and Objectives of Financial Analysis – Annual Report As an Input for Analysis – Basic Understanding of Annual Reports - Tools of Financial Analysis – Horizontal Analysis – Vertical Analysis – Trend Analysis – Accounting Ratios – Significance of Ratio Analysis in Decision-making – Snap-shot of the Past to predict the Future – Computation of Key Ratios – Liquidity Ratios – Profitability Ratios – Performance Ratios – Ratios that are helpful for Potential Investors.

UNIT IV: FUNDS PROCUREMENT (9 Hrs)

Meaning of Funds – Sources of Funds – Long-Term Sources – Short-Term Sources – Financing Decisions in Business – Capital Structure – Need and Importance of Capital Structure – Determining Optimum Capital Structure – Concept and Computation of Earnings Before Interest and Tax (EBIT), Earnings Before Tax (EBT), and Earnings After Tax (EAT)(Simple Problems) - Leverage in Finance – Types and Computation of Leverages – Operating Leverage, Financial Leverage, and Combined Leverage.

UNIT V: FUNDS DEPLOYMENT (9 Hrs)

Investment Decisions – Types of Investment Decisions: Long-Term Investment Decisions. Significance – Methods: Pay-Back Period Method, Net Present Value Method and Benefit-Cost Ratio Method. Short-Term Investment Decisions – Concept of Working Capital – Need and Importance of Working Capital in Business – Determinants of Working Capital in a Business. Components of Working Capital. Dividends: Concept and Meaning – Implications of Dividend Decisions on Liquidity Management.

Text Books

1. R. Narayanaswamy, Financial Accounting – A managerial perspective, PHI Learning, New Delhi. (2015 or later edition)
2. C. Paramasivan and T. Subramanian. Financial Management. New Age International, New Delhi. (2015 or later edition)

Reference Books

1. S.N. Maheswari, Sharad K. Maheswari & Suneel K. Maheswari. Accounting For Management. Vikas Publishing (2017 or later edition)
2. Varun Dawar & Narendar L. Ahuja. Financial Accounting and Analysis. Taxmann Publications. (2018 or later edition)
3. Athma. P. Financial Accounting and Analysis. Himalaya Publishing House. (2017 or later edtion)
4. Prasanna Chandra. Financial Management. Tata-McGraw Hill Publishers, New Delhi. (2019 or later edition)
5. S.C. Kuchhal. Financial Management. Chaitanya Publishing House, Allahabad. (2014 or later edition)

Web Resources

1. http://www.annualreports.com/
2. http://www.mmachennai.org/
3. https://finance.yahoo.com/
4. https://icmai.in/icmai/
5. https://nptel.ac.in/courses/110/107/110107144/
6. https://web.utk.edu/~jwachowi/wacho_world.html
7. https://www.icai.org/indexbkp.html
8. https://www.icsi.edu/home/
9. https://www.investopedia.com/
10. https://www.moneycontrol.com/
11. https://www.rbi.org.in/

COs/POs/PSOs Mapping

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

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

OPEN ELECTIVES
UNDER REGULATIONS 2019

OPEN ELECTIVES OFFERED IN SEMESTER – VI

Course Code	Course Name
U19EEO53 / U19EEO63	Conventional and Non-Conventional Energy Sources (Common to ECE, ICE, MECH, CIVIL, BME, Mechatronics)
U19EEO54/ U19EEO64	Industrial Drives and Control (Common to ECE, ICE, MECH, Mechatronics)
U19CSO54 / U19CSO64	Platform Technology (Common to EEE, ECE, ICE, MECH, CIVIL & BME)
U19CSO55 / U19CSO65	Graphics Designing (Common to EEE, ECE, ICE, MECH, CIVIL & BME)
U19ITO53/ U19ITO63	Essentials of Data Science (Common to EEE, ECE, ICE, MECH, CIVIL & BME)
U19ITO54/ U19ITO64	Mobile Application Development (Common to EEE, ECE, ICE, MECH, CIVIL, BME, Mechatronics)
U19ICO54 / U19ICO64	Measurement and Instrumentation (Common to ECE, Mechatronics)
U19MEO54 / U19MEO64	Heating Ventilation and Air Conditioning Systems (HVAC) (Common to EEE, ECE, ICE, CIVIL)
U19MEO55 / U19MEO65	Creativity Innovation and New Product Development (Common to EEE, ECE, ICE, CIVIL)
U19CEO53 / U19CEO63	Disaster Management (Common to EEE, ECE, CSE, IT, ICE, MECH, BME)
U19CEO54 / U19CEO64	Air Pollution and Solid Waste Management (Common to EEE, ECE, CSE, IT, ICE, MECH, BME)
U19BMO53 / U19BMO63	Biometric Systems (Common to EEE, ECE,CSE, IT, ICE, MECH, Mechatronics)
U19BMO54 / U19BMO64	Medical Robotics (Common to EEE, ECE,CSE, IT, ICE, MECH, Mechatronics)
U19ADO53/U19ADO63	Principle of Artificial Intelligence and Machine Learning (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE)
U19ADO54/U19ADO64	Data Science Application of Vision (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)
U19CCO54/ U19CCO64	Web Programming (Common to EEE,ECE, MECH, CIVIL, ICE Mechatronics, BME))

		L	T	P	C	Hrs
U19EEO53 / U19EEO63	**CONVENTIONAL AND NON-CONVENTIONAL ENERGY SOURCES** (Common to ECE, ICE, MECH, CIVIL, BME, Mechatronics)	3	0	0	3	45

Course Objectives

- To get knowledge on the status of conventional and non-conventional energy resources in world.
- To have a clear idea about the operation of conventional power plant and its associated equipment's.
- To learn about the concept of energy harvesting of solar through thermal and PV module
- To understand the technological basis for harnessing wind energy.
- To get a clear knowledge on power generation using Ocean, Tidal Energy and Bio-Energy

Course Outcomes

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

CO1 – Identify the world and Indian energy scenario and the necessity of renewable energy sources **(K1)**
CO2 – Gain knowledge for the generation of electrical power from various power plants **(K1)**
CO3 – Analyse and compare the various solar harvesting techniques **(K3)**
CO4 – Describe the aerodynamics of wind turbines and calculate their power, energy production**(K1)**
CO5 – Describe the construction and working principle of various equipment's used in Ocean, Tidal Energy and Bio-Energy power plants **(K2)**

UNIT I ENERGY RESOURCES (9 Hrs)

Perspective of energy resources – Forms of Energy – Conventional and non-conventional sources of energy– World's energy status - Energy reserves in India. Limitations of Conventional sources of energy efficiency – Renewable Energy Sources – Energy parameters – Energy Intensity - Gross Domestic product.

UNIT II POWER PLANTS (9 Hrs)

Thermal power plant – layout, working principle. Gas turbine power plant – layout, working principle. Nuclear power plants: fuels, nuclear fuel cycle, reactors and nuclear waste management. Hydro Electric plants – Types, energy conversion schemes, environmental aspects.

UNIT III SOLAR ENERGY SYSTEMS (9 Hrs)

Solar radiation - Principles of solar energy collection –Types of collector – working principles - Characteristics - efficiency - Solar Energy applications – water heaters, air heaters, solar cooling; solar drying and power generation – solar tower concept – solar pump. Photovoltaic (PV) technology – photovoltaic effect – modelling -Characteristics – efficiency of solar cells.

UNIT IV WIND ENERGY SYSTEMS (9 Hrs)

General theory of wind mills – Types of wind mills – performance of wind machines–wind power – efficiency. Merits and Limitations of Wind energy system – Modes of wind power generation.

UNIT V ALTERNATE ENERGY SYSTEMS (9 Hrs)

Ocean and Tidal energy conversion - working principle of OTEC – Anderson closed cycle OTEC System. Tidal power – tides - tidal range - types of tidal power plants, single basin and double basins schemes. Bio-mass Energy – Biogas plants.

Text Books

1. S. Rao and Dr. B. B. Parulekar, "Energy Technology", Khanna Publication, 3rd Edition, 1999.
2. B. H. Khan, "Non-Conventional Energy Resources", Tata McGraw Hill Education, 2nd Edition, 2009.
3. **D. P. Kothari, K. C. Singal, Rakesh Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI, 2011**

Reference Books

1. G. D. Rai, "Non-conventional energy sources", Khanna Publication. 4th Edition, 2002.
2. Pulfrey, David. L, "Photo voltaic Power Generation", Van Nostrand reinhold Company, 1983.
3. Abbasik, "Renewable Energy Sources and their Environment", PHI, 2008.
4. Steve Doty, Wayne C. Turner, "Energy Management Handbook", Fairmont Press, 8th Edition, 2012.
5. S.A.Abbasi and N. Abbasi, "Renewable Energy Sources and Their Environmental Impact", PHI, 2001.

Web References

1. https://www.tutorialspoint.com/renewable_energy/index.htm
2. https://nptel.ac.in/courses/112/107/112107291/
3. https://byjus.com/physics/conventional-and-nonconventional-sources-of-energy/
4. https://www.jagranjosh.com/general-knowledge/nonconventional-sources-of-energy-1448698715-1
5. https://wb.gov.in/departments-power-and-non-conventional-energy-sources.aspx

COs / POs and PSOs Mapping

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

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

		L	T	P	C	Hrs
U19EEO54/ U19EEO64	**INDUSTRIAL DRIVES AND CONTROL** (Common to ECE, ICE, MECH, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To introduce the concept of selection and Utilization of Electric drives.
- To understand power flow diagram for industrial process and drives.
- To introduce effect of heating and cooling characteristics of drives.
- To introduce the various speed control techniques for DC drives.
- To introduce the various speed control techniques for AC drives

Course Outcomes

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

CO1 – Select the appropriate motors to meet the load requirements.**(K3)**
CO2 – Explain the industrial process and selection of drives for various applications. (**K2)**
CO3 – Describe the thermal characteristics of electric motors.**(K1)**
CO4 – Analyse the speed torque characteristics of converter and chopper fed DC drives. **(K3)**
CO5 – Apply the various speed control methods for Induction and synchronous motor.**(K3)**

UNIT I INTRODUCTION TO ELECTRIC DRIVES (9 Hrs)

Need for Drive – Concept of electric drives – Motors used in drives – Types of loads – Choices – Classification – Multi quadrant operation – Fundamental torque equation – Nature and classification of load torques.

UNIT II INDUSTRIAL PROCESS AND DRIVES (9 Hrs)

Process flow diagram of paper mill – Cement mill – Sugar mill – Steel mill –Textile mills – Hoists and cranes – Centrifugal pumps and compressors – Solar powered pump drives –Selection of drives.

UNIT III THERMAL CHARACTERISTICS OF ELECTRIC MOTORS (9 Hrs)

Effect of heating – Heating and cooling characteristics – Loading condition and classes of duty – Determination of rating of motors – Effect of load inertia – Load equalization – Environmental factors.

UNIT IV SPEED CONTROL OF DC DRIVES (9 Hrs)

Controlled rectifier fed separately excited DC drives – Single phase drives – Three phase drives – Four quadrant operation fully controlled rectifier – Rectifier control of DC series motor – Chopper control of separately excited and series DC motor.

UNIT V SPEED CONTROL OF AC DRIVES (9 Hrs)

VSI and CSI driven induction motor – Closed loop speed control - static rotor resistance control – Slip power recovery schemes – performance comparison of CSI and VSI fed drives – Variable frequency control of multiple synchronous motors.

Text Books

1. B. N. Sarkar, "Fundamentals of industrial drives", PHI Learning Pvt Ltd Education, 2011.
2. Gobal K. Dubey, "Fundamentals of Electrical Drives", Alpha Science Int. Ltd., Pangbourne, 2nd Edition, 2002.
3. R. Krishnan, "Electric Motor Drives–Modeling, Analysis and Control", Pearson Education, 1st Edition, 2002.

Reference Books

1. S. B. Dewan, G. R. Slemon & A. Stranghan, "Power Semiconductor controlled Drives", John willey Publication
2. KokKiong Tan & Andi Sudjana Putra, "Drives and Control for Industrial Automation Advances in Industrial Control", Springer Science & Business Media, 2010.
3. Juha Pyrhonen, Valeria Hrabovcova, R. Scott Semken, "Electrical Machine Drives Control: An Introduction", John Wiley & Sons, 2016

Web References

1. www.siemens.com/paperwww.siemens.com/cemet
2. www.siemens.com/metal
3. www.siemens.comn/sugar
4. www.abb.com/industries
5. www.krupp polysius.com

COs / POs and 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	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
3	3	3	3	1	-	-	-	-	-	-	-	-	1	-	-
4	3	3	3	1	-	-	-	-	-	-	-	-	1	-	-
5	3	3	3	1	-	-	-	-	-	-	-	-	1	-	-

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

		L	T	P	C	Hrs
U19CSO54/ U19CSO64	**PLATFORM TECHNOLOGY** (Common to EEE, ECE, ICE, CIVIL & BME)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the fundamentals of developing modular application by using object oriented concepts.
- To utilize the C# and .NET framework to build distributed enterprise applications.
- To develop Console Application, Windows Application and Web Applications.
- To connect to multiple data sources and managing them effectively.
- To develop the Enterprise kind of applications

Course Outcomes

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

CO1 - Understand the concept of .NET Framework. **(K2)**
CO2 - Develop, implement and creating Applications with C#. **(K4)**
CO3 - Evaluate various graphics and window forms. **(K5)**
CO4 - Integrating front end applications with Database connectivity. **(K3)**
CO5 - Classifying various Enterprise applications into real world problems. **(K3)**

UNIT I INTRODUCTION TO .NET FRAMEWORK (9 Hrs)

.NET Framework - Common language Runtime (CLR) – Common Type System (CTS) – Common language Specification (CLS) – Compilation process – Assemblies – Namespaces – Command line compiler.

UNIT II C# FUNDAMENTALS (9 Hrs)

C# class - object - string formatting - Types - scope - Constants - C# iteration - Control flow - Operators - Array - String - Enumerations - Structures - Custom namespaces. Programming constructs – value types and reference types – object oriented concepts – Encapsulation – Inheritance – polymorphism – Interfaces – collections – Multithreading.

UNIT III GRAPHICS AND WINDOWS FORMS (9 Hrs)

Tool box controls – Container control – Menu – Tool bar – Tool tip Controls during design time – Run time – Graphics programming GDI+.

UNIT IV DATABASE PROGRAMMING (9 Hrs)

Data Access with ADO.NET – Architecture – Data reader – Data Adapter – Command – Connection – Data set – Data binding – Data Grid Control – XML based Data sets.

UNIT V J2EE (9 Hrs)

Enterprise Edition Overview – Multi-Tier Architecture – Best Practices – Comparison between J2EE and .NET.

Text Books

1. David Chappell, “Understanding .NET – A Tutorial and Analysis”, Addison Wesley, 2002.
2. Herbert Schildt, “C# 3.0 The Complete Reference”, McGraw-Hill Professional, Third Edition, 2008.
3. Keogh, “J2EE The Complete Reference”, Tata McGraw-Hill, 2008.

Reference Books

1. Andrew Troelsen, “Pro C# 5.0 and the .NET 4.5 Framework”, Sixth edition, A Press, 2012.
2. Joh Skeet, “C# in depth, Manning publications”, Third Edition, 2014.
3. Adrew Stellman and Jennifer Greene, “Head First C#”, Third Edition, O’Reilly, 2013.
4. Rod Johnson, “J2EE Design and Development”, Wrox, 2002

5. Michael Schmalz, “C# Database Basics”, O'Reilly Media, January 2012.

Web Resources

1. https://www. nptel.ac.in/
2. https://www.c-sharpcorner.com/csharp-tutorials
3. https://www.guru99.com/c-sharp-tutorial.html

COs/POs/PSOs Mapping

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

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

U19CSO55/ U19CSO65	GRAPHICS DESIGNING (Common to EEE, ECE, ICE, CIVIL & BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To develop basic skills using graphics and theory used in design process.
- Create computer-based projects using Adobe Photoshop.
- Understand, develop and employ visual hierarchy using images and text
- Use a computer to create and manipulate images and layers for use in various print and digital mediums.
- To acquire the knowledge of Animation

Course Outcomes

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

CO1 – Develop the basic design elements of graphics. **(K3)**
CO2 – Apply the various Photoshop tools. **(K3)**
CO3 – Modify the image size, selection and grids using tools. **(k3)**
CO4 – Create and Work with coloured layers. **(K4)**
CO5 – Apply different methods for Animation & Panoramic Picture creation. **(K5)**

UNIT I BASIC CONCEPTS (9 Hrs)

Basic Concepts of Designing - Design Principles – Basics of design elements – Typography – Color theory - Introduction to Graphics - Introduction to Photoshop - Bitmap and Vector Images - Understanding Image Size and Resolution

UNIT II INTRODUCTION TO PHOTOSHOP (9 Hrs)

Introduction to Tools - Environment - layout of Photoshop - Design layout setup - color - resolution setting - using basic marquee - selection tools Usage of lasso tools - Using brushes - using and filling colors - layers Using text tool - free transform tool - Exercise: Designing Greeting card / Advertisement

UNIT III IMAGE SIZE, SELECTION, GRID AND GUIDES (9 Hrs)

Modifying Image Size - Resolution, Marquee - Lasso - Magic Wand - Selection Tools – Selecting – Saving - Crop tool - Coping Selection And Image - Grid and Guide Options – Masks – Channel - Painting and editing - Working with quick masks - Painting (Brush, and its effects) - Blending Modes, Color palettes – Editing - Background - Color - Touchup - Cleanup - Gradient tools - layer blending modes - all types of text tools - shape tools Exercise : Designing Magazine cover - Poster - Brochure

UNIT IV LAYERS (9 Hrs)

The layer Palette - Changing and controlling layer order - Editing layers - Adjustment layers - Layer Effects Filters - Actions - Automation - Extract - Filter Gallery - Liquefy , Pattern making - Vanishing point - Built in Bitmap Filters - 3rd party Plug-ins - Using predefined Actions - Creating and Recording Actions - Using built in automation - Learning Filter effects - managing the files with layers and layer effects - plugins Manipulation tools - Image control options – HUE - Levels - brightness control Using image – modifying - changing color Exercise : Converting black and white photo to color - designing a photo album

UNIT V ANIMATION & PANORAMIC PICTURE CREATION (9Hrs)

Creating product Packaging designs - CD cover - Book and magazine front cover - Envelope - Visiting card - Color correction and color channel management - Design automation theory and Practical's Samples and demos - guidelines for freelance work - website links - resource sharing - Preparing Image For Print and Web - Calculating Image size and Resolution, Changing Image Dimensions - Layout Preview - Color Separation - Optimizing Images for Web - File Formats - Creating Webpages - web photo galleries

Text Books
1. Adobe Creative Team, “Adobe Photoshop – Classroom in a Book”, Adobe system incorporation, Adobe Press, 2010.
2. Katherine A.Hughes, “Graphic Design”, Learn It,Do It,CRC Press 2019.
3. Ken Pender, “Digital color in Graphics Design”, CRC Press 2012.

Reference Books
1. Mike Wooldridge, “Teach Yourself Visually Adobe Photoshop CS 5”, Wiley Publishing, 2010
2. Lesa Snider, “Photoshop the missing Manual”, O’Reilly Media, Inc, 2010.
3. Poppy Evans, Aaris Sherin, Irina Lee, “The Graphic Design”, Rockport, 2013.
4. Peter Bauer, “Photoshop CC for Dummies”, Wiley, 2013.
5. Scott Onstott, “Enhancing CAD Drawings with Photoshop”, Wiley,2006

Web Resources
1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-831-user-interface-design-and-implementation-spring-2011/lecture-notes/MIT6_831S11_lec18.pdfhttp://www.moshplant.com/direct-or/bezier/
2. https://www.cs.montana.edu/courses/spring2004/352/lectures/CS351-GUIDesign.pdf
3. https://www.university.youth4work.com/study-material/graphic-design-lecture
4. https://kmayeunhia.wordpress.com/lecture-notes/
5. https://nptel.ac.in/courses/106/106/106106090/

COs/POs/PSOs Mapping

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

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

U19ITTO53/ U19ITTO63	**ESSENTIALS OF DATA SCIENCE** (Common to EEE, ECE, ICE, CIVIL & BME)	**L**	**T**	**P**	**C**	**Hrs**
		3	**0**	**0**	**3**	**45**

Course Objectives

- To gain knowledge about the concepts involved in data analytics.
- To discover insights in data using R programming.
- To summarize the operations involved in Hadoop Map Reduce.
- To make use of algorithms related to regression and classification.
- To examine data using time series analysis and text analysis

Course Outcomes

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

CO1 - Experiment with data analytics using R language**. (K3)**
CO2 - Demonstrate clustering algorithms and association rules. **(K3)**
CO3 - Use algorithms related to regression and classification. **(K3)**
CO4 - Explore data using time series analysis and text analysis. **(K2)**
CO5 - Summarize Hadoop platform to solve map reduce problems. **(K2)**

UNIT I DATA ANALYTICS USING R (9 Hrs)

Big Data Overview-Examples of Big Data Analytics-Data Analytics Lifecycle overview-Phases in the lifecycle-GINA Case Study-Introduction to R programming-Exploratory Data Analysis-Statistical Methods for Evaluation.

UNIT II CLUSTERING AND ASSOCIATION RULES (9 Hrs)

Overview of clustering-Scope of Clustering Techniques- K Means clustering- Additional Algorithms- Clustering in practise: Fake news identification-Overview of Association rules-Apriori Algorithm-Evaluation of Candidate Rules-Applications of Association Rules-An Example: Transactions in a grocery store-Validation and Testing-Diagnosis

UNIT III REGRESSION AND CLASSIFICATION (9 Hrs)

Scope of Regression Techniques-Linear Regression-Logistic Regression-Additional Regression models-Scope of Classification Techniques-Decision Trees-Naïve Bayes-Diagnostics of Classifiers-Additional Classification Methods-Applications: Prediction of crop yield

UNIT IV TIME SERIES ANALYSIS AND TEXT ANALYSIS (9 Hrs)

Overview of Time Series Analysis-ARIMA Model-Additional Methods-Text Analysis Steps-A Text Analysis Example-Collecting Raw Text-Representing Texts-TFIDF-Categorizing documents by topics-Determining Sentiments-Gaining Insights.

UNIT V HADOOP MAP REDUCE AND DATA ANALYTICS (9 Hrs)

Installing and Understanding Hadoop-HDFS and Map Reduce Architecture-Hadoop Map Reduce Example-Hadoop Map Reduce in R-Data Analytics Problems: Exploring web pages categorization - Computing the frequency of stock market change-Real Time Recommender model using Apache Spark.

Text Books

1. David Dietrich, Barry Heller and Beibei Yang, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, EMC Education Services, Reprint 2015, Wiley, ISBN: 9788126556533.
2. VigneshPrajapathi, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013, Birmingham, Mumbai.
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding opportunities in Huge DataStreams with Advanced Analytics”, John Wiley & sons, 2012.

Reference Books

1. Roger D. Peng, “R Programming for Data Science”, LeanPub, 2015.
2. Bart Baesens , “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications“, Wiley Publishers, 2014.

Web References

1. www.ibm.com/Data Analytics/
2. https://www.ijser.org/researchpaper/Importance-of-Clustering-in-Data-Mining.pdf
3. https://datafloq.com/read/7-innovative-uses-of-clustering-algorithms/6224
4. https://publications.waset.org/10011058/improving-fake-news-detection-using-k-means-and-support-vector-machine-approaches
5. https://statisticsbyjim.com/regression/when-use-regression-analysis/

COs/POs/PSOs Mapping

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

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

		L	T	P	C	Hrs
U19ITO54/ U19ITO64	**MOBILE APPLICATION DEVELOPMENT** (Common to EEE, ECE, ICE, CIVIL. Mechatronics & BME)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the basic concepts of mobile computing
- To be familiar with the network protocol stack
- To learn the basics of mobile telecommunication system
- To be exposed to Ad-Hoc networks
- To gain knowledge about different mobile platforms and application development

Course Outcomes

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

CO1 - Explain the basics of mobile telecommunication system **(K2)**
CO2 - Articulate the required functionality at each layer for given application **(K2)**
CO3 - Identify solution for all functionality at each layer. **(K2)**
CO4 - Use simulator tools and design Ad hoc networks **(K3)**
CO5 - Develop a mobile application **(K3)**

UNIT I INTRODUCTION (9 Hrs)

Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications – Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues – Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes.

UNIT II MOBILE INTERNET PROTOCOL AND TRANSPORT LAYER (9 Hrs)

Overview of Mobile IP – Features of Mobile IP – Key Mechanism in Mobile IP – route Optimization. Overview of TCP/IP – Architecture of TCP/IP- Adaptation of TCP Window – Improvement in TCP Performance.

UNIT III MOBILE TELECOMMUNICATION SYSTEM (9 Hrs)

Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) – Universal Mobile Telecommunication System (UMTS).

UNIT III MOBILE AD-HOC NETWORKS (9 Hrs)

Ad-Hoc Basic Concepts – Characteristics – Applications – Design Issues – Routing – Essential of Traditional Routing Protocols –Popular Routing Protocols – Vehicular Ad Hoc networks (VANET) – MANET Vs VANET – Security.

UNIT V MOBILE PLATFORMS AND APPLICATIONS (9 Hrs)

Mobile Device Operating Systems – Special Constrains & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – M- Commerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

Text Books

1. Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, PHI Learning Pvt. Ltd, New Delhi – 2012.
2. Jochen H. Schller, “Mobile Communications”, Second Edition, Pearson Education, New Delhi, 2007
3. C.K.Toh, “AdHoc Mobile Wireless Networks”, First Edition, Pearson Education, 2002.

Reference Books

1. Dharma Prakash Agarval, Qing and An Zeng, “Introduction to Wireless and Mobile systems”, Thomson Asia Pvt Ltd, 2005.

2. William.C.Y.Lee,“Mobile Cellular Telecommunications-Analog and Digital Systems”, Second Edition,TataMcGraw Hill Edition ,2006.
3. UweHansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, Springer, 2003.

Web References

1. Developers : http://developer.android.com/index.html
2. Apple Developer : https://developer.apple.com/
3. http://developer.windowsphone.com
4. BlackBerry Developer : http://developer.blackberry.com/

COs/POs/PSOs Mapping

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

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

		L	T	P	C	Hrs
U19ICO54 / U19ICO64	**MEASUREMENT AND INSTRUMENTATION** (Common to **ECE**, Mechatronics)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To introduce the meters used to measure current and voltage
- To have an adequate knowledge in the measurement techniques for power and energy, power and energy meters are included
- To provide Elaborate discussion about potentiometer & instrument transformers
- To provide detailed study of resistance measuring methods
- To provide detailed study of inductance and capacitance measurement

Course Outcomes

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

CO1 - Measure current and voltage.
CO2 - Understand AC and DC measurements.
CO3 - Measure power and calibration of energy meters
CO4 - Measure current and voltage using potentiometric method.
CO5 - Understand the resistance measurement

UNIT I MEASUREMENT OF VOLTAGE AND CURRENT (9 Hrs)

Galvanometers: – Ballistic, D'Arsonval galvanometer – Theory, calibration, application – Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type & thermal type meter, rectifier type – Extension of range and calibration of voltmeter and ammeter – Errors and compensation

UNIT II MEASUREMENT OF POWER AND ENERGY (9 Hrs)

Electrodynamometer type wattmeter: –Theory & its errors – Methods of correction – LPF wattmeter– Phantom loading –Induction type kWh meter – Induction type energy meter – Calibration of wattmeter and Energy meter.

UNIT III POTENTIOMETERS & INSTRUMENT TRANSFORMERS (9 Hrs)

DC potentiometer:– Basic circuit, standardization – Laboratory type (Crompton's) – AC potentiometer:-Drysdale (polar type) type – Gall-Tinsley (coordinate) type – Limitations & applications – Instrument Transformer:-C.T and P.T construction, theory, operation and characteristics

UNIT IV RESISTANCE MEASUREMENT (9 Hrs)

Measurement of low, medium & high resistance: – Ammeter, voltmeter method – Wheatstone bridge– Kelvin double bridge – Series and shunt type ohmmeter – High resistance measurement :-Loss of charge method, Megohm bridge method –Megger – Direct deflection methods – Price's guard wire method – Earth resistance measurement

UNIT V IMPEDANCE MEASUREMENT (9 Hrs)

A.C bridges:– Measurement of inductance, capacitance – Q of coil – Maxwell Bridge –Wein's bridge– Schering bridge – Anderson bridge –Hay's bridge- Campbell bridge to measure mutual inductance – Errors in A.C. bridge methods and their compensation – Detectors – Excited field – A.C. galvanometer– Vibration galvanometer.

Text Books

1. E.W. Golding & F.C. Widdis, 'Electrical Measurements & Measuring Instruments', A.H. Wheeler& Co,2001
2. H.S. Kalsi, Electronic Instrumentation, McGraw-Hill Education, New Delhi, 2010

Reference Books

1. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation Dhanpat Rai and Co, New Delhi, 2010.
2. S.K.Singh, 'Industrial Instrumentation and control', Tata McGraw Hill, 2nd edn., 2002.
3. J.B.Gupta 'A Course in Electronic and Electrical Measurements and Instrumentation', S.K. Kataria & Sons, Delhi, 2003.

Web References

1. https://lecturenotes.in/notes/7259-notes-for-electrical-measurement-and-instrumentation-mi-by-ranu-singh
2. https://lecturenotes.in/subject/265/electrical-measurement-and-instrumentation

COs/POs/PSOs Mapping

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

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

		L	T	P	C	Hrs
U19MEO54/ U19MEO64	**HEATING VENTILATION AND AIR CONDITIONING SYSTEM** (Common to EEE, ECE, ICE and CIVIL)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the principles of heating ventilation and air conditioning, refrigerant properties, selection
- To learn about the heating and cooling load estimation
- To understand about air distribution systems, industrial ventilation
- To impart knowledge of the psychometric properties, processes and air-conditioning systems
- To provide knowledge on different components and parameters involved in design of air conditioning systems using cooling load calculations

Course Outcomes

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

CO1 - Describe the principles of heating ventilation and refrigerant properties. **(K1)**
CO2 - Analyse the factors affecting the load estimate. **(K4)**
CO3 – Explain the air distribution classification, types of airflow and types of cross section. **(K1)**
CO4 - Appraise the psychometric processes and air conditioning system performance. **(K5)**
CO5 - Design the Air-conditioning systems with available resources as cost effective. **(K5)**

UNIT I INTRODUCTION TO HVAC (9 Hrs)

Definition – Principles of HVAC –Scope of HVAC Industry with overview of consulting & construction Industry-market size – Growth – Penetration – opportunities- challenges – Energy usage and saving of HVAC - Terminologies – Heat and its types – Psychometric chart – Properties of Air – Codes & Standards used in HVAC-Refrigerants - Desirable properties – classification – refrigerants used – nomenclature – Selection of refrigerants - ozone depletion – global warming–ASHRAE – Recent substitute for refrigerants.

UNIT II VENTILATION, HEATING AND COOLING LOAD (9 Hrs)

Basics of Heat transfer in a building envelop – Understanding of Outdoor & Indoor condition – Factors affecting the loads estimate Sources of Heat gain – External: Sun gain through Glass/Window/Roof/Wall – Partition gain – Internal: People/Lights/Electrical Equipments/motors/Kitchen Appliances – Heat gain through Infiltration air – Ventilation, air quantity and loads –Need, threshold limits of contaminants, estimation of ventilation rate, decay equation, air flow around buildings – Methods of Ventilation – Infiltration load calculation – Heating and cooling load estimation – Calculating ESHF, GTH, ADP, Dehumidified CFM – Cold storage design

UNIT III DESIGN OF AIR DISTRIBUTION SYSTEM (9 Hrs)

Air Distribution – Classification – Types of Air flow – Types of Cross section – Types of Velocity & pressure duct – Types of material – Types of Insulations – Duct Accessories – SMACNA standard – Duct designing methods: Velocity reduction method, Equal friction method, Static regain method - Duct designing Software – Duct sheet metal calculation: GI sheet, Gauge of duct & thickness of Gauge, Hanger spacing,Hanger Rod Diameter and Angle support Size –Air terminal selection – Industrial ventilation: Steel plants, car parks, plant rooms and mines

UNIT IV INTRODUCTION TO PSYCHROMETRIC AND HUMAN COMFORT (9 Hrs)

Principle and psychrometric properties of air – Psychrometric Chart – Psychrometric relations; Dalton's law of partial pressures –Wet bulb temperature and measurement – Adiabatic saturation temperature – Psychrometric processes – mixing of air stream - sensible heat factor – HVAC systems: Unitary, Semi-central, Central, Air-cooled systems, Water cooled systems–Human Comfort – Heat transfer from body, convection, radiation, conduction, evaporation, clothing resistance, activity level - Concept of human comfort – Thermal response – comfort factors– Environmental indices - Indoor air quality(IQA) - Effective temperature and comfort chart – Heat production and regulation of human body.

UNIT V DESIGN OF AIR CONDITIONING SYSTEMS COMPONENTS (9 Hrs)

Air conditioning loads - Sources of heat load – Sensible load – Latent load - Conduction load – Sun load – Load from occupants – Equipment load – Infiltration air load- Load from moisture gain – Fresh air load- ASHARE standards - concepts of RSHF, GSHF- problems, concept of ESHF and ADP temperature - Requirements of industrial air conditioning – Calculation of load on air-conditioning system – Design of space cooling load - Air-conditioning devices and components:Air filters, types, efficiency – Humidifiers and Dehumidifiers – selection of humidifier and design – Fans, types &selection - Coil, Characteristics, types & Coil Accessories - condensate control-blowers – Cooling towers and spray ponds – Air distribution system –precision air conditioning - Automotive air conditioning - Heat pump – heat sources – different heat pump circuits – Commissioning and Maintenance.

Text books

1. Arora, C.P.," Refrigeration and Air conditioning", TataMcGraw-Hill, New Delhi, Third edition, 2017.
2. McQuiston, F.C., Parker, J.D and Spilter, J.D.," Heating Ventilating and Air Conditioning", John Wiley & Sons Inc., 2001.
3. Stocker W.F and Jones J.W, "Refrigeration and Air Conditioning ", McGraw-Hill, 1995.

Reference books

1. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International Publisher, New Delhi, 2015.
2. Arora.S.C and Domkundwar.S, "A course in refrigeration and Air conditioning", DhanpatRai(P) Ltd, New Delhi, 2016.
3. Legg, R.C., "Air Conditioning System - Design, Commissioning and maintenance", Batsford Ltd, London 1991.
4. Haines, W.R, and Wilso, C.L," HVAC systems Design Handbook", Mcgraw Hill, 2nd Edition, New Delhi, 1994
5. Sapali S.N, "Refrigeration and air Conditioning", PHI, second edition, 2014.

Web References

1. http://nptel.ac.in/courses/112105128/
2. Httpp://ocw.mit.edu/courses/mechanical engineering/
3. http://www.nptelvideos.in/2012/12/refrigeration-and-airconditioning.html
4. https://www.youtube.com/watch?v=ScVBPAitibQ
5. https://www.youtube.com/watch?v=z8ZStRCacdM

COs/POs/PSOs Mapping

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

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

U19MEO55/ U19MEO65	**CREATIVITY INNOVATION AND NEW PRODUCT DEVELOPMENT** (Common to EEE, ECE, ICE, CIVIL. Mechatronics & BME)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the need for creativity and innovation
- To learn about the project selection and evaluation
- To learn about the Patent and IPR
- To understand the quality standards and new product planning
- To learn model preparation and evaluation

Course Outcomes

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

CO1 - Describe the creativity and problem solving. **(K1)**
CO2 - Analyse the methods for project selection and evaluation. **(K4)**
CO3 - Analyse the patent laws and IPR. **(K4)**
CO4 - Describe the new product planning. **(K1)**
CO5 - Acquire knowledge about the patent applications. **(K1)**

UNIT I INTRODUCTION (9 Hrs)

The process of technological innovation - factors contributing to successful technological innovation - the need for creativity and innovation - creativity and problem solving -brainstorming - different techniques

UNIT II PROJECT SELECTION AND EVALUATION (9 Hrs)

Collection of ideas and purpose of project - Selection criteria - screening ideas for new products evaluation techniques

UNIT III NEW PRODUCT DEVELOPMENT (9 Hrs)

Research and new product development - Patents - Patent search - Patent laws-International code for patents - Intellectual property rights (IPR)

UNIT IV NEW PRODUCT PLANNING (9 Hrs)

Design of proto type - testing - quality standards - marketing research introducing new Products

UNIT V MODEL PREPARATION & EVALUATION (9 Hrs)

Creative design - Model Preparation - Testing - Cost evaluation – Patent application

Text Books

1. Twiss, Brian. “Managing Technological Innovation”, Pitman Publishing Ltd., 1992.
2. Watton, Harry B. “New Product Planning”, Prentice Hall Inc., 1992.
3. Lawrence Sanders G, Saylor foundation Publishing Ltd., 2012.

Reference Books

1. Nystrom, Harry “Creativity and Innovation”, John Wiley & Sons, 1979.
2. Dr Paul Trott, “Innovation Management and New Product Development”, 6th edition, Pearson, 2017
3. Khandwalla, N – “Fourth Eye (Excellence through Creativity) - Wheeler Publishing”, 1992.
4. Bulletins I.P.R, TIFAC, New Delhi, 1997.
5. Jacob Goldenberg, Creativity in Product Innovation, Cambridge University Press, 2002.

Web References

1. https://nptel.ac.in/courses/107/103/107103082/
2. https://nptel.ac.in/courses/107/101/107101086/

3. https://nptel.ac.in/courses/110/107/110107094/
4. https://www.youtube.com/watch?v=H6OlyjLJf6k
5. https://www.youtube.com/watch?v=CnKeVs-_9zs

COs/POs/PSOs Mapping

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

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

		L	T	P	C	Hours
U19CEO53 / U19CEO63	**DISASTER MANAGEMENT** (Common to EEE, ECE, CSE,IT,ICE, MECH & BME)	**3**	**0**	**0**	**3**	**45**

Course Objectives

This course should enable the students to

- Understand the basic conceptual understanding of disasters
- Understand approaches of Disaster Management
- Build skills to respond to disaster
- Understand the safety precaution
- Understand the basic planning and policy act of the disaster

Course Outcomes

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

CO1 - Infer Disasters, man-made Hazards and Vulnerabilities **(K2)**
CO2 - Summarize the flood management studies **(K2)**
CO3 - Identify disaster mitigation and management mechanism **(K1)**
CO4 - Estimate the disaster safety precaution **(K2)**
CO5 - Determine the disaster plan and act **(K3)**

UNIT I DEFINITION AND TYPES (9 Hrs)

Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

UNIT II STUDY OF IMPORTANT DISASTERS (9 Hrs)

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) Earthquakes, Landside). Social Economics and Environmental impact of disasters.

UNIT III MITIGATION AND MANAGEMENT (9 Hrs)

Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, landside and its managements case studies of disasters in Sikkim (e.g) Earthquakes, Landside). Social Economics and Environmental impact of disasters.

UNIT IV SAFETY PROCESS (9 Hrs)

Coping with Disaster: Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

UNIT V PLANNING AND ACT (9 Hrs)

Planning for disaster management: Strategies for disaster management planning - Steps for formulating a disaster risk reduction plan - Disaster management Act and Policy in India - Organizational structure for disaster management in India - Preparation of state and district disaster management plans

Text Books

1. Dr. Mrinalini Pandey, Disaster Management, Wiley India Pvt. Ltd
2. J. P. Singhal, Disaster Management, Laxmi Publications

3. C. K. Rajan, Navale Pandharinath, Earth and Atmospheric Disaster Management : Nature and Manmade, B S Publication

Reference Books

1. Mrinalini Pandey, “Disaster Management”, Wiley 2014.
2. T. Bhattacharya, “Disaster Science and Management”, McGraw Hill Education (India) Pvt Ltd Wiley 2015
3. N. Pandharinath, CK Rajan, “Earth and Atmospheric Disasters Management”, BS Publications 2009.
4. National Disaster Management Plan, Ministry of Home affairs, Government of India
5. Manual on Disaster Management, National Disaster Management, Agency Govt of India.

Web References

6. http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf
7. http://nidm.gov.in/pdf/guidelines/new/sdmp.pdf
8. http://sdmassam.nic.in/pdf/publication/undp/disaster_management_in_india.pdf
9.

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

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

U19CEO54 / U19CEO64	**AIR POLLUTION AND SOLID WASTE MANAGEMENT** (Common to EEE, ECE, CSE,IT,ICE, MECH & BME)	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To provide general understanding of air pollution, air pollutants, their sources and their effects
- To provide knowledge about meteorological parameters, air sampling and measurement of pollutants.
- To provide knowledge of air pollution controlling technologies, air pollution due to automobiles and general Idea of noise pollution.
- To study the importance of solid waste management by processing, treatment, disposal and reuse of solid waste.
- To study about the equipment used for waste collection and transportation of solids waste.

Course Outcome

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

CO1 - Discuss the type, sources & effect of air pollutants (**K2)**
CO2 - Demonstrate the parameters affecting air pollution and various methods of measurement and estimation of pollutants **(K3)**
CO3 - Infer knowledge of basics of noise pollution **(K2)**
CO4 - Distinguish various air pollution control equipment's & pollution caused due to automobile exhaust **(K4)**
CO5 - Describe the concepts of solid waste management **(K2)**

UNIT I INTRODUCTION TO AIR POLLUTION (9 Hrs)
Introduction to air pollution: Air pollution episodes, Atmosphere and its zones, classification and sources of air pollutants, effects of air pollutants on man, plants animal & materials

UNIT II METEOROLOGICAL ASPECTS (9 Hrs)
Meteorological Aspects: Atmospheric stability, plume behavior, Ambient air sampling and stack sampling, collection of particulates and gaseous pollutants, methods of estimation.

UNIT III AIR POLLUTION CONTROL METHODS (9 Hrs)
Air pollution control methods and equipment: Principle of control methods for particulates and gaseous pollutants, gravity settlers, electrostatic precipitators, bag filters cyclones, wet scrubbers, automobile exhaust: Pollution due to diesel and petrol engines, exhaust treatment and abatement, noise Pollution: Sources, ill effects, control measures.

UNIT IV SOLID WASTE MANAGEMENT (9 Hrs)
Introduction to solid waste management, sources, quantification and characterisation, classification and components, sampling and analysis, Method of collection

UNIT V EQUIPMENT (9 Hrs)
Equipment used for collection and transportation, transfer stations, solid waste processing and management. Treatment and disposal methods: composting, sanitary landfills, Incineration – concept, components and applications, leachate management.

Text Books

1. M.N. Rao & H.V.N. Rao, 1988, Air Pollution, Tata McGraw Hill Publishing Co. Ltd.
2. C.S. RAO, 2007, Environmental Pollution Control Engineering, New Age International, Wiley Estern Ltd. New Delhi.
3. Stern A. C., 1973, Air pollution, Academic Press.
4. A.D. Bhide & Sunderesan B.B., 1983, Solid Waste Management in Developing countries, INSDOC, New Delhi.
5. Tohobanoglous, 1993, Intgrated Solid Waste Management Engineering Principle and Management Issues, McGraw-Hill publication Ltd.

Reference books

1. P. Aarne Vesilind, William Worrell & Debra Reinhart, 2002, Solid Waste Engineering, Cengage Learning India pvt. Ltd.
2. Dr. Y Anjaneyulu, 2002, Air Pollution and Control Technologies, Allied Publisher pvt. Ltd.
3. Waste Management: A Reference Handbook. Contributors: Jacqueline Vaughn - Author. Publisher: ABC-Clio
4. K. V. S. G. Murlikrishna, 1995, Air Pollution, Kaushal& Company.

Web References

1. https://nptel.ac.in/courses/120108005/
2. http://cpheeo.gov.in/upload/uploadfiles/files/Part1
3. https://nptel.ac.in/content/storage2/courses/104103022

COs/POs/PSOs Mapping

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

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

U19BMO53/ U19BMO63	**BIOMETRIC SYSTEMS** (Common to EEE, ECE, CSE,IT,ICE,MECH & Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the basics of Biometric systems
- To gain knowledge in different fingerprint technologies
- To understand the classification of face recognition methods.
- To understand multimodal Biometrics and its performance evaluation.
- To know personal privacy and security implications of biometrics systems.

Course Outcomes

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

CO1 - Explain the fundamentals of biometric systems **(K2)**
CO2 - Describe the various fingerprint technologies **(K3)**
CO3 - Distinguish different face recognition and hand geometry pattern **(K3)**
CO4 - Analyse the multimodal biometrics and performance evaluation of biometrics **(K4)**
CO5 – Recognize various Biometric authentication methods **(K3)**

UNIT I INTRODUCTION TO BIOMETRICS (9 Hrs)

Introduction– biometric technologies – passive biometrics – active biometrics - Biometric systems – Enrolment – templates – algorithm – verification – Authentication technologies –Need for strong authentication - Protecting privacy and biometrics policy – Biometric applications – biometric characteristics.

UNIT II FINGERPRINT TECHNOLOGY (9 Hrs)

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - fingerprint sensors using RF imaging techniques – fingerprint quality assessment – computer enhancement and modelling of fingerprint images – fingerprint enhancement – Feature extraction – fingerprint classification – fingerprint matching

UNIT III FACE RECOGNITION AND HAND GEOMETRY (9 Hrs)

Introduction to face recognition - face recognition from correspondence maps - Hand geometry- scanning - feature extraction - Adaptive Classifiers - Visual Based feature extraction and Pattern Classification -types of algorithm - Biometric fusion.

UNIT IV MULTIMODAL BIOMETRICS AND PERFORMANCE EVALUATION (9 Hrs)

Voice scan - Physiological biometrics –Behavioural biometrics - Introduction to multimodal biometric system- Integration strategies - Architecture -level of fusion - combination strategy – training and adaptability - examples of multimodal biometric systems - Performance evaluation - Statistical Measures of Biometrics- FAR - FRR - FTE - EER -Memory requirement and allocation.

UNIT V BIOMETRIC AUTHENTICATION (9 Hrs)

Introduction - Biometric Authentication Methods - Biometric authentication by fingerprint - Biometric Authentication by Face Recognition. Expectation-Maximization theory - Support Vector Machines- Biometric authentication by hand geometry- Securing and trusting a biometric transaction – matching location – local host - authentication server – match on card (MOC) – Multibiometrics and Two-Factor Authentication.

Text Books

1. Anil K. Jain, Arun Ross, and Karthik Nandakumar " Introduction to Biometrics", Springer ,2011
2. Richard O. Duda, David G.Stork,Peter E. Hart, "Pattern Classification,", Wiley 2007
3. S.Y.Kung, S.H. Lin, M.W.Mak, "Biometric Authentication: A Machine Learning Approach", Prentice Hall,2005

Reference Books

1. Anil K. Jain, Patrick Flynn, and Arun A. Ross, “Handbook of Biometrics”, Springer, 2008
2. John Chirillo, Scott Blaul, “Implementing Biometric Security”, John Wiley, 2003.
3. John R. Vacca, “Biometric Technologies and Verification Systems”, Elsevier Inc, 2007
4. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, “Biometric Systems, Technology Design and Performance Evaluation”,Springer,2005
5. Nikolaos V. Boulgouris,Konstantinos N. Plataniotis ,Evangelia Micheli-Tzanakou,”Biometrics: Theory, Methods, and Applications” , Wiley 2009

Web Resources:

1. http://www.findbiometrics.com/Pages/glossary.html
2. http://www.biometrics.gov/Documents/privacy.pdf
2. http://zing.ncsl.nist.gov/biousa/docs/Usability_and_Biometrics_final2.pdf
3. User Interface, System Design
4. http://www.cesg.gov.uk/site/ast/biometrics/media/BEM_10.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	1	-	1
2	3	2	2	1	1	2	-	-	-	-	-	1	1	-	1
3	3	2	2	1	2	2	-	-	-	-	-	1	1	-	1
4	3	1	1	1	1	1	-	-	-	-	-	1	1	-	1
5	3	1	2	1	2	2	-	-	-	-	-	1	1	-	1

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

U19BMO54/ U19BMO64	MEDICAL ROBOTICS (Common to EEE, ECE,CSE, IT, ICE, MECH& Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives:

- To understand the basics of Robotics
- To gain knowledge in Kinematics
- To know about the robot vision
- To describe various motion planning solutions
- To explain various applications of Robots in Medicine

Course Outcomes:

After completion of the course, the students will be able to
CO1 - Understand the basics of robotic systems**. (K2)**
CO2 - Explore workspace and related motion of the Robots **(K3)**
CO3 - Analyse and extract information from the image using Robots **(K3)**
CO4 - Design of task planning and simulating the task. **(K4)**
CO5 – Construct Robots for Medical applications **(K4)**.

UNIT I INTRODUCTION (9 Hrs)

Introduction- Automation and Robots – Classification - Applications- Specifications – Direct Kinematics Dot and cross products – Coordinate frames – Rotations – Homogeneous coordinates Link coordination arm equation – Four-axis robot -Five-axis robot - Six-axis robot.

UNIT II KINEMATICS (9 Hrs)

Inverse Kinematics – General properties of solutions tool configuration – Workspace analysis and trajectory planning work envelope - examples- workspace fixtures – Pick and place operations – Continuous path motion – Interpolated motion – Straight-line motion.

UNIT III ROBOT VISION (9 Hrs)

Robot Vision- Image representation – Template matching – Polyhedral objects – Shane analysis – Segmentation – Thresholding – region labelling – Shrink operators – Swell operators – Euler numbers – Perspective transformation – Structured illumination – Camera calibration.

UNIT IV PLANNING (9 Hrs)

Task Planning – Task level programming – Uncertainty – Configuration – Space, Gross motion – Planning – Grasp Planning – Fine-motion planning – Simulation of planar motion – Source and Goal scenes – Task Planner simulation.

UNIT V MEDICAL APPLICATIONS (9 Hrs)

Applications in Biomedical Engineering – Biologically Inspired Robots – Application in Rehabilitation – Interactive Therapy – Bionic Arm – Clinical and Surgical – Gynaecology – Orthopaedics – Neurosurgery.

Text Books

1. Robert Schilling, "Fundamentals of Robotics-Analysis and control", Prentice Hall, 2003.
2. Paula Gomes, "Biomedical Instrument and Robotic Surgery System: Design and Development for Biomedical Applications", Woodhead Publishing, 2012
3. Klafter, Chmielewski and Negin, "Robotic Engineering - An Integrated approach",, PHI, f*irst edition,* 2009

Reference Books

1. J.J.Craig, "Introduction to Robotics", Pearson Education, 2005.
2. Fu, Lee and Gonzalez., "Robotics, control vision and intelligence", McGraw Hill International, 2nd edition, 2007
3. John J. Craig, "Introduction to Robotics", Addison Wesley Publishing, 3rd edition, 2010.
4. Saeed B. Niku, "Introduction to Robotics: Analysis, Systems, Applications", Prentice Hall, 2001.
5. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, "Robotics", McGraw Hill, 2008.

Web Resources

1. https://www.intechopen.com/books/medical_robotics/motion_tracking_for_minimally_invasive_robotic surgery
2. https://nptel.ac.in/courses/112/105/112105249/
3. https://www.intechopen.com/books/medical_robotics/robotic_applications_in_neurosurgery
4. https://www.intechopen.com/books/medical_robotics/medical_robotics_in_cardiac_surgery
5. https://www.worldscientific.com/worldscinet/jmrr

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

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

Course Code	Course Title	L	T	P	C	Hrs
U19ADO53	**PRINCIPLE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING** (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE)	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand basic principles of Artificial Intelligence
- To learn and design Knowledge representation
- To understand the concept of reasoning
- To master the fundamentals of machine learning, mathematical framework and learning algorithms
- To understand the reinforcement and statistical learning.

Course Outcomes

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

CO1 - Understand foundational principles of artificial intelligence. **(K2)**
CO2 - Understand formal methods of knowledge representation. **(K2)**
CO3 - Understand the fundamental issues and challenges of Reasoning. **(K2)**
CO4 - Relate the underlying mathematical relationships with Machine Learning algorithms. **(K3)**
CO5 - Classify various models for Artificial Intelligence programming techniques. **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Introduction to Artificial Intelligence - Artificial Intelligence Problems -Timelines of Artificial Intelligence - Production Systems - State Space Representation - Branches of Artificial Intelligence - Application of Artificial Intelligence.

UNIT II KNOWLEDGE REPRESENTATION (9 Hrs)

Knowledge Management - Types of Knowledge - Knowledge representation - Approaches to Knowledge representation - Issues in Knowledge representation - Knowledge base. First order Logic – Frames — Conceptual Dependency.

UNIT III REASONING (9 Hrs)

Types of reasoning - reasoning with Fuzzy Logic - Rule based Reasoning - Diagnosis Reasoning.

UNIT IV LEARNING (9 Hrs)

Types of Learning - Machine Learning - Intelligent agents - Association Learning: Apriori Algorithm - Case Study: Customer Sequence and SCADA Application – k-Means Clustering - Fuzzy Clustering - Cluster Similarity

UNIT V REINFORCEMENT AND STATISTICAL LEARNING (9 Hrs)

Markov Decision Problem - Hidden Markov Model - Linear Classifier - decision Trees: Random forest - Bayesian Network – ANN - ANN Learning process - Types of Network – Perceptron - RBF Network - Case studies: Character recognition.

Text Books

1. Anand Hareendran S and Vinod Chandra S.S. “Artificial Intelligence and Machine Learning” PHI Publication, 2014.
2. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Science, 1997.
3. Peter Harrington, “Machine Learning in action”, Manning Publication, 2012.

Reference Books

1. Charu C. Aggarwal “Data Classification Algorithms and Applications”, Chapman & Hall/CRC Data Mining and Knowledge Discovery Series.
2. Andreas C. Mueller and Sarah Guido, “Introduction to Machine Learning with Python”, O’Reilly Media, Inc. First Edition, 2016.
3. Eremy Watt, Reza Borhani, and Aggelos K. Katsaggelos “Machine Learning Refined Foundations, Algorithms, and Applications”, Cambridge University Press, 2016.
4. Shai Shalev-Shwartz and Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press, 2014.

Web Resources

1. https://www.coursera.org/learn/machine-learning
2. https://ml-cheatsheet.readthedocs.io/en/latest/regression_algos.html
3. https://machinelearningmastery.com/a-tour-of-machine-learning-algorithms

COs/POs/PSOs Mapping

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

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

U19ADO54/ U19ADO64	DATA SCIENCE APPLICATION OF VISION (Common to EEE, ECE, CSE, IT, ICE, MECH, CIVIL, CCE, BME, Mechatronics)	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To understand the capability of a machine to get and analyse visual information and make decisions
- To learn methods and algorithms for Vision
- To learn how to use deep learning for Vision tasks
- To understand the neural network concepts
- To study the real world applications using computer vision

Course Outcomes

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

CO1 - Understand the methods and algorithms for image processing. **(K2)**
CO2 - Apply object detection and segmentation concepts for image processing. **(K3)**
CO3 - Apply scalable algorithms for large datasets in vision. **(K3)**
CO4 - Analyze deep learning and neural network architectures for image and video processing. **(K4)**
CO5 - Apply vision-based solutions for specific real-world applications. **(K3)**

UNIT I IMAGE FUNDAMENTALS (9 Hrs)

Pixels - The Building Blocks of Images - The Image Coordinate System - RGB and BGR Ordering - Scaling and Aspect Ratios. Image filters - Gaussian blur - Median filter - Dilation and erosion - Custom filters - Image thresholding - Edge detection - Sobel edge detector - Canny edge detector.

UNIT II OBJECT DETECTION AND SEGMENTATION (9 Hrs)

Image Features - Harris corner detection - Local Binary Patterns - Image stitching - Segmentation: Contour detection - The Watershed algorithm - Super pixels - Normalized graph cut.

UNIT III MACHINE LEARNING WITH COMPUTER VISION (9 Hrs)

Data pre-processing - Image translation through random cropping - Image rotation and scaling - Applications of machine learning for computer vision - Logistic regression - Support vector machines - K-means clustering.

UNIT IV IMAGE CLASSIFICATION USING NEURAL NETWORKS (9 Hrs)

Image Classification Basics Types of Learning - The Deep Learning Classification Pipeline - Introduction to Neural Networks - The Perceptron Algorithm - Backpropagation and Multi-layer Networks - The Four Ingredients in a Neural Network Recipe - Weight Initialization - Constant Initialization - Uniform and Normal Distributions - LeCun Uniform and Normal - Understanding Convolutions - CNN Building Blocks - Common Architectures and Training Patterns.

UNIT V COMPUTER VISION AS A SERVICE (9 Hrs)

Computer vision as a service – architecture - Developing a server-client model - Computer vision engine.

Text Books

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2009.
2. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis and Machine Vision”, Third Edition, Cengage Learning, 2007.
3. Gary Bradski, “Learning OpenCV”, First Edition, 2008.

Reference Books

1. Alok Kumar Singh Kushwaha, Rajeev Srivastava, “Recognition of Humans and Their Activities for Video Surveillance”, IGI Global, 2014.
2. Ying-li Tian, Arun Hampapur, Lisa Brown, Rogerio Feris, Max Lu, Andrew Senior, “Event Detection, Query, and Retrieval for Video Surveillance”, IGI Global, 2009.
3. Matthew Turk, Gang Hua, “Vision-based Interaction”, First Edition, Morgan Claypool, 2013.
4. Ian Goodfellow, Yoshuo Bengio, Aaron Courville, “Deep Learning (Adaptive Computation and Machine Learning series)”, MIT Press, 2017.
5. Fan Jiang, “Anomalous Event Detection from Surveillance Video”, ProQuest, 2012.

Web Resources

6. https://www.kaggle.com/learn/computer-vision
7. https://machinelearningmastery.com/what-is-computer-vision/
8. https://www.udemy.com/course/pythoncv/
9. https://www.analyticsvidhya.com/blog/2019/03/opencv-functions-computer-vision-python/
10. https://www.youtube.com/watch?v=N81PCpADwKQ&ab_channel=ProgrammingKnowledge

COs/POs/PSOs Mapping

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

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

		L	T	P	C	Hrs
U19CCO54/ U19CCO64	**WEB PROGRAMMING** (Common to EEE,ECE, MECH, CIVIL, ICE Mechatronics & BME)	**3**	**-**	**-**	**3**	**45**

Course Objectives

- To Learn the fundamentals of web application development
- To understand the design components and tools using CSS
- To learn the concepts of JavaScript and programming fundamentals.
- To understand the working procedure of XML
- To study about advance scripting and Ajax applications

Course Outcomes

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

CO1 - Comprehend basic web applications using HTML **(K2)**
CO2 - Use CSS to design web applications **(K3)**
CO3 - Use java scripts functions for the web page creation **(K3)**
CO4 - Explain XML structure **(K2)**
CO5 - Demonstrate the web 2.0 application to advance scripts **(K2)**

UNIT - I INTRODUCTION TO WWW & HTML (9 Hrs)

Protocols, secure connections, application and development tools, the web browser, What is server, dynamic IP, Web Design: Web site design principles, planning the site and navigation. **HTML:** The development process, Html tags and simple HTML forms.

UNIT – II STYLE SHEETS (9 Hrs)

CSS: Need for CSS, Introduction to CSS, basic syntax and structure, using CSS, background images, colors and properties, manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS, CSS2.

UNIT - III JAVA SCRIPTS (9 Hrs)

Client side scripting, JavaScript, develop JavaScript, simple JavaScript, variables, functions, conditions, loops and repetition.

UNIT –IV XML (9 Hrs)

XML: Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Well formed, using XML with application XML, XSL and XSLT. Introduction to XSL, XML transformed simple example, XSL elements, transforming with XSLT.

UNIT –V ADVANCE SCRIPT (9 Hrs)

JavaScript and objects, JavaScript own objects, the DOM and web browser environments, forms and validations **DHTML:** Combining HTML, CSS and JavaScript, events and buttons, controlling your browser, **AJAX**: Introduction, advantages & disadvantages, AJAX based web application, alternatives of AJAX.

Text Books

1. Ralph Moseley, M.T. Savaliya, “Developing Web Applications”, BPB Publications, 2017.
2. Hirdesh Bhardwaj,, “Web Designing”, Pothi.com, 2016
3. P.J. Deitel and H.M. Deitel, Internet and World Wide Web - How to Program, Pearson Education, 2009.

Reference Books

1. Ralph Moseley, “Developing Web Applications”, Wiley India Pvt. Ltd, 2013
2. Joel Sklar, “ Principles of Web Design”, 6th edition, Cengage Learning, Inc, 2014
3. B. M. Harwani,” Developing Web Applications in PHP and AJAX”, Tata McGraw-Hill Education,2010
4. UttamK.Roy, Web Technologies, Oxford University Press, 2010.
5. Rajkamal, Web Technology, Tata McGraw-Hill, 2009.

Web References

1. https://nptel.ac.in/courses/106/106/106106156/
2. https://www.coursera.org/learn/html-css-javascript-for-web-developers
3. https://code.tutsplus.com/courses/how-to-become-a-web-developer
4. https://webdesignerwall.com/
5. https://www.smashingmagazine.com/

COs/POs/PSOs Mapping

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

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

SEMESTER – V										
Sl. No.	**Course code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U19ECT51	Probability and Random Processes	BS	2	2	0	3	25	75	100
2	U19ECT52	Linear Integrated Circuits	PC	3	0	0	3	25	75	100
3	U19ECT53	Microcontroller	PC	3	0	0	3	25	75	100
4	U19ECT54	Digital Signal Processing	PC	2	2	0	3	25	75	100
5	U19ECE5X	Professional Elective - II#	PE	3	0	0	3	25	75	100
6	U19XXO5X	Open Elective-II$	HS	3	0	0	3	25	75	100
Practical										
7	U19ECP51	Linear Integrated Circuits Laboratory	PC	0	0	2	1	50	50	100
8	U19ECP52	Microcontroller Laboratory	PC	0	0	2	1	50	50	100
9	U19ECP53	Digital Signal Processing Laboratory	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19ECC5X	Certification Course -III**	EEC	0	0	4	-	100	-	100
11	U19ECS51	Skill Development Course 5: Foreign Language/ IELTS- I	EEC	0	0	2	-	100	-	100
12	U19ECS52	Skill Development Course 6:Presentation Skills using ICT	EEC	0	0	2	-	100	-	100
Mandatory Course										
13	U19ECM51	Essence of Indian Traditional Knowledge	MC	2	0	0	-	100	-	100
							21	700	600	1300

U19ECT51	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 (12Hrs)
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 (12Hrs)
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.

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

Reference Books
1. P.Balaji, “Probability and Random Processes”, Balaji publishers, 5^{th}Edition, 2018.
2. M. Bhatt and Ravish R. Singh, “Probability and Statistics”, McGraw Hill Education, 2^{nd} Edition, 2017.
3. P.Kandasamy, Thilagavathi. K and Gunavathi.K., “Probability Random variable and Random Process”, S.Chand&Co. Pvt. Ltd, 2^{nd} 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., Second Edition, 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

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

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

U19ECT52	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

Text Books

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

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

U19ECT53	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 microcontroller.

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.

Text Books

1. Mazidi Ali Muhammad, MazidiGillispie Janice, and McKinlay Rolin D, “The 8051 Microcontroller and Embedded Systems using Assembly and C”, Pearson Publication, 2rd 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, 2^{nd} 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” 4^{th} 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

U19ECT54	DIGITAL SIGNAL PROCESSING	L	T	P	C	Hours
		3	1	0	4	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

Text Books

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

U19ECP51 **L T P C Hrs**

LINEAR INTEGRATED CIRCUITS LABORATORY 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 are able to

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 multivibrator 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 study 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 2nd order LPF, HPF, BPF and BSF
6. Log, antilog and instrumentation amplifier
   To study (a) logarithmic and antilog amplifiers (b) Instrumentation amplifier
7. Multivibrators using Op-Amp
   To design and study the working of
   (a). Astable Multivibrator 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. Multivibrators using IC 555
   To design and study the working of
   (a). Astable multivibrator
   (b). Monostable Multivibrator 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

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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

		L	T	P	C	Hrs
U19ECP52	**MICROCONTROLLER LABORATORY**	**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 / Embedded C 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

U19ECP53	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

		L	T	P	C	Hrs
U19ECC5X	**CERTIFICATION COURSE - III**	**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.

U19ECS51	SKILL DEVELOPMENT COURSE (Foreign Language / IELTS – I)	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

L T P C Hrs

U19ECS52	**SKILL DEVELOPMENT COURSE 6** (Presentation Skills using ICT)	**0**	**0**	**2**	**-**	**30**

The methodology used is “learning by doing”, a hands-on approach, enabling the students to follow their own pace. The teacher, after explaining the project, became a tutor, answering questions and helping students 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.

		L	T	P	C	Hrs
U19ECM51	**ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE**	**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 BanarsidassPublishers, ISBN 13: 978- 8120810990, 2014

Professional Elective – II (Offered in Semester V)		
Sl. No.	**Course Code**	**Course Title**
1	U19ECE51	Hardware Description Languages
2	U19ECE52	Vehicular Communication
3	U19ECE53	Industry 4.0 Technology
4	U19ECE54	Information Theory and Coding
5	U19ECE55	Robotics and Control

U19ECE51	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

Text Books

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
U19ECE52	**VEHICULAR COMMUNICATION**	**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 802.11p VANET 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

Text Books

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

U19ECE53	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

Text Books

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

U19ECE54	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.

Text Books

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

		L	T	P	C	Hrs
U19ECE55	**ROBOTICS AND CONTROL**	**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 horse power calculation, magnetostrictive 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, work space 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 Non industrial robots, Robots for welding, painting and assembly – Remote Controlled robots – Robots for nuclear, thermal and chemical plants – Industrial automation – Typical examples of automated industries.

Text Books

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

SEMESTER – VI										
Sl. No	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U19ECT61	Control Systems	PC	2	2	0	3	25	75	100
2	U19ECT62	Digital VLSI System Design	PC	3	0	0	3	25	75	100
3	U19ECT63	Wireless Communication	PC	3	0	0	3	25	75	100
4	U19ECT64	Transmission Lines and Antennas	PC	3	0	0	3	25	75	100
5	U19ECE6X	Professional Elective - III#	PE	3	0	0	3	25	75	100
6	U19XXO6X	Open Elective-III$	OE	3	0	0	3	25	75	100
Practical										
7	U19ECP61	VLSI Design Laboratory	PC	0	0	2	1	50	50	100
8	U19ECP62	Wireless Communication Laboratory	PC	0	0	2	1	50	50	100
9	U19ECP63	Electronic Design Workshop	PC	0	0	2	1	50	50	100
Employability Enhancement Course										
10	U19ECC6X	Certification Course -IV**	EEC	0	0	4	-	100	-	100
11	U19ECS61	Skill Development Course 7: Foreign Language/IELTS - II	MC	0	0	2	-	100	-	100
12	U19ECS62	Skill Development Course 8: Technical Seminar	MC	2	0	0	-	100	-	100
13	U19ECS63	Skill Development Course 9: NPTEL/MOOC-I	MC	0	0	0	-	100	-	100
Mandatory Course										
14	U19ECM61	Professional Ethics	MC	2	0	0	-	100	-	100
							21	800	600	1400

U19ECT61	CONTROL SYSTEMS	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 are able to

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.

Text Books

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

U19ECT62	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

CO1 – Understand the basic principles of design and implementation of digital circuits**. (K2)**
CO2 – Discuss about the different combinational and sequential logic blocks**. (K3)**
CO3 – Describe the terms and keywords in Verilog HDL. **(K2)**
CO4 - Identify the various levels of modeling of Verilog HDL**. (K2)**
CO5 - 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.

Text Books

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

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	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

		L	T	P	C	Hrs
U19ECT63	**WIRELESS COMMUNICATION**	**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.

Text Books

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

U19ECT64	TRANSMISSION LINES AND 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

Text Books

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. publications, 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

U19ECP61	VLSI DESIGN LABORATORY	L	T	P	C	Hrs
		0	0	3	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

U19ECP62	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.
3. Simulate the transmission of ping messaged over a network topology consisting of 6 Nodes and find the number of packets dropped due to congestion.
4. Simulate an Ethernet LAN using N-nodes (6-10), change error rate and data rate and Compare the throughput.

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. 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

U19ECP63	ELECTRONIC DESIGN WORKSHOP	L	T	P	C	Hrs
		0	0	3	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

		L	T	P	C	Hrs
U19ECC6X	**CERTIFICATION COURSE - IV**	**0**	**0**	**4**	**-**	**50**

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

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

		L	T	P	C	Hrs
U19ECS61	**SKILL DEVELOPMENT COURSE 7** (Foreign Language / IELTS – II)	**0**	**0**	**2**	**-**	**30**

Student should choose the Foreign Language/IELTS course like Japanese/French/ Germany/IELTS, etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator, Class advisor and language Experts. The courses are to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. Students have to complete the courses successfully. The Committee will monitor the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the completion of course. The marks attained for this course is not considered for CGPA calculation

L T P C Hrs

U19ECS62	**SKILL DEVELOPMENT COURSE 8** (Technical Seminar)	**0**	**0**	**2**	**-**	**30**

Course Objectives

- To encourage the students to study advanced engineering developments
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as over head projectors, power pointpresentation and demonstrative models.

Course Outcomes

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

CO1 - Review, prepare and present technological developments.

CO2 - Face the placement interviews.

Method of Evaluation:

- During the seminar session each student is expected to prepare and present a topic on engineering/technology, for duration of about 20 minutes.
- In a session of three periods per week, 8 to 10 students are expected to present the seminar.
- Each student is expected to present atleast twice during the semester and the student is evaluatedbased on that.
- At the end of the semester, he / she can submit a report on his / her topic of seminar and marks aregiven based on the report.
- A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student andmaintain attendance also.
- Evaluation is 100% internal. The marks attained for this course is not considered for CGPA calculation.

		L	T	P	C	Hrs
U19ECS63	**SKILL DEVELOPMENT COURSE 9** (NPTEL / MOOC - I)	**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.

		L	T	P	C	Hrs
U19ECM61	**PROFESSIONAL ETHICS**	**0**	**0**	**2**	**-**	**30**

Course Objectives

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

Course Outcomes

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

Apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

UNIT I HUMAN VALUES (06 Hrs)

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Livingpeacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS (06 Hrs)

Senses of „Engineering Ethics" — Variety of moral issues — Types of inquiry — Moral dilemmas — MoralAutonomy – Kohlberg‟s theory – Gilligan‟s theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION (06 Hrs)

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A BalancedOutlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS Safety (06 Hrs)

and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights –Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES (06 Hrs)

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development– Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Codeof Conduct — Corporate Social Responsibility

Reference Books

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi,2004.
3. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
4. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics –Concepts and Cases",Cengage Learning, 2009
5. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
6. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", OxfordUniversity Press, Oxford, 2001
7. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and SocialResponsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi2013.
8. World Community Service Centre, " Value Education", Vethathiri publications, Erode,2011

Web References:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

Professional Elective – III (Offered in Semester VI)	
Course Code	**Course Title**
U19ECE61	Low Power VLSI Design
U19ECE62	Aircraft communication and Navigation Systems
U19ECE63	Nano-electronics and Devices
U19ECE64	Speech and Audio Signal Processing
U19ECE65	Soft Computing

		L	T	P	C	Hrs
U19ECE61	**LOW POWER VLSI DESIGN**	**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

Text Books

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. DimitriosSoudris, ChirstianPignet 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
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

U19ECE62	AIRCRAFT COMMUNICATIONS 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.

Text Books

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

		L	T	P	C	Hrs
U19ECE63	**NANO ELECTRONICS AND DEVICES**	**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.

Text Books

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

		L	T	P	C	Hrs
U19ECE64	**SPEECH AND AUDIO SIGNAL PROCESSING**	**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.

Text Books

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)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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

U19ECE65	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.

Text Books:

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, 1st Edition, 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

SEMESTER – VII

Sl. No	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	U19ECT71	Millimeter and Optical Wave Communication	PC	3	0	0	3	25	75	100
2	U19ECT72	IoT and Applications	PC	3	0	0	3	25	75	100
3	U19ECE7X	Professional Elective – IV#	PE	3	0	0	3	25	75	100
4	U19XXO7X	Open Elective – IV$	OE	3	0	0	3	25	75	100
Practical										
5	U19ECP71	Business Basics for Entrepreneur	HS	0	0	2	1	100	-	100
6	U19ECP72	High Frequency Communication Laboratory	PC	0	0	2	1	50	50	100
7	U19ECP73	Internet of Things Laboratory	PC	0	0	2	1	50	50	100
8	U19ECP74	Comprehensive Viva Voce	PC	0	0	2	1	50	50	100
Project Work										
9	U19ECW71	Project Phase – I	PW	0	0	4	2	50	50	100
10	U19ECW72	Internship / Inplant Training	PW	0	0	0	2	100	-	100
							20	500	500	1000

		L	T	P	C	Hrs
U19ECT71	**MILLIMETER AND OPTICAL WAVE COMMUNICATION**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To understand the principle of millimeter waves and millimeter transceivers
- To introduce the transceivers for millimeter
- 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 concept of propagation of light in space

Course Outcomes

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

CO1: Comprehend and appreciate the significance and role of millimeter waves **(K3)**

CO2: Insight about the fibers types characteristics and light propagation **(K2)**

CO3: 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 are explored 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 TRANCEIVERS FOR MILLIMETER WAVES (9 Hrs)

Millimeter wave link budget – Transceiver architecture – Transceiver without 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.

Text Books

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

Reference Books

1. HemaniKaushal, 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, 3rd 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, 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	3	3	3	3	-	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

U19ECT72	INTERNET OF THINGS	L	T	P	C	Hours
		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's.
- 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- learn about Interface I/O devices, sensors & communication modules. **(K2)**
CO3-Understand the concepts of remotely monitor data and control devices.**(K4)**
CO4-Build and deploy an various architecture with their elements. **(K3)**
CO5-Can develop real time IoT based projects.**(K4)**

UNIT – I IoT & WEB TECHNOLOGY (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, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

UNIT -II (9 Hrs)

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT - III IoT ARCHITECTURE (9 Hrs)

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

UNIT - IV IoT APPLICATIONS FOR VALUE CREATIONS (9 Hrs)

Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

UNIT - V IoT PRIVACY, SECURITY AND GOVERNANCE (9 Hrs)

Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

Text Books

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, 2nd edition, May 2017
3. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013

Reference Books

1. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs 2014
2. Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi, 2012
3. Adrian McEwen, “Designing the Internet of Things”, Wiley, 2007
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	2	3	2	-	2	1	-	-	-	-	1	3	3	-
2	2	2	3	2	-	2	1	-	-	-	-	1	3	3	-
3	2	2	3	2	-	2	1	-	-	-	-	1	3	3	-
4	2	2	3	2	-	2	1	-	-	-	-	1	3	3	-
5	2	3	3	2	-	2	1	-	-	-	-	1	3	3	-

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

U19ECP71	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

Text Books

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

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

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

		L	T	P	C	Hrs
U19ECP72	**HIGH FREQUENCY COMMUNICATION LABORATORY**	**0**	**0**	**3**	**1**	**45**

Course Objectives

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

Course Outcomes

After completion of the course, students will be able to

CO1- Design and conduct experiments to demonstrate the trade-offs involved in the design of highfrequency band pass communication links and the associated components**. (K4)**

CO2- Comprehensively record and report the measured data, and would be capable of analyzing and interpreting the experimental measurement data and produce meaningful conclusions **(K4)**

CO3- Acquire knowledge about the Spectral Characterization of Optical Sources **(K4)**

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

CO5- Understand the design and testing of Antennas **(K2**)

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 detector 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 photo detection
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. Characterisation of Directional Couplers and Multiport junctions
15. Gunn Diode Characteristics
16. Microwave IC – Filter Characteristics

Reference Books

1. HemaniKaushal, 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, 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	2	2	3	3	2	2	-	-	-	-	-	1	3	-	2
2	2	2	3	3	2	2	-	-	-	-	-	1	3	-	2
3	2	2	3	3	2	2	-	-	-	-	-	1	3	-	2
4	2	2	3	3	2	2	-	-	-	-	-	1	3	-	2
5	2	2	3	3	2	2	-	-	-	-	-	1	3	-	2

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

U19ECP73	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's.
- 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-Memorize the concept of internet of Things and its hardware and software components**. (K2)**

CO2-Demonstrate by Interfacing I/O devices, sensors & communication modules with Raspberry Pi**. (K3)**

CO3-Identify the concepts of remotely monitor data and control devices**. (K2)**

CO4-Organize the server for various application to understand the data sharing in cloud**. (K4)**

CO5-Design and Develop the real time IoT projects with cloud. **(K6)**

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. To Interface PIR sensor and LCD with Raspberry Pi to display "Motion Detected" when PIR senses the value.

Cycle II : Server Configuration

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

Reference Books

1. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs 2014
2. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi, 2012
3. Adrian McEwen, "Designing the Internet of Things", Wiley, 2007
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	3	2	2	2	3	2	-	-	-	-	2	1	3	2	2
2	3	2	2	2	3	2	-	-	-	-	2	1	3	3	2
3	3	2	2	2	3	2	-	-	-	-	2	1	3	2	2
4	3	2	2	2	3	2	-	-	-	-	2	1	3	3	2
5	3	2	2	2	3	2	-	-	-	-	2	1	3	3	2

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

U19ECP74	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. A committee comprising of the faculty members of the department will make the internal assessment for a total of 50 marks. 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 Design
- Test 2 - Signal Processing, Electromagnetic Waves and Waveguides, Antennas Control Systems
- Test 3 - Analog and digital communication, advanced communication systems.

		L	T	P	C	Hrs
U19ECW71	**PROJECT PHASE - I**	**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 for a total of 100 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.

U19ECW72	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 two weeks to four weeks. Students are also permitted to undergo internships during their seventh semester after the theory classes are over. Each student has to submit a detailed report on In-Plant Training which He/ She has undergone

Professional Elective – IV (Offered in Semester VII)		
Sl. No.	**Course Code**	**Course Title**
1	U19ECE71	CAD for VLSI Circuits
2	U19ECE72	Satellite Communication
3	U19ECE73	Fuzzy logic and Neural Network
4	U19ECE74	Biomedical Signal Processing
5	U19ECE75	Wireless Sensor Networks

U19ECE71	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 about 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 also about scheduling 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.

Text Books

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

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 DimitriosSoudris, ChirstianPignet, 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

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	-	-	-	-
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

U19ECE72	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 of 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, geo stationary 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, inter modulation 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). Role of Satellite in future network.

Text Books

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, Techniquesand 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

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	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
U19ECE73	**FUZZY LOGIC AND NEURAL NETWORK**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To study basic concept of fuzzy sets and fuzzy logic control
- To understand algorithm and basic rules in adaptive fuzzy logic
- To learn about basics of neural network concepts
- To understand mapping and recurrent networks
- To apply the concepts of fuzzy logic and neural networks

Course Outcomes

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

CO1 – Describe the basic concept of fuzzy sets and fuzzy logic control **(K1)**
CO2 – Understand algorithm and basic rules in adaptive fuzzy logic **(K2)**
CO3 – Compute the multilayer perceptions of neural network concepts **(K3)**
CO4 – Understand the mapping and recurrent networks **(K2)**
CO5 – Apply fuzzy and neural logic for signal processing. **(K3)**

UNIT - I FUZZY SET THEORY AND FUZZY LOGIC CONTROL (9 Hrs)

Basic concepts of fuzzy sets- Operations on fuzzy sets- Fuzzy relation equations- Fuzzy logic control Fuzzification –De-fuzzification- Knowledge base- Decision making logic- Membership functions – Rule base.

UNIT - II ADAPTIVE FUZZY SYSTEMS (9 Hrs)

Performance index - Modification of rule base - Modification of membership functions - Simultaneous modification of rule base and membership functions- Genetic algorithms-Adaptive fuzzy system Neuro fuzzy systems.

UNIT - III ARTIFICIAL NEURAL NETWORKS (9 Hrs)

Introduction- History of neural networks- multilayer perceptions- Back propagation algorithm and its Variants- Different types of learning, examples

UNIT - IV MAPPING AND RECURRENT NETWORKS (9 Hrs)

Counter propagation –Self organization Map- Cognition and Neocognitron- Hopfield Net- Kohonnen Nets- Grossberg Nets- ART-I, ART-II reinforcement learning

UNIT - V APPLICATION OF FUZZY LOGIC AND NEURAL NETWORKS (9 Hrs)

Application of fuzzy logic and neural networks to Measurement- Control- Adaptive Neural Controllers – Signal Processing and Image Processing

Text Books

1. Vallum B.R And Hayagriva V.R, “C++, Neural networks and Fuzzy logic”, BPB Publications, New Delhi, 2012
2. Chennakesava R. Alavala, “Fuzzy logic & Neural Networks”, New Age International, 2014
3. George J. Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic-Theory and Applications”, Prentice Hall, 1995

Reference Books

1. Millon W. T, Sutton R.S and Werbos P. J, “Neural Networks for control”, MIT Press 2007
2. Kosko, “Neural Networks and Fuzzy systems”, Prentice hall of India Pvt. Ltd.,, New Delhi, 2015
3. J.M.Zurada, “Introduction to artificial neural systems”, Jaico Publication house,Delhi 1994
4. J.Klin and T.A.Folger, “Fuzzy sets‖ University and information- Prentice Hall -1996
5. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, “Neuro-Fuzzy and Soft Computing”, Prentice-Hall of India, 2003

Web Resources

1. https://nptel.ac.in/courses/117105084/
2. https://www.classcentral.com/course/swayam-fuzzy-logic-and-neural-networks-13036
3. https://margaretmz.medium.com/deep-learning-moocs-1be70cf9737f
4. https://nptel.ac.in/courses/108104049/16
5. https://www.coursera.org/projects/simulate-machine-intel-fuzzy-logic-google-sheets-bigml?

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

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

		L	T	P	C	Hrs
U19ECE74	**BIOMEDICAL SIGNAL PROCESSING**	**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 the knowledge in basics of bio signal Processing **(K2)**
CO2 - Use Various Signal Processing techniques to identify ECG parameters **(K3)**
CO3 - Relate Various Signal Processing techniques for analysis of EEG **(K3)**
CO4 - Apply wavelet analysis to identify different features of biological signals. **(K3)**
CO5 – Discuss the concept of Brain Computer Interface **(K2)**

UNIT – I INTRODUCTION TO BIOSIGNAL PROCESSING (9Hrs)

General measurement and diagnostic system, classification of signals, introduction to biomedical signals, Biomedical signal acquisition and processing, Difficulties in signal acquisition. Signal Averaging: Basics of signal averaging, signal averaging as a digital filter, a typical averager, software for signal averaging, limitations of signal averaging.

UNIT - II CARDIOLOGICAL SIGNAL PROCESSING (9Hrs)

Basic electrocardiography, ECG lead systems, ECG signal characteristics, QRS detector – power spectrum of the ECG, Bandpass filtering techniques, Differential techniques, matching techniques, ST segment analyzer – portable arrhythmia monitor, arrhythmia analysis.

UNIT - III NEUROLOGICAL SIGNAL PROCESSING (9Hrs)

Basic of EEG signal, lead systems, linear prediction theory, parametric model, phenomenological model, Autoregressive method, signal averaging. Sleep, Markov model and chain, Dynamics of sleep – wake transforms, Transient detection and elimination.

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.

Text Books

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. Neeraj Vyas, S. Khalid, “ Biomedical Signal Processing”, University Science Press, 2011.

Reference Books

1. Monson H.Hayes, “Statistical Digital Signal Processing and Modeling”, Wiley-India, 2009.
2. StephaneMallat, “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

U19ECE75	WIRELESS SENSOR NETWORK	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To acquire knowledge about challenges involved to design wireless sensor networks.
- To gain understanding about the network architecture of WSN and its function.
- To gain understanding about the network protocols of WSN.
- To learn about the different routing protocols for WSN.
- To get a broad understanding of the applications for the emerging technology WSN.

Course Outcomes

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

CO1 – Describe the characteristics of WSN **(K2)**
CO2 – Explain the idea of WSN architecture and its functions **(K2)**
CO3 – Discuss an about MAC protocols for wireless sensor networks. **(K2)**
CO4 – Interpret about the various routing protocols for wireless sensor networks. **(K3)**
CO5 – Demonstrate the application of emerging technology WSN. **(K3)**

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 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 (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

COs/POs/PSOs Mapping

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

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

SEMESTER – VIII										
Sl. No.	**Course Code**	**Course Title**	**Category**	**Periods**			**Credits**	**Max. Marks**		
				L	**T**	**P**		**CAM**	**ESM**	**Total**
Theory										
1	U19ECT81	Cyber Physical System and Security	PC	3	0	0	3	25	75	100
2	U19ECE8X	Professional Elective – V#	PE	3	0	0	3	25	75	100
3	U19ECE8X	Professional Elective – VI#	PE	3	0	0	3	25	75	100
Practical										
4	U19ECP81	Entrepreneurship Management	HS	0	0	2	1	100	-	100
Project Work										
5	U19ECW81	Project phase – II	PW	0	0	16	8	40	60	100
Employability Enhancement Course										
6	U19ECS81	Skill Development Course10:NPTEL/MOOC-II	MC	0	0	0	-	100	-	100
							18	315	285	600

U19ECT81	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 analyze 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 (9Hrs)

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.

Text Books

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

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	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

U19ECP81	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: ENTRPRENEURIAL 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 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 performance of women entrepreneurs
5. Entrepreneurship as a tool for sustainable employment
6. Examination of problem facing small scale business
7. Survival strategies in small business
8. The role of insurance in minimizing business risk

Text Books

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

U19ECW81	PROJECT PHASE - II	L	T	P	C
		0	0	16	8

Extension and completion of project work stated in the previous semester. On completion of the project work, each student has to prepare a project report and submit the same to the department.

In the Phase II, the project work and the report will be evaluated by the internal assessment committee by conducting two reviews and one demo for a total of 40 marks. The end semester examinations, which carries a total of 60 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the the Controller of Examinations.

		L	T	P	C	Hrs
U19ECS81	**SKILL DEVELOPMENT COURSE 10** (NPTEL / MOOC - II)	**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 – V (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U19ECE80	VLSI for Communication Systems
2	U19ECE81	Machine Learning for Wireless Communication
3	U19ECE82	Virtual and Augmented Reality
4	U19ECE83	Adaptive Signal Processing
5	U19ECE84	Real Time Systems

U19ECE80	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 - Analyse 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)

Analog-to-Digital Converters – Demodulators - A/D converters Used in a Receiver - Low-Pass Sigma-Delta Modulators - Band Pass Sigma-Delta Modulators - Implementation of Band Pass Sigma-Delta Modulators- I/Q mismatch in Mixer and A/D Converters - adaptive filters, Equalizers and transceivers.

UNIT - V IMPLEMENTATIONS (9 Hrs)

VLSI architecture for Multitier Wireless System - Hardware Design Issues for Next generation CDMA System

Text Books

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

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

U19ECE81	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 algorithms 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 algorithms and its 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)

Machine Learning Algorithms - KNN, SVM, Random Forest. 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- Optical Character Recognition, Email spam identification. Machine Learning for communication: signal processing, adaptive filtering, modulation, spectrum sensing.

Text Books

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 https://www.edx.org/course/machine-learning-data-science-analyticscolumbiax-ds102x-0#
4. http://scikit-learn.org/stable/modules/clustering.html
5. 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

		L	T	P	C	Hrs
U19ECE82	**VIRTUAL AND AUGMENTED REALITY**	**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 - Contrast the Virtual Environment in Animation**. (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 – Real time computer graphics – Flight Simulation – Virtual environments –requirement – benefits of virtual reality- 3D Computer Graphics : Introduction – The Virtual world space– the perspective projection – Human vision – stereo perspective projection – 3D clipping - 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 –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.

Text Books

1. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
2. M. LaValle, "Virtual Reality, Steven", Cambridge University Press, 2016
3. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Inter science, India, 2003.

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

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

U19ECE83 **ADAPTIVE SIGNAL PROCESSING**

L	T	P	C	Hrs
3	0	0	3	45

Course Objectives

- To review the basics of statistical signal processing
- To 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.

Text Books

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

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

U19ECE84	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.

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

Text Books

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 – VI (Offered in Semester VIII)		
Sl. No.	**Course Code**	**Course Title**
1	U19ECE85	High Speed Electronics
2	U19ECE86	5G Wireless Communication Systems
3	U19ECE87	Biomedical Electronics
4	U19ECE88	Advanced Digital Image and Video Processing
5	U19ECE89	Hardware Software Co-design

U19ECE85	HIGH SPEED ELECTRONICS	L	T	P	C	Hrs
		3	0	0	3	45

Course Objectives

- To give exposure on the energy band diagram of Semiconductor Material.
- To understand the characteristics and structure of BJT.
- To understand the characteristics and structure of MOSFET.
- To acquire knowledge about the various power devices.
- To create awareness about photonic devices and sensors.

Course Outcomes

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

CO1 – Understand the concept of Semiconductor Material and its Characteristics. **(K2)**
CO2 – Discuss about BJT and its characteristics. **(K2)**
CO3 – Describe the structure and characteristics of MOSFET. **(K2)**
CO4 – Describe about the power devices and their characteristics. **(K2)**
CO5 – Apply the knowledge of photonic devices and sensors to various applications. **(K3)**

UNIT - I SEMICONDUCTOR MATERIAL CHARACTERISTICS (9 Hrs)

Crystal structure of Si, GaAs - electrons in periodic lattices - energy band and energy band gap - carrier concentration at thermal equilibrium and carrier transport phenomenon - phonon- optical – thermal properties.

UNIT - II BIPOLAR TRANSISTORS (9 Hrs)

Introduction – Static characteristics of BJT – basic current voltage relationship - microwave characteristics of BJT – small signal characteristics - related device structures – Heterojunction bipolar transistor.

UNIT - III MOSFETs (9 Hrs)

Introduction – basic device characteristics – non uniform doping and buried channel device – device scaling and short channel effects – MOSFET structures – circuit applications.

UNIT - IV POWER DEVICES (9 Hrs)

Tunnel diode – related tunnel devices – IMPATT diodes – Static and Dynamic characteristics – power and efficiency – BARITT diode and TUNNETT diode – Thyristor – Thyristor characteristics.

UNIT - V PHOTONIC DEVICES, SENSORS AND APPLICATIONS (9 Hrs)

Light emitting diode – photoconductor – photodiodes – avalanche photodiode – phototransistor – charge coupled device – Thermal , mechanical , magnetic and chemical sensors.

Textbooks

1 Nandita Das Gupta and Amitava Das Gupta, “Semiconductor Devices: Modeling and Technology”, Prentice Hall of India, 2004.
2 S. M. Sze, “Physics of Semiconductor Devices”, 3rd edition, John Wiley and Sons,2007.
3 Donald A Neamen, Semiconductor Physics and Devices: Basic Principles, McGraw-Hill, 2011.

Reference Books

1. M.S.Tyagi, “Introduction to Semiconductor Materials and Devices”, John Wiley and Sons, 2008.
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. P. Bhattacharya, Semiconductor Optoelectronics Devices, 2nd Edition, PHI, 2009.

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	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

		L	T	P	C	Hrs
U19ECE86	**5G WIRELESS COMMUNICATION SYSTEMS**	**3**	**0**	**0**	**3**	**45**

Course Objectives

- To Learn the Basics of 5G and about 5Gregulation 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 analyze5G 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 5Gusing massive MIMO **(K2)**
CO3 - Attain knowledge about 5GRadio Access Technologies and its channel models **(K3)**
CO4 - Understand about 5Gnetwork architecture (**K3)**
CO5 - Implementation and evaluation of 5G and its applications **(K4)**

UNIT–I INTRODUCTION AND ROADMAP TO 5G (9Hrs)

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 (9Hrs)

Millimetre Wave Communications: 5G mm wave basics, 5G mm wave propagation and coverage – 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.

UNIT – IV NETWORKING IN 5G (9Hrs)

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 (9Hrs)

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.

Text Books

1. AfifOsseiran, Jose F. Monserrat and Patrick Marsch, - 5G Mobile and Wireless Communications Technology, Cambridge University Press, 2016.(Hardback format, 2019)
2. Sachan, V. K.. Fundamentals of 5G Wireless Communications. N.p.: Amazon Digital Services LLC - KDP Print US, 2020.
3. Stallings, William. 5g Wireless: A Comprehensive Introduction. United Kingdom, Pearson Education (US), 2021.

Reference Books

1. Kanatas, Athanasios G., Konstantina S. Nikita, and Panagiotis Takis Mathiopoulos, eds. New directions in wireless communications systems: from mobile to 5G. CRC Press, 2017.
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. Wong, Vincent WS, Robert Schober, Derrick Wing Kwan Ng, and Li-Chun Wang, eds. Key technologies for 5G wireless systems. Cambridge university press, 2017.
5. Jonathan Rodriguez, - Fundamentals of 5G mobile networks, John Wiley & Sons, Ltd, 2015.

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	3	2	1	-	-	-	-	-	-	-	-	2	2	-	2
2	3	2	1	-	-	-	-	-	-	-	-	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 L1evel: 1-Low, 2-Medium, 3-High

U19ECE87	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 CALIBRATION OF MEDICAL EQUIPMENT (9 Hrs)

Ventilator testers, SPO2analysers, NIBP analysers, Electro surgical analysers, Defibrillator analysers. Testing and maintenance of Heart lung machine, surgical lights, patient monitor, anaesthesia machine, dialyzer, surgical tools

UNIT-IV ASSISTING DEVICES (9 Hrs)

Blood pressure monitors – Electro-cardio scope - Pulse Oximeter - pH meter - Auto analyzer – Pacemakers – Defibrillator - Heart lung machine - Nerve and muscle stimulators - Dialysis machines - Surgical diathermy equipment – Nebulizer; inhalator - Aspirator – Humidifier - Ventilator and spirometry.

UNIT-V RECENT TRENDS IN MEDICAL ELECTRONICS (9 Hrs)

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.

Text Books

1. Leslie Cromwell, 'Biomedical Instrumentation and Measurement', Prentice Hall of India, New Delhi, second edition, 2014
2. R S Khandpur, "Handbook of Biomedical Instrumentation", 1st ed., Tata McGraw Hill Publishing Company Limited, 2014
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, 2012
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

U19ECE88	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 study the fundamentals of video processing
- To illustrate the general methodologies for 2D motion estimation used in video processing.

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 video processing **(K2)**
CO5 - Identify the general methodologies for 2D motion estimation **(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 INTRODUCTION TO VIDEO PROCESSING (9 Hrs)

Basic Steps of Video Processing: Analog Video, Digital Video. Time-Varying Image Formation models: Three-Dimensional Motion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT – V 2-D MOTION ESTIMATION (9 Hrs)

2-D Motion Estimation: Optical flow, General Methodologies, Pixel Based Motion Estimation, Block Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

Text Books

1. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2015
2. Yao wang, Joem Ostarmann and Ya – quin Zhang, ”Video processing and communication “,1st edition , PHI
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. John Woods, “Multidimensional Signal, Image and Video Processing and Coding” 2ndEd, Elsevier.
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://nptel.ac.in/courses/117/104/117104020/

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

Correlation L1evel: 1-Low, 2-Medium, 3-High

		L	T	P	C	Hrs
U19ECE89	**HARDWARE SOFTWARE CO-DESIGN**	**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.

Text Books

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