SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(AN AUTONOMOUS INSTITUTION)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM & SYLLABI
(Regulations 2023)

M.Tech - Electronics and Communication Engineering

SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(AN AUTONOMOUS INSTITUTION)

M.TECH.
ELECTRONICS AND COMMUNICATION ENGINEERING

(Regulations-2023)

CURRICULUM & SYLLABI

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 instil 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 intrapersonal 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

PROGRAMME OUTCOMES (POs)

PO1: Exploration of Research:

An ability to independently carry out research/investigation and development work to solve practical problems.

PO2: Technical Skill:

An ability to write and present a substantial technical report/document.

PO3: Expertise in Academics:

Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: Scholarship of Knowledge:

Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

PO5: Usage of Modern Tools:

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

PO6: Ethical Practices and Social Responsibility:

Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

PROGRAM EDUCATIONAL OBCTIVES (PEOs)

PEO1: Technical Knowledge

To develop intellectual combination of technology with modern electronics and communication systems through well-built technical acquaintance

PEO2: Leadership Skill

To endure changes and challenges in the areas of Electronics and Communication Engineering with good leadership skills.

PEO3: Research and Development

To identify the requisite of the nation, industry and come out with innovative solutions to maintain a sustainable position

PEO4: Professional Behavior

To promote competitive graduates global wise in Electronics and Communication Engineering

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Technical Knowledge in Electronics and Communication Engineering

Ability to understand the technological advancements in the field of electronics and communication by using modern design tools and sub system end processes

PSO2: Competency in Electronics

Apply research ideas to offer solutions for extant problems in areas including signal processing, image processing, consumer electronics, VLSI, Embedded with given requirements

PSO3: Competency in Communication

Ability to develop and provide optimal solutions to subsystems like RF, baseband of modern communication systems and networks.

SEMESTER–I

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P23MAT101	Probability and Stochastic Process	BS	2	2	0	3	40	60	100
2	P23ECT101	Advanced Digital Communication	PC	3	0	0	3	40	60	100
3	P23ECT102	Millimeter Wave Communication Networks	PC	3	0	0	3	40	60	100
4	P23ECT103	High Speed Electronics	PC	3	0	0	3	40	60	100
5	P23HSTC01	Research Methodology and IPR	HS	2	0	0	2	40	60	100
6	P23ECE1XX	Professional Elective - I	PE	3	0	0	3	40	60	100
Practical										
7	P23ECP101	Advanced Digital Communication Laboratory	PC	0	0	4	2	50	50	100
8	P23HSPC01	Technical Report Writing & Seminar	HS	0	0	4	2	100	0	100
Ability Enhancement Course										
9	P23ECC1XX	Certification Course – I	AEC	0	0	4	-	100	-	100
10	P23ACT10X	Audit Course - I	AEC	2	0	0	-	100	-	100
							21	**590**	**410**	**1000**

SEMESTER–II

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P23VETC01	Advanced Digital System Design	PC	3	0	0	3	40	60	100
2	P23VETC02	Embedded Processors	PC	3	0	0	3	40	60	100
3	P23VETC03	Embedded System Design	PC	3	0	0	3	40	60	100
4	P23ECT204	Digital Image and Video Processing	PC	3	0	0	3	40	60	100
5	P23ECE2XX	Professional Elective - II	PE	3	0	0	3	40	60	100
6	P23ECEXX	Professional Elective - III	PE	3	0	0	3	40	60	100
Practical										
7	P23ECP202	Digital Image and Video Processing laboratory	PC	0	0	4	2	50	50	100
8	P23HSPC02	Seminar on ICT-a hands on approach	HS	0	0	4	2	100	0	100
Ability Enhancement Course										
10	P23ECC2XX	Certification Course – II	AEC	0	0	4	-	100	-	100
11	P23ACT20X	Audit Course-II	AEC	2	0	0	-	100	-	100
Total							**22**	**590**	**410**	**1000**

SEMESTER–III

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P23ECE3XX	Professional Elective - IV	PE	3	0	0	3	40	60	100
2	P23ECE3XX	Professional Elective - V	PE	3	0	0	3	40	60	100
3	P23ECE3XX	Professional Elective - VI	PE	3	0	0	3	40	60	100
Project Work										
4	P23ECW301	Project Phase - I	PA	0	0	12	6	50	50	100
5	P23ECW302	Internship	PA	0	0	0	2	100	-	100
Mandatory Course										
6	P23ECC301	NPTEL / GIAN / MOOC	AEC	0	0	0	-	100	-	100
Total							**17**	**370**	**230**	**600**

SEMESTER–IV

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Project Work										
1	P23ECW403	Project Phase - II	PA	0	0	24	12	50	50	100
Total							**12**	**50**	**50**	**100**

* Professional Elective Courses are to be selected from the list given in Annexure I
# Ability Enhancement Courses are to be selected from the list given in Annexure II
** Audit Courses are to be selected from the list given in Annexure III

BS – Basic Science
HS – Humanity Science
PC – Professional Core
PE – Professional Elective
PA – Project Work
C – Common Course
AEC – Audit Course
AEC – Ability Enhancement Course

Credit Distribution

Semester- I	Semester - II	Semester - III	Semester - IV	Total
21	**22**	**17**	**12**	**72**

Total number of credits required to complete
M.Tech in Electronics and Communication Engineering **72 credits**

Annexure – I

PROFESSIONAL ELECTIVE COURSES

Professional Elective –I (Offered in Semester I)		
Sl. No.	**Course Code**	**Course Title**
1	P23ECE101	Advanced Microprocessor and Interfacing
2	P23ECE102	Image Processing and Recognition
3	P23ECE103	MIMO Systems
4	P23ECE104	Optical Communication and Networking
5	P23ECE105	Wireless Sensor Networks and its applications
Professional Elective – II (Offered in Semester II)		
Sl. No	**Course Code**	**Course Title**
1	P23VEEC01	Design of Analog and Mixed VLSI Circuits
2	P23VEEC02	Internet of Things and its Implementation
3	P23ECE206	Advanced Satellite Communication
4	P23ECE207	Mobile Communication System
5	P23ECE208	Statistical Information Processing
Professional Elective –III (Offered in Semester II)		
Sl. No	**Course Code**	**Course Title**
1	P23VEEC03	System on Chip Design
2	P23ECE309	Advanced Communication Network
3	P23ECE310	Advanced Radiation Systems
4	P23ECE311	Embedded Networking and Automation of Electrical System
5	P23ECE312	Industrial Electronics
Professional Elective–IV (Offered in Semester III)		
Sl. No	**Course Code**	**Course Title**
1	P23VEEC04	Real Time Operating System
2	P23VEEC05	Cloud computing and Distributed System
3	P23ECE413	Automotive Embedded System
4	P23ECE414	Information and Network Security
5	P23ECE415	RF and Microwave Engineering
Professional Elective –V (Offered in Semester III)		
Sl. No	**Course Code**	**Course Title**
1	P23VEEC06	Edge Computing
2	P23ECE516	Cognitive Radio Technology
3	P23ECE517	Embedded Computing
4	P23ECE518	Markov Chains and Queuing Systems
5	P23ECE519	Modeling and Simulation of Wireless Communication Systems
Professional Elective–VI (Offered in Semester III)		
Sl. No	**Course Code**	**Course Title**
1	P23ECE620	Unmanned Aerial Vehicle
2	P23ECE621	Free Space Optical Networks
3	P23ECE622	Intelligent Control and Automation
4	P23ECE623	Multicarrier Wireless Communication
5	P23ECE624	Smart system design

Annexure-II

ABILITY ENHANCEMENT COURSES–(A) CERTIFICATION COURSES

S. No	Course Code	Course Title	Certified By
1	P23XXCX01	Adobe Photoshop	Adobe
2	P23XXCX02	Adobe Animate	Adobe
3	P23XXCX03	Adobe Dreamweaver	Adobe
4	P23XXCX04	Adobe After Effects	Adobe
5	P23XXCX05	Adobe Illustrator	Adobe
6	P23XXCX06	Adobe InDesign	Adobe
7	P23XXCX07	Autodesk AutoCAD -ACU	Autodesk
8	P23XXCX08	Autodesk Inventor - ACU	Autodesk
9	P23XXCX09	Autodesk Revit - ACU	Autodesk
10	P23XXCX10	Autodesk Fusion 360 - ACU	Autodesk
11	P23XXCX11	Autodesk 3ds Max - ACU	Autodesk
12	P23XXCX12	Autodesk Maya - ACU	Autodesk
13	P23XXCX13	Cloud Security Foundations	AWS
14	P23XXCX14	Cloud Computing Architecture	AWS
15	P23XXCX15	Cloud Foundation	AWS
16	P23XXCX16	Cloud Practitioner	AWS
17	P23XXCX17	Cloud Solution Architect	AWS
18	P23XXCX18	Data Engineering	AWS
19	P23XXCX19	Machine Learning Foundation	AWS
20	P23XXCX20	Robotic Process Automation / Medical Robotics	Blue Prism
21	P23XXCX21	Advance Programming Using C	CISCO
22	P23XXCX22	Advance Programming Using C ++	CISCO
23	P23XXCX23	C Programming	CISCO
24	P23XXCX24	C++ Programming	CISCO
25	P23XXCX25	CCNP Enterprise: Advanced Routing	CISCO
26	P23XXCX26	CCNP Enterprise: Core Networking	CISCO
27	P23XXCX27	Cisco Certified Network Associate - Level 2	CISCO
28	P23XXCX28	Cisco Certified Network Associate- Level 1	CISCO
29	P23XXCX29	Cisco Certified Network Associate- Level 3	CISCO
30	P23XXCX30	Fundamentals of Internet of Things	CISCO
31	P23XXCX31	Python Programming	CISCO
32	P23XXCX32	Java Script Programming	CISCO
33	P23XXCX33	NGD Linux Essentials	CISCO
34	P23XXCX34	NGD Linux I	CISCO
35	P23XXCX35	NGD Linux II	CISCO

36	P23XXCX36	Advance Java Programming	Ethnotech
37	P23XXCX37	Android Programming / Android Medical App Development	Ethnotech
38	P23XXCX38	Angular JS	Ethnotech
39	P23XXCX39	Catia	Ethnotech
40	P23XXCX40	Communication Skills for Business	Ethnotech
41	P23XXCX41	Coral Draw	Ethnotech
42	P23XXCX42	Data Science Using R	Ethnotech
43	P23XXCX43	Digital Marketing	Ethnotech
44	P23XXCX44	Embedded System Using C	Ethnotech
45	P23XXCX45	Embedded System with IoT / Arduino	Ethnotech
46	P23XXCX46	English for IT	Ethnotech
47	P23XXCX47	Plaxis	Ethnotech
48	P23XXCX48	Sketch Up	Ethnotech
49	P23XXCX49	Financial Planning, Banking and Investment Management	Ethnotech
50	P23XXCX50	Foundation of Stock Market Investing	Ethnotech
51	P23XXCX51	Machine Learning / Machine Learning for Medical Diagnosis	Ethnotech
52	P23XXCX52	IOT Using Python	Ethnotech
53	P23XXCX53	Creo (Modelling & Simulation)	Ethnotech
54	P23XXCX54	Soft Skills, Verbal, Aptitude	Ethnotech
55	P23XXCX55	Software Testing	Ethnotech
56	P23XXCX56	MX-Road	Ethnotech
57	P23XXCX57	CLO 3D	Ethnotech
58	P23XXCX58	Solid works	Ethnotech
59	P23XXCX59	Staad Pro	Ethnotech
60	P23XXCX60	Total Station	Ethnotech
61	P23XXCX61	Hydraulic Automation	Festo
62	P23XXCX62	Industrial Automation	Festo
63	P23XXCX63	Pneumatics Automation	Festo
64	P23XXCX64	Agile Methodologies	IBM
65	P23XXCX65	Block Chain	IBM
66	P23XXCX66	Devops	IBM
67	P23XXCX67	Artificial Intelligence	ITS
68	P23XXCX68	Cloud Computing	ITS
69	P23XXCX69	Computational Thinking	ITS
70	P23XXCX70	Cyber Security	ITS
71	P23XXCX71	Data Analytics	ITS
72	P23XXCX72	Databases	ITS
73	P23XXCX73	Java Programming	ITS
74	P23XXCX74	Networking	ITS
75	P23XXCX75	Internet of Things / Solar and Smart Energy System with IoT	ITS
76	P23XXCX76	Web Application Development (HTML, CSS, JS)	ITS
77	P23XXCX77	Network Security	ITS & Palo alto
78	P23XXCX78	MATLAB	MathWorks

79	P23XXCX79	Azure Fundamentals	Microsoft
80	P23XXCX80	Azure AI (AI-900)	Microsoft
81	P23XXCX81	Azure Data (DP -900)	Microsoft
82	P23XXCX82	Microsoft 365 Fundamentals (SS-900)	Microsoft
83	P23XXCX83	Microsoft Security, Compliance and Identity (SC-900)	Microsoft
84	P23XXCX84	Microsoft Power Platform (PI-900)	Microsoft
85	P23XXCX85	Microsoft Dynamics Fundamentals 365 – CRM	Microsoft
86	P23XXCX86	Microsoft Excel	Microsoft
87	P23XXCX87	Microsoft Excel Expert	Microsoft
88	P23XXCX88	Securities Market Foundation	NISM
89	P23XXCX89	Derivatives Equinity	NISM
90	P23XXCX90	Research Analyst	NISM
91	P23XXCX91	Portfolio Management Services	NISM
92	P23XXCX92	Cyber Security	Palo alto
93	P23XXCX93	Cloud Security	Palo alto
94	P23XXCX94	PMI – Ready	PMI
95	P23XXCX95	Tally – GST & TDS	Tally
96	P23XXCX96	Advance Tally	Tally
97	P23XXCX97	Associate Artist	Unity
98	P23XXCX98	Certified Unity Programming	Unity
99	P23XXCX99	VR Development	Unity

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

Annexure-III

AUDIT COURSES

Sl. No.	Course Code	Course Title
1	P23ACTX01	English for Research Paper Writing
2	P23ACTX02	Disaster Management
3	P23ACTX03	Sanskrit for Technical Knowledge
4	P23ACTX04	Value Education
5	P23ACTX05	Constitution of India
6	P23ACTX06	Pedagogy Studies
7	P23ACTX07	Stress Management by Yoga
8	P23ACTX08	Personality Development Through Life Enlightenment Skills
9	P23ACTX09	Unnat Bharat Abhiyan

SEMESTER – I

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P23MAT101	Probability and Stochastic Process	BS	2	2	0	3	40	60	100
2	P23ECT101	Advanced Digital Communication	PC	3	0	0	3	40	60	100
3	P23ECT102	Millimeter Wave Communication Networks	PC	3	0	0	3	40	60	100
4	P23ECT103	High Speed Electronics	PC	3	0	0	3	40	60	100
5	P23HSTC01	Research Methodology and IPR	HS	2	0	0	2	40	60	100
6	P23ECE1XX	Professional Elective - I	PE	3	0	0	3	40	60	100
Practical										
7	P23ECP101	Advanced Digital Communication Laboratory	PC	0	0	4	2	50	50	100
8	P23HSPC01	Technical Report Writing & Seminar	HS	0	0	4	2	100	0	100
Ability Enhancement Course										
9	P23ECC1XX	Certification Course – I	AEC	0	0	4	-	100	-	100
10	P23ACT10X	Audit Course - I	AEC	2	0	0	-	100	-	100
							21	590	410	1000

Department	**Mathematics**	Programme**: M.Tech. - ECE**						
Semester	**I**	Course Category**: BS**				***End Semester Exam Type: TE**		
Course Code	**P23MAT101**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Probability and Stochastic Process**	2	2	0	3	40	60	100

Prerequisite	**Basic Mathematics**	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Illustrate about random process	K2
	CO2 Distinguish multiple random variables	K2
	CO3 Analyze stochastic process	K3
	CO4 Application of FDTD	K3
	CO5 Simulate the response of LTI system using MATLAB	K4

Unit-I	**Random Variables**	**Periods: 12**
Random variables: Probability axioms - conditional probability - discrete and continuous random variables, Cumulative Distribution Function (CDF) - Probability Mass Function (PMF) - Probability Density Function (PDF) - Conditional PMF/PDF - Expected value - Variance; Functions of a random variable; Expected value of the derived random variable		**CO1**
Unit-II	**Multiple Random Variables**	**Periods: 12**
Multiple random variables: Joint CDF/PMF/PDF - functions of multiple random variables - multiple functions of multiple random variables - independent/uncorrelated random variables - sums of random variables - moment generating function - random sums of random variables.		**CO2**
Unit-III	**Stochastic Processes**	**Periods: 12**
Classification of stochastic process - stationary process (SSS and WSS) - ergodic process - independent increment process - counting process - narrowband process - normal process - Wiener process - Shot noise process - autocorrelation function.		**CO3**
Unit-IV	**Finite Difference Time Domain Method**	**Periods: 12**
Wave Equation: Dispersion and Stability ; The FDTD method: Staggered Grids- one space dimension-three space dimensions-integral interpretation of the FDTD method- dispersion analysis in three Dimensions ; Boundary conditions for open regions: The perfectly matched Layer - near to far field transformation.		**CO4**
Unit-V	**Instructional Activities**	**Periods: 12**
Response of LTI system's - probability distribution and density function - Weiner and Shot noise process- Practical applications of wave scattering in FDTD using related platforms.		**CO5**

Lecture Periods: 60	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 60**

Textbooks

1. Anders B, Thomas R, Ingelstro P, "Computational Electromagnetics", 2nd Edition, Springer, 2013.
2. Michel K.O, "Applied Probability and Stochastic Processes", John Wiley and Sons, 2008.
3. Paboulis A, Unnikrishna P S, "Probability, Random Variables and Stochastic Processes", 4th Edition, Tata McGraw Hill, 2002.

Reference Books

1. Steven K. "Intuitive Probability and Random Processes using MATLAB", Springer, 2006.

2. Sadiku M N O, “Numerical Techniques in Electromagnetics”, 2nd Edition, CRC Press, 2000.
3. Sankaran K, “Accurate Domain Truncation Techniques for Time-Domain Conformal Methods”, ETH Zurich, 2007.
4. “Introduction to ordinary differential equations” by E. Coddington. 2003
5. “Differential Equations” by Polking, Boggess and Arnold. Second Edition.

Web References

1. http://users.ece.utexas.edu/~gustavo/ee381j.html
2. http://www2.math.uu.se/research/telecom/software.html
3. http://www.ifp.illinois.edu/~hajek/Papers/randomprocesses.html
4. http://www.feynmanlectures.caltech.edu/II_toc.html
5. http://nptel.ac.in/courses/111105035/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	-	1	-	-	-	1	2	1
2	2	-	1	-	-	-	1	2	1
3	2	-	1	1	-	-	1	2	1
4	2	-	1	1	-	-	1	2	1
5	2	-	1	1	-	-	1	2	1

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

Department	ECE	Programme: M.Tech. - ECE						
Semester	I	Course Category: PC				*End Semester Exam Type: TE		
Course Code	P23ECT101	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Advanced Digital Communication	3	-	-	3	40	60	100

Prerequisite	**Basic knowledge in Communication Systems**		
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Develop the ability to understand the concepts of signal space analysis and apply it in digital modulation technique	K3
	CO2	Establish knowledge on different digital receivers with different type of noise	K3
	CO3	Conceptually appreciate different Equalization techniques	K3
	CO4	Comprehend the synchronization methods	K3
	CO5	Develop the ability to comprehend various digital communication techniques using simulation tools	K4

Unit-I	**Digital Modulation Techniques**	**Periods: 09**
Elements of Digital Communication system - Factors influencing digital modulation techniques; Linear Modulation Techniques: BPSK - QPSK - DPSK; Constant envelope modulation techniques: MSK- GMSK; Linear and constant envelope modulation techniques: M-ary PSK and M-ary QAM		**CO1**
Unit-II	**Additive White Gaussian Noise Channel**	**Periods: 09**
Optimum receiver for signals corrupted by AWGN - performance of the optimum receiver for memory less modulation; optimum receiver for CPM signals - optimum receiver for signals with random phase in AWGN channel.		**CO2**
Unit-III	**Equalization Techniques**	**Periods: 09**
Optimum receiver for channels with ISI and AWGN – Nyquist criterion for zero ISI - linear equalization and its variations - Decision Feedback Equalization - Predictive Decision Feedback Equalization -Turbo equalization		**CO3**
Unit-IV	**Synchronization**	**Periods: 09**
Signal Parameter Estimation: Carrier phase estimation - symbol timing estimation - joint estimation of carrier phase and symbol timing - performance characteristics of ML estimators.		**CO4**
Unit-V	**Instructional Activities**	**Periods: 09**
Simulation: Different digital modulation - AWGN channel - equalization techniques and synchronization using any related platforms		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. John G Proakis," Digital-communications" 5th edition, 2008.
2. John G P, Masoud S, "Digital Communications," 5th Edition, McGraw Hill Book Company, 2014.
3. Don Torrieri, "Principles of Spread Spectrum Communication Systems", Springer, 2005

Reference Books

1. Bernard S, "Digital Communication fundamentals and applications," 2nd Edition, Pearson Education, 2009.
2. Theodire S R, "Wireless Communications", 2nd Edition Pearson Education, 2010.
3. A B Carlson, "Communication. Systems". Tata Mc Graw Hill, 2000.
4. B P Lathi, "Modern Digital & Analog Communication", Willey2000.
5. Simon S. Haykin,Michael Moher, David Koilpillai, "Modern Wireless Communication ", Pearson Publication 2011

Web References

1. http://nptel.iitm.ac.in/courses/117101051.html

2. http://nptel.ac.in
3. https://nptel.ac.in/courses/108/101/108101113/
4. https://nptel.ac.in/courses/117/101/117101051/
5. https://nptel.ac.in/courses/117/105/117105144/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	-	3	3	-	-	1	3	3
2	3	-	3	3	-	-	1	3	3
3	3	-	3	3	-	-	1	3	3
4	3	-	3	3	-	-	1	3	3
5	3	-	3	3	3	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

Department	ECE	Programme: **M.Tech. - ECE**						
Semester	I	Course Category: **PC**				*End Semester Exam Type: **TE**		
Course Code	P23ECT102	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Millimeter Wave Communication Networks**	3	-	-	3	40	60	100

Prerequisite	Basic knowledge in Communication Engineering		
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Develop an understanding on standards of Millimeter wave	3
	CO2	Have an ability to analyze various antennas used in millimeter	4
	CO3	Develop an ability to use different modulation techniques	4
	CO4	Have an ability to analyze various Beam steering and beam forming technology	4
	CO5	Simulate various MIMO configurations	4

Unit-I	**Multi-Gigabit 60-GHz Millimeter Wave Radios**	**Periods: 09**
Millimeter wave characteristics-Channel performance at 60GHz, Gigabit wireless communication, Standards- WiGig, IEEE 802.11ad, IEEE 802.15.3c,WirelessHD,ECMA-387/ISO/IEC 13156,Coexistence with wireless backhaul, Millimeter wave applications- WLAN, WPAN, Outdoor point to point		**CO1**
Unit-II	**Millimeter Wave Antennas**	**Periods: 09**
Path loss and antenna directivity, Antenna beam width, Maximum possible gain to Q, Polarization, Beam steering antenna, Millimeter wave design consideration		**CO2**
Unit-III	**Millimeter Wave Transceivers**	**Periods: 09**
Millimeter wave link budget, Transceiver architecture, Receiver without local oscillator, Millimeter wave calibration, Modulation techniques-OOK, PSK, FSK, QAM, OFDM		**CO3**
Unit-IV	**Advanced Beam Steering and Beam Forming**	**Periods: 09**
Need for beam steering and beam forming, Adaptive frame structure-Advanced beam steering technology, Advanced beam forming technology, Advanced antenna ID technology		**CO4**
Unit-V	**Instructional Activities**	**Periods: 09**
Simulations on Spatial diversity of antenna arrays, Multiple antennas, Multiple transceivers, Noise coupling in MIMO system		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Kao-Cheng Huang, Zhaocheng Wang, “Millimeter wave communication systems”,John Wiley & Sons, Hoboken, New Jersey, 2011.
2. Jonathan Wells, “Multi-Gigabit Microwave and Millimeter-Wave Wireless Communications”,Artech House, 2010.
3. Asif Oseiran, Jose F.Monserrat and Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016

Reference Books

1. Jonathan Wells, “Multi-Gigabit Microwave and Millimeter-Wave Wireless Communications”, Artech House, 2010.

2. Su-Khiong Yong, Pengfei Xia and Alberto Valdes-Garcia, "60GHz Technology for Gbps WLAN and WPAN: From Theory to Practice", Wiley 2010
3. Jonathan Rodriquez, "Fundamentals of 5G Mobile Networks", Wiley, 2015
4. Patrick Marsch, Omer Bulakci, Olav Queseth and Mauro Boldi, "5G System Design – Architectural and Functional Considerations and Long-Term Research", Wiley, 2018
5. Randy. L, Haupt, "Antenna Arrays, A Computational Approach", John Wiley & Sons, 2010

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1. https://nptel.ac.in/courses/117/105/117105139/
2. https://onlinecourses.nptel.ac.in/noc20_ee71/preview
3. https://web.stanford.edu/class/ee359/lectures.html
4. https://www.digimat.in/nptel/courses/video/117105139/L01.html
5. https://www.youtube.com/watch?v=QE-GmtXIKG

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	1	3	3	-	-	2	-	3
2	3	1	3	3	-	-	2	-	3
3	3	1	3	3	-	-	2	-	3
4	3	1	3	3	-	-	2	-	3
5	3	1	3	3	3	-	2	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

Department	ECE	Programme: M.Tech.- ECE						
Semester	I	Course Category: PC				*End Semester Exam Type: TE		
Course Code	P23ECT103	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	High Speed Electronics	3	0	0	3	40	60	100

Prerequisite		
Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Understand the concept of Semiconductor Material with its Characteristics	2
	CO2 To explain about homo junction and its characteristics in FET, BJT	2
	CO3 Differentiate homo-junction and hetero-junction Devices	2
	CO4 Apply knowledge of Advanced Devices in High Speed Application	2
	CO5 Understand various process of Fabrication and Characterization Techniques	2

Unit-I	Semiconductor Material Characteristics	Periods: 09
Review of Crystal Structure: Crystal structure of important semiconductors (Si, GaAs, InP) - electrons in periodic lattices - energy band diagram - carrier concentration and carrier transport phenomenon - electrical - optical - thermal and high field properties of semiconductors		CO1
Unit-II	**Homojunction Device**	**Periods: 09**
Homojunction Devices (BJT and FET): Structure - band diagram - operation - I–V and C–V characteristics (analytical expressions) - small signal switching models		CO2
Unit-III	**MOS Device**	**Periods: 09**
MOS Diode: Structure - band diagram - operation - C–V characteristics - effects of oxide charges - avalanche injection - high field effects and breakdown; Heterojunction Based MOSFET: Band diagram - structure - operation - I–V and C–V characteristics (analytical expressions) - MOSFET breakdown and punch through – sub-threshold current -scaling down; Alternate High k-dielectric Materials: HF–MOSFETs - SOI MOSFET - buried channel MOSFET - charge coupled devices		CO3
Unit-IV	**Advanced Device**	**Periods: 09**
HBT and HEMT Devices: AlGaAs/ GaAs, InP and SiGe based HBT and HEMT structure - band diagram - operation - I–V and C–V characteristics (analytical expressions) - small signal switching models - benefits of hetero-junction transistor for high speed applications		CO4
Unit-V	**Fabrication and Characterization Techniques**	**Periods: 09**
Crystal Growth and Wafer Preparation: Epitaxy - diffusion - ion implantation - dielectric film deposition and oxidization techniques - masking and lithography techniques (optical, e-beam and other advanced lithography techniques) - metallization - bipolar and MOS integration techniques - interface passivation techniques; Characterization Techniques: Four probe and hall effect measurement - I–V and C–V for dopant profile characterization and DLTS		CO5

Lecture Periods: 45	Tutorial Periods: -	Practical Periods: -	Total Periods: 45

Textbooks

1. Nandita Das Gupta and Amitava Das Gupta, “Semiconductor Devices: Modeling and Technology”, Prentice Hall of India,2012.
2. M. S. Tyagi, “Introduction to Semiconductor Materials and Devices”, John Wiley and Sons, 2008.
3. M. J. Madou, Fundamentals of Microfabrication, 2nd Edition, CRC Press, 2011.
4. P. Bhattacharya, Semiconductor Optoelectronics Devices, 2nd Edition, PHI, 2009

Reference Books

1. S. M. Sze, “Physics of Semiconductor Devices”, 3rd edition, John Wiley and Sons,2007.
2. J. Singh, “Semiconductor Devices: Basic Principles”, John Wiley and Sons,2007.

3 J. P. McKelvey, Introduction to Solid State and Semiconductor Physics, Harper and Row and John Weathe Hill.
4 Cheng T. Wang, Ed., Introduction to Semiconductor Technology: GaAs and Related Compounds, John Wiley & Sons, 1990.
5 Donald A Neamen, Semiconductor Physics and Devices: Basic Principles, McGraw-Hill (1997) ISBN 0-256-24214-3

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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

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	1	1	1	-	-	1	-	3
2	2	1	2	1	-	-	1	-	3
3	2	1	2	1	-	-	1	-	3
4	2	2	2	1	-	-	1	-	3
5	2	2	1	1	-	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

Department	ECE	Programme: **M.Tech.- ECE**						
Semester	I	Course Category: **HS**			*End Semester Exam Type: **TE**			
Course Code	P23HSTC01	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Research Methodology and IPR**	3	0	0	3	40	60	100

Prerequisite	**Nil**	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Formulate research problem	2
	CO2 Carry out research analysis	2
	CO3 Follow research ethics	2
	CO4 Describe today's world is controlled by Computer, Information Technology, but tomorrow world will beruled by ideas, concept, and creativity	2
	CO5 Interpret IPR and filing patents in R & D	3

Unit-I	**Research Problem Formulation**	**Periods: 09**
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations		**CO1**
Unit-II	**Literature Review**	**Periods: 09**
Effective literature studies approaches, analysis, plagiarism, and research ethics		**CO2**
Unit-III	**Technical Writing /Presentation**	**Periods: 09**
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.		**CO3**
Unit-IV	**Introduction to Intellectual Property Rights (IPR)**	**Periods: 09**
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT		**CO4**
Unit-V	**Intellectual Property Rights (IPR)**	**Periods: 09**
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'" Kenwyn Publisher, 1996
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"2nd edition, Lansdowne publisher, 2001
3. C.R. Kothari, Gaurav Garg, New Age International, Research Methodology: Methods and Techniques 4th Edition, 2018

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1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
2. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010.
3. C.R. Kothari, Gaurav Garg, New Age International, Research Methodology: Methods and Techniques 4th Edition, 2018.
4. Trochim, Research Methods: the concise knowledge base, Atomic Dog Publishing 2005.
5. Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications,2009

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1. https://www.scribd.com/document/427419672/Research-Methodology-and-Ipr
2. https://www.isical.ac.in/~palash/research-methodology/RM-lec9.pdf
3. https://www.wipo.int/edocs/pubdocs/en/intproperty/958/wipo_pub_958_3.pdf
4. https://lecturenotes.in/m/21513-research-methodology-
5. https://iare.ac.in/sites/default/files/MTECH-CAD.CAM-R18-RM-IP-NOTES.pdf

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	1	-	-
2	3	2	1	1	2	1	1	-	-
3	3	2	1	1	2	1	1	-	-
4	3	2	1	1	2	1	1	-	-
5	3	2	1	1	2	1	1	-	-

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

Department	ECE	Programme: **M.Tech. - ECE**						
Semester	I	Course Category: **PC**			*End Semester Exam Type: **LE**			
Course Code	P23ECP101	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Advanced Digital Communication Laboratory**	0	0	4	2	50	50	100

Prerequisite	**Basic Communication**	
Course Outcome	**On completion of the course, the students will be able to**	**BT Level**
	CO1 Design the base band requirement of communication systems.	4
	CO2 Understand the concept of different modulation techniques using MATLAB/ Lab view	4
	CO3 Analyze and visualize practical implementation of mobile application-based modulation techniques	4
	CO4 Understand the types of analyzers used at high frequency analysis	4
	CO5 To analyze the radiation pattern of antennas	4

List Lab Experiments

Simulation based experiments: (MATLAB/ LABVIEW simulation)

1. Sampling & reconstruction of low pass signals
2. BPSK Modulation & detection
3. BER of BPSK in AWGN channel
4. QPSK generation & detection
5. BER of QPSK in AWGN channel
6. QAM generation & detection
7. 16 QAM constellation diagram
8. Measurement of passive components using Vector Network Analyzer, Spectrum Analyzer and Signal Generator

Communication Based Experiments

9. Design and analysis of GMSK modulator and demodulator
10. Data transmission, Multiplexing and BER measurement through optical fiber
11. Characterization of Directional Coupler and Power Divider using microstrip trainer kit
12. Measurement of radiation pattern of microstrip patch antenna
13. Study of DPCM and ADPCM using Advanced Digital Modulator trainer kit

Reference Books

1. Bernard S, “Digital Communication fundamentals and applications,” 2nd Edition, Pearson Education, 2009.
2. Theodire S R, “Wireless Communications”, 2nd Edition Pearson Education, 2010.
3. A B Carlson, “Communication. Systems”. Tata Mc Graw Hill, 2000.
4. B P Lathi, “Modern Digital & Analog Communication”, Willey2000.
5. Simon S. Haykin,Michael Moher, ication “, Pearson Publication David Koilpillai, “Modern Wireless Commun 2011

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2. http://nptel.ac.in
3. https://nptel.ac.in/courses/108/101/108101113/
4. https://nptel.ac.in/courses/117/101/117101051/
5. https://nptel.ac.in/courses/117/105/117105144/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	1	3	3	3	-	1	3	3
2	3	1	3	3	3	-	1	3	3
3	3	1	3	3	3	-	1	3	3
4	3	1	3	3	3	-	1	3	3
5	3	1	3	3	3	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	Performance in practical classes			Model Practical Examination	Attendance		
	Conduction of practical	Record work	viva				
Marks	15	5	5	15	10	50	100

Department	**ECE**	Programme**: M.Tech. - ECE**						
Semester	**I**	Course Category**: HS**				*****End Semester Exam Type**: LE**		
Course Code	**P23HSPC01**	**Periods/Week**			**Credit**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Technical Report Writing & Seminar**	0	0	4	2	50	50	100

Prerequisite			
Course Outcome	**On completion of the course, the students will be able to**		**BT Level**
	CO1	Select a subject, narrowing the subject into a topic	2
	CO2	Explain objective and collect the relevant bibliography	2
	CO3	Describe the papers and understand the author's contributions and critically analyzing each paper	3
	CO4	Prepare a working outline and linking the papers and preparing a draft of the paper	2
	CO5	Prepare conclusions based on the reading of all the papers, Writing the Final Paper, and giving final Presentation	3

Activity	**Instructions**	**Submission week**	**Evaluation**
Selection of area of interest and Topic	select an area of interest, topic and state an objective	2nd week	**3 %** Based on clarity of thought, current relevance and clarity in writing
Stating an Objective			
Collecting Information about area & topic	• List 1 Special Interest Groups or professional society • List 2 journals • List 2 conferences, symposia or workshops • List 1 thesis title • List 3 web presences (mailing lists, forums, news sites) • List 3 authors who publish regularly in your area • Attach a call for papers (CFP) from your area.	3rd week	**3%** (The selected information must be area specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• Provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - try to: - Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them. - Favour papers from well-known journals and conferences, in the field (as indicated in other Favour more recent papers, - Pick a recent survey of the field so you can quickly gain an overview, Find relationships with respect to each other and to your topic area (classification scheme/categorization) - Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered	4th week	6% (The list of standard papers and reason for selection)

Reading and notes for first 5 papers	Reading Paper Process For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? • Conclude with limitations/issues not addressed by the paper (from the perspective of survey)	6th week	8% (The table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for next 5 papers	Repeat Reading Paper Process	7th week	8% (The table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	8% (This component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	6% (Clarity, purpose and conclusion) 6% Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	5% (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11th week	10% (this component will be evaluated based on the linking and classification among the papers)
Conclusions	Write your conclusions and future work	12th week	5% (conclusions)
Final Draft	Complete the final draft of your paper	13th week	10% (formatting, English, Clarity and linking) 4% Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th week	10% (based on presentation and Viva-voce)

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	3	3	1	3	3	2	1	2
2	2	3	2	1	3	2	2	1	2
3	2	3	2	1	3	2	2	1	2
4	2	3	2	1	3	2	2	1	2
5	2	3	2	1	3	2	2	1	2

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)				Attendance	End Semester Examination (ESE) Marks	Total Marks
	Weekly Progress	Seminar	Record work	Viva			
Marks	40	30	10	10	10	-	100

PROFESSIONAL ELECTIVE COURSES

Professional Elective –I (Offered in Semester I)		
Sl. No.	**Course Code**	**Course Title**
1	P23ECE101	Advanced Microprocessor and Interfacing
2	P23ECE102	Image Processing and Recognition
3	P23ECE103	MIMO Systems
4	P23ECE104	Optical Communication and Networking
5	P23ECE105	Wireless Sensor Networks and its applications

Department	**ECE**	Programme: **M.Tech. - ECE**						
Semester	**I**	Course Category: **PE**				*End Semester Exam Type: **TE**		
Course Code	**P23ECE101**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Advanced Microprocessor and Interfacing**	3	0	0	3	40	60	100

Prerequisite			
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Explain advanced microprocessor architecture	K2
	CO2	Interpret modular programming concepts	K2
	CO3	Describe organization PIC16F877 microcontrollers	K2
	CO4	Interface peripheral devices with PIC16F877 Microcontrollers	K3
	CO5	Design and develop on Microcontroller Based system design	K4

Unit - I	**Advanced Microprocessor Architecture**	**Periods: 9**
Internal Microprocessor Architecture-Real mode memory addressing – Protected Mode Memory addressing – Memory paging - Data addressing modes – Program memory addressing modes – Stack memory addressing modes – Data movement instructions – Program control instructions- Arithmetic and Logic Instructions		**CO1**
Unit - II	**Modular Programming and its Concepts**	**Periods: 9**
Fundamental of high-level synthesis, Logic synthesis, Logic optimization and technology mapping, Lookup table technology mapping, Timing analysis, Timing optimization, Area optimization		**CO2**
Unit - III	**PIC Microcontroller**	**Periods: 9**
Architecture – memory organization – addressing modes – instruction set – PIC programming in Assembly & C –I/O port, Data Conversion, RAM & ROM Allocation, Timer programming		**CO3**
Unit - IV	**Peripheral of PIC Microcontroller**	**Periods: 9**
Timers – Interrupts, I/O ports- I2C bus-A/D converter-UART- CCP modules -ADC, DAC and Sensor Interfacing –Flash and EEPROM memories.		**CO4**
Unit - V	**Instructional Activity**	**Periods: 9**
Microcontroller based system design: Interfacing LCD Display – Keypad Interfacing - Generation of Gate signals for converters and Inverters - Motor Control – Controlling DC/ AC appliances – Measurement of frequency – Standalone Data Acquisition System.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Danny Causey, Rolin McKinlay and Muhammad Ali Mazidi 'PIC Microcontroller and Embedded Systems: Using Assembly and C for PIC18', Microdigitaled, 2016
2. Daniele Lacamera, 'Embedded Systems Architecture: Explore architectural concepts, pragmatic design patterns, and best practices to produce robust systems', Packt Publishing Limited, 2018
3. Marilyn Wolf 'PIC Embedded System Interfacing: Design for the Internet-of-Things (IoT) and Cyber-Physical Systems (CPS)', Elsevier Science & Technology, 2019

Reference Books

1. MykePredko, "Programming and customizing the 8051 microcontrollers", Tata McGraw Hill, 2001.
2. Rajkamal,". Microcontrollers-Architecture, Programming, Interfacing & System design",2nd edition, Pearson, 2012.
3. I Scott Mackenzie and Raphael C.W. Phan, "The Micro controller", Pearson, Fourth edition 2012
4. MS Mohanamba Govindappa,". PIC Microcontroller Programming with Sample Source Code", Createspace Independent Publishing Platform, 2018
5. William Jayden,". Interfacing PIC Microcontrollers to Peripherial", Createspace Independent Publishing Platform, 2017

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2. http:// www.microchip.com/design-centers/microcontrollers
3. https://learn.mikroe.com/
4. https://microcontrollerslab.com/pic-microcontroller-architecture/
5. https://nptel.ac.in/courses/117/104/117104072/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	-	3	3	-	1	3	-	3
2	2	-	3	3	-	1	3	-	3
3	2	-	3	3	-	1	3	-	3
4	2	-	3	3	-	1	3	-	3
5	2	2	3	3	2	1	3	-	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	**ECE**	Programme: **M.Tech. - ECE**						
Semester	**I**	Course Category: **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23ECE102**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Image Processing and Recognition**	3	0	0	3	40	60	100

Prerequisite			
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Understand the fundamentals of image processing	K2
	CO2	Understand image analysis algorithms	K2
	CO3	Understand the basic theory and algorithms that are widely used in digital image processing	K3
	CO4	Develop hands-on experience in using computers to process images	K3
	CO5	Understand current applications in the field of Image Processing	K3

Unit - I	**Imaging Fundamentals**	**Periods: 9**
Introduction to Imaging Technologies-Photographic- X-Ray-MRI-SAR-IR imaging–Image Representations- Image Transforms- DCT- Walsh-Hadamard - Hoteling- Wavelet–Curvelet.		**CO1**
Unit - II	**Image Quality Enhancement**	**Periods: 9**
Contrast- noise- Sharpness –Gray level Transformation – Histogram processing –Spatial Domain spatial filtering – smoothing, sharpening filters- Frequency Domain Smoothing, sharpening Image Restoration Techniques – Inverse-Wiener		**CO2**
Unit - III	**Processing and Analyzing Images**	**Periods: 9**
Point Detection- Line Detection – Edge Detection – Scene Segmentation and labeling – Counting objects – Perimeter measurement- Hough Transform – Shape of Regions- Morphological operations –Texture		**CO3**
Unit - IV	**Statistical Decision Making**	**Periods: 9**
Bayes Theorem – Multiple features- Decision Boundaries- Confusion matrices- Nonparametric Histogram- Single nearest neighbor technique-K-NN		**CO4**
Unit - V	**Imaging Applications**	**Periods: 9**
System design**-** Optical character Recognition- Rule based Character Recognition- Face and Facial feature Extraction - Video motion Analysis- Image Fusion- Watermarking – spatial & frequency domain.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Rafael.C.Gonzalez and Richard.E. Woods, “Digital Image Processing”, Pearson Education, 2003
2. William.K.Pratt, “Digital Image Processing”, Fourth edition, A John Wiley and Publications.2013
3. Earl Gose, Richard Johnson Baugh, “Pattern Recognition and Image analysis”, Prentice Hall India Pvt Ltd, 2004

Reference Books

1. Rafael.C.Gonzalez and Richard.E. Woods, “Digital Image Processing”, Pearson Education, 2003.
2. Earl Gose, Richard Johnson Baugh, “Pattern Recognition and Image analysis”, Prentice Hall India Pvt Ltd, 2004
3. Frank Y. Shih , “Image Processing and Pattern Recognition : Fundamentals and Techniques”, John Wiley & Sons Inc, 2010
4. Stepan Bilan ,” Image Processing and Pattern Recognition Based on Parallel Shift Technology”, Taylor & Francis Ltd, CRC Press,2018
5. Kenneth R Castleman ,” Digital Image Processing”, Pearson Education, 2007

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1. https://nptel.ac.in/courses/1183641105/
2. https://nptel.ac.in/courses/117/105/117105079/
3. https://staff.fnwi.uva.nl/r.vandenboomgaard/IPCV20172018/LectureNotes/index.html
4. http://www.vssut.ac.in/lecture_notes/lecture1423722885.pdf
5. https://shodhganga.inflibnet.ac.in/bitstream/10603/152244/8/08_chapter%201.pdf

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	-	2
2	1	-	2	2	-	-	1	-	2
3	1	-	2	2	-	-	1	-	2
4	1	-	2	2	-	-	1	-	2
5	1	-	2	2	3	-	1	3	2

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	**ECE**	Programme: **M.Tech. - ECE**						
Semester	**I**	Course Category: **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23ECE103**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MIMO Systems**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

Prerequisite	Communication	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand channel modelling and propagation, MIMO Capacity, space-time coding, MIMO receivers, MIMO for multi-carrier systems	**K2**
	CO2 Understand the precoding and equalization techniques	**K2**
	CO3 Learn about the Beamforming techniques	**K2**
	CO4 Understand cooperative and coordinated multi-cell MIMO, Introduction to MIMO in 4G	**K2**
	CO5 Perform Mathematical modelling and analysis of MIMO systems	**K3**

Unit - I	**Introduction to MIMO**	**Periods: 9**
Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems. Diversity, exploiting multipath diversity, transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receiver diversity, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity		**CO1**
Unit - II	**Equalization and Precoding**	**Periods: 9**
The generic MIMO problem, Singular Value Decomposition, Eigenvalues and eigenvectors, Equalizing MIMO systems, Disadvantages of equalising MIMO systems, Predistortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of precoding and combining, Channel state information.		**CO2**
Unit - III	**Beamforming**	**Periods: 9**
Codebooks for MIMO, Beamforming, Beamforming principles, Increased spectrum efficiency, Interference cancellation, Switched beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer. MIMO in LTE, Codewords to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beamforming in LTE, Cyclic delay diversity-based pre-coding, Pre-coding codebooks,		**CO3**
Unit - IV	**Case Study**	**Periods: 9**
Case study: Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments.		**CO4**
Unit - V	**Instructional Activity**	**Periods: 9**
Simulation: Channel estimation with different techniques, Training based channel estimation, Blind channel estimation, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications: From Real-world Propagation to Space-time Code Design", Academic Press, 1st edition, 2010.
2. Mohinder Janakiraman, "Space - Time Codes and MIMO Systems", Artech House Publishers, 2004.
3. Aydin Sezgin , "Transceivers for MIMO Systems: Design, Analysis and Iterative Decoding: Space-Time Diversity and Multiplexing Schemes", VDM Verlag Dr. Müller e.K. , 2013.

Reference Books

1. E. Biglieri, R. Calderbank, A. Constantinides, A. Goldsmith, A. Paulraj, H. V. Poor, MIMO Wireless Communications, Cambridge Press, 2007.

Department	ECE	Programme: **M.Tech. - ECE**

2. T. M. Duman, A. Ghrayeb, Coding for MIMO Communication Systems, Wiley, 2007.
3. A. Paulraj, R. Nabar, D. Gore, Introduction to Space-Time Wireless Communications, Cambridge Press, 2003.
4. D. Tse, P. Viswanath, Fundamentals of Wireless Communications, Cambridge Press, 2005.
5. Antonis Kalis , Athanasios G. Kanatas ," Parasitic Antenna Arrays for Wireless MIMO Systems", Springer-Verlag New York Inc., 2014 edition, 2013.

Web References

1. https://nptel.ac.in/courses/117/105/117105132/
2. https://onlinecourses.nptel.ac.in/noc20_ee33/preview
3. http://www.iitg.ac.in/engfac/krs/public_html/lectures/ee634/
4. http://www.iitg.ac.in/engfac/krs/public_html/mimo.pdf
5. https://www.csie.ntu.edu.tw/~hsinmu/courses/_media/wn_11fall/mimo.pdf

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	-	3	3	-	-	1	1	2
2	2	-	3	3	-	-	1	1	2
3	2	-	3	3	-	-	1	1	2
4	2	-	3	3	-	-	1	1	2
5	2	-	3	3	3	-	1	1	2

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	ECE	Programme: **M.Tech. - ECE**						
Semester	I	Course Category: **PE**				*End Semester Exam Type: **TE**		
Course Code	**P23ECE104**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Optical Communication and Networking**	3	0	0	3	40	60	100

Prerequisite			
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Receiver, amplifier, add drop multiplexer and optical cross connects	K2
	CO2	Analyze the performance of analog and digital optical communication system	K3
	CO3	Solve the problems of wavelength assignment and routing in WDM networks	K3
	CO4	Perform protection in SONET/SDH network and optical layer protection	K3
	CO5	Architect an optical communication network to meet a given set of specification	K4

Unit - I	**Optical Communication and Networking Overview**	**Periods: 9**
Motivation optical communication and network - application in Telecom Networks, CATV Networks, Under Sea Network Transmission Characteristics: light propagation in fibre, loss and bandwidth, dispersion, nonlinear effect functions		**CO1**
Unit - II	**Optical Transmitter and Receiver**	**Periods: 9**
Optical Transmitter: Light Emitting Diode – Laser, Optical Receiver: photo detector, Avalanche photodiode Optical Amplifier: EDFA, SOA Enabling Technologies: Modulation – Demodulation		**CO2**
Unit - III	**First Generation Optical Network**	**Periods: 9**
Introduction to First generation Optical Network: SONET/SDH –FDDI – protection Second generation optical network: layered architecture – protection High speed light wave Links-OADM configuration-Optical ETHERNET-Soliton		**CO3**
Unit - IV	**Broadcast and Select Network**	**Periods: 9**
WDM networks: Wavelength assignment and routing-WDM network design, Access Network: HFC- FTTC - Photonic Packet switching network: Interleaving - Synchronization, Header Processing - buffering		**CO4**
Unit - V	**Instructional Activity**	**Periods: 9**
Case study on -Digital receiver performance: Probability of error receiver sensitivity, The Quantum Unit. Eye Diagram: Eye Pattern, Point to point – mesh network, power penalties.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Gerd Kaiser, “Optical fiber communications”, 4th ed. McGraw Hill Int., 2008.
2. David Greenfield, “The Essential Guide to Optical Networks” Prentice Hall PTR 2001.
3. Swagat Karve , Akshay Jadhav, Amol Kadam,” Optical Communication & Networking “,LAP Lambert Academic Publishing,2020.

Reference Books

1. John M.Senior, Optical fiber communication, Pearson Education, second edition.2007.
2. Rajiv Ramaswami, Optical Networks, Second Edition, Elsevier, 2004.
3. J.Gower, Optical Communication System, Prentice Hall of India, 2001.
4. Govind P. Agrawal, Fiber-optic communication systems, third edition, John Wiley and sons, 2004.
5. Zhongqi Pan, Qiang Wang, Yang Yue,” Optical Communications and Networking : Prospects in Industrial Applications”, MDPI AG,2020.

Web References

1. https://nptel.ac.in/courses/23792461105/

2. www.zapmeta.co.in/fiber+optic+link
3. https://lecturenotes.in/subject/877/optical-communication-and-network-ocn
4. https://learnengineering.in/ec6702-optical-communication-and-networks/
5. http://www.brainkart.com/subject/Optical-Communication-and-Networks_224/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	-	3
2	1	-	2	2	-	-	1	-	3
3	1	-	2	2	-	-	1	-	3
4	1	-	2	2	-	-	1	-	3
5	1	-	2	2	3	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	**ECE**	Programme: **M.Tech. - ECE**						
Semester	**I**	Course Category: **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23ECE105**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Wireless Sensor Networks and its applications**	3	0	0	3	40	60	100

Prerequisite

Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Design wireless sensor network system for different applications under consideration	**K2**
	CO2	Understand the hardware details of different types of sensors and select right type of sensor for various applications	**K2**
	CO3	Understand radio standards and communication protocols to be used for wireless sensor network-based systems and application	**K3**
	CO4	Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms	**K3**
	CO5	Handle special issues related to sensors like energy conservation and security challenges	**K4**

Unit - I	**Introduction**	**Periods: 9**
Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details		**CO1**
Unit - II	**Architecture**	**Periods: 9**
Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and SunSPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.		**CO2**
Unit - III	**Network Simulations**	**Periods: 9**
Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (NS-2) and commercial (QualNet, Opnet)		**CO3**
Unit - IV	**Sensor Network Protocols**	**Periods: 9**
Overview of sensor network protocols (details of at least 2 important protocol per layer):Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy),UWB.		**CO4**
Unit - V	**Instructional Activity**	**Periods: 9**
Case study on -Digital receiver performance: Probability of error receiver sensitivity, The Quantum Unit. Eye Diagram: Eye Pattern, Point to point – mesh network, power penalties.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Gerd Kaiser, “Optical fiber communications”, 4th ed. McGraw Hill Int., 2008.
2. David Greenfield, “The Essential Guide to Optical Networks” Prentice Hall PTR 2001.
3. Swagat Karve , Akshay Jadhav , Amol Kadam,” Optical Communication & Networking “,LAP Lambert Academic Publishing,2020.

Reference Books

1. John M.Senior, Optical fiber communication, Pearson Education, second edition.2007.
2. Rajiv Ramaswami, Optical Networks, Second Edition, Elsevier, 2004.
3. J.Gower, Optical Communication System, Prentice Hall of India, 2001.
4. Govind P. Agrawal, Fiber-optic communication systems, third edition, John Wiley and sons, 2004.
5. Zhongqi Pan, Qiang Wang , Yang Yue,” Optical Communications and Networking : Prospects in Industrial Applications”, MDPI AG,2020.

Web References

1. https://nptel.ac.in/courses/23792461105/
2. www.zapmeta.co.in/fiber+optic+link
3. https://lecturenotes.in/subject/877/optical-communication-and-network-ocn
4. https://learnengineering.in/ec6702-optical-communication-and-networks/
5. http://www.brainkart.com/subject/Optical-Communication-and-Networks_224/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	1	1	-	-	1	-	3
2	1	-	1	1	-	-	1	-	3
3	1	-	1	1	-	-	1	-	3
4	1	-	1	1	-	-	1	-	3
5	1	-	1	1	-	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from

SEMESTER – II

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P23VETC01	Advanced Digital System Design	PC	3	0	0	3	40	60	100
2	P23VETC02	Embedded Processors	PC	3	0	0	3	40	60	100
3	P23VETC03	Embedded System Design	PC	3	0	0	3	40	60	100
4	P23ECT204	Digital Image and Video Processing	PC	3	0	0	3	40	60	100
5	P23ECE2XX	Professional Elective-II	PE	3	0	0	3	40	60	100
6	P23ECE2XX	Professional Elective-III	PE	3	0	0	3	40	60	100
Practical										
7	P23ECP202	Digital Image and Video Processing laboratory	PC	0	0	4	2	50	50	100
8	P23HSPC02	Seminar on ICT- a hands on approach	HS	0	0	4	2	50	-	100
Ability Enhancement Course										
9	P23ECC2XX	Certification Course – II	AEC	0	0	4	-	100	-	100
10	P23ACT20X	Audit Course-II	AEC	2	0	0	-	100	-	100
							22	590	410	1000

Department	**ECE**	Programme**: M.Tech. - ECE**						
Semester	**II**	Course Category: **PC**			*End Semester Exam Type: **TE**			
Course Code	**P23VETC01**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Advanced Digital System Design**	3	-	-	3	40	60	100
(Common to M.Tech ECE and M.Tech – VLSI & ES)								
Prerequisite	Knowledge of Digital Circuits							

Course Outcome	**Upon completion of the course, the students will be able to**	BT Mapping (Highest Level)
CO1	Realize the Algorithmic State Machine	K3
CO2	Design and analyze the asynchronous sequential digital circuits	K3
CO3	Design and analyze the synchronous sequential circuits using PLDs	K3
CO4	Identify the fault in the digital circuits	K3
CO5	Simulate and synthesis the sequential circuits	K4

Unit - I	**Sequential Circuit Design**	**Periods: 9**
Analysis of clocked synchronous sequential circuits and modeling- state diagram - state table - state table assignment and reduction - design of iterative circuits - ASM chart and realization using ASM		**CO1**
Unit - II	**Asynchronous Sequential Circuit Design**	**Periods: 9**
Analysis of asynchronous sequential circuit: Design of asynchronous sequential circuit - static and dynamic methods - flow table reduction - races - state assignment transition table and problems in transition table - essential hazards - data synchronizers - mixed operating mode asynchronous circuits		**CO2**
Unit - III	**Synchronous Design Using Programmable Devices**	**Periods: 9**
Programming logic device families: Designing a synchronous sequential circuit using PLA/PAL - realization of finite state machine using PLD/FPGA		**CO3**
Unit - IV	**Fault Diagnosis and Testability Algorithms**	**Periods: 9**
Fault diagnosis method: Path sensitization method - Boolean difference method - D – algorithm - tolerance techniques - compact algorithm - fault in PLA/PAL- test generation - DFT schemes - built in self-test		**CO4**
Unit - V	**Instructional Activity**	**Periods: 9**
Simulation of synchronous/ asynchronous sequential circuits: Logic compilation - two level and multi-level logic synthesis - sequential logic synthesis -technology mapping - tools for mapping to PLDs and FPGAs		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Charles H R Jr, Larry L K, “Fundamentals of Logic Design “, 7th Edition, Global Engineering, 2014.
2. Parag K L, ‘Fault Tolerant and Fault Testable Hardware Design” 1st Edition, B S Publications, 2002.
3. ParagK.L, “Digital system Design using PLD “, B S Publications,2003

Reference Books

1. Nripendra N B, Logic Design Theory Prentice Hall of India, 1993.
2. Charles H RJr, Digital System Design using VHDL ll, 2nd Edition, CL Engineering, 2007
3. Michael D C, “Modeling, Synthesis, and Rapid Prototyping with the VERILOG HDL”, Prentice Hall, 2006.
4. O. Hamblen, T. S. Hall, and M. D. Furman, "Rapid Prototyping of Digital Systems", SPOC Edition, Springer, 2008
5. Stephen Brown, and Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", Third Edition, McGraw-Hill, 2014.

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1. http://nptel.ac.in/courses/117108040/downloads/Digital%20System%20Design.pdf
2. https://www.doulos.com/knowhow/verilog_designers_guide/
3. https://www.nandland.com/

4. https://lecturenotes.in/notes/15423-note-for-digital-system-design-dsd-by-vtu-rangers
5. https://www.sjsu.edu/people/thuy.le/docs/271syl.pdf

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	-	3	3	-	1	3	3	-
2	2	-	3	3	-	1	3	3	-
3	2	-	3	3	-	1	3	3	-
4	2	-	3	3	-	1	3	3	-
5	2	2	3	3	2	1	3	3	-

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	**ECE**	Programme**: M.Tech. ECE**						
Semester	**II**	Course Category: **PC**			*End Semester Exam Type**: TE**			
Course Code	**P23VETC02**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Embedded Processors**	3	-	-	3	40	60	100

(Common to M.Tech ECE and M.Tech – VLSI & ES)

Prerequisite	Embedded systems	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Analyze the architectures of different Embedded Processors	K3
	CO2 Identify an appropriate on chip peripherals for serial and parallel communication	K2
	CO3 Examine the functions of ARM processors	K3
	CO4 Develop real time applications using ARM processors	K3
	CO5 Develop a firmware for embedded applications	K3

Unit - I	**Introduction to Embedded Processors**	**Periods: 9**
Introduction to embedded processors– Compare Von Neumann architecture and Harvard architecture, RISC Vs CISC – System on Chip (SoC)-Introduction to SoC Architecture, An approach for SOC Design, System Architecture and Complexity. Processor Selection for SOC, Basic concepts in Processor Architecture, Overview of SOC external memory, Internal Memory, Scratchpads and Cache memory, SOC Memory System, Models of Simple Processor – memory interaction, SOC Standard Buses		**CO1**
Unit - II	**Embedded Processors on Chip Peripherals**	**Periods: 9**
Memory - Interrupts - I/O Ports-Timers & Real Time Clock (RTC), Watch dog timer - CCP modules - Capture Mode - Compare Mode-PWM Mode - Serial communication module - USART - SPI interface - I2C interface, Analog Comparator, Analog interfacing and data acquisition.		**CO2**
Unit - III	**ARM Processor**	**Periods: 9**
Architecture of ARM Controller – Registers, Pipeline organization 3 stage & 5 stage, Thumb mode of operation - D/A and A/D converter, sensors, actuators and their interfacing – Case study- Digital clock, Temperature sensing, Light sensing, Introduction to Internet of Things, smart home concepts		**CO3**
Unit - IV	**Real World Interfacing Using ARM Processor**	**Periods: 9**
Interfacing the peripherals to LPC2148: GSM and GPS using UART, on-chip ADC using interrupt (VIC), EEPROM using I2C, SD card interface using SPI, on-chip DAC for waveform generation.		**CO4**
Unit - V	**ARM Cortex Processors**	**Periods: 9**
Introduction to ARM CORTEX series, improvement over classical series and advantages for embedded system design. CORTEX A, CORTEX M, CORTEX R processors series, versions, features and applications, need of operating system in developing complex applications in embedded system, Firmware development for ARM Cortex, Survey of CORTEX M3 based controllers, its features and comparison		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. F. Vahid and T. Givargis, “Embedded System Design: A Unified Hardware/Software Introduction”, Wiley India Pvt. Ltd., 2002.
2. Lyla B. Das, “Architecture, Programming and Interfacing of Low-power Processors ARM 7, Cortex-M”, Cengage, 1st Edition, 2017.

Reference Books

1. Andrew Sloss, Dominic Symes, Chris Wright, “ARM System Developer’s Guide – Designing and Optimizing System Software”, ELSEVIER
2. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M”, Newness, ELSEVIER

3. Embedded Systems: Real-Time Interfacing to ARM Cortex-M Microcontrollers,2014, Jonathan W Valvano CreateSpace publications ISBN: 978-1463590154.

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1. LPC 214x User manual (UM10139): - www.nxp.com
2. LPC 17xx User manual (UM10360): - www.nxp.com
3. ARM architecture reference manual: - www.arm.com
4. http://processors.wiki.ti.com/index.php/HandsOn_Training_for_TI_Embedded_Processors
5. http://processors.wiki.ti.com/index.php/MCU_Day_Internet_of_Things_2013_Workshop

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	3	3	3	3	-	3	2	-
2	3	3	3	3	3	-	3	2	-
3	3	3	3	3	3	-	3	2	-
4	3	3	3	3	3	-	3	2	-
5	3	3	3	3	3	-	3	2	-

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

Department	ECE	Programme: M.Tech. - ECE						
Semester	II	Course Category: PC			*End Semester Exam Type: TE			
Course Code	P23VETC03	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Embedded System Design	3	0	0	3	40	60	100

(Common to M.Tech ECE and M.Tech – VLSI & ES)

Prerequisite	Embedded system	
Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Analyze various architectures	K2
	CO2 Discuss the performance evaluation of OS	K3
	CO3 Discuss scheduling	K3
	CO4 Evaluate RTOS	K4
	CO5 Analyze on digital camera architecture	K4

Unit - I	Introduction to Embedded Systems	Periods: 9
Introduction to Embedded systems – Embedded hardware, Embedded software, Classification and Examples of embedded systems, System on Chip, Design process. Skills required for an embedded system designer. Overview of 8051 Architecture, Real world Interfacing, Introduction to advanced architectures – x86, ARM and SHARC architectures - Processor and Memory organization, Instruction level parallelism, Performance metrics, Processor and Memory selection.		CO1
Unit - II	**Program Design and Analysis**	**Periods: 9**
Formalism for system design using UML (Unified Modelling Language), Model for Program flow graph (flow graphs). Basic Compilation techniques, Optimization of execution time, program size, energy and power. Processes and Operating system: Multiple tasks and processes, context switching, OS states, structure, timing requirements, Scheduling policies, and Inter- process communication Mechanisms. Performance Evaluation of OS		CO2
Unit - III	**Real Time Scheduling**	**Periods: 9**
State-machines, State charts, traditional logics and real-time logic. Deterministic scheduling: assumptions and candidate Algorithms, RM (rate monotonic) and EDF (earliest deadline first),realizing the assumptions, priority inversion and inheritance, Execution time prediction: Approaches and issues, measurement of S/W by S/W, program analysis by timing scheme, prediction by optimization, system interferences and architectural complexities		CO3
Unit - IV	**Real Time Operating Systems**	**Periods: 9**
OS services, Process management, timer and event functions, Memory management, Device, file and I/O management, Interrupt Routines in RTOS environment, basic design using RTOS, Performance metrics, OS security issues, Comparative study of sample of RTOS such as eCOS, real time Linux, Windows CE.		CO4
Unit - V	**Instructional Activities**	**Periods: 9**
Case studies: Digital Camera hardware and software architecture, Mobile phone software for key inputs.		CO5

Lecture Periods: 45	Tutorial Periods: -	Practical Periods: -	Total Periods: 45

Textbooks

1. Wayne Wolf, “Computers as Components: Principles of Embedded Computing system Design,” 2nd Edition, Morgan Kaufmann Publishers, 2008.
2. Steve Furber, “ARM System-on-Chip Architecture”, 2nd Edition, Pearson Education, 2001
3. Raj Kamal, “Embedded Systems-Architecture, Programming and Design,” The McGraw Hill Companies, 2nd Edition, 2008.

Reference Books

1. Allan C. Shaw, “Real time systems & Software,” John Wiley & Sons, India Reprint, 2001.
2. Richard Zurawski, “Embedded Systems Handbook,” Industrial Information Technology series, Taylor and Francis group, the academic division of T&F Informa plc.
3. The Definitive Guide to the ARM Cortex-M3, Joseph Yiu, 2nd Edition, Elsevier Inc. 2010

4. Andrew N Sloss, Dominic Symes, Chris Wright, “ARM System Developer's Guide - Designing and Optimizing System Software”, 2006, Elsevier.
5. Arnold. S. Berger, “Embedded Systems Design - An introduction to Processes, Tools and Techniques”, Easwer Press.

Web References

1. https://nptel.ac.in/courses/108/102/108102045/
2. https://nptel.ac.in/courses/106/105/106105193/
3. https://nptel.ac.in/courses/106/105/106105159/
4. https://nptel.ac.in/courses/106/103/106103182/
5. http://www.nptelvideos.in/2012/11/embedded-systems.html

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	1	1	-	-	1	-	3
2	1	-	1	1	-	-	1	-	3
3	1	-	1	1	-	-	1	-	3
4	1	-	1	1	-	-	1	-	3
5	1	-	1	1	3	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	ECE	Programme: **M.Tech - ECE**						
Semester	II	Course Category: **PC**				*End Semester Exam Type: **TE**		
Course Code	P23ECT204	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Digital Image and Video Processing**	3	-	-	3	40	60	100

Prerequisite	Digital Image Processing	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Learn different techniques for image enhancement, video and image recovery	K1
	CO2 Understand techniques for image and video segmentation	K2
	CO3 Study techniques for image and video compression and object recognition	K2
	CO4 Study about different colour models and processing techniques	K2
	CO5 Analysis the noise in real time environment	K4

Unit - I	**Digital Image and Video Fundamentals**	**Periods: 9**
Digital image and video fundamentals and formats, 2-D and 3-D sampling and aliasing, 2-D/3-D filtering, image decimation/interpolation, video sampling and interpolation, Basic image processing operations, Image Transforms Need for image transforms, DFT, DCT, Walsh, Hadamard transform, Haar transform, Wavelet transform		**CO1**
Unit - II	**Image and Video Enhancement and Restoration**	**Periods: 9**
Histogram, point processing, filtering, image restoration, algorithms for 2-D motion estimation, change detection, motion-compensated filtering, frame rate conversion, deinterlacing, video resolution enhancement, Image and Video restoration (recovery)		**CO2**
Unit - III	**Image and Video Segmentation**	**Periods: 9**
Discontinuity based segmentation- Line detection, edge detection, thresholding, Region based segmentation, Scene Change Detection, Spatiotemporal Change Detection, Motion Segmentation, Simultaneous Motion Estimation and Segmentation Semantic Video Object Segmentation, Morphological image processing		**CO3**
Unit - IV	**Wavelet Transform**	**Periods: 9**
Colour fundamentals, Colour models, Conversion of colour models, Pseudo colour image processing, Full colour processing		**CO4**
Unit - V	**Instructional Activities**	**Periods: 9**
Audio and video analysis for the real time environment; noise cancellation in image using adaptive filters; Video recognition and speech-to-text conversion using related tools		**CO5**

Lecture Periods:45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Ed. Al Bovik," Handbook of Image and Video Processing", 2nd Edition, Academic Press, 2000.
2. J. W. Woods, "Multidimensional Signal, Image and Video Processing and Coding", 2nd Edition, Academic Press, 2011.
3. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition, Prentice Hall, 2008

Reference Books

1. J.G.Proakis and D.G.Manolakis "Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 3rdEdition, John Wiley and Sons Ltd, 2009.
3. Lokenath D and Firdous A S, "Wavelet Transforms and Their Applications", 2nd Edition, Birkhauser, Springer,

2014.
4. AM. Tekalp, “Digital Video Processing”, 2nd Edition, Prentice Hall, 2015.
5. S. Shridhar, “Digital Image Processing”, 2nd Edition, Oxford University Press, 2016.

Web References

1. www.ece.umd.edu/class/enee630.F2012.html
2. http://ar.book.org/s/?q=DSP+PROAKIS&yearFrom=&yearTo=&language=&extension=&t=0
3. https://www.coursera.*org*/learn/digital
4. http://www.nptelvideos.in/2012/12/digital-image-processing.html
5. https://nptel.ac.in/courses/117/105/117105079

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	1	2	2	-	-	1	-	3
2	3	1	2	2	-	-	1	-	3
3	3	1	2	2	-	-	1	-	3
4	3	1	2	2	-	-	1	-	3
5	3	1	2	2	3	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

Department	ECE	Programme: **M.Tech. - ECE**						
Semester	II	Course Category: **PC**				*End Semester Exam Type: **LE**		
Course Code	P23ECP202	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Digital Image and Video Processing Laboratory**	-	-	4	2	50	50	100

Prerequisite	Knowledge in Image Processing		
Course Outcome	**On completion of the course, the students will be able to**		**BT Level**
	CO1	Perform image and video enhancement	K4
	CO2	Perform image and video segmentation	K4
	CO3	Detect an object in an image/video	K4
	CO4	Estimate the image restoration	K3
	CO5	Perform the boundary features	K3

List of Lab Activities and Experiments

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization
3. Implement segmentation algorithms
4. Perform video enhancement
5. Perform video segmentation
6. Perform image compression using lossy technique
7. Perform image compression using lossless technique
8. Perform image restoration
9. Convert a colour model into another
10. Calculate boundary features of an image
11. Calculate regional features of an image
12. Detect an object in an image/video using template matching/Bayes classifier

Reference Books

Web References

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

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

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

Department	**ECE**	Programme: **M.Tech. - ECE**						
Semester	**II**	Course Category: **HS**				*End Semester Exam Type: **LE**		
Course Code	**P23HSPC02**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Seminar on ICT-a Hands on Approach**	-	-	4	2	50	50	100

(ECE)

Prerequisite		
Course Outcome	**On completion of the course, the students will be able to**	**BT Level**
	CO1 Select a topic, narrowing the topic into presentation.	K4
	CO2 State an objective and use the relevant ICT tools to make the presentation effective.	K4
	CO3 Study the topic and understanding the contributions and prepare report.	K4
	CO4 Prepare a working demo.	K3
	CO5 Prepare conclusions based on the reading of the topic and giving final Presentation.	K3

The methodology used is “learning by doing”, a hands-on approach, enabling the students to follow their own pace. The teacher, after explaining the project, became a tutor, answering questions and helping students on their learning experience.

ICT skills

- Understand ICT workflow in the respective domain choose.
- Manage multitasking.
- Deal with main issues using tech in class.
- Record, edit and deliver audio and video.
- Automate assessments and results.

Scope

- Perspective in order to design activities in class.
- Understand the process of creating audiovisuals.

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 on the assigned topic and prepare a report, running to 30 or 40 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 (comprising of the Head of the Department and two faculty members) for a total of 100 marks.

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	**Program Outcomes (POs)**	**Program Specific Outcomes (PSOs)**

	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	-	3	1	1	3	3	3	-	-
2	-	3	1	1	3	2	3	-	-
3	-	3	1	1	3	2	3	-	-
4	-	3	1	1	3	2	3	-	-
5	-	3	1	1	3	2	3	-	-

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

PROFESSIONAL ELECTIVE COURSES

Professional Elective –II (Offered in Semester II)		
Sl. No.	**Course Code**	**Course Title**
1	P23VEEC01	Design of Analog and Mixed VLSI Circuits
2	P23VEEC02	Internet of Things and its Implementation
3	P23ECE206	Advanced Satellite Communication
4	P23ECE207	Mobile Communication System
5	P23ECE208	Statistical Information Processing

Department	**Electronics and Communication Engineering**	Programme: **M.Tech. - VLSI & ES**						
Semester	**II**	Course Category: **PE**			End Semester Exam Type **TE**			
Course Code	**P23VEEC01**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Design of Analog and Mixed VLSI Circuits**	3	0	0	3	40	60	100

Common to all the M.Tech (ECE and VLSI & ES)

		On completion of the course, the students will be able to	BT Mapping (Highest Level)
Course Outcome	**CO1**	Distinguish the concept of analog integrated circuits of ADC and DAC Specifications.	**K3**
	CO2	Demonstrate the concept of Architecture of data converter.	**K3**
	CO3	Contrast the about SNR in data Converter and filters.	**K3**
	CO4	Discover the concept of operational amplifiers and mixed signal circuits.	**K3**
	CO5	Operation and features of Phase locked loop mixed mode VLSI circuits and differential amplifier.	**K4**

Unit - I	**Data Converters**	**Periods: 9**
Data Converter Fundamentals: Analog versus digital discrete time signals - converting analog signals to data signals- sample and hold characteristics - DAC specifications - ADC specifications - mixed-signal layout issues.		**CO1**
Unit - II	**Data Converter Architectures**	**Periods: 9**
Data Converter Architectures: DAC architectures - digital input code - resistors string - R-2R ladder networks - current steering - charge scaling – DACs - cyclic DAC - pipeline DAC - ADC architectures – flash ADC - 2- step flash ADC - pipeline ADC - integrating ADC - successive approximation ADC		**CO2**
Unit - III	**SNR in Data Converters**	**Periods: 9**
Data Converter SNR: Improving SNR using averaging (Excluding Jitter & averaging onwards) - decimating filters for ADCs (Excluding Decimating without averaging onwards) - interpolating filters for DAC - band pass and high pass sync. Filters.		**CO3**
Unit - IV	**Operational Amplifiers and Mixed Signal Circuits**	**Periods: 9**
Differential amplifier- basic differential pair - Gilbert Cell; Op-Amp: Performance parameters - one stage and two stage Op-Amp - design of two stage Op-Amps - gain boosting - common mode Feedback – slew rate – offset effects –PSRR- noise – stability and frequency compensation - two stage open loop comparators–high speed comparators - sample and hold circuit- switched capacitor circuits - oscillators - VCO - PLL.		**CO4**
Unit - V	**Instructional Activities**	**Periods: 9**
Design and simulation of different VLSI Circuits: Current mirrors - Differential Amplifier - PLL - ADC/DAC		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Razavi B, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill Edition, 2008.
2. Baker R J, "CMOS: Circuit Design, Layout and Simulation", 3rd Edition, John Wiley and Sons, NJ, 2010
3. Karl Stephan, "Analog and Mixed-Signal Electronics", John Wiley and Sons, 2015
4. Mourad Fakhfakh, Esteban Tlelo-cuautle and Rafael Castro-Lopez, "Analog/RF and Mixed-Signal

CircuitSystematic Design", Springer-Verlag Berlin and Heidelberg GmbH & Co. KG, 2015

Web References

1. http://nptel.ac.in/courses/117101105/
2. http://nptel.ac.in/courses/117101106/
3. http://nptel.ac.in/courses/117106034/
4. https://freevideolectures.com/course/3676/cmos-mixed-signal-vlsi-design

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	-	3	3	-	1	3	3	-
2	2	-	3	3	-	1	3	3	-
3	2	-	3	3	-	1	3	3	-
4	2	-	3	3	-	1	3	3	-
5	2	2	3	3	2	1	3	3	-

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

Department	**Electronics and Communication Engineering**	Programme: **M.Tech. VLSI & ES**						
Semester	**II**	Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**P23VEEC02**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Internet of Things and its Implementation**	**3**	**0**	**0**	**3**	40	60	100

Common to all the M.Tech (ECE and VLSI & ES)

Course Outcome		**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1	Articulate the main concepts, key technologies, strength and limitations of IoT	**K2**
	CO2	Identify the architecture, infrastructure models of IoT	**K2**
	CO3	Analyze the networking and how the sensors are communicated in IoT.	**K3**
	CO4	Analyze and design different models for IoT implementation.	**K3**
	CO5	Identify and design the new models for market strategic interaction.	**K3**

Unit-I	**Introduction to Internet of Things & UML**	**Periods: 9**
Rise of the machines – Evolution of IoT – Web 3.0 view of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT Architecture -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem –Smart Objects and Connecting Smart Objects - IoT levels and deployment templates. Overview of Unified Modeling Language (UML). IoT Models: Domain Model, Information Model, Functional Model, Communication Model, Security Model.		**CO1**
Unit-II	**Middleware and Protocols of IOT**	**Periods: 9**
Middleware architecture of RFID, WSN, SCADA, M2M –Interoperability challenges of IoT-Protocols for RFID, WSN, SCADA, M2M- Zigbee, KNX, BAC Net, MODBUS - Challenges Introduced by 5G in IoT Middleware (Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT		**CO2**
Unit-III	**Communication and Networking**	**Periods: 9**
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks		**CO3**
Unit-IV	**IOT Implementation Tools**	**Periods: 9**
Introduction to Python, Introduction to different IoT tools, developing applications through IoT tools, developing sensor-based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi		**CO4**
Unit-V	**Instructional Activities**	**Periods: 9**
Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and lifestyle – Case study.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Honbo Zhou, “Internet of Things in the cloud:A middleware perspective”, CRC press, 2012.
2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-onApproach)”, VPT, 1st Edition, 2014.
3. Holler, Jan., Tsiatsis, Vlasios., Mulligan, Catherine., Karnouskos, Stamatis., Avesand, Stefan., Boyle, David. Internet of Things. Netherlands: Elsevier Science, 2014.
4. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.

Web References

1. http://www.abouttheinternetofthings.com/category/iot-features/
2. https://nptel.ac.in/courses/106/105/106105166/
3. https://lecturenotes.in/subject/370/internet-of-things-iot
4. https://www.codeproject.com/Learn/IoT/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	-	3	3	-	1	3	-	3
2	2	-	3	3	-	1	3	-	3
3	2	-	3	3	-	1	3	-	3
4	2	-	3	3	-	1	3	-	3
5	2	2	3	3	2	1	3	-	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

Department	**ECE**	Programme: **M.Tech. - ECE**						
Semester	**II**	Course Category: **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23ECE206**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Advanced Satellite Communication**	3	0	0	3	40	60	100

Prerequisite	Computer architecture and Basic about electrical systems	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Analyze various elements of satellite orbits	K2
	CO2 Remember about Space and Earth segment	K2
	CO3 Design Satellite link budget	K3
	CO4 Understand VSAT Network architectures	K3
	CO5 Design and implement satellite system design using relevant simulation tool	K4

Unit - I	**Introduction and Satellite Access**	**Periods: 9**
Orbits of Satellite: Low - medium - geo synchronous - angle period - returning period - orbital spacing - delay transponder - earth stations - antennas and earth coverage - altitude and eclipses; Multiple Access: Demand assigned FDMA - spade system - TDMA - satellite switched TDMA - CDMA.		**CO1**
Unit - II	**Space Segment and Earth Segment**	**Periods: 9**
Space Segment: Power supply - altitude control - station keeping - thermal control - TT and C subsystem - transponders; Earth Segment: Receive only home TV system - outdoor unit -indoor unit - master antenna TV system - community antenna TV system.		**CO2**
Unit - III	**Satellite Link Design**	**Periods: 9**
Link Design: System noise temperature and G/T ratio - C/N design of uplink and downlink - error control for digital satellite link.		**CO3**
Unit - IV	**VSAT Systems**	**Periods: 9**
VSAT Systems: Network architectures - access control protocols - earth station engineering - antennas - link margins - system design procedure.		**CO4**
Unit - V	**Instructional Activities**	**Periods: 9**
Simulation of link budget for two satellite systems - simulation of transponders and antenna system using related tools.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Timothy Pratt and Charles W. Bostain, “Satellite Communications”, 2nd Edition, Wiley,2012.
2. D. Roddy, “Satellite Communication”, 4th Edition (Reprint), McGraw Hill, 2009.
3. Masoumeh Karimi , “Advances in Satellite Communications”, IntechOpen, 2011

Reference Books

1. Wilbur L. Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, “Satellite Communication Systems Engineering”, Prentice Hall/ Pearson, 2007.
2. Tri T. Ha, “Digital Satellite Communication”, 2nd Edition, McGraw Hill, 1990.
3. Brian Ackroyd, “World Satellite Communication and Earth Station Design”, BSP Professional Books, 1990.
4. Gerard Maral , Michel Bousquet , Zhili Sun,” Satellite Communications Systems : Systems, Techniques and Technology”, John Wiley and Sons Ltd, Wiley-Blackwell ,2020
5. Bruce R. Elbert ,” Introduction to Satellite Communications”, Artech House Publishers , third edition, 2008.

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1. https://nptel.ac.in/courses/117/105/117105131/
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3. http://advancedengineering.umd.edu/node/2320
4. http://personal.stevens.edu/~yyao/syllabus-674.html
5. http://staff.um.edu.mt/carl.debono/lectures.html

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	3	3	-	-	1	3	3
2	1	-	3	3	-	-	1	3	3
3	1	-	3	3	-	-	1	3	3
4	1	-	3	3	-	-	1	3	3
5	1	-	3	3	3	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	ECE	Programme: **M.Tech. - ECE**						
Semester	II	Course Category: **PE**				*End Semester Exam Type: **TE**		
Course Code	P23ECE207	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Mobile Communication System**	3	0	0	3	40	60	100

Prerequisite			
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Explain trends in cellular communication	K2
	CO2	Able to distinguish between different standards	K2
	CO3	Apply diversity schemes in MIMO	K2
	CO4	Able to demonstrate various routing protocols	K2
	CO5	Case study of mobile communication standards using tools	K4

Unit - I	**Introduction to Cellular Concepts**	**Periods: 9**
Evolution of mobile radio communication - trends in cellular radio and personal communication; Basics of cellular concepts - types and components of mobile communication - operation of cellular system - handoff - radio channel characterization - multiple access schemes.		**CO1**
Unit - II	**Mobile Standards**	**Periods: 9**
System architecture and working principle: GSM - SCSD - GPRS - EDGE - CDMA digital cellular standard - 3G CDMA 2000 - 3G W-CDMA - IMT-2000 - 4G LTE - 5G.		**CO2**
Unit - III	**Diversity Schemes**	**Periods: 9**
Realization of independent fading paths - Receiver diversity - selection combing -Threshold combing - maximal - ratio combing - equal - gain combing; Transmitter Diversity - channel known at transmitter - channel unknown at transmitter - transmit and receive diversity for MIMO systems.		**CO3**
Unit - IV	**Mobile Ip Network and Transport Layer**	**Periods: 9**
Introduction to Mobile IP: Requirements - IP packet delivery- agent discovery- registration, networks - routing - destination sequence distance vector - dynamic source routing and alternative metrics; Traditional TCP - congestion control- slow start- fast retransmit - fast recovery- implications of mobility; Classical TCP improvements - methods of mobile TCP: Indirect TCP - snooping TCP - mobile TCP - fast retransmit.		**CO4**
Unit - V	**Instructional Activities**	**Periods: 9**
Simulation study of any (five) mobile communication standards using related tools.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Mullett, “Introduction to Wireless Telecommunication Systems & Networks”, Cengage Learning, 2008.
2. Theodore S. Rappaport, “Wireless Communications Principles & Practice”, PHI, 2007.
3. Man Young Rhee, “Mobile Communication Systems and Security”, John Wiley & Sons, 2009.

Reference Books

1. Mullett, “Introduction to Wireless Telecommunication Systems& Networks”, Cengage Learning, 2008.
2. Theodore S. Rappaport, “Wireless Communications Principles & Practice”, PHI, 2007
3. Schiller J, “Mobile Communications”, Pearson Education, 2007.
4. Mark J W, Jhuang W, “Wireless Communications & Networking”, PHI, 2006.
5. Krzysztof Wesolowski, “Mobile Communication Systems”, Wiley, 2002.

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1. https://nptel.ac.in/courses/117/102/117102062/
2. https://nptel.ac.in/courses/106/106/106106167/

3. https://nptel.ac.in/courses/117/104/117104099/
4. https://www.digitaltrends.com/mobile/4g-vs-lte
5. http://www.etsi.org/technologies-clusters/technologies/mobile/umts

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	3	3
2	1	-	2	2	-	-	1	3	3
3	1	-	2	2	-	-	1	3	3
4	1	-	2	2	-	-	1	3	3
5	1	-	2	2	3	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	ECE	Programme: **M.Tech. - ECE**						
Semester	II	Course Category: **PE**			*End Semester Exam Type: **TE**			
Course Code	P23ECE208	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Statistical Information Processing**	3	0	0	3	40	60	100

Prerequisite			
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Characterize and apply probabilistic techniques in modern decision systems, such as information systems, receivers, filtering and statistical operations	K2
	CO2	Demonstrate mathematical modelling and problem solving using such models	K2
	CO3	Comparatively evolve key results developed in this course for applications to signal processing, communications systems	K3
	CO4	Analysis the probabilistic and stochastic themes for modelling and analysis of various systems involving functionalities in decision making, statistical inference, estimation and detection	K3
	CO5	Develop frameworks based in probabilistic and stochastic themes for modelling and analysis of various systems	K3

Unit - I	**Introduction**	**Periods: 9**
Review of random variables: Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Chebyshev's inequality theorem, Central Limit theorem, Discrete &Continuous Random Variables. Random process: Expectations, Moments, Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions.		**CO1**
Unit - II	**Channel Modeling**	**Periods: 9**
Random signal modelling: MA(q), AR(p), ARMA(p,q) models, Hidden Markov Model & its applications, Linear System with random input , Forward and Backward Predictions, Levinson Durbin Algorithm. Statistical Decision Theory: Bayes' Criterion, Binary Hypothesis Testing, M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing.		**CO2**
Unit - III	**Channel Estimations**	**Periods: 9**
Parameter Estimation Theory: Maximum Likelihood Estimation, Generalized Likelihood Ratio Test, Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate, Multiple Parameter Estimation Best Linear Unbiased Estimator ,Least-Square Estimation Recursive Least-Square Estimator.		**CO3**
Unit - IV	**Channel Coding**	**Periods: 9**
Information Theory and Source Coding: Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, Shanon Fano, Arithmetic, Adaptive coding. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem.		**CO4**
Unit - V	**Instructional Activities**	**Periods: 9**
Simulation: examples of BCH codes, & Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, McGraw-Hill, 2002.
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.
3. Sergei V. Chekanov , "Numeric Computation and Statistical Data Analysis on the Java Platform", Springer International Publishing AG , first edition, 2016.

Reference Books

1. MouradBarkat, "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.

2. R G. Gallager, “Information theory and reliable communication”, Wiley, 1st edition, 1968.
3. F. J. MacWilliams and N. J. A. Sloane, “The Theory of Error-Correcting Codes”, New York, North-Holland, 1977.
4. Rosen K.H, “Elementary Number Theory”, Addison-Wesley, 6th edition, 2010.
5. Ali Grami , “Probability, Random Variables, Statistics, and Random Processes: Fundamentals & Applications “,John Wiley and Sons Ltd, Wiley-Blackwell , 2019.

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1. https://nptel.ac.in/courses/108/103/108103158/
2. https://nptel.ac.in/content/storage2/courses/117103067/module_01_introduction_to_probability/lect_01/slides/slide14.htm
3. https://people.eecs.berkeley.edu/~wlr/126notes.pdf
4. https://web.math.princeton.edu/~rvan/ORF309.pdf
5. https://www.math.kth.se/matstat/gru/sf2940/lectnotemat5.pdf

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	1	1
2	1	-	2	2	-	-	1	1	1
3	1	-	2	2	-	-	1	1	1
4	1	-	2	2	-	-	1	1	1
5	1	-	2	2	3	-	1	1	1

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

PROFESSIONAL ELECTIVE COURSES

Professional Elective –III (Offered in Semester II)		
Sl. No.	**Course Code**	**Course Title**
1	P23VEEC03	System on Chip Design
2	P23ECE309	Advanced Communication Network
3	P23ECE310	Advanced Radiation Systems
4	P23ECE311	Embedded Networking and Automation of Electrical System
5	P23ECE312	Industrial Electronics

Department	**Electronics and Communication Engineering**		Programme: **M.Tech. - VLSI & ES**						
Semester	**III**		Course Category: **PE**			End Semester Exam Type: **TE**			
Course Code	**P23VEEC03**		Periods/Week			Credit	Maximum Marks		
			L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**System-on-Chip Design**		3	0	0	3	40	60	100
Common to all the M.Tech (ECE and VLSI & ES)									
Course Outcome	On completion of the course, the students will be able to						BT Mapping (Highest Level)		
	CO1	Memorize the system architecture, components of system hardware and software.					**K2**		
	CO2	Explain the basic concepts of processor architecture and instructions and delays.					**K2**		
	CO3	Describe external and internal memory of SOC and organization.					**K2**		
	CO4	Explain SOC customization and reconfiguration technologies.					**K2**		
	CO5	Apply the knowledge of SOC design in real time applications.					**K3**		

Unit - I	**Introduction**	**Periods: 9**
System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, an approach for SOC Design, System Architecture and Complexity.		**CO1**
Unit - II	**Processors**	**Periods: 9**
Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.		**CO2**
Unit - III	**Memory Design F for SOC**	**Periods: 9**
Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.		**CO3**
Unit - IV	**Interconnect Customization and Configuration**	**Periods: 9**
Interconnect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, SOC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration -overhead analysis and trade-off analysis on reconfigurable Parallelism.		**CO4**
Unit - V	**Instructional Activities**	**Periods: 9**
SOC Design approach: simulate and verify AES algorithms, design and evaluation of Image compression JPEG compression.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

Computer System Design System-on-Chip - Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd. 2012.
ARM System on Chip Architecture – Steve Furber –2nd Ed., Addison Wesley Professional 2000.
D. C. Black, J. Donovan, B. Bunton, A. Keist, SystemC: From the Ground Up, Second Edition, Springer, 2010.
P. Marwedel, Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems, Third Edition, Springer, 2018.

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https://www.coursera.org/lecture/fpga-intro/programmable-system-on-chip-X5Gaq
https://ieeexplore.ieee.org/document/5490602

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COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	3	3	3	1	3	2	2	-
2	3	3	3	3	1	3	2	2	-
3	3	3	3	3	1	3	2	2	-
4	3	3	3	3	1	3	2	2	-
5	3	3	3	3	1	3	2	2	-

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	ECE	Programme: **M.Tech. - ECE**						
Semester	III	Course Category: **PE**			*End Semester Exam Type: **TE**			
Course Code	P23ECE309	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Advanced Communication Network**	3	0	0	3	40	60	100

Prerequisite			
Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Understand advanced concepts in Communication Networking	K2
	CO2	Design and develop protocols for Communication Networks	K2
	CO3	Understand the mechanisms in Quality of Service in networking	K3
	CO4	Optimize the Network Design	K3
	CO5	Design and develop a Network system using simulation tool	K3

Unit - I	**Network Service and Architecture**	**Periods: 9**
Overview of Internet- Overview of ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. High bandwidth delay networks. Fairness issues in TCP. Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model. Resource reservation in Internet. Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP).		**CO1**
Unit - II	**Scheduling**	**Periods: 9**
Packet Scheduling Algorithms - requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.; Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.		**CO2**
Unit - III	**Routings**	**Periods: 9**
IP address lookup-challenges. Packet classification algorithms and Flow Identification- Grid of Tries, Cross producing and controlled prefix expansion algorithms. Admission control in Internet. Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework.		**CO3**
Unit - IV	**IP Functions**	**Periods: 9**
IPV4, IPV6, IP tunneling, IP switching and MPLS. Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic Engineering issues in MPLS.		**CO4**
Unit - V	**Instructional Activities**	**Periods: 9**
Simulations: analysis the network delays, throughput calculations, error rate analysis		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Jean Wairand and PravinVaraiya, “High Performance Communications Networks”, 2nd edition, 2000.
2. Jean Le Boudec and Patrick Thiran, “Network Calculus A Theory of Deterministic Queueing Systems for the Internet”, Springer Veriag, 2001.
3. Curt White,” Data Communications and Computer Networks: A Business User's Approach”, Cengage Learning, Inc, CENGAGE Learning Custom Publishing, 8th edition, 2015.

Reference Books

1. Zhang Wang, “Internet QoS”, Morgan Kaufman, 2001.
2. Anurag Kumar, D. Manjunath and Joy Kuri, “Communication Networking: An Analytical Approach”, Morgan Kaufman Publishers, 2004.
3. George Kesidis, “ATM Network Performance”, Kluwer Academic, Research Papers, 2005

4. Ricarda Koch, Ralph Luftner," Communication Networks in Automation: Bus Systems. Components. Configuration and Management. Protocols. Security ", Publicis MCD Verlag, Germany, 2019
5. R. Srikant, Lei Ying," Communication Networks: An Optimization, Control, and Stochastic Networks Perspective ", CAMBRIDGE UNIVERSITY PRESS, 2014

Web References

1. https://nptel.ac.in/courses/117/105/117105076/
2. https://nptel.ac.in/courses/106/105/106105183/
3. https://nptel.ac.in/courses/117/101/117101050/
4. http://www.alphace.ac.in/downloads/notes/ece/10EC71_NOTES.pdf
5. https://www.vssut.ac.in/lecture_notes/lecture1428550521.pdf

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	2	2
2	1	-	2	2	-	-	1	2	2
3	1	-	2	2	-	-	1	2	2
4	1	-	2	2	-	-	1	2	2
5	1	-	2	2	-	-	1	2	2

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	ECE	Programme: M.Tech. - ECE						
Semester	III	Course Category: PE				*End Semester Exam Type: TE		
Course Code	P23ECE310	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Advanced Radiation Systems	3	0	0	3	40	60	100

Prerequisite	Electromagnetics, Antennas and Wave propagation	
Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Ability to understand antenna concepts	2
	CO2 Knowledge of modern antenna design	2
	CO3 Ability to understand about frequency independent antennas	4
	CO4 Acquire knowledge in impedance matching and tuning of microstrip antennas	4
	CO5 Ability to design antenna for various applications	4

Unit - I	Concepts Of Radiation And Antenna Fundamentals	Periods: 9
Physical concept of Radiation: Radiation from surface and line current distributions - fundamental parameters of antennas - Friss Transmission Equation - radiation integrals and auxiliary potential functions - Near and Far Field regions - Reciprocity and reaction theorems - radiation hazards and solutions		CO1
Unit - II	**Aperture And Reflector Antennas**	**Periods: 9**
Huygens's principle - radiation from rectangular and circular apertures - design considerations - Babinets principle - radiation from sectoral - pyramidal - conical and corrugated Horns - design concepts of parabolic reflectors and case grain antennas.		CO2
Unit - III	**Broadband Antennas**	**Periods: 9**
Principles - frequency independent antennas - design and properties of log periodic - Yagi-Uda antennas - loop antennas - helical antennas - biconical antennas - broadcast antenna - spiral antenna and slot antennas.		CO3
Unit - IV	**Microstrip Antennas**	**Periods: 9**
Microstrip Antennas: Radiation mechanism - parameters and applications - feeding methods - design of rectangular and circular patch - impedance matching of microstrip antennas - broadband- compact and tuneable microstrip antennas.		CO4
Unit - V	**Instructional Activities**	**Periods: 9**
Design, simulation and analysis of different antennas for wireless applications using related simulation tools.		CO5

Lecture Periods: 45	Tutorial Periods: -	Practical Periods: -	Total Periods: 45

Textbooks

1. Jordan E C and Balmain K G, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Pearson Education, 2015.
2. Balanis C A, "Antenna Theory: Analysis and Design", 4th Edition, John Wiley and Sons, New Jersey, 2016.
3. K.D.Prasad, "Antenna and Wave Propagation" 2nd edition, Sathya Prakasam, New Delhi, 2005

Reference Books

1. Jordan E C and Balmain K G, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Pearson Education, 2015.
2. Balanis C A, "Antenna Theory: Analysis and Design", 4th Edition, John Wiley and Sons, New Jersey, 2016.
3. Kraus J D and Marhefka R J, "Antennas for All Applications", 3rd Edition, Tata McGraw Hill, 2002.
4. Elliot R S, "Antenna Theory and Design", Revised Edition, John Wiley and Sons, India, 2006.
5. Girish Kumar and Ray K P, "Broadband Microstrip Antennas", Artech House, 2003.

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2. http://www.nptel.ac.in/courses/108101092/
3. http://www.nptel.ac.in/courses/108104099/
4. http://www.nptel.ac.in/courses/108104087/
5. https://www.pulseelectronics.com/docs/library/Antenna%20Basic%20Concepts%2007%2012.pdf

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	3	3	-	-	1	3	3
2	1	-	3	3	-	-	1	3	3
3	1	-	3	3	-	-	1	3	3
4	1	-	3	3	-	-	1	3	3
5	1	-	3	3	3	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	**ECE**	Programme: **M.Tech. - ECE**						
Semester	**II**	Course Category: **PE**				*End Semester Exam Type: **TE**		
Course Code	**P23ECE311**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Embedded Networking and Automation of Electrical System**	3	0	0	3	40	60	100

Prerequisite	Computer architecture and Basic about electrical systems	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Demonstrate criteria of choice of sensors, components to build meters	3
	CO2 Illustrate the demand for BUS communication protocols are introduced	3
	CO3 Analyse the need and standards in Substation automation	4
	CO4 Deployment of PAN for metering networked commercial applications	4
	CO5 Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded networked communications.	3

Unit - I	**Building System Automation**	**Periods: 9**
Sensor Types & Characteristics: Sensing Voltage, Current, flux, Torque, Position, Proximity, Accelerometer - Data acquisition system- Signal conditioning circuit design- UC Based & PC based data acquisition – uC for automation and protection of electrical appliances –processor based digital controllers for switching Actuators: Stepper motors, Relays –System automation with multi-channel Instrumentation and interface .		**CO1**
Unit - II	**Embedded Networking of Instrument Cluster**	**Periods: 9**
Embedded Networking: Introduction – Cluster of Instruments in System- Comparison of bus protocols – RS 232C- embedded ethernet - MOD bus and CAN bus, LIN BUS- Introduction to WSN-– Commercially available sensor nodes-Zigbee protocol -Network Topology Energy efficient MAC protocols –SMAC –Data Centric routing Applications of sensor networks- Database perspective on sensor networks- IoT Applications .		**CO2**
Unit - III	**Automation of Substation**	**Periods: 9**
Substation automation- Distribution SCADA system principles -role of PMU,RTU, IEDs, BUS for smart Substation automation- Introduction to Role of IEC 61850,IEEEC37.118 std- Interoperability and IEC 61850-challenges of Substations in Smart Grid - challenges of Energy Storage and Distribution Systems monitoring - Communication Challenges in monitoring electric utility asset .		**CO3**
Unit - IV	**Metering of Smart Grid**	**Periods: 9**
Characteristics of Smart Grid- Generation by Renewable Energy Sources based on solar grid Challenges in Smart Grid and Microgrids- electrical measurements with AMI -Smart meters for EV plug in electric vehicles power management -Home Area Net metering and Demand side Energy Management applications		**CO4**
Unit - V	**Instructional Activity**	**Periods: 9**
Power Quality issues of Grid connected Renewable Energy Sources -Smart meters for Power Quality monitoring and Control - Power Quality issues -Surges – Flicker – Inter harmonics - Transients – Power Quality Benchmarking – Power Quality Meters- Meter data management In Smart Grid-, communication enabled Power Quality metering		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Ernest O. Doeblin and Dhanesh N Manik, “Measurement Systems – Application and Design”, 5th Edn, TMH, 2007.
2. James Northcote-Green, Robert Wilson “Control and automation of electrical power distribution systems”, CRC, Taylor and Francis, 2017

Reference Books

1. Krzysztof Iniewski,” Smart Grid, Infrastructure & Networking”, TMcGH,2012

2. Shih-Lin Wu,Yu-Chee Tseng,{"Wireless Ad Hoc Networking, PAN, LAN, SAN, Aurebach Pub,2012

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2. https://www.studocu.com/in/document/anna-university/electronics-communication-engineering/embedded-networking-introduction/37122560
3. https://www.geeksforgeeks.org/introduction-of-embedded-systems-set-1/
4. https://nptel.ac.in/courses/108102045
5. http://www.infocobuild.com/education/audio-video-courses/electronics/EmbeddedSystems-IIT-Delhi/lecture-24.html

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	1	2	1	2	1	1	-	-
2	1	-	2	2	3	1	1	-	-
3	3	1	2	-	-	-	1	-	-
4	2	1	2	3	3	2	1	-	-
5	2	1	2	-	-	3	1	-	-

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	ECE	Programme: **M.Tech. - ECE**						
Semester	II	Course Category: **PE**				*End Semester Exam Type: **TE**		
Course Code	P23ECE312	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Industrial Electronics**	3	0	0	3	40	60	100

Prerequisite	**Analog Electronic Circuits**	
Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Learn about the latest electronic devices available in industry.	K3
	CO2 Effectively explain the structure and operation of common linear components	K3
	CO3 Learn about the digital ICs and sensory electronic devices	K3
	CO4 Use tools/test equipment to analyze electronic components	K3
	CO5 Learn about industrial control devices	K3

Unit - I	**Introduction to Industrial Electronics and its Safety**	**Periods: 9**
History-Manufacturing Classifications-Classes of Industrial Controls-Technology Pyramid Tree and Industrial Control Overview • Introduction to Safety -Safety Standards -Presence Sensors - Interlock Devices -Developing a Safety Strategy		**CO1**
Unit - II	**Discrete Control Input and Output Devices**	**Periods: 9**
Introduction to discrete control - Mechanical and Electrical Switch Classifications - Mutually-Activated Electronic Circuit Switches - Mechanically-Activated Electronic Circuit Switches - Discrete Output Devices - Relays - Control Diagrams		**CO2**
Unit - III	**Discrete Automation Sensors and Devices**	**Periods: 9**
Introduction to Electronic Sensors - Non-contact Sensors - Sensor Output Interfaces - Analog Automation Sensors - Sensor Applications and Selection - Integrating Sensors into Power and Control Circuits		**CO3**
Unit - IV	**Analog Process Control Devices and Sensors**	**Periods: 9**
Process Actuators and Output Devices - Control Valves - Electrical Heating Elements - Control Sensors, Transmitters, and Transducers - Temperature Sensors - Pressure Sensors - Flow Sensors - Level Sensors - Position Sensors		**CO4**
Unit - V	**Instructional Activity**	**Periods: 9**
Classification of Network Media - Enterprise Networks - Fieldbus Networks - Factory-Floor Data Network		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. J.A. Rehg and Santori, Industrial Electronics, Pearson Education, Inc. Upper Saddle River, New Jersey, 2006
2. S. Solomon, Sensors Handbook, Mc Graw Hill Companies, Inc. USA, 2010 2nd Edition

Reference Books

1. T. Barlet, Industrial Electronics-Devices Systems and Applications, Delmar Publishers, Albany New York, 1997
2. T.E. Kissel, Industrial Electronics, Prentice Hall Simon and Schuster, PTE LTD, Singapore, 1997 International Edition

Web References

1. https://frank.pocnet.net/other/Philips/Kretzmann_IndustrialElectronicsHandbook_1964.pdf
2. https://labvolt.festo.com/downloads/91579-00_transducerfundamentals_sw_ed4_pr1.pdf
3. http://www.inohv8.info/industrial%20tronics.pdf
4. https://www.daenotes.com/electronics/book/industrial-electronics
5. https://archive.nptel.ac.in/courses/108/102/108102145/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	3	3	3	-		2	3	-
2	3	3	3	3	1		2	3	-
3	3	3	3	3	1		2	3	-
4	3	3	3	3	2		2	3	-
5	3	3	3	3	3		2	3	-

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

**Assignment to be given from Unit-5

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**				*End Semester Exam Type: **TE**		
Course Code	**P23ACTX01**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**English for Research Paper Writing**	**2**	**-**	**-**	**-**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand that how to improve your writing skills and level of readability.	**K2**
	CO2 Learn about what to write in each section.	**K1**
	CO3 Understand the skills needed when writing a Title.	**K2**
	CO4 Understand the skills needed when writing the Conclusion.	**K2**
	CO5 Ensure the good quality of paper at very first-time submission.	**K3**

UNIT- I	**Introduction to Research Paper Writing**	**Periods: 6**
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.		**CO1**
UNIT- II	**Presentation Skills**	**Periods: 6**
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.		**CO2**
UNIT- III	**Title Writing Skills**	**Periods: 6**
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.		**CO3**
UNIT- IV	**Result Writing Skills**	**Periods: 6**
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.		**CO4**
UNIT- V	**Verification Skills**	**Periods: 6**
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission.		**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Adrian Wallwork, “English for Writing Research Papers”, Springer, New York, Dordrecht Heidelberg London, 2011.
2. Day R, “How to Write and Publish a Scientific Paper”, Cambridge University Press, 2006.
3. Goldbort R, “Writing for Science”, Yale University Press (Available on Google Books), 2006.
4. Highman N, “Handbook of Writing for the Mathematical Sciences”, SIAM. Highman’s book, 1998.

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX02**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Disaster Management**	**2**	**-**	**-**	**-**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Ability to summarize basics of disaster.	**K1**
	CO2 Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.	**K2**
	CO3 Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.	**K3**
	CO4 Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.	**K3**
	CO5 Ability to develop the strengths and weaknesses of disaster management approaches.	**K3**

UNIT- I	**Introduction**	**Periods: 6**
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.		**CO1**
UNIT- II	**Repercussions of Disasters and Hazards**	**Periods: 6**
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.		**CO2**
UNIT- III	**Disaster Prone Areas in India**	**Periods: 6**
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics.		**CO3**
UNIT- IV	**Disaster Preparedness and Management**	**Periods: 6**
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.		**CO4**
UNIT- V	**Risk Assessment**	**Periods: 6**
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival		**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Goel S. L., "Disaster Administration And Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company, 2007.
3. Sahni, Pardeep Et.Al. , "Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi, 2001.

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX03**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Sanskrit for Tecnical Knowledge**	**2**	**-**	**-**	**-**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understanding basic Sanskrit language.	**K2**
	CO2 Write sentences	**K2**
	CO3 Know the order and roots of Sanskrit.	**K3**
	CO4 Know about technical information about Sanskrit literature	**K3**
	CO5 Understand the technical concepts of Engineering.	**K2**

UNIT- I	**Alphabets**	**Periods: 6**
Alphabets in Sanskrit.		**CO1**
UNIT- II	**Tenses and Sentences**	**Periods: 6**
Past/Present/Future Tense - Simple Sentences.		**CO2**
UNIT- III	**Order and Roots**	**Periods: 6**
Order - Introduction of roots of Engineering-Electrical, Mechanical, Architecture, Mathematics.		**CO3**
UNIT- IV	**Sanskrit Literature**	**Periods: 6**
Technical information about Sanskrit Literature.		**CO4**
UNIT- V	**Technical Concepts of Engineering**	**Periods: 6**
Technical concepts		**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Dr. Vishwas, “Abhyaspustakam”, Samskrita-Bharti Publication, New Delhi.
2. Prathama Deeksha, Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, “Teach Yourself Sanskrit”, New Delhi Publication.
3. Suresh Soni, “India’s Glorious Scientific Tradition”, Ocean books (P) Ltd., New Delhi, 2017

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX04**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Value Education**	**2**	**-**	**-**	**-**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Knowledge of self-development.	**K2**
	CO2 Learn the importance of Human values.	**K1**
	CO3 Developing the overall personality.	**K3**
	CO4 Developing Character and Competence	**K3**

UNIT- I	**Values and Self Development**	**Periods: 6**
Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgments of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.		**CO1**
UNIT- II	**Cultivation of Values**	**Periods: 6**
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline		CO2
UNIT- III	**Personality Development**	**Periods: 6**
Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.		**CO3**
UNIT- IV	**Character Development**	**Periods: 6**
Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role.		**CO4**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX05**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Constitution of India**	**2**	**-**	**-**	**-**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.	**K3**
	CO2 Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.	**K3**
	CO3 Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections.	**K3**
	CO4 Discuss the passage of the Hindu Code Bill of 1956.	**K3**
	CO5 Discuss the administration and Election commission	**K3**

UNIT- I	**History of Making of The Indian Constitution**	**Periods: 6**
History, Drafting Committee, (Composition & Working).		**CO1**
UNIT- II	**Philosophy of The Indian Constitution**	**Periods: 6**
Preamble, Salient Features.		**CO2**
UNIT- III	**Contours of Constitutional Rights and Duties**	**Periods: 6**
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.		**CO3**
UNIT- IV	**Organs of Governance**	**Periods: 6**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.		**CO4**
UNIT- V	**Local Administration and Election Commission**	**Periods: 6**
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy. Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.		**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. "The Constitution of India, 1950(Bare Act), Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution, 1 st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edition, Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
5. Suresh Soni, "India's Glorious Scientific Tradition" Ocean books (P) Ltd., New Delhi, 2017.

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX06**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Pedagogy Studies**	**2**	**-**	**-**	**-**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?	**K2**
	CO2 What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?	**K2**
	CO3 How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?	**K2**
	CO4 Illustrate Professional development	**K3**
	CO5 Identify Research gaps and Future Directions	**K3**

UNIT- I	**Introduction and Methodology**	**Periods: 6**
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions – Overview of methodology and Searching.		CO1
UNIT- II	**Thematic Overview**	**Periods: 6**
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.		**CO2**
UNIT- III	**Evidence on The Effectiveness of Pedagogical Practices**	**Periods: 6**
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies		**CO3**
UNIT- IV	**Professional Development**	**Periods: 6**
Professional development: alignment with classroom practices and follows up support – Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes		**CO4**
UNIT- V	**Research Gaps and Future Directions**	**Periods: 6**
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.		**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Ackers J, Hardman,F, "Classroom interaction in Kenyan primary schools, Compare", 31(2): 245- 261, 2001.
2. Agrawal M, "Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies", 36(3):361-379, 2004.
3. Akyeampong K, "Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report", London, DFID, 2003.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, "Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?", International Journal Educational Development, 33(3): 272–282, 2013.
5. Alexander RJ, "Culture and pedagogy: International comparisons in primary education", Oxford and Boston: Blackwell, 2001.
6. Chavan M, "Read India: Amass scale, rapid, 'learning to read' campaign", 2003.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		

Marks	20	20	25	25	10	-	100

Department	**Electronics and Communication Engineering**		Programme: **M.Tech.**					
Semester	**I/II**		Course Category : **AC**			*End Semester Exam Type: **TE**		
Course Code	**P23ACTX07**		Periods / Week			Credit	Maximum Marks	
			L	T	P	C	CAM	ESE	TM
Course Name	**Stress Management by Yoga**		**2**	**-**	**-**	**-**	**100**	**-**	**100**
(Common to all M.Tech Programme)									
Prerequisite	No Prerequisite needed								
Course Outcomes	**On completion of the course, the students will be able to**						BT Mapping (Highest Level)		
	CO1	Develop healthy mind in a healthy body thus improving social health also					**K2**		
	CO2	Improve efficiency.					**K2**		
	CO3	Understand Asan and Pranayam					**K2**		
	CO4	Apply Asanas					**K4**		
	CO5	Apply Pranayam					**K4**		
UNIT- I	**Introduction**						**Periods: 6**		
Definitions of Eight parts of yoga. (Ashtanga).									**CO1**
UNIT- II	**Do`s and Don't's in Life**						**Periods: 6**		
Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.									**CO2**
UNIT- III	**Asan and Pranayam**						**Periods: 6**		
Asan and Pranayam - Various yoga poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam.									**CO3**
UNIT- IV	**Asan Practices**						**Periods: 6**		
Practice on Various yoga poses									**CO4**
UNIT- V	**Pranayam Practices**						**Periods: 6**		
Practice on various pranayam									**CO5**
Lecture Periods: 30		**Tutorial Periods: -**		**Practical Periods: -**			**Total Periods: 30**		

Reference Books

1. Janardan Swami Yoga bhyasi Mandal, "Yogic Asanas for Group Tarining-Part-I", Nagpur.
2. Swami Vivekananda, "Rajayoga or conquering the Internal Nature", Advaita Ashrama Publication Department, Kolkata

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX08**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Personality Development through Life Enlightenment Skills**	**2**	**-**	**-**	**-**	**100**	**-**	**100**
(Common to all M.Tech Programme)								
Prerequisite	No Prerequisite needed							
Course Outcomes	**On completion of the course, the students will be able to**					BT Mapping (Highest Level)		
	CO1	Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.				**K3**		
	CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity.				**K1**		
	CO3	Study of Neet is hatakam will help in developing versatile personality of students.				**K3**		
UNIT- I						**Periods: 6**		
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's) 4-Verses 18, 38,39 Chapter18 – Verses37,38,63.								**CO1**
UNIT- II						**Periods: 12**		
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3- Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.model – shrimad bhagwad geeta - Chapter2- Verses 17, Chapter 3-Verses 36,37,42 – Chapter.								**CO2**
UNIT- III						**Periods: 12**		
Statements of basic knowledge – Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18 - Personality of role.								**CO3**
Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**			**Total Periods: 30**			
Reference Books								
1. Gopinath, Rashtriya Sanskrit Sansthanam P, "Bhartrihari's Three Satakam, Niti-sringar- vairagya", New Delhi,2010. 2. Swami Swarupananda, Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016								

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**I/II**	Course Category : **AC**			*End Semester Exam Type: **TE**			
Course Code	**P23ACTX09**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Unnat Bharath Abhiyan**	**2**	**-**	**-**	**-**	**100**	**-**	**100**

(Common to all M.Tech Programme)

Prerequisite	No Prerequisite needed	
Course Outcomes	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Gain an understanding of rural life, culture and social realities	**K3**
	CO2 Develop a sense of empathy and bonds of mutuality with local community	**K1**
	CO3 Appreciate significant contributions of local communities to Indian society and economy	**K3**
	CO4 Learn to value the local knowledge and wisdom of the community	**K3**
	CO5 Identify opportunities for contributing to community's socio-economic improvements.	**K3**

UNIT- I	**Appreciation of Rural Society**	**Periods: 6**
Rural life style, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of "soul of India lies in villages' (Gandhi), rural infrastructure.		**CO1**
UNIT- II	**Understanding Rural Economy and Livelihood**	**Periods: 6**
Agriculture, farming, landownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets.		**CO2**
UNIT- III	**Rural Institutions**	**Periods: 6**
Traditional rural organizations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), local civil society, local administration.		**CO3**
UNIT- IV	**Rural Development Programmes**	**Periods: 6**
History of rural development in India, current national programmes: Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awaas Yojana, Skill India, Gram Panchayat Decentralized Planning, NRLM, MNREGA, etc.		**CO4**
UNIT- V	**Field Based Practical Activities**	**Periods: 6**
Visit MGNREGS project sites. Swachh Bharat project sites, Conduct Mission Antyodaya surveys, Interactive community exercise with local leaders, Panchayat functionaries, Visit Rural Schools / mid-day meal centres, study Academic and infrastructural resources and gaps, Participate in Gram Sabha meetings, Visit local Anganwadi Centre, Conduct soil health test, drinking water analysis.		**CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 30**

Reference Books

1. Singh, Katar, "Rural Development : Principles, Policies and Management", Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, "Sustainable Development Goals", 2015.
4. M.P.Boraian, "Best Practices in Rural Development", Shanlax Publishers, 2016

Evaluation Method

Assessment	**Continuous Assessment Marks (CAM)**					**End Semester Examination (ESE) Marks**	**Total Marks**
	Assignment 1	**Assignment 2**	**Test 1**	**Test 2**	**Attendance**		
Marks	20	20	25	25	10	-	100

SEMESTER–III

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P23ECE3XX	Professional Elective - IV	PE	3	0	0	3	40	60	100
2	P23ECE3XX	Professional Elective - V	PE	3	0	0	3	40	60	100
3	P23ECE3XX	Professional Elective - VI	PE	3	0	0	3	40	60	100
Project Work										
4	P23ECW301	Project Phase - I	PA	0	0	12	6	50	50	100
5	P23ECW302	Internship	PA	0	0	0	2	100	-	100
Mandatory Course										
6	P23ECC301	NPTEL / GIAN / MOOC	AEC	0	0	0	-	100	-	100
Total							**17**	**370**	**230**	**600**

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PA**			*End Semester Exam Type: **LE**			
Course Code	**P23ECW301**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Project Phase - I**	**-**	**-**	**12**	**6**	**50**	**50**	**100**

Aim & Objective:

The project work aims to develop the work practice and to apply theoretical and practical tools/techniques for solving real life problems related to industry and current research. The objective of the project work is to improve the professional competency and research attitude by touching the areas which are not covered in theory or laboratory classes.

- The project work shall be a design project/experimental project and/or computer simulation project on any of the topic in manufacturing engineering or related field.
- The project work shall be allotted individually on different topics.
- The students shall be encouraged to do their project work in the parent institute itself. In exceptional cases the students shall be permitted to undertake continue their project outside the parent institute with appropriate permission from Head of the institution through the Project Coordinator.
- Department shall constitute an Evaluation Committee to review the project work.
- The Evaluation committee shall consist of at least three faculty members namely internal guide, project coordinator and another expert in the specified area of the project.

The student is required to undertake the project phase I during the third semester and the same shall be continued in the 4 th semester (Phase II). Phase I consist of preliminary thesis work, three reviews of the work and the submission of preliminary report. First review shall highlight the topic, objectives and origin of problem, second review shall highlight, Literature survey, methodology and expected results. Third review shall evaluate the progress of the work, preliminary report and scope of the work which shall be completed in the 4 th semester. Also the evaluation of project phase - I shall be done externally.

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **PA**				*End Semester Exam Type: -		
Course Code	**P23ECW302**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Internship**	**-**	**-**	**-**	**2**	**100**	**-**	**100**

Students should undergo training or internship during summer / winter vacation at Industry/ Research organization / University (after due approval from the Programme Academic Coordinator and Department Consultative Committee (DCC). In such cases, the internship/training should be undergone continuously (without break) in one organization. Normally no extension of time is allowed. However, DCC may provide relaxation based on the exceptional case. The students are allowed to undergo three to four weeks internship in established industry / Esteemed institution during vacation period. The student should give presentation and submit report to DCC. The Internship is assessed internally for 100 marks.

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**III**	Course Category : **AEC**				*End Semester Exam Type: -		
Course Code	**P23ECC301**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**NPTEL/SWAYAM/MOOC**	**-**	**-**	**-**	**-**	**100**	**-**	**100**

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator and Subject Experts. Students have to complete 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 marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation.

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**IV**	Course Category : **PA**			*End Semester Exam Type: **LE**			
Course Code	**P23ECW403**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Project Phase - II**	**-**	**-**	**24**	**12**	**50**	**50**	**100**

Aim & Objective:

The project work aims to develop the work practice and to apply theoretical and practical tools/techniques for solving real life problems related to industry and current research. The objective of the project work is to improve the professional competency and research attitude by touching the areas which are not covered in theory or laboratory classes.

- The project work shall be a design project/experimental project and/or computer simulation project on any of the topic in manufacturing engineering or related field.
- The project work shall be allotted individually on different topics.
- The students shall be encouraged to do their project work in the parent institute itself. In exceptional cases the students shall be permitted to undertake continue their project outside the parent institute with appropriate permission from Head of the institution through the Project Coordinator.
- Department shall constitute an Evaluation Committee to review the project work.
- The Evaluation committee shall consist of at least three faculty members namely internal guide, project coordinator and another expert in the specified area of the project.

Project phase II is a continuation of project phase I which started in the third semester. There shall be three reviews in the fourth semester, first in the beginning of the semester, second in the middle of the semester and the Third at the end of the semester. First review is to evaluate the progress of the work and planned activity; second review shall be presentation and discussion. Third review shall be a presubmission presentation before the evaluation committee to assess the quality and quantity of the work done. This would be a pre qualifying exercise for the students for getting approval for the submission of the thesis. At least one technical paper shall be prepared for possible publication in journals or conferences. The technical paper shall be submitted along with the thesis. The final evaluation of the project shall be done externally.

PROFESSIONAL ELECTIVE COURSES

Professional Elective–IV (Offered in Semester III)		
Sl. No	**Course Code**	**Course Title**
1	P23VEEC04	Real Time Operating System
2	P23VEEC05	Cloud computing and Distributed System
3	P23ECE413	Automotive Embedded System
4	P23ECE414	Information and Network Security
5	P23ECE415	RF and Microwave Engineering

Department	**Electronics and Communication Engineering**	Programme: **M.Tech VLSI & ES**						
Semester	**III**	Course Category Code: **PE**			End Semester Exam Type: **TE**			
Course Code	**P20VEEC04**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Real Time Operating System**	3	0	0	3	40	60	100

Common to all the M.Tech (ECE and VLSI & ES)

Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Define and demonstrate understanding of key real-time system terminology and design issues.	**K2**
	CO2	Analyze and compare process scheduling algorithms (round robin, fixed priority, dynamic priority) considering real-time constraints, and choose the optimal one for specific needs.	**K4**
	CO3	Implement mechanisms for enforcing mutual exclusion and protecting critical sections to guarantee correct system behavior.	**K3**
	CO4	Understand the architecture and operation of Windows CE and polled loop systems, identifying their suitability for specific real-time applications.	**K2**
	CO5	Design and implement real-time control systems using embedded hardware (e.g., CAN bus) and RTOS capabilities to achieve desired behaviors and meet real-time constraints.	**K3**

Unit-I	**Basic real time concepts**	**Periods: 9**
Terminologies – Real time system design issues – Hardware Developments – Hardware Interfacing – CPU – RISC vs CISC – Memory Access – Memory Organization – Direct Memory Access – Memory Mapped Input/output – Pipelining – Coprocessors.		**CO1**
Unit-II	**Real time operating systems**	**Periods: 9**
Real Time Kernels: Pseudokernels, Interrupt Driven Systems, Hybrid Systems – Theoretical Foundations of Real Time Operating Systems: Process scheduling – Round Robin Scheduling – Fixed Priority Scheduling – Dynamic Priority Scheduling – Buffering data – Time Relative buffering – Queues – Semaphores.		**CO2**
Unit-III	**Resources - resource access control**	**Periods: 9**
Enforcement of mutual exclusion and critical sections – Resource Conflicts and Blocking – Effects of Resource contention and Resource Access Control: Priority Inversion, Timing Anomalies, Deadlock – Non Preemptive Critical Sections – Basic Priority Inheritance Protocol – Basic Priority Ceiling Protocol.		**CO3**
Unit-IV	**WinCE**	**Periods: 9**
Introduction WinCE, Polled Loop Systems - RTOS Porting to a Target, Explanation of Application, Kernel, OAL, Explanation of CPU, SOC, Platform, MMU, MMU for ARM based devices in WinCE, Comparison of µCos-II, Embedded Linux, Real Time Linux, Vx-Works, QNX Nutrino, ThreadEX		**CO4**
Unit-V	**Instructional Activities**	**Periods: 9**
Design and simulate static & dynamic scheduling algorithms in suitable platform. Simulation of RTOS for the application of Engine Management System using CAN protocols or GNU gcc *tools.*		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Book

1. Phillip A. Laplante, “Real Time System Design and Analysis”, John Wiley & Sons Publications, 2004.
2. Jane W.S. Liu, “Real Time Systems”, Prentice Hall, 2000.
3. Samuel Phuns, Professional Windows Embedded CE 6.0, Wrox, 2008.
4. Rajkamal, Embedded System, Tata McGraw Hill, 2003.

Web References

1. http://www.nptel.iitm.ac.in
2. http://www.ocw.mit.edu.
3. http://web.iiit.ac.in/~bezawada/CN.html
4. https://www.tutorialspoint.com/Real-Time-Embedded-Systems

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	-	3	3	1	1	3	-	2
2	2	-	3	3	1	1	3	-	2
3	2	-	3	3	1	1	3	-	2
4	2	-	3	3	1	1	3	-	2
5	2	2	3	3	2	1	3	-	2

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

Department	**Electronics and Communication Engineering**				Programme: **M.Tech VLSI & ES**		
Semester	**III**				Course Category Code**:** **PE**	End Semester Exam Type**:** **TE**	
Course Code	**P23VEEC05**	Periods/Week			Credit	Maximum Marks	
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**Cloud Computing and Distributed Systems**	**45**	**0**	**0**	**3**	**40**	**60**	**100**

Common to all the M.Tech (ECE and VLSI & ES)

Course Outcome	**On completion of the course, the students will be able to**	BT Mapping (Highest Level)
	CO1 Understand cloud computing architecture and deployment model.	**K3**
	CO2 Outline cloud service models and Interconnection networks.	**K2**
	CO3 Implement Parallel and Distributed Programming Models.	**K3**
	CO4 Deploy applications over commercial cloud computing infrastructures	**K3**
	CO5 Solve a real-world problem using cloud computing through group collaboration.	**K4**

Unit-I	**Cloud Architecture**	**Periods: 9**
Cloud Computing Infrastructure- Cloud Computing Types- Service Architecture- Cloud Computing Reference Model- Cloud System Architecture- Cloud Deployment Model- Basic Principles- Two-layer Connectivity for Cloud Federation- Cloud Ecosystem Model- Cloud Unified Process.		**CO1**
Unit-II	**Cloud Service Models**	**Periods: 9**
Service Models: Public, Private, and Hybrid Clouds- Platform-as-a-Service (PaaS)-Data-Center Design and Interconnection Networks: Warehouse-Scale Data-Center Design-Data Center Interconnection Networks- A Generic Cloud Architecture Design -Architectural Design Challenges.		**CO2**
Unit-III	**Distributed System Models**	**Periods: 9**
Clusters of Cooperative Computers-Cloud Computing over the Internet-Software Environments: Service-Oriented Architecture (SOA)-Parallel and Distributed Programming, Performance Metrics and Scalability Analysis -Energy Efficiency in Distributed Computing.		**CO3**
Unit-IV	**Programming Paradigms**	**Periods: 9**
Parallel and Distributed Programming Paradigms-MapReduce, Twister and Iterative MapReduce-Hadoop Library from Apache-Dryad and DryadLINQ from Microsoft-Sawzall and Pig Latin High-Level Languages-Mapping Applications to Parallel and Distributed Systems.		**CO4**
Unit-V	**Instructional Activities**	**Periods: 9**
Programming Support of Google App Engine-Amazon AWS and Microsoft Azure - Open-Source Eucalyptus, Nimbus, Open Nebula, Sector/Sphere and Open Stack.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Kai Hwang, Jack Dongarra, Geoffrey C. Fox “Distributed and Cloud Computing: From Parallel Processing to the Internet of Things”,2011
2. A. Srinivasan, J. Suresh, “Cloud Computing: A Practical Approach for Learning And Implementation”, Pearson,2014
3. Thomas Erl, Ricardo Puttini, Zaigham Mahmood "Cloud Computing Concepts, Technology & Architecture", Pearson Education (US),2013.
4. Frank M. Groom, Stephan S. Jones, "Enterprise Cloud Computing for Non-Engineers", Taylor & Francis Ltd, CRC Press, 2018

Web References

1. https://www.iare.ac.in/sites/default/files/lecture_notes/CC%20LECTURE%20NOTES.pdf
2. https://nptel.ac.in/courses/106/105/106105167/
3. https://mrcet.com/downloads/digital_notes/CSE/IV%20Year/CLOUD%20COMPUTING%20NOTES.pdf
4. https://nptel.ac.in/courses/106/106/106106107/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	-	3	3	2	1	2	-	2
2	2	-	3	3	2	1	2	-	2
3	2	-	3	3	2	1	2	-	2
4	2	-	3	3	2	1	2	-	2
5	2	2	3	3	2	1	2	-	2

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.ECE**						
Semester	**III**	CourseCategoryCode:**PE**			*End SemesterExamType:**TE**			
CourseCode	**P23ECE413**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**AUTOMOTIVE EMBEDDED SYSTEM**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

Course Outcome	**On completion of the course, the students will be able to**		**BT Mapping (Highest Level)**
	CO1	Understand the fundamentals of automotive embedded systems and their significance in the automotive industry.	**K2**
	CO2	Understand the principles behind sensor measurements and their application in automotive systems.	**K3**
	CO3	Understanding how electronic systems manage and optimize the performance of internal combustion engines.	**K3**
	CO4	Understanding the fundamental principles of vehicle motion, including acceleration, deceleration, and turning dynamics.	**K2**
	CO5	Evaluate the effectiveness and significance of safety systems in enhancing vehicle safety and user experience.	**K4**

UNIT-I	**AUTOMOTIVE FUNDAMENTALS**	**Periods:9**
Introduction to Automotive Embedded Systems - Overview of present-day embedded products - Basic building blocks of embedded systems - Automotive Systems Overview - Embedded Technology in Automotive Industry. Embedded System Development Process - Tool Chain and Cross Compilation. Future Trends in Automotive Embedded Systems: Hybrid Vehicles, Electric Vehicles.		**CO1**

UNIT-II	**AUTOMOTIVE SENSORS AND ACTUATORS**	**Periods:9**
Basics and overview-Automotive applications-Sensor classification. Sensor measuring principles-Position sensor-speed and rpm sensors-Acceleration sensors-Pressure sensors-Force and Torque sensors. Sensor types-Engine speed sensor-wheel speed sensor-Accelerator pedal sensor-torque sensor-steering angle sensor-rain/light sensor.		**CO2**

UNIT-III	**ELECTRONIC ENGINE CONTROL**	**Periods:9**
Engine Control Unit (ECU) – Fuel Injection Systems – Ignition Systems – Throttle Control – Exhaust Gas Recirculation (EGR) - Variable Valve Timing (VVT). OBD (On-Board Diagnostics)		**CO3**

UNIT-IV	**VEHICLE MOTION CONTROL**	**Periods:9**
Suspension Systems – Steering Systems – Braking Systems. Traction Control Systems – Electronic Stability Control (ESC), Adaptive Cruise Control (ACC).		**CO4**

UNIT-V	**INSTRUCTIONAL ACTIVITIES**	**Periods:9**
dSPACE Automotive Simulation Models, Integrated Calibration and Application Tool, Design and develop Antilock braking system, Air bag restraint system, Voice warning system		**CO5**

LecturePeriods:45	**Tutorial Periods: -**	**PracticalPeriods: -**	**Total Periods:45**

Textbooks

1. William Ribbens, “Understanding Automotive Electronics an Engineering Perspective”, 7th Edition, Butterworth-Heinemann (an imprint of Elsevier Publications), 2012.
2. John B. Peatman, “Design with PIC microcontrollers”, Pearson Education, Singapore - 1998.

Reference Books

1. Robert Bosch Gmbh, “Automotive Electronics Handbook”. 2018.
2. Tom Denton, “Automobile Electrical and Electronic Systems”, fifth edition, Taylor & Francis Ltd., 2017.

Web References

1. http://www.nptel.iitm.ac.in
2. https://www.edx.org/learn/robotic-process-automation
3. https://www.iare.ac.in/sites/default/files/lecture_notes/ROBOTICS_LECURE_NOTES
4. https://lecturenotes.in/m/21711-note-of-automation-and-robotics-by-akash-sharma
5. http://www.ocw.mit.edu

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	-	-	3	1	1	3	-	3
2	2	-	3	3	1	1	3	-	3
3	2	1	3	3	1	1	3	-	3
4	2	2	3	3	1	1	3	-	3
5	2	2	3	3	2	1	3	-	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.ECE**						
Semester	**III**	Course Category Code: **PE**				*End Semester Exam Type: **TE**		
Course Code	**P20ECE414**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INFORMATION AND NETWORK SECURITY**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

Course Outcome	**On completion of the course, the students will be able to**		**BT Mapping (Highest Level)**
	CO1	Able to give outline on security issues	**K2**
	CO2	Discuss on different security and authentication algorithms	**K2**
	CO3	Discuss on security in 3G and 4G	**K2**
	CO4	Able to comprehend on firewall design principle	**K2**
	CO5	Able to simulate public key and private key cryptography algorithms	**K4**

UNIT-I	**ADVANCED ENCRYPTION STANDARD**	**Periods:9**
Evaluation criteria for AES- AES Cipher- Substitute Bytes Transformation-Shift Rows Transformation-Mix Columns Transformation-Add Round Key Transformation-AES Key Expansion-Equivalent Inverse Cipher-implementation Aspects.		**CO1**
UNIT-II	**DATA SECURITY AND AUTHENTICATION**	**Periods:9**
Triple DES with two keys - stream cipher - RC4 - RSA algorithm - elliptical curve cryptography algorithm; MD5 - HASH algorithm: Secure Hash Algorithm (SHA) - Digital Signatures standards.		**CO2**
UNIT-III	**IP AND WEB SECURITY**	**Periods:9**
Network Security: IP security overview - IP security architecture - authentication header – encapsulating security payload - combining security association - key management- web security considerations - secure socket layer and transport layer security - secure electronic transaction - security in GSM -security in 3G and 4G.		**CO3**
UNIT-IV	**SYSTEM SECURITY**	**Periods:9**
Intruders and intrusion detection: Malicious software - viruses and related threats - virus counter measures - distributed denial of service attack - firewalls design principles- trusted systems.		**CO4**
UNIT-V	**INSTRUCTIONAL ACTIVITIES**	**Periods:9**
Simulation of minimum of (three) public key and private key cryptography algorithms using related tools.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Stallings W, “Cryptography and Network Security”, 5th Edition, Prentice Hall, 2007.
2. Mark Stamp Wiley, “Information Security: Principles and Practice”, 2nd Edition, 2011.

Reference Books

1. Thomas S, Cover M and Joy A T, “Elements of Information Theory”, 2nd Edition, John Wiley &

Sons,
2006.
2. MacKay J C D, “Information Theory, Inference and Learning Algorithms”, 2nd Edition, Cambridge
University Press, 2003.
3. McEliece J R, “The Theory of Information and Coding”, 2nd Edition, Cambridge University Press, 2002.
4. Everyday Cryptography: Fundamental Principles and Applications Keith M. Martin Oxford Scholarship
Online: 2013

Web References

1. https://www.cl.cam.ac.uk/teaching/1314/InfoTheory
2. https://www.vssut.ac.in/lecture_notes/lecture1423183198
3. http://gva.noekeon.org/QCandSKD/QCandSKD-introduction.html
4. https://www.vssut.ac.in/lecture_notes/lecture1428550736
5. win.tue.nl/~tozceleb/2IC60/lecture_notes

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	2	2
2	1	-	2	2	-	-	1	2	2
3	1	-	2	2	-	-	1	2	2
4	1	-	2	2	-	-	1	2	2
5	1	-	2	2	3	-	1	2	2

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech. ECE**						
Semester	**III**	Course Category Code: **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23ECE415**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**RF AND MICROWAVE ENGINEERING**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Explain the Concepts and Applications of RF and Microwave	**K2**
	CO2 Can analyze the RF Electronics Concepts	**K2**
	CO3 Explain the Concepts of RF and Microwave Amplifiers Design	**K3**
	CO4 Design the RF Amplifier active circuits through EDA tools	**K3**
	CO5 Can test and practice the concepts through EDA tools	**K3**

UNIT-I	**RF AND MICROWAVE CONCEPTS AND APPLICATIONS**	**Periods:9**
Introduction, Reasons for using RF/Microwaves, RF/Microwave applications, Radio frequency waves, RF and Microwave circuit design, The unchanging fundamentals versus the ever-evolving structure, General active circuit block diagrams.		**CO1**
UNIT-II	**RF ELECTRONICS CONCEPTS**	**Periods:9**
RF/Microwaves versus DC or low AC signals, EM spectrum, Wave length and frequency, Introduction to component basics, Resonant circuits, Analysis of a simple circuit in phasor domain, Impedance transformers, RF impedance matching, Three element matching.		**CO2**
UNIT-III	**RF AND MICROWAVE AMPLIFIERS SMALL AND LARGE SIGNAL DESIGN**	**Periods:9**
Types of amplifiers, Small signal amplifiers, Design of different types of amplifiers, Multistage small signal amplifier design, High-power amplifiers, Large signal amplifier design, Microwave power combining/dividing techniques, Signal distortion due to inter modulation products, Multistage amplifiers, Large signal design.		**CO3**
UNIT-IV	**RADIO FREQUENCY AND MICROWAVE OSCILLATOR DESIGN**	**Periods:9**
Introduction, Oscillator versus amplifier design, Oscillation conditions, Design of transistor oscillators, Generator-tuning networks.		**CO4**
UNIT-V	**INSTRUCTIONAL ACTIVITIES**	**Periods:9**
Using ADS tool design and analyze the performance of the different types of RF amplifiers.		**CO5**

Lecture Periods:45	**Tutorial Periods: 1**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Mathew M. Radmanesh, “Radio Frequency and Microwave Electronics”, Prentice hall,2001.
2.Joseph Helszain,“Microwave Engineering, Active and Non-reciprocal Circuits”, McGraw Hill International Edition, 1992.

Reference Books

1.Microwave Semiconductor Devices and their applications, By Watson ,McGraw Hill
2.Microwave Semiconductors, By H.VShurmer, Wien Oldenbourg

Web References

1. https://ia601604.us.archive.org/21/items/RFCircuitDesign2ndEdition/RF%20Circuit%20Design%20-%202nd%20Edition.pdf
2. HW#3-1 - standard solution - Hw # 3 JangHanna selres (X) shunt (B) ct war . f . = shunt , N : - Studocu
3. https://www.studocu.com/in

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	1	-	1	-	-	2	1	2
2	3	1	-	2	3	-	2	1	2
3	3	3	-	3	3	-	2	1	2
4	3	3	-	3	3	-	2	1	2
5	3	3	-	3	3	-	2	1	2

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

Professional Elective –V (Offered in Semester III)		
Sl. No	**Course Code**	**Course Title**
1	P23VEEC06	Edge Computing
2	P23ECE516	Cognitive Radio Technology
3	P23ECE517	Embedded Computing
4	P23ECE518	Markov Chains and Queuing Systems
5	P23ECE519	Modeling and Simulation of Wireless Communication Systems

Department	Electronics and Communication Engineering	Programme: M.Tech VLSI&ES						
Semester	III	Course Category Code: PE			End Semester Exam Type: TE			
Course Code	P23VEEC06	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	Edge Computing	3	0	0	3	40	60	100

Common to all the M.Tech (ECE and VLSI & ES)

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Comprehend concepts on Edge computing and its deployment	**K2**
	CO2 Comprehend concepts Edge Computing based on sensing and Internet connectivity	**K2**
	CO3 Identify and describe the key architectural features of Edge Computing and their network	**K2**
	CO4 Conceptualize applications implementing edge computing	**K3**
	CO5 Identify and model Edge model using simulation tool	**K2**

Unit-I	**IoT And Edge Computing Definition And Use Cases**	**Periods:9**
Introduction to Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M.		**CO1**
Unit-II	**IoT Architecture And Core IoT Modules**	**Periods:9**
A connected ecosystem,IoT versus machine-to-machine versus, SCADA, The value of a network and Metcalfe's and Beckstrom's laws, IoT and edge architecture, Role of an architect, Understanding Implementations with examples-Example use case and deployment, Case study – Telemedicine palliative care, Requirements, Implementation, Use case retrospective.		**CO2**
Unit-III	**Non-IP Based And IP-Based Wpan**	**Periods:9**
Non-IP Based WPAN ;802.15 standards, Zigbee, Z-wave, Bluetooth. IP-Based WPAN and WLAN, TCP/IP, WPAN with IP – 6LoWPAN, IEEE 802.11 protocols and WLAN, Edge to Cloud Protocols, MQTT, Constrained Application Protocol.		**CO3**
Unit-IV	**Security In Edge Devices**	**Periods:9**
IoT and Edge Security, Physical and hardware security, Shell security, Cryptography, Software-Defined Perimeter, Block chains and cryptocurrencies in IoT, Government regulations and intervention		**CO4**
Unit-V	**Instructional Activities**	**Periods:9**
Deploy IoT Edge module to a virtual Linux device. Deploy IoT Edge module to a Windows device. Principle of Installation of Linux Operating System porting. Use IoT edge device as a gateway. Edge computing with RaspberryPi,		**CO5**

Lecture Periods: 45	Tutorial Periods: -	Practical Periods: -	Total Periods: 45

Reference Books

1. Perry Lea," IoT and Edge Computing for Architects"-second edition, Packt, March,2020
2. Mohiuddin Ahmed (Editor), Paul Haskell-Dowland (Editor), "Secure Edge Computing: Applications, Techniques and Challenges", CRC press, first edition, August 2021.
3. Asoke K Talukder and Roopa R Yavagal, "Mobile Computing," Tata McGraw Hill, 2010
4. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama,Wiley, January 2019

Web References

1. https://www.youtube.com/watch?v=8WBPcfjftyw
2. http://acl.digimat.in/nptel/courses/video/106104242/L02.html
3. https://www.youtube.com/watch?v=ulCZQDUN0tc
4. https://www.youtube.com/watch?v=nPOUoJavYQc

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	2	1	-	2	-	1	3	1
2	3	2	1	-	2	-	1	3	1
3	3	2	1	-	2	-	1	3	1
4	3	2	1	-	2	-	1	3	1
5	3	2	1	-	2	-	1	3	1

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

** Assignment to be given from Unit-5

Department	**Electronics and Communication Engineering**	Programme: **M.Tech. VLSI & ES**						
Semester	**III**	Course Category Code: **PE**			End Semester Exam Type: **TE**			
Course Code	**P23VEE316**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**
Course Name	**CAD for VLSI Circuits**	**3**	**-**	**-**	**3**	**40**	**60**	**100**

	On completion of the course, the students will be able to		BT Mapping (Highest Level)
Course Outcome	**CO1**	Knowledge On VLSI Design Methodologies & CAD Tools.	**K3**
	CO2	Analyze The Design Trade Off In Various Partitioning And Placement In VLSI Design Automation.	**K2**
	CO3	Solve The Performance Issues In Circuit Layout.	**K3**
	CO4	Analyze The Problem Formulations For Clock-Tree And Timing Performance Constraints	**K3**
	CO5	Demonstrate Different Levels Of Simulation And Synthesis In VLSI Circuits	**K4**

Unit-I	**VLSI Design Methodologies And Algorithms**	**Periods:9**
VLSI Design Problem, Design Domain, methods and Technologies Algorithmic and System Design, Terminology of Graph Theory, Computational Complexity, Graph Algorithms, Tractable and Intractable problems, back tracking and Branch and Bound, local Search, , Tabu Search, Genetic Algorithms.		**CO1**
Unit-II	**Partitioning & Placement**	**Periods:9**
Partitioning – Terminology ,Optimization goal ,Partitioning Algorithms- Kernighan-Lin (KL) Algorithm, Extensions of the Kernighan-Lin Algorithm, Fiduccia-Mattheyses (FM) Algorithm, Goldberg and Burstein algorithm. Placement –Optimization Objectives- Global Placement, Min-Cut Placement, Analytic Placement, Simulated Annealing, Modern Placement Algorithms, Legalization and Detailed Placement.		**CO2**
Unit-III	**Routing**	**Periods:9**
Terminology and Definitions - Single-Net Routing - Full-Netlist Routing - Horizontal and Vertical Constraint Graphs - Channel Routing Algorithms - Switchbox Routing - Over-the-Cell Routing Algorithms. Net Ordering in Area Routing.		**CO3**
Unit-IV	**Trees And Timing Closure**	**Periods:9**
Steiner Trees, Maze Search - Basic Concepts in Clock Networks, Problem Formulations for Clock-Tree Routing - Modern Clock Tree Synthesis, Zero Global Skew, Clock Tree Buffering. Timing Analysis and Performance Constraints - Timing-Driven Placement - Timing-Driven Routing, The Bounded-Radius, Bounded-Cost Algorithm, Prim-Dijkstra Tradeoff - Physical Synthesis, Gate Sizing, Buffering, Netlist Restructuring - Performance-Driven Design Flow.		**CO4**
Unit-V	**Instructional Activities**	**Periods:9**
Simulation – Gate level modeling – Switch level modeling- Combinational Logic Synthesis -Two level logic Synthesis.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. Andrew B. Kahng, Jens Lienig, Igor L. Markov and Jin Hu “VLSI Physical Design: From Graph Partitioning to Timing Closure”, 2022.
2. Sahib H.Gerez, “Algorithms for VLSI design automation”, John Wiley & Sons John Wiley & Sons, 2006.
3. Naveed A. Sherwani “Algorithm for VLSI Physical Design Automation”, 3rd Edition, Springer, 2012.Sung Kyu Lim, “Practical Problems in VLSI Physical Design Automation”, Springer, 2008.
4. ChristophnMeinel& Thorsten Theobold, “Algorithm and Data Structures for VLSI Design”,1st Edition, Kluwer Academic Publisher, 2002.

Web References

1. https://www.ifte.de/books/eda
2. https://vast.cs.ucla.edu/software
3. https://www.scribd.com/doc/154485696/CAD-for-VLSI-Algorithms-for-VLSI-Design-Automation-by-Gerez
4. https://archive.nptel.ac.in/courses/106/106/106106088/

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	2	1	-	2	-	1	3	1
2	3	2	1	-	2	-	1	3	1
3	3	2	1	-	2	-	1	3	1
4	3	2	1	-	2	-	1	3	1
5	3	2	1	-	2	-	1	3	1

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.ECE**						
Semester	**III**	Course Category Code: **PE**				*End Semester Exam Type: **TE**		
Course Code	**P20ECE516**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**COGNITIVE RADIO TECHNOLOGY**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

Course Outcome	**On completion of the course, the students will be able to**		**BT Mapping (Highest Level)**
	CO1	Illustrate the Fundamentals of communication networks	**K3**
	CO2	Discuss the architecture goals of SDR	**K2**
	CO3	Discuss different architecture of Cognitive radio network	**K2**
	CO4	Discuss security threats to the radio software	**K2**
	CO5	Able to simulate spectrum allocation algorithms in CR	**K4**

UNIT-I	**COMMUNICATION NETWORKS**	**Periods:9**
Fundamentals of communication networks: New challenges - multiple access schemes –cross layer design and optimization; Multicarrier modulation and equalization - ISI; RF spectrum and regulation: Regulatory issues of cognitive access.		**CO1**
UNIT-II	**SDR ARCHITECTURE**	**Periods:9**
Software Defined Radio Architecture- Digital Signal Processor and SDR Baseband Architecture- Reconfigurable Wireless Communication Systems- Digital Radio Processing : Conventional RF- Digital Radio Processing (DRP) Based System Architecture		**CO2**
UNIT-III	**CR ARCHITECTURE**	**Periods:9)**
Cognitive radio network architectures: Architectures for spectrum sharing - Network optimization - Topology aware CRN architectures - Haykin dynamic spectrum architecture.		**CO3**
UNIT-IV	**CR NETWORK SECURITY**	**Periods:9**
Primary user emulation attacks - Robust Distributed Spectrum Sensing- security vulnerabilities in IEEE 802.22 - Security threats to the radio software.		**CO4**
UNIT-V	**INSTRUCTIONAL ACTIVITIES**	**Periods:9**
Simulation of CR & SDC network using related tools.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1.Alexander M. Wyglinski, MaziarNekovee, and Thomas Hou Y, “Cognitive Radio Communications and Networks - Principles and Practice”, Elsevier Inc., 2010.

2.Kwang-Cheng Chen and Ramjee Prasad, “Cognitive Radio Networks”, John Wiley & Sons Ltd, 2009.

Reference Books

1. Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, “Cognitive Radio Networks - From Theory to Practice”, Springer Series: Analog Circuits and Signal Processing, 2009.

2. Mitola J, “Cognitive Radio: An Integrated Agent Architecture for software defined radio”, Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.

3. Peyman Setoodeh, Simon Haykin,“Fundamentals of Cognitive Radios “Simon Haykin, Wiley, 2017

4. Ekram Hossain, Dusit Niyato, Zhu Han “Dynamic Spectrum Access and Management in Cognitive Radio networks”, ,2009.

Web References

1. http://www.radio-electronics.com/info/rf-technology-design/cognitive-radio-cr/technology- tutorial.php
2. http://www.sciencedirect.com/science/book/9780123747150
3. http://www.xgtechnology.com/innovations/cognitive-radio-networks/
4. https://nptel.ac.in/courses/108/107/108107107/
5. https://www.tonex.com/training-courses/sdr-training/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	3	3
2	1	-	2	2	-	-	1	3	3
3	1	-	2	2	-	-	1	3	3
4	1	-	2	2	-	-	1	3	3
5	1	-	2	2	3	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.ECE**						
Semester	**III**	Course Category Code: **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23ECE517**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**EMBEDDED COMPUTING**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

Course Outcome	**On completion of the course, the students will be able to**		**BT Mapping (Highest Level)**
	CO1	Understand the concepts of distributed embedded computing Systems.	**K2**
	CO2	Demonstrate the use of various concepts with the help of programs	**K3**
	CO3	Summarize the concepts of software development tools.	**K2**
	CO4	Understand the various functions of RTOS.	**K2**
	CO5	Develop the knowledge on board support packages and device drivers.	**K4**

UNIT-I	**EMBEDDED COMPUTING ARCHITECTURE**	**Periods:9**
Synthesis of the information technologies of distributed embedded systems-analog/digital co-design-optimizing functional distribution in complex system design- validation and fas prototyping of multiprocessor system-on-chip-dynamic scheduling algorithm for real-time multiprocessor systems.		**CO1**
UNIT-II	**EMBEDDED C AND ASSEMBLY**	**Periods:9**
Programming in Assembly –Register Usage Conventions –Typical Use of Addressing Options-Instruction sequencing –Procedure call and Return –Parameter Passing – Retrieving Parameters –Temporary Variables- I/O Programming: Interrupt Driver I/O		**CO2**
UNIT-III	**SOFTWARE DEVELOPMENT AND TOOLS**	**Periods:9)**
Assembler, compiler, cross-compiler, linker and integrated development environment-debugging strategies-simulators-emulators-logic analyzers- concepts of JTAG		**CO3**
UNIT-IV	**RTOS CONCEPT**	**Periods:9**
Fore ground and back ground process-resourses-tasks-multi tasking-priorities-schedulers-kernel-exclusion –inter-task communication-interrupts-clock tick-micro C/os II kernel structure-Micro C/OS II initialisation –starting Micro C/OS II RTOS Functions:task management –time management-semaphore management-mutual exclusion-semaphore –event management-message management-memory management- porting Micro C/OS II		**CO4**
UNIT-V	**INSTRUCTIONAL ACTIVITIES**	**Periods:9**
Keil and Proteous Tool - Linux serial driver, Ethernet driver, I2C subsystem, USB gadgets, Watchdog timer, Kernel Modules, Application porting roadmap, Programming with pthreads, Operting System Porting Layer,Kernel API Driver.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. .Bernd Kleinjohann, Architecture and Design of Distributed Embedded Systems, Kluwer Academic Publishers, 2001
2. Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.
3. Daniel Lewis, Fundamentals of Embedded Software where C and Assembly Meet, Prentice Hall Inc., 2002

Reference Books

1. Mark Mitchell, Jeffrey Oldham and Alex Samuel, Advanced Linux Programming, New Riders Publications, 2002.
2. Dhananjay M. Dhamdhere, Operating Systems A concept based Approach, Tata Mcgraw-Hill Publishing Company Ltd, 2003

Web References

1. www.linuxjournal.com
2. www.inderscience.com/ijes
3. www.hipeac.net

TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	1	-	-	-	-	2	3	3
2	3	2	1	-	-	-	2	3	3
3	2	1	-	-	-	-	2	3	3
4	2	1	-	-	-	-	2	3	3
5	2	1	-	-	-	-	2	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

Department	Electronics and Communication Engineering	Programme: **M.Tech.ECE**						
Semester	**III**	Course Category Code: **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23ECE518**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MARKOV CHAINS AND QUEUING SYSTEMS**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

			BT Mapping
Course Outcome	On completion of the course, the students will be able to		
	CO1	Infer and use discrete-time Markov chains, Poisson and related processes, continuous-time Markov chains, and renewal processes	**K1**
	CO2	Relate probabilistic models to various problems of engineering and bioengineering practice	**K2**
	CO3	Illustrate Kendall's notation and queueing theory and evaluate performance measures.	**K3**
	CO4	Describe Single class Networks and Product-form queueing networks	**K4**
	CO5	Discover methods like inverse distribution function, normal random variable simulation, and sampling from the simplex.	**K4**

UNIT-I	**MARKOV CHAINS**	**Periods:9**
Markov Chain -Irreducibility and Aperiodicity- Stationary Distribution- Reversibility and Time Reversals Classifying the States of a Markov Chain-Classical (and Useful) Markov Chains -Gambler's Ruin-Coupon Collecting-The Polya Urn Model, Birth-and-Death Chains, Random Walks on Groups -Random Walks on Z and Refection Principles		**CO1**
UNIT-II	**MARKOV CHAIN STATE METHODS**	**Periods:9**
Symbolic Solution: Birth-Death Process - Hessenberg Matrix: Non-Markovian Queues - Numerical Solution: Direct Methods, Gaussian Elimination, The Grassmann Algorithm, Numerical Solution: Iterative Methods, Convergence of Iterative Methods, Power Method, Jacobi's Method, Gauss-Seidel Method, The Method of Successive Over-Relaxation		**CO2**
UNIT-III	**QUEUEING THEORY**	**Periods:9**
Kendall's Notation- Performance Measures-The M/M/l System -The M/M/l/K Finite Capacity System -The M/G/l System-The GI/M/l System -The GI/G/m System- Priority Queueing-Conservation Laws-The Asymmetric System -Analysis of M/M/m Loss Systems -System Systems with Batch Service		**CO3**
UNIT-IV	**QUEUEING NETWORKS**	**Periods:9**
Single Class Networks, Multiclass Networks, Performance Measures -Single Class Networks, Multiclass Networks, Product-Form Queueing Networks -Global Balance, Local Balance, Product-Form, Jackson Networks, Gordon/Newell Networks, BCMP Networks, The Concept of Chains, BCMP Theorem		**CO4**
UNIT-V	**INSTRUCTIONAL ACTIVITIES**	**Periods:9**
Simulating Discrete Distributions and Sampling -Inverse Distribution Function Method - Simulating Normal Random Variables -Sampling from the Simplex -Large Sets, M/G/1 & G/M/1 queues and G/G/1 queues.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Queuing Networks and Markov Chains: Modeling and Performance Evaluation with Computer Science Applications, Gunter Belch, Stefan Greiner, Hermann de Meer, and Kishor S. Trivedi,2nd Edition, 2007
2. Markov Chains and Mixing Times: Second Edition, David A. Levin Yuval Peres,2nd edition 2007

Reference Books

1. A.O. Allen, "Probability, Statistics and Queueing Theory with Computer Applications", Elsevier, 2nd edition, 2005.
2. H.A. Taha, "Operations Research", Pearson Education, Asia, 8th edition, 2007.
3. K.S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2nd edition, 2002.

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1. https://www.youtube.com/watch?v=qK-PUTuUSpw
2. https://www.youtube.com/watch?v=i3AkTO9HLXo
3. https://www.youtube.com/watch?v=4H9dMn919cs
4. https://www.youtube.com/watch?v=AsTuNP0N7DU
5. https://archive.nptel.ac.in/courses/111/103/111103159/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	1	1	-	-	1	-	-
2	1	-	1	1	-	-	1	-	-
3	1	-	1	1	-	-	1	-	-
4	1	-	1	1	-	-	1	-	-
5	1	-	1	1	3	-	1	-	-

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech ECE**						
Semester	**III**	Course Category Code: **PE**				*End Semester Exam Type: **TE**		
Course Code	**P20ECE519**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**MODELING AND SIMULATION OF WIRELESS COMMUNICATION SYSTEMS**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

Course Outcome	**On completion of the course, the students will be able to**		BT Mapping (Highest Level)
	CO1	Discuss about simulation methodology and fundamental concepts of Random signals	**K1**
	CO2	Establish Stationary and Ergodic Processes	**K3**
	CO3	Illustrate the methodologies involved in simulation of wireless system	**K3**
	CO4	Distinguish different time varying system models	**K3**
	CO5	Design the linear and non-linear system using simulation tools	**K4**

UNIT-I	**Simulation Methodology**	**Periods:9**
Examples of complexity - multidisciplinary aspects of simulation - models - deterministic and stochastic simulations, Simulation methodology - performance estimation; Fundamental Concepts: Sampling - quantizing - reconstruction and interpolation - simulation sampling frequency - complex envelope techniques.		**CO1**
UNIT-II	**Generation of Random Signals**	**Periods:9**
Stationary and Ergodic Processes- Uniform random number generators - mapping uniform random variables to an arbitrary PDF - generating uncorrelated and correlated Gaussian random numbers – PN sequence generators; Establishing a PDF and PSD Post Processing-estimation-modeling of system building blocks such as filters.		**CO2**
UNIT-III	**Methodology for Simulating a Wireless System**	**Periods:9**
Spectrum and scatter-plots—BER simulations using Monte Carlo technique- Semi Analytic Techniques System: Level simplifications and sampling rate considerations - modeling and simulation of nonlinearities with memory		**CO3**
UNIT-IV	**Time-Varying Systems**	**Periods:9**
Models for LTV systems - random process models - Wired and guided wave - radio channels - multipath fading channels - random process models - Discrete memory less channel models - Markov models for discrete channels with memory- HMMs - Gilbert and Fritchman models - estimation of Markov model parameters.		**CO4**
UNIT-V	**Instructional Activities**	**Periods:9**
Design of Linear and nonlinear systems using different techniques with the help of simulation tools -case studies of simulation of MPSK systems with amplitude and phase noise- using LTE tool simulation of OFDM systems		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. William H T, Samshanmugan K, Rappaport T S and Kosbar K L, “Principles of Communication Systems Simulation with Wireless Applications”, Pearson Education, 1st Edition, 2011.

2. Jeruchim M C, Philip B and Samshanmugam K, “Simulation of Communication Systems: Modeling Methodology and Techniques”, 2nd Edition, Kluwer Academic Publisher, 2002
3. G. Rubino and B. Tuffin, Rare Event Simulation Using Monte Carlo Methods, John Wiley and Sons, 2009.
4. M. Schiff, Introduction to Communication Systems Simulation, Artech House, 2006.

ference Book

1. Jack L. Burbank, William Kasch and Jon Ward, “An Introduction to Network Modeling and Simulation for the Practicing Engineer”, Wiley publication, 2011.
2. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, ‘’Discrete-Event System Simulation’’, Pearson Education, 4th Edition, 2007. 2. Lawrence M. Leemis and Stephen K. Park, ‘’Discrete – Event Simulation A First Course’’, Pearson Education/PHI, 2006

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1. http://ee.sharif.edu/~simcommsys/
2. https://nptel.ac.in/courses/106/106/106106167/
3. https://nptel.ac.in/courses/112/107/112107220/
4. https://nptel.ac.in/courses/117/105/117105132/
5. https://nptel.ac.in/courses/117/102/117102062/

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

Cos	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	3	3
2	1	-	2	2	-	--	1	3	3
3	1	-	2	2	-	-	1	3	3
4	1	-	2	2	-	-	1	3	3
5	1	-	2	2	3	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

Professional Elective–VI (Offered in Semester III)		
Sl. No	**Course Code**	**Course Title**
1	P23ECE620	Unmanned Aerial Vehicle
2	P23ECE621	Free Space Optical Networks
3	P23ECE622	Intelligent Control and Automation
4	P23ECE623	Multicarrier Wireless Communication
5	P23ECE624	Smart system design

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.ECE**						
Semester	**III**	Course Category Code: **PE**			*End Semester Exam Type: **TE**			
Course Code	**P23ECE620**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**UNMANNED AERIAL VEHICLES**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

			BT Mapping (Highest Level)
Course Outcome		**On completion of the course, the students will be able to**	
	CO1	Explain the principles and technologies underlying unmanned aerial vehicles.	**K2**
	CO2	Apply theoretical knowledge to design and optimize propulsion systems and structural components	**K2**
	CO3	Utilize to develop flight control algorithms and Payloads for UAV operations	**K3**
	CO4	Apply theoretical knowledge to design and optimize flight control systems	**K3**
	CO5	Design and simulate the drone for different legal limitations.	**K4**

UNIT-I	**UAV AND PERFORMANCE OF AERODYNAMICS**	**Periods:9**
Classes and Missions of UAVs, Examples of UAV systems small, small, Medium, and Large UAV, The Air Vehicle Basic Aerodynamics: Basic Aerodynamics equations, Aircraft polar, the real wing and Airplane, Induced drag, the boundary layer, Flapping wings, Total Air-Vehicle Drag. Performance: Overview, climbing flight, Range and Endurance, Gliding Flight.		**CO1**
UNIT-II	**UAV PROPULSION AND ITS TECHNIQUES**	**Periods:9**
Propulsion Overview, Thrust Generation, Powered Lift, Sources of Power, The Two-Cycle Engine, The Rotary Engine, The Gas Turbine, Electric Motors, and Sources of Electrical Energy. Loads and Structures - Loads, Dynamic Loads, Structural Materials, Sandwich Construction, Skin or Reinforcing Materials, Resin Materials, Core Materials, and Construction Techniques.		**CO2**
UNIT-III	**ADVANCED MISSION PLANNING AND CONTROL**	**Periods:9**
Mission Planning and Control station, control of Air Vehicle and Payload, Reconnaissance/Surveillance Payloads, Weapon Payloads, Launch Systems-conventional takeoff, Rocket Assisted Takeoff, vertical Takeoff off, Recovery Systems, Launch and Recovery Tradeoffs		**CO3**
UNIT-IV	**STABILITY AND CONTROL**	**Periods:9**
Stability and Control Overview, Stability, longitudinal, lateral, dynamic stability, Aerodynamics control, pitch control, lateral control, Autopilots, sensor, controller, actuator, airframe control, inner and outer loops, Flight-Control Classification, Overall, Modes of Operation, Sensors Supporting the Autopilot.		**CO4**
UNIT-V	**INSTRUCTIONAL ACTIVITIES**	**Periods:9**
Design and build a propeller car-Building Supplies for Propeller Car-Propelling the payload with electric propulsion-Use block programming to navigate a spherical programmable robot through a maze and verify obstacle avoidance using SIMNET.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Paul Gerin Fahlstrom," Introduction to UAV Systems", Thomas James Gleason Wiley Publication,5th Edition,2022
2. Landen Rosen, "Unmanned Aerial Vehicle", Alpha Editions, 2015. ISBN13: 9789385505034.

Reference Books

1. Reg Augstin," Unmanned Aircraft Systems: UAVS Design, Development And Deployment", A John Wiley and Sons, Ltd., Publication,2010
2. Louis J.Rodrigues," Unmanned Aerial Vehicles: DOD's Acquisition Efforts", Alpha Editions, 2000, ISBN13: 9781297017544.
3. Kimon P.Valavanis., Vachtsevanos, George J.," Handbook of Unmanned Aerial Vehicles", Springer, 2015.

Web References

3. https://onlinecourses.nptel.ac.in/noc21_ae13/preview
4. https://archive.nptel.ac.in/courses/101/104/101104073/
5. https://www.britannica.com/technology/unmanned-aerial-vehicle
6. Nhttps://archive.nptel.ac.in/courses/101/104/101104073/

Os/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	2	2	-	3	1	2	1	-
2	3	2	1	-	2	1	2	1	-
3	3	2	1	-	3	1	2	1	-
4	3	2	2	-	2	1	2	1	-
5	3	2	1	-	3	1	2	1	-

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

Semester	III	Course Category Code :PE			*End Semester Exam Type: TE		
Course Code	P23ECE621	Periods/Week			Credit	Maximum Marks	
		L	T	P	C	CAM	ESE	TM
Course Name	FREE SPACE OPTICAL NETWORKS	3	0	0	3	40	60	100

Course Outcome	On completion of the course, the students will be able to		**BT Mapping (Highest Level)**
	CO1	Design and analyze the free space optical communication systems.	**K3**
	CO2	Identify and select suitable components for building a FSO system	**K3**
	CO3	Infer FSO channels with their mathematical representation	**K4**
	CO4	Explain the beam propagation mechanism	**K2**
	CO5	Compare performances of FSO networks	**K4**

UNIT-I	**FSO TECHNOLOGY**	**Periods:9**
Propagation of light in unguided media - laser beam characteristics - atmospheric effects on optical signals - coding for atmospheric optical propagation - factors affecting FSO - LOS - LIDAR		**CO1**
UNIT-II	**OPTICAL COMPONENTS AND SUBSYSTEMS**	**Periods:9**
Radiometry : basic concepts - Optical spectral windows, materials and eye-safety - Transmitters - LED - Laser Diodes - Modulation Schemes - Receivers - Types of Detectors - Receiver Configuration - Optical Post and Pre-amplifiers - Link Design Trade-off - Acquisition, Tracking and Pointing		**CO2**
UNIT-III	**FREE SPACE OPTICAL CHANNEL MODELS**	**Periods:9**
Atmospheric Channel - Losses - Absorption and Scattering Losses - Free Space Loss - Beam Divergence Loss - Pointing Loss - Loss due to Weather Conditions - Atmospheric Turbulence - Atmospheric Turbulent Channel Model - Techniques for Turbulence Mitigation - Visibility - Atmospheric attenuation - Meteorological disturbances - Free space optical links		**CO3**
UNIT-IV	**INTEGRATION OF FSO IN OPTICAL NETWORKS**	**Periods:9**
Revolution of Optical Networking - Next Generation Optical Networking - Classifying the Global Optical Network - Driving FSO from the EDGE - FSO in Metropolitan Optical Networks - FSO Market - Installation of Free space Optical Systems - Free space optics and Laser safety.		**CO4**
UNIT-V	**INSTRUCTIONAL ACTIVITIES**	**Periods:9**
Simulation of PP FSO system using ring topology / WDM Mesh FSO network with service protection enabled scenario - performance comparison of FSO networks in ring and mesh topology using related tools.		**CO5**

LecturePeriods:45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods:45**

Textbooks

1. Stamatios V. Kartalopoulos, “Free Space Optical Networks for Ultra-Broad Band Services”, IEEE Press, 2011.
2. Heinz Willebrand and Baksheesh S. Ghuman, “Free Space Optics: Enabling Optical Connectivity in Today's Networks”, Sams Publishing, 2002.
3. Olivier Bouchet, HerveSizun, Christian Boisrobert and Frederique De Fornel, “Free-Space Optics:
4. Propagation and Communication”, John Wiley and Sons, 2010

Reference Books

1. Hemani Kaushal, V.K. Jain, Subrat Kar 'free space optical networks'· 2018
2. In Keun Son, "Design and Optimization of Free Space Optical Networks", Auburn University, Dissertations, Electrical Engineering and Computer Engineering, 2010.
3. Fang Liu, "Bootstrapping Free-space Optical Networks", University of Maryland, 2004.

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1. http://whatis.techtarget.com/definition/free-space-optics-FSO.html 2.
2.http://ee.stanford.edu/~jmk/research/fsocom.html 3. http://www.rp-
3.photonics.com/free_space_optical_communications.html 4.
4.https://mrcet.com/downloads/digital_notes/ECE/III%20Year/FIBER%20OPTICAL%20COMMUNICATIONS.pdf
5. https://link.springer.com/book/10.1007/978-0-387-28677-8

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	3	3
2	1	-	2	2	-	-	1	3	3
3	1	-	2	2	-	-	1	3	3
4	1	-	2	2	-	-	1	3	3
5	1	-	2	2	3	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.ECE**						
Semester	**III**	Course Category Code:**PE**			*End Semester Exam Type: **TE**			
Course Code	**P23ECE622**	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**INTELLIGENT CONTROL AND**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

	AUTOMATION		
Course Outcome	**On completion of the course, the students will be able to**		**BT Mapping (Highest Level)**
	CO1	Explain the principles of soft computing tools like neural networks and fuzzy logic.	**K2**
	CO2	Apply neural networks and fuzzy logic for system identification	**K3**
	CO3	Develop understanding of various non-linear control strategies	**K3**
	CO4	Understand the role of artificial intelligence (AI) in enhancing automation capabilities.	**K3**
	CO5	Utilize MATLAB/Simulink's graphical interface for designing and implementing control algorithms.	**K4**

UNIT-I	**SOFT COMPUTING TOOLS**	**Periods:9**
Concepts for Intelligent Systems - Artificial Neural Networks - Perceptual Networks - Radial Basis Function Networks - Back-propagation Networks and Recurrent Networks - System Identification Using Neural Networks - Fuzzy logic - Knowledge Representation - Fuzzy Sets - Fuzzy Rules and Reasoning - Fuzzy Logic Control - Mamdani Model - Takagi-Sugeno Model - System Identification using T-S Fuzzy Models.		**CO1**
UNIT-II	**ADAPTIVE CONTROL STRATEGIES**	**Periods:9**
Nonlinear Control - Nonlinear State-space Model - Lyapunov Stability Theory - Lyapunov's Indirect Method - Nonlinear Control Strategies Direct Adaptive Control Using Neural Networks - Direct Adaptive Control - SISO and MIMO Systems - Back-stepping Control.		**CO2**
UNIT-III	**FUZZY LOGIC CONTROL**	**Periods:9**
Fuzzy Model Based Control - T-S Fuzzy model - Linear Matrix Inequality (LMI) Technique - Fixed Gain state Feedback Controller Design Technique - Variable Gain Controller Design using Single Linear Nominal Plant and each Linear Subsystem as Nominal Plant - Controller Design using Discrete T-S Fuzzy System. Hybrid Control: Introduction to Genetic Algorithm (GA); Neuro-Fuzzy and Fuzzy-GA based hybrid system design.		**CO3**
UNIT-IV	**INTELLIGENT AUTOMATION SYSTEMS**	**Periods:9**
Structure & Objective, Introduction to Automation, Evolution of Automation, Different stages of Automation, Components of Intelligent Automation Technology, Robotic Process Automation (RPA), Fitment of RPA, Fitment of AI components for Automation, Fitment of AI components for Automation, Fitment of workflow for Automation		**CO4**
UNIT-V	**INSTRUCTIONAL ACTIVITIES**	**Periods:9**
Design and simulate various intelligent control using MATLAB/Simulink tools, Design and Implement using Fuzzy Logic, Neural Network, Evolutionary Computation Toolbox in MATLAB.		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Text Books

1.Klir G.J and Folger T.A, “Fuzzy sets, Uncertainty and Information”, Prentice Hall of India, New Delhi 1994.
2. Bose and Liang, “Artificial Neural Networks”, Tata Mcgraw Hill, 1996.
3. Kosco B, “Neural Networks and Fuzzy Systems: A Dynamic Approach to Machine Intelligence”, Prentice Hall of India, New Delhi, 1992.

Reference Books

1. Bourbakis. N.G, “Artificial intelligence and automation”, World Scientific Edition, 1998.
2. Johannessen.J.A, “Artificial intelligence, automation and the future of competence at work”, Routledge, Chapman

& Hall, Incorporated Edition,2020.
3. Tzafestas, S.G. and Verbruggen, H.B,"Artificial intelligence in industrial decision making, control and automation: An Introduction", Springer Science & Business Media Edition, 2012.
4. Astrom .K, "Adaptive Control", Second Edition, Pearson Education Asia Pvt. Ltd, 2002.
5. Chang C. Hong, Tong H. Lee and Weng K. Ho, Adaptive Control, ISA press, Research Triangle Park, 1993.

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1.https://onlinecourses.nptel.ac.in/noc21_cs79/preview

2. https://onlinecourses.nptel.ac.in/noc24_ee56/preview

3. https://archive.nptel.ac.in/courses/108/105/108105063/

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	-	3	3	-
CO2	3	3	2	2	-	-	2	3	-
CO3	3	3	1	2	-	-	2	3	-
CO4	3	3	2	2	-	-	3	3	-
CO5	3	3	2	2	-	-	2	3	-

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

Department	Electronics and Communication Engineering	Programme: **M.Tech.ECE**						
Semester	III	Course Category Code: **PE**			*End Semester Exam Type: **TE**			
Course Code	P23ECE623	Periods/Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ES	TM

							E	
Course Name	**MULTICARRIER WIRELESS COMMUNICATION**	**3**	**0**	**0**	**3**	**40**	**60**	**100**

Course Outcome	**On completion of the course, the students will be able to**	**BT Mapping (Highest Level)**
	CO1 Comprehends the basic principles of OFDM concepts	**K2**
	CO2 Analysis of Noncontiguous OFDM for future Radio	**K4**
	CO3 Outline the generalized multicarrier techniques for 5G Radio	**K2**
	CO4 Illustrate the functions of filter bank multicarrier technologies	**K3**
	CO5 Comprehends the available multicarrier technologies for advanced wireless communication.	**K4**

UNIT-I	**OFDM SYNCHRONIZATION**	**Periods:9**
OFDM introduction and Block Diagram – Design of OFDM Signal – OFDM System Model – Synchronization Errors – Performance of an uncoded OFDM systems – Peak Power Problem – Clipping and Peak Windowing – Peak cancellation – PAP Reduction Codes – Symbol Scrambling.		**CO1**
UNIT-II	**NONCONTIGUOUS OFDM FOR FUTURE RADIO**	**Periods:9**
Enhanced NC-OFDM with cancellation carriers – Reception quality improvement for cancellation carrier method – Reduced complexity reduced-power – Reduction of subcarrier spectrum sidelobes by flexible quasi systematic precoding – Precoder Design – NC-OFDM Receiver design - NC-OFDM Receiver Synchronization.		**CO2**
UNIT-III	**GENERALIZED MULTICARRIER TECHNIQUES FOR 5G RADIO**	**Periods:9**
Principles of GMC – Frame Theory and Gabor Transform – Peak to average power ratio reduction in GMC Transmitters – Link adaption in GMC systems – GMC receiver issues		**CO3**
UNIT-IV	**FILTER BANK MULTICARRIER TECHNOLOGIES**	**Periods:9**
Principles of FBMC Transmission – FBMC Transceiver Design - Pulse Design: Nyquist Filters and Ambiguity Function – IOTA Functions – PHYDYAS Pulse – Other Pulse-Shape Proposals for FBMC.		**CO4**
UNIT-V	**INSTRUCTIONAL ACTIVITIES**	**Periods:9**
PAPR Reduction in OFDM, Sequential PAPR and OOB Power Reduction, Successive Interference Cancellation, Practical FBMC System Design Issues: Self Interference Problem, Computational Complexity, MIMO technique for FBMC Transmission		**CO5**

Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Textbooks

1. Ramjee P, “OFDM for Wireless Communication Systems”, Artech House, 2004.
2. Hanna Bogucka, Adrian Kliks and Pawel Kryszkiewicz, “Advanced Multicarrier Technologies for Future Radio Communication 5G and Beyond”, Wiley, 2017
3. Maximilian Matthé, “Waveform Design for Generalized Frequency Division Multiplexing”, 2014.

Reference Books

1. Carl R. Nassar, Bala Natarajan, Zhiqiang Wu, David A. Wiegandt Multi-Carrier Technologies for Wireless Communication, 2010.
2. Hanzo L and Keller T, “OFDM and MC-CDMA: A Primer”, John Wiley & Sons, 2006.
3. Bahai Ahmad R S, Burton R S and Mustafa E, “Multi-Carrier Digital Communications: Theory and Applications of OFDM”, 2nd Edition, Springer, 2004.
4. Rahmatallah Y and Mohan S, “Peak-to-Average Power Ratio Reduction in OFDM System: A

Survey and Taxonomy", IEEE Communication Surveys and Tutorials, vol. 15, no. 5, pp. 1567-1592, 2013.

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1. https://www.semanticscholar.org/paper/Waveform-contenders-for-5G-%E2%80%94-OFDM-vs.-FBMC-vs.-UFMC-Schaich-Wild/39280b6a8986215c121c834e186e876d4e8695e1
2. https://arxiv.org/ftp/arxiv/papers/1802/1802.02623.pdf
3. https://www.silextechnology.com/unwired/ofdma-explained
4. https://ieeexplore.ieee.org/document/8204497
5. https://futurenetworks.ieee.org/tech-focus/june-2017/noma-in-5g-systems#:~:text=The%20primary%20reason%20for%20adopting,%2Ddomain%20and%20code%2Ddomain.&text=Power%2Ddomain%20NOMA%20attains%20multiplexing,achieves%20multiplexing%20in%20code%20domain.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	3	3
2	1	-	2	2	-	-	1	3	3
3	1	-	2	2	-	-	1	3	3
4	1	-	2	2	-	-	1	3	3
5	1	-	2	2	3	-	1	3	3

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

Department	**Electronics and Communication Engineering**	Programme**: M.Tech.-ECE**						
Semester	**III**	Course Category: **PE**			*End Semester Exam Type: **ES**			
Course Code	**P23ECE624**	Periods/Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CAM**	**ESE**	**TM**

Course Name	Smart System Design	3	0	0	3	40	60	100

Course Outcome	On completion of the course, the students will be able to	BT Mapping (Highest Level)
	CO1 Understand the recent trends of the Smart Systems	K2
	CO2 Design and Real-Time implementation of Smart Systems	K3
	CO3 Understand the architecture of Embedded Appliances	K2
	CO4 Design of a wearable devices for Health care monitoring	K3
	CO5 Design a Mobile Robot by using Simulation tools.	K4

Unit-I	EMBEDDED SYSTEM BASED SMART SYSTEMS	Periods: 9
Overview of a smart system - Design Requirements - Hardware and software selection - Smart sensors and Actuators – Communication protocols used in smart systems – Data Analytics: Need & Types – Open-source Analytics Platform for embedded systems (IFTTT &Thingspeak) – Smart Microcontrollers - Embedded system for Smart card design and development – Recent trends.		CO1
Unit-II	**HOME AUTOMATION SYSTEMS AND ITS IMPLEMENTATION**	**Periods: 9**
Home Automation – Design Considerations: Control Unit, Sensing Requirements, Communication, Data Security - System Architecture - Essential Components - Linux and Raspberry Pi – Design and Real-Time implementation.		CO2
Unit-III	**SMART APPLIANCES AND ENERGY MANAGEMENT**	**Periods: 9**
Energy Management: Demand-side Load Management: Energy scheduling – Significance of smart appliances in energy management - Embedded and Integrated Platforms for Energy Management - Smart Meters: Significance, Architecture & Energy Measurement Technique - Smart Networks for Embedded Appliances – Security Considerations.		CO3
Unit-IV	**SMART WEARABLE SYSTEMS AND MOBILE ROBOTS**	**Periods: 9**
Application of Smart Wearable in Healthcare & Activity Monitoring - Functional requirements– Selection of body sensors, Hardware platform, OS and Software platform – Selection of suitable communication protocol. Robots and Controllers Components, Mobile Robot Design.		CO4
Unit-V	**INSTRUCTIONAL ACTIVITY**	**Periods: 9**
Simulation of Autonomous Multifunctional Mobile Robot using EyeSim Simulator ,Simulation of Three-Servo Ant Robot and Autonomous Hex copter System.		CO5

Lecture Periods: 45	Tutorial Periods: -	Practical Periods: -	Total Periods: 45

1. Grimm, Christoph, Neumann, Peter, Mahlknech and Stefan, Embedded Systems for Smart Appliances and Energy Management, Springer 2013.
2. Raj Kamal, Embedded Systems - Architecture, Programming and Design, McGraw- Hill, 2008.
3. Thomas Braunl, Embedded Robotics, Springer, 2003

Reference Books

1. Karim Yaghmour, Embedded Android, O'Reilly, 2013.
2. Steven Goodwin, Smart Home Automation with Linux and Raspberry Pi, Apress, 2013

Web References

1. https://nptel.ac.in/courses/112104251

2. https://archive.nptel.ac.in/courses/112/108/112108092/
3. https://onlinecourses.nptel.ac.in/noc23_me18/preview
4. https://www.memsnet.org/mems/what_is.html

* TE – Theory Exam, LE – Lab Exam

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	2	1	2	-	1	3	3	-
2	3	2	1	2	-	1	3	3	-
3	3	2	1	2	-	1	3	3	-
4	3	2	1	2	-	1	3	3	-
5	3	2	1	2	-	1	3	3	-

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

Evaluation Method

Assessment	Continuous Assessment Marks (CAM)					End Semester Examination (ESE) Marks	Total Marks
	CAT 1	CAT 2	Model Exam	Assignment*	Attendance		
Marks	10		15	10	5	60	100

SEMESTER–IV

Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Project Work										
1	P23ECW403	Project Phase - II	PA	0	0	24	12	50	50	100
Total							**12**	**50**	**50**	**100**

Department	**Electronics and Communication Engineering**	Programme: **M.Tech.**						
Semester	**IV**	Course Category : **PA**			*End Semester Exam Type: **LE**			
Course Code	**P23ECW403**	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CAM	ESE	TM
Course Name	**Project Phase - II**	**-**	**-**	**24**	**12**	**50**	**50**	**100**

Aim & Objective:

The project work aims to develop the work practice and to apply theoretical and practical tools/techniques for solving real life problems related to industry and current research. The objective of the project work is to improve the professional competency and research attitude by touching the areas which are not covered in theory or laboratory classes.

- The project work shall be a design project/experimental project and/or computer simulation project on any of the topic in manufacturing engineering or related field.
- The project work shall be allotted individually on different topics.
- The students shall be encouraged to do their project work in the parent institute itself. In exceptional cases the students shall be permitted to undertake continue their project outside the parent institute with appropriate permission from Head of the institution through the Project Coordinator.
- Department shall constitute an Evaluation Committee to review the project work.
- The Evaluation committee shall consist of at least three faculty members namely internal guide, project coordinator and another expert in the specified area of the project.

Project phase II is a continuation of project phase I which started in the third semester. There shall be three reviews in the fourth semester, first in the beginning of the semester, second in the middle of the semester and the Third at the end of the semester. First review is to evaluate the progress of the work and planned activity; second review shall be presentation and discussion. Third review shall be a presubmission presentation before the evaluation committee to assess the quality and quantity of the work done. This would be a pre qualifying exercise for the students for getting approval for the submission of the thesis. At least one technical paper shall be prepared for possible publication in journals or conferences. The technical paper shall be submitted along with the thesis. The final evaluation of the project shall be done externally.