Program and Course Structure
School of Engineering Technology
Department of Electrical, Electronics and Communication Engineering

M.Tech in Electronics and Communication Engineering with Specialization in Digital Communication/VLSI Technology/Electronic System Designing and Management/Embedded Systems
Programme Code: SET0502
Batch -2019-21

1. Standard Structure of the Program at University Level

1.1 Vision, Mission and Core Values of the University

Vision of the University

To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship.

Mission of the University

1. Transformative educational experience
2. Enrichment by educational initiatives that encourage global outlook
3. Develop research, support disruptive innovations and accelerate entrepreneurship
4. Seeking beyond boundaries

Core Values

- Integrity
- Leadership
- Diversity
- Community

1.2 Vision and Mission of the School of Engineering and Technology

Vision of the School

To become a globally acclaimed institution of higher learning in engineering and technology promoting excellence in research, innovation and entrepreneurship to provide sustainable solution to the needs of the society

Mission of the School

1. To impart quality education with strong industry & academic connectivity in the expanding fields of Engineering and Technology in a conducive and enriching learning environment.
2. To produce technocrats equipped with technical & soft skills and experiential learning required to stay current with the modern tools in emerging technologies to fulfill professional responsibilities.
3. To inculcate a culture of interdisciplinary research, innovation and entrepreneurship to provide sustainable solutions to meet the growing challenges and societal needs.
4. To foster collaborative learning and to play adaptive leadership role in professional career and pursuit of higher education through effective mentoring and counseling.

1.2.1Vision and Mission of the Department of Electrical, Electronics and Communication Engineering

Vision of the Department

To become an internationally acclaimed destination of academic excellence in the discipline of Electrical, Electronics and Communication Engineering by promoting research, innovation and entrepreneurship to serve society**.**

Mission of the Department

M1-To provide comprehensive technical knowledge in Electrical, Electronics and Communication Engineering.

M2- To facilitate and foster the industry-academia collaboration to enhance technical skills and employability.

M3-To promote interdisciplinary and multi-disciplinary research, innovations and entrepreneurship to serve society.

M4- To develop core values, professional ethics and lifelong learning skills through interactive support systems.

1.3 Program Educational Objectives (PEO)

1.3.1 Writing Program Educational Objectives (PEO)

PEO1: To produce engineering post graduates who have the ability to demonstrate technical competence for helping develop solutions to the real world problems.

PEO2: To foster students to take individual responsibility and to work as a part of/lead a team towards the fulfillment of both individual and organizational goals

PEO3: To meet educational and industrial needs through effective communication of knowledge and ethics.

PEO4: To equip students to upskill through self-learning while pursuing their professional career and higher education

PEO5: To strengthen research activities.

1.3.2 Map PEOs with School Mission Statements:

PEO Statements	School Mission 1	School Mission 2	School Mission 3	School Mission 4
PEO1	3	3	2	2
PEO2	1	1	2	3
PEO3	3	3	2	2
PEO4	1	2	3	2
PEO5	2	2	3	1

1. **Slight (Low) 2. Moderate (Medium) 3. Substantial (High)**

1.3.2.1 Map PEOs with Department Mission Statements:

PEO Statements	Department Mission 1	Department Mission 2	Department Mission 3	Department Mission 4
PEO1	3	3	3	3
PEO2	3	2	2	2
PEO3	2	1	3	2
PEO4	1	1	2	1
PEO5	2	2	1	1

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

1.3.3 Program Outcomes (PO's)

PO1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO8: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO9: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO10: **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSOs for M.Tech in ECE with specialization in Digital Communication

PSO1: knowing about recent trends in Advanced Communication security and able to solve real world problem using concepts of digital communication.

PSOs for M.Tech in ECE with specialization in VLSI Technology

PSO2: Ability to adapt to emerging multidisciplinary needs in area of design, prototyping etc. to add further value to the technological world of IC technologies.

PSOs for M.Tech in ECE with specialization in Embedded System

PSO3: knowledge and application of recent trends in embedded system.

1.3.4 Mapping of Program Outcome Vs Program Educational Objectives

Mapping	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	3	2	1	-
PO2	3	3	2	-	2
PO3	3	3	3	-	3
PO4	3	3	2	-	2
PO5	2	3	2	-	2
PO6	1	2	3	3	2
PO7	1	1	1	2	1
PO8	-	-	2	2	1
PO9	2	1	3	-	3
PO10	-	-	2	2	2
PSO1	2	2	2	1	3
PSO2	2	1	3	2	3
PSO3	2	1	3	2	3

1. Slight (Low)

2. Moderate (Medium)

3. Substantial (High)

1.3.5The components of the curriculum

Course Component	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total number of credits
Program Core	18.1	17	13
Department Electives	40.2	29	29
Community Connect	2.8	2	2
Dissertation	36.1	52	26
Seminar	2.8	4	2

1.3.6.1 COURSE ATRICULATION MATRIX:

COs	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO7	PO 8	PO9	PO1 0	PSO 1	PSO 2	PSO 3
ECE 687	3	2	2	2	2	2					3	1	1
ECE 684	3	2	1	2	2	2					3	2	2
ECE61 4	3	2	1	2	2	2					1	3	1
ECE61 2	3	2	2	2	2	2					1	3	1
ECE61 1	3	3	2	2	2	2					2	2	3
ECE81 4	3	3	2	2	2	2					2	2	3
ECP 684	3	3	2	2	2	2					3	2	2
ECE 619	3	3	2	2	2	2					3	3	3
ECE81 1	3	3	2	2	2	2					3	1	2
ECE82 0	3	3	2	2	2	2					3	2	2
ECE82 4	3	3	2	2	2	2					2	1	3
ECE82 5	3	3	2	3	2	2					1	2	3
ECP82 5	3	2	2	3	2	1					1	2	3
ECE82 6	3	3	2	2	2	2					1	3	2
ECE82 7	3	3	2	3	2	2					1	3	2
ECP82 7	3	3	2	3	3	2					1	3	2
CCU10 1	1	2	2	1	1	2	3	3	3	3	1	1	1
MRM0 01	1	2	2	2	1	2	2	3	3	3	1	1	1
ECE69 6	3	3	2	3	3	2	2	2	3	3	3	3	3
ECE69 8	3	3	2	3	3	2	2	2	3	3	3	3	3
ECE69 9	3	3	2	3	3	2	2	2	3	3	3	3	3

1-Slight (Low)

2-Moderate (Medium)

3-Substantial (High)

School of Engineering and Technology
M.Tech in ECE
Batch: 2019-21
TERM: I

S. No.	Subject Code	Subjects	Teaching Load			Credits	Pre-Requisite/Co Requisite	Type of Course[1]: 1. CC 2. AECC 3. SEC 4. DSE
			L	T	P			
THEORY SUBJECTS								
1.	ECE 687	Mobile and Wireless Communication	3	0	0	3		AECC
2.	ECE 684	Discrete Time Signal Processing	3	0	0	3		AECC
3.		Department Elective -I	3	0	0	3		DSE
4.		Department Elective -2	3	1	0	4		DSE
5.		Department Elective -3	3	0	0	3		DSE
6.		Department Elective -4	3	0	0	3		DSE
Practical/Viva-Voce/Jury								
7.	ECP 684	Discrete Time Signal Processing Lab	0	0	4	2		AECC
TOTAL CREDITS						**21**		

[1] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

School of Engineering and Technology
M.Tech in ECE
Batch: 2019-21
TERM: II

S. No.	Course Code	Course	Teaching Load			Credits	Pre-Requisite/Co Requisite	Type of Course[2]: 1.CC 2. AECC 3. SEC 4. DSE
			L	T	P			
THEORY SUBJECTS								
1.	ECE 615	Internet of Things and Applications	3	0	0	3		AECC
2.		Department Elective-5	3	0	0	3		DSE
3.		Department Elective-6	3	1	0	4		DSE
4		Department Elective-7	3	1	0	4		DSE
5		Department Elective-8	3	0	4	5		DSE
Practical/Viva-Voce/Jury								
6.		Community Connect	0	0	4	2		SEC
7.		Research Methodology	0	0	4	2		AECC
TOTAL CREDITS						**23**		

School of Engineering and Technology
M.Tech in ECE
Batch: 2019-21
TERM: III

[1] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

S. No.	Course Code	Course	Teaching Load			Credits	Pre-Requisite/Co Requisite	Type of Course[3]: 1. CC 2. AECC 3. SEC 4. DSE
			L	T	P			
Practical/Viva-Voce/Jury								
1.		Seminar	0	0	4	2		SEC
2.		Dissertation-1	0	0	20	10		SEC
TOTAL CREDITS						**12**		

School of Engineering and Technology
M.Tech in ECE
Batch: 2019-21

TERM: IV

S.	Course	Course	Teaching	Credits	Pre-	Type of

[3] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

No.	Code		Load				Requisite/Co Requisite	Course[4]: 1. CC 2. AECC 3. SEC 4. DSE
			L	T	P			
Practical/Viva-Voce/Jury								
1.		Dissertation- II	0	0	32	16		SEC
TOTAL CREDITS						**72**		

2.1 Syllabus for Theory Subjects

School: SET	**Batch : 2019-21**
Program: M.Tech	**Current Academic Year: 2019-20**

[4] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

Branch: DC		**Semester: I**	
1	Course Code	ECE687	
2	Course Title	**Computational Methods for Communication**	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Compulsory	
5	Course Objective	1.To extend and formalise knowledge of the theory of probability and random variables 2. To introduce new techniques for carrying out probability calculations and identifying probability distributions 3.To motivate the use of statistical inference in practical data analysis 4.To study elementary concepts and techniques in statistical methodology	
6	Course Outcomes	CO1: Familiarization of basic probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables. CO2: Calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables. CO3: Derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions. CO4: Translate real-world problems into probability models. CO5: Know discrete time Markov chains and methods of finding the equilibrium probability distributions.	
7	Course Description	The main objective of this course is to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like modeling, prediction and computer networks etc.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to probability theory**	CO1
	A	Experiments, Sample space, Events, Axioms	CO1
	B	Assigning probabilities, Joint and conditional, Baye's theorem	CO1
	C	Discrete random variables, Engineering example	CO1,C02
	Unit 2	**Random variables, Distributions, Density functions**	CO2
	A	CDF, PDF, Uniform Distribution, Gaussian Distribution	CO2
	B	Rayleigh, Rician types of random variables	CO2
	C	Expected value, Central moments, Conditional expected values	CO2
	Unit 3	**Characteristics Functions**	
	A	Probability generating functions	CO3
	B	Moment generating function	CO3
	C	Engineering applications	CO3
	Unit 4	**Random process**	

	A	Definition and characterisation			CO4
	B	Mathematical tools for studying random processes			CO4
	C	Stationery and Ergodic random processes, Properties of ACF			CO4
	Unit 5	**Types of Random Process**			
	A	Binomial Process, Poisson Process			CO4
	B	Gaussian Process			CO4
	C	Markov Process			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. S.L.Miller and D.C.Childers, **"Probability and random processes: application to signal processing and communication"**, Academic press/Elsevier 2004. 2. A.Papoullis and S.U.Pillai, **"Probability, random variables and stochastic processes"**, McGraw Hill 2002			
	Other References	1. Peyton Z. Peebles, **"Probability, Random variables and random signal principles"**, TMH, 4th edition, 2007. 2. H Stark and Woods, **"Probability, random processes and application"**, PHI, 2001.			

CO , PO & PSO MAPPING:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PSO 1	PSO 2	PS O3
ECE687. 1	2	1	1	2	2	2	2	2	1	1	1		
ECE687. 2	3	3	3	2	3	2	2	3	1	2	2		

ECE687.3	3	2	1	2	2	2	2	3	1	2	1		
ECE687.4	3	2	3	2	1	2	2	3	1	1	1		
ECE687.5	3	2	3	2	3	2	2	3	1	1	2		
ECE687	3	2	2	2	2	2	2	3	1	1	2		

1-Slight (Low)

2-Moderate (Medium)

3-Substantial (High)

School: SET		**Batch : 2019-21**
Program: M.Tech		**Current Academic Year: 2019-20**
Branch: DC		**Semester: I**
1	Course Code	ECE684
2	Course Title	Discrete Time Signal Processing
3	Credits	3
4	Contact	3-0-0

	Hours (L-T-P)		
	Course Status	Compulsory	
5	Course Objective	• The objective of DSP is usually to measure, filter and/or compress continuous real-world analog signals. • This course is the mathematical manipulation of an information signal to modify or improve it in some way. • This is characterized by the representation of discrete time, discrete frequency, or other discrete domain signals by a sequence of numbers or symbols.	
6	Course Outcomes	After completing this course students will be able to 1. Apply real time processing of audio and speech signal. 2. Do the sonar and radar signal processing, sensor array processing, spectral estimation, statistical signal processing. 3. To develop the understanding about the mathematics behind signal processing, for communications, control of systems, biomedical signal processing, seismic data processing, digital image processing etc. 4. Use computing software package like MATLAB, and acquainted with digital processing tools available in MATLAB. 5. Develop a signal processing system to analyze, predict and manipulate real data.	
7	Course Description	Digital Signal Processing (DSP) is concerned with the representation, transformation and manipulation of signals on a computer. After half a century advances, DSP has become an important field, and has penetrated a wide range of application systems, such as consumer electronics, digital communications, medical imaging and so on. With the dramatic increase of the processing capability of signal processing microprocessors, it is the expectation that the importance and role of DSP is to accelerate and expand. Discrete-Time Signal Processing is a general term including DSP as a special case. This course will introduce the basic concepts and techniques for processing discrete-time signal on a computer. By the end of this course, the students should be able to understand the most important principles in DSP	
8	Outline syllabus		CO Mapping
	Unit 1	**Realisation of FIR Filters & IIR Filters**	
	A	Implementation of Discrete-Time Systems Digital Filter Structure: Block Diagram representation.	CO1, CO2
	B	Signal Flow Graph Representation, FIR Digital Filter Structure.	CO1.CO3
	C	Direct-Form Structure, Cascade Form Structures.	CO2
	Unit 2	**Fundamentals of Multirate Digital Signal Procesing**	
	A	Basic Multirate operations- Decimation and Interpolation	CO2

		,Sampling, Sampling Rate Conversion Digital Filter Banks,			
	B	Two channel Quadrature Mirror Filter bank,			CO1, CO3
	C	Multilevel Filter Banks			CO1.CO4
	Unit 3	**Design of Digital Filters**			
	A	Design of Digital Filters Design of FIR Filters: Symmetric and Antisymmetric FIR Filters, Design of Linear phase FIR Filter using Windows and Frequency sampling method			CO1,CO3
	B	Introduction to Chebyshev and Butterworth Filter, Gibbs phenomenon, Design of Optimum Equiripple Linear-phase FIR Filters			CO4
	C	Design of IIR Filters: Design by Approximation of Derivatives			CO5
	Unit 4	**The Discrete Fourier Transform & Efficient Computation of the DFT: FFT Algorithm**			
	A	Basic elements of Digital Signal Processing, Ideal Sampling reconstruction and concept of aliasing, Introduction to CTFT and DTFT , Discrete Fourier Transform .			CO3,CO4
	B	Properties of DFT: Periodicity, Linearity, Symmetry, Multiplication of two DFT, Circular Convolution, circular correlation, multiplication of two sequences, Parseval's theorem.			CO4
	C	Decimation-in-Time FFT algorithms & Decimation-in-frequency FFT algorithms			CO1, CO4
	Unit 5	**Adaptive Signal Processing and Applications.**			
	A	Adaptive systems - definitions and characteristics,			CO4
	B	Minimum Mean Square Error Critirean,The Window LMS Algortithm			CO41, CO4
	C	Introduction to filtering smoothing and prediction, Wiener – Hopf equation, Voice Processing, Application to Radar,DFT use in Spectral Estimation.			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	*References-* *1. A. Y. Oppenhein and R. W. Schater, "Digital Signal Processing", PHI 1975* *2. A. Y. Oppenhein, R. W. Schater and J. R. Buck, "Discrete Time Signal Processing", PHI 1999.*			
	Other References	*1.G. Proakis and D.G. Manolakis, "Digital Signal Processing, Principals, Algorithms, and Applications", Pearson Education, 4th ed., 2007.*			

		2.S.Salivahanan, A. Vallavaraj "Digital Signal Processing"Tata McGraw-Hill Education ,2007	

CO , PO & PSO MAPPING:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2	PSO 3
ECE684 .1	2	1	1	2	2	2	1	3	1	1	2		
ECE684 .2	3	2	1	2	2	2	1	3	1	1	3		
ECE684 .3	3	2	1	2	2	2	1	3	1	1	3		
ECE684 .4	3	2	1	2	2	2	1	3	1	1	3		
ECE684 .5	3	2	2	2	2	2	2	3	2	3	3		
ECE684	3	2	1	2	2	2	1	3	1	1	3		

1-Slight (Low)

2-Moderate (Medium)

3-Substantial (High)

Advanced Digital Communication

School: SET		**Batch : 2019-21**	
Program: M.Tech		**Current Academic Year: 2019-20**	
Branch: DC		**Semester: I**	
1	Course Code	ECE 685	
2	Course Title	Advanced Digital Communication	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Compulsory	
5	Course Objective	• Fundamentals of digital communication • Multiple access techniques-system	
6	Course Outcomes	After completing this course, students will be able to: CO1: Analyse Equivalent signal-optimum detection of random signal CO2: Analyse multiple access techniques for LAN CO3: Analyse commercial applications CO4: Analyse Fading-signal time spreading-time CO5: Analyse the Equalisers	
7	Course Description	Analyze various modulation, equalization, diversity and coding techniques for communication systems. Compare performance of different types of modulation on different wireless application fading channels. Design and demonstrate various modulation/coding equalization techniques and measure their performance.	
8	Outline syllabus		CO Mapping
	Unit 1	**Detection and Estimation**	
	A	Fundamentals of digital Communication-Model-response of bank of correlators	CO1
	B	Poe correlation receiver-matched Filter-Estimation-maximum likelihood	CO1
	C	Weiner-linear prediction-optimum detection of Equivalent signal-optimum detection of random signal	CO1
	Unit 2	**Multiplexing and multiple access**	
	A	Multiple access techniques-system and architecture	CO2
	B	Access algorithms-multiple access techniques for INTELSAT	CO2
	C	Multiple access techniques for LAN	CO2
	Unit 3	**Spread spectrum Techniques**	
	A	Spread spectrum overview-PN sequences	CO3
	B	DS spread Spectrum-Frequency hopping synchronization	CO3
	C	Jamming considerations- commercial applications-cellular systems	CO3

	Unit 4	**Digital Communications through Fading Channels**			
	A	Path loss model, Shadow Fading			CO4
	B	Fading-signal time spreading			CO4
	C	Time variance caused by motion			CO4
	Unit 5	**Equaliser**			
	A	mitigating the degradation effects of Fading.			CO5
	B	-Rake Receiver			CO5
	C	Viterbi equaliser.			CO5
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA 30%	MTE 20%	ETE 50%	
	Text book/s*	*Bernard Sclar and Pabitra kumar Ray "Digital Communications Fundamentals and Applications", Pearson Education,2nd edition,2001*			
	Other References	1. *Simon Haykin, "Digital Communications", John Wiley and sons,1998* 2. *1. J. Proakis, "Digital Communications", McGraw Hill, 4th edition,2007*			

CO , PO & PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE685.1	2	2	1	2	1	1	1	2	2	2	2		
ECE685.2	3	3	3	2	2	2	2	3	2	2	2		
ECE685.3	3	2	1	2	2	1	1	2	2	3	3		
ECE685.4	3	2	3	2	2	1	1	2	2	2	3		
ECE685.5	3	2	3	2	2	1	1	2	2	3	2		
ECE685	3	2	1	2	2	2	1	3	1	1	3		

Neural Network

School: SET		**Batch: 2019-21**	
Program: M. Tech		**Current Academic Year: 2019-20**	
Branch: DC		**Semester: I**	
1	Course Code	ECE 688	
2	Course Title	Neural Network	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Departmental Elective	
5	Course Objective	Fundamental techniques and principles of neural computation Investigation of some common models and their applications	
6	Course Outcomes	CO1: Analyse Organization of the Brain. CO2: Analyse Biological and Artificial Neuron Models. CO3: Single layer perceptron and designing of algorithms and learning of curve rate CO4: Multilayer perceptron and Back-propagation algorithm with improvisation algorithm CO5: Radial-basis function networks and strategies CO6: Designing of Kohonen Self-Organising Maps**.**	
7	Course Description	Neural networks provide a model of computation drastically different from traditional computers. This course will provide learning and understanding of neural network architectures and algorithms, for applications in pattern recognition, image processing, and computer vision.	
8	Outline syllabus		CO Mapping
	Unit 1	**Neurons and Neural Networks**	
	A	Artificial and biological neural networks, Artificial intelligence and neural networks	CO1
	B	Biological neurons, Models of single neurons	CO2
	C	Different neural network models	CO2
	Unit 2	**Single Layer Perceptrons**	
	A	Least mean square algorithm	CO3
	B	Learning curve	CO3
	C	Learning rates, Perceptron	CO3
	Unit 3	**Multilayer Perceptrons**	CO4
	A	The XOR problem	CO4
	B	Back-propagation algorithm	CO4
	C	Heuristic for improving the back-propagation algorithm	CO4
	Unit 4	**Radial-Basis Function Networks**	CO5
	A	Interpolation	CO5

	B	Regularisation			CO5
	C	Learning strategies			CO5
	Unit 5	**Kohonen Self-Organising Maps**			CO6
	A	Self-organising map			CO6
	B	The SOM algorithm			CO6
	C	Learning vector quantisation			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	• **S. Haykin**, *Neural Networks: A Comprehensive Foundation* 2nd edition, (Prentice Hall, 1999) • **K. Mehrotra, C. Mohan, and S. Ranka**, *Elements of Artificial Neural Networks*, MIT Press, 1997.			
	Other References	1. The Essence of Neural Networks, R. Callan, Prentice Hall Europe, 1999. 2. Introduction to Neural Networks, R. Beale and T. Jackson, IOP Press, 1990 3. An Introduction to Neural Network, K Gurney, UCL Press, London, 1997			

CO , PO & PSO MAPPING:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE688.1	2	2	1	2	2	2	2	2	2	1	2		
ECE688.2	3	3	3	2	2	2	2	2	2	2	2		
ECE688.3	3	2	1	2	2	2	2	2	2	2	2		
ECE688.4	3	2	3	2	2	2	2	2	2	2	2		
ECE688.5	3	2	3	2	2	2	2	2	2	2	2		
ECE688	3	2	2	2	2	2	2	2	2	2	2		

Normalized CO Average: (Level 1: 0 - 0.33; Level 2: 0.34 - 0.66; Level 3: 0.67 - 1)

1-Slight (Low) **2-Moderate (Medium)** **3-Substantial (High)**

School: SET		**Batch : 2019-21**
Program: M.Tech		**Current Academic Year: 2019-20**
Branch: D.C		**Semester:I**
1	Course Code	**ECE686**

2	Course Title	Microwave Communication	
3	Credits		
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Department Elective	
5	Course Objective	1. To understand microwave and millimetre wave vacuum tube and solid state devices 2. To understand various type of antennas and their applications 3. To understand the designing of radio link	
6	Course Outcomes	After completing this course, students will be able to: CO1: The concept of microwave generation CO2: Analyse impedance matching CO3: Design and use of various antennas CO4:Apply concepts microwave propagation CO5: Analyze the Effect of atmosphere on radio wave propagation	
7	Course Description	This course is intended to introduce to students: (i) various types of devices for generation of microwaves (ii) concepts of impedance matching networks (iii) Scattering parameters (iv) Development of the free space communication link equations (iv) Microwave propagation losses.	
8	Outline syllabus		CO Mapping
	Unit 1	**Microwave and millimetre wave devices**	
	A	Overview of microwave and millimetre wave vacuum tube devices, limitations of microwave vacuum tubes	CO1
	B	Microwave and millimetre wave solid state devices, Gunn devices,	CO1
	C	IMPATT devices, and microwave and mm wave performance of IMPATT.	CO1
	Unit 2	**Microwave and mm wave circuits**	
	A	Review of scattering matrix concept in the light of vector network analyser.	CO2
	B	Impedance matching network, couplers, power dividers, resonators and filters	CO2
	C	Detectors, mixers, attenuators, phase shifters, amplifier and oscillator.	CO2
	Unit 3	**Antennas**	
	A	Hertzian dipole, loop antenna, helical antenna, frequency independent antenna: log spiral and log periodic dipole antenna array.	CO3
	B	Babinet principle, waveguide slot antenna, micro-strip antenna, horn antenna, parabolic antenna.	CO3
	C	Antenna arrays and phased array antenna.	CO3

	Unit 4	**Microwave and mm wave propagation**			
	A	Basic radio wave propagation mechanisms, Friis transmission formula.			CO3 & CO4
	B	Plane earth propagation model, Tropo-scatter systems, ionosphere propagation.			CO4
	C	Duct propagation, microwave radio link and calculation of link budget.			CO4
	Unit 5	**Effect of atmosphere on radio wave propagation**			CO5
	A	Effect on radio wave propagation due to rain, fog.			CO5
	B	Effect on radio wave propagation due to snow, ice.			CO5
	C	Effect on radio wave propagation due to atmospheric gases, Earth's magnetic field.			CO5
	Mode of examination	Theory/Jury/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	*P Bhartia & I J Bahl, Millimeter wave engineering and Applications, John Wiley & Sons*			
	Other References	*David M Pozar, Microwave Engineering, John Wiley & Sons*			
		R E Collin, Antenna & Radio wave Propagation, McGraw Hill Book Co.			

CO , PO & PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE686.1	3	3	2	1	2	2	2	2	2	2	2		
ECE686.2	3	3	2	2	2	2	2	2	2	2	2		
ECE686.3	3	3	3	2	2	2	2	2	2	2	2		
ECE686.4	3	2	1	2	2	2	2	2	2	2	3		
ECE686.5	3	2	3	2	2	2	2	2	2	2	3		
ECE686	3	3	3	2	2	2	2	2	2	2	2		

School: SET		**Batch : 2019-21**
Program: M. Tech		**Current Academic Year: 2019-20**
Branch:D.C		**Semester:II**
1	Course Code	ECE 687
2	**Course Title**	**Design of Communication Networks**

3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Department Elective	
5	Course Objective	1. The objective of the course is to develop mathematical models that allow the study of admission control, congestion control and pricing mechanisms used in emerging high-speed and wireless network 2. primary focus of the course would be the Internet 3. models developed in this course will be motivated by emerging protocols and services in the Internet such as RED, ECN and Diff Serv	
6	Course Outcomes	CO1: Demonstrate the understanding of Communication Networks CO2: Configure Elements of Queueing Theory CO3: Demonstrate the understanding of Internet Congestion Control CO4: Configure Traffic modelling CO5: Programming for communication networks	
7	Course Description	An introduction to networking, which is a technology used to extend telecommunications connectivity for information distribution over large geographic regions. Topics include architecture, design, and implementation, as well as the influence of the state and federal regulatory environments.	
8	Outline syllabus		CO Mapping
	Unit 1	**Overview and Taxonomy of Communication Networks**	CO1
	A	circuit switched networks	CO1
	B	virtual-circuit switched networks	CO1
	C	Internet congestion control	CO1
	Unit 2	**Elements of Queueing Theory**	CO2
	A	Markov Chains, Poisson process	CO2
	B	M/M/1 queue, M/G/1 queue, multi-server queues	CO2
	C	Erlang-B formula, Little's law, P-K formula	CO2
	Unit 3	**Internet Congestion Control**	CO3
	A	optimization based framework, relation to TCP	CO3
	B	linearized stability with round-trip delay	CO3
	C	Active Queue Management (AQM): Tail drop, RED	CO3
	Unit 4	**Stochastic and Deterministic Traffic Modeling**	CO4
	A	leaky bucket regulator and worst-case provisioning	CO4
	B	network calculus, Chern off bound and zero-buffer multiplexing	CO4
	C	large buffer behavior and effective bandwidth	CO4
	Unit 5	**Stochastic dynamic programming**	CO5
	A	Markov decision processes	CO5
	B	applications to optimal control of communication networks	CO5

	C	Loss Networks: resource allocation for circuit switching (trunk reservation), reduced load approximation			CO5
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. A. Kumar, D. Manjunath and J. Kuri, "Communication Networking : An Analytical Approach," Morgan Kaufmann Series in Networking Edition, 2004. 2. R. W. Wolff, "Stochastic Modeling and the Theory of Queues," Prentice Hall, 1989			
	Other References	1. S. Ross, "Stochastic Processes," Wiley, 1995. 2. J. Walrand and P. Varaiya, "High Performance Communication Networks," Morgan Kaufman 1996. 3. J. Bucklew, "Large Deviation Techniques In Decision, Simulation And Estimation," Wiley, New York, NY, 1990			

CO , PO & PSO MAPPING:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE687.1	3	3	2	1	2	2	2	2	2	2	2		
ECE687.2	3	3	2	1	2	2	2	2	2	2	2		
ECE687.3	3	3	3	1	2	2	2	2	2	2	2		
ECE687.4	3	2	1	1	2	2	2	2	2	2	3		
ECE687.5	3	2	3	1	2	2	2	2	2	2	3		
ECE 687	3	3	2	2	2	2	2	2	2	2	2		

School: SET		**Batch : 2019-21**
Program: M.TECH		**Current Academic Year: 2019-20**
Branch:D.C		**Semester II**
1	Course Code	ECE 690
2	Course Title	**Image Processing**
3	Credits	3

4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Department Elective	
5	Course Objective	This course will introduce the fundamentals of statistical pattern recognition. focus on generative methods such as those based on Bayes decision theory and related techniques of parameter estimation and density estimation. Methods of pattern recognition are useful in many applications such as information retrieval, data mining, document image analysis and recognition, computational linguistics, forensics, biometrics and bioinformatics.	
6	Course Outcomes	CO1: understanding of fundamental concepts in pattern recognition CO2: maximum likelihood estimation &Bayesian estimation CO3: ability to apply mathematical and algorithmic principles in designing pattern recognition systems while understanding the tradeoffs involved in design choice CO4: familiar with current techniques and skills for practical pattern recognition applications. CO5: design and develop a pattern recognition system for the specific application.	
7	Course Description	Pattern recognition is the scientific discipline whose goal is the classification of objects into several categories or classes. These objects can be images (2D signals) or signal waveforms (1D signals) or any type of measurements that need to be classified. The objects are referred using the generic term patterns. Pattern recognition is an integral part of machine intelligence systems.	
8	Outline syllabus		CO Mapping
	Unit 1	**Pattern recognition fundamentals**	
	A	Basic concepts of pattern recognition, fundamental problems in pattern recognition system	CO1,CO2
	B	design concepts and methodologies, example of automatic pattern recognition systems	CO1.CO3
	C	A simple automatic pattern recognition model.	CO2
	Unit 2	**Bayesian decision theory**	
	A	Minimum-error-rate classification, Classifiers, Discriminant functions	CO2
	B	Decision surfaces, Normal density and discriminant functions	CO1, CO3
	C	Discrete features, Missing and noisy features, Bayesian networks (Graphical models) and inferencing.	CO1.CO4

	Unit 3	**Maximum-likelihood and Bayesian parameter estimation**			
	A	Maximum-Likelihood estimation: Gaussian case, Maximum a Posteriori estimation			CO2,CO3
	B	Bayesian estimation: Gaussian case, Problems of dimensionality			CO4
	C	Dimensionality reduction: Fisher discriminant analysis, PCA Expectation Maximization method: Missing features			CO5
	Unit 4	**Sequential Models**			
	A	State Space, Hidden Markov models, Dynamic Bayesian			CO3,CO4
	B	Non-parametric techniques for density estimation: Parzen-window method, K-Nearest Neighbor method			CO4
	C	Linear discriminant functions: Gradient descent procedures, Perceptron criterion function, Minimum-squared-error procedures.			CO1,CO4
	Unit 5	**Unsupervised learning and clustering**			
	A	Unsupervised maximum-likelihood estimates, Unsupervised Bayesian learning			CO4
	B	Criterion functions for clustering, Algorithms for clustering: Kmeans, Hierarchical and other methods			CO4,CO5
	C	Cluster validation, Low-dimensional representation and multidimensional scaling (MDS)			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Pattern Recognition principles: Julus T. Tou and Rafel C. Gonzalez, Addision –Wesley. 2. Pattern recognition and machine learning, Christopher M. Bishop, Springer 2006.			
	Other References	1. A probabilistic theory of pattern recognition, Luc Devroye, László Györfi, Gábor Lugosi, Springer, 1996. 2. Pattern classification, Richard O. Duda, Peter E. Hart and David G. Stork, Wiley, 2001. 3. Pattern Classification, R.O.Duda, P.E.Hart and D.G.Stork, John Wiley.			

CCO , PO & PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE690.1	3	3	2	2	2	2	2	2	2	2	2		
ECE690.2	3	3	2	2	2	2	2	2	2	2	2		
ECE690.3	3	3	3	2	2	2	2	2	2	2	2		
ECE690.4	3	2	1	2	2	2	2	2	2	2	3		
ECE90.5	3	2	3	2	2	2	2	2	2	2	3		
ECE690	3	3	2	2	2	2	2	2	2	2	2		

School: SET		**Batch: 2019-21**
Program: M. TECH		**Current Academic Year: 2019-20**
Branch:D.C		**Semester:I**
1	Course Code	ECE 667
2	Course Title	**Data Communication**
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course	Departmental Elective

	Status		
5	Course Objective	This course will introduce knowledge of Fundamentals of Digital Communication, Baseband pulse shaping, error detection and correction codes, Synchronous and Asynchronous transmission	
6	Course Outcomes	CO1: Knowledge of Digital Communication CO2: Knowledge of Baseband Transmission CO3: Knowledge of Bandpass data transmission CO4: Elaboration of Detection Codes CO5: Knowledge of Asynchronous and synchronous data transmission	
7	Course Description	Students are expected to have a strong mathematical background and an understanding of probability theory, understanding the procedure of transmitting data over the network and how to resolve the conflicting issues arising in the course of transmission.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction**	
	A	Fundamentals of Digital Communication, Communication channel, Measurement of information	CO1
	B	Encoding of source output, Shannon fano Encoding Algorithm	CO1
	C	Discrete and continues-channel,Entropy, Variable length codes, Data compression. Shannon-Hartley Theorem	CO1
	Unit 2	**Baseband Data Transmission**	
	A	Baseband Data Transmission, Baseband pulse shaping	CO2
	B	Dubinary Baseband PAM, System many signaling schemes	CO2
	C	Equalization Synchronisation Scrambler .Unscrambler	CO2
	Unit 3	**Band Pass Data Transmission System**	
	A	Band Pass Data Transmission System ASK,PSK, FSK	CO3
	B	DPSK &PSK,MSK, Modulation schemes	CO3
	C	Coherent and non-coherent detector Probability of Error (PE), Performance Analysis and comparison	CO3
	Unit 4	**Error Detection and correction codes**	
	A	Error Detection and correction codes Linear block Encoding	CO4
	B	Algebraic Codes Cyclic codes	CO4
	C	Convolution codes, Performance codes	CO4
	Unit 5	**Synchronous and Asynchronous transmission**	
	A	Synchronous and Asynchronous transmission. Modem, Serial interface	CO5
	B	Circuit Switching, Packet Switching, Hybrid switching	CO5

	C	Architecture of computer network, OSI model, Data communication protocols.			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Behrouz.a.Forouzan,"Data Communication and Networking", Tata McGraw Hill, New Delhi,2006.			
	Other References	1. Simon Haykin,"Digital Communications", Wiley India Edition 2. B.P.Lathi,"Modern Digital and Analog Communication Systems" Third edition,Oxford University Press			

CO , PO & PSO MAPPING:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE667.1	3	3	2	2	2	2	2	2	2	3	2		
ECE667.2	3	3	2	2	2	2	2	2	2	3	3		
ECE667.3	3	3	3	2	2	2	2	2	2	3	3		
ECE667.4	3	2	1	2	2	2	2	2	2	3	3		
ECE667.5	3	2	3	2	2	2	2	2	2	3	3		
ECE667	3	3	2	2	2	2	2	2	2	3	3		

School: SET		**Batch : 2019-21**
Program: M. Tech		**Current Academic Year: 2019-20**
Branch:D.C		**Semester: II**
1	Course Code	ECE 690
2	Course Title	**Cryptography**
3	Credits	
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Departmental Elective
5	Course Objective	1. To understand the various key distribution and management schemes.

		2. To understand how to deploy encryption techniques to secure data in transit across data networks 3. To design security applications in the field of Information technology	
6	Course Outcomes	CO1: classify the symmetric encryption techniques CO2: Discuss authentication applications CO3: Illustrate various Public key cryptographic techniques CO4: Summarize the intrusion detection and its solutions to overcome the attacks CO5: Basic concepts of system level security	
7	Course Description	Understanding the fundamentals of Cryptography. Cryptography is a tremendous tool which provides basis for many security mechanisms	
8	Outline syllabus		CO Mapping
	Unit 1	**Basic symmetric-key encryption**	
	A	Overview of cryptography, One time pad and stream ciphers	CO2
	B	Block ciphers, Block cipher abstractions: PRPs and PRFs	CO2
	C	Attacks on block ciphers	CO1
	Unit 2	**Message integrity**	
	A	Message integrity: definition and applications CBC-MAC and PMAC	CO2
	B	Collision resistant hashing (Merkle-Damgard and Davies-Meyer. MACs from collision resistance)	CO2
	C	Authenticated encryption: security against active attacks & intro to session setup using a key distribution center (KDC).	CO2
	Unit 3	**Public key cryptography**	
	A	Arithmetic modulo primes	CO3
	B	Cryptography using arithmetic modulo primes (vanilla key exchange (Diffie-Hellman); the CDH and discrete-log assumptions)	CO3
	C	Public key encryption (semantically secure ElGamal encryption; CCA security)	CO3
	Unit 4	**Digital signatures**	
	A	Digital signatures: definitions and applications How to sign using RSA.	CO4
	B	More signature schemes and applications (Hash based signatures)	CO4
	C	certificates, certificate transparency, certificate revocation	CO4
	Unit 5	**Challenge response authentication**	
	A	Identification protocols: Password protocols, salts; one time passwords (S/Key and Secur	CO5

		ID); challenge response authentication.			
	B	Authenticated key exchange and SSL/TLS session setup			CO5
	C	Zero knowledge protocols			CO5
	Mode of examination	Theory/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	*Introduction to Modern Cryptography* (2nd edition) by J. Katz and Y. Lindell.			
	Other References	**Boneh-Shoup :** *A Graduate Course in Applied Cryptography (V 0.4)* by D. Boneh and V. Shoup			

CO , PO & PSO MAPPING:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE690.1	2	1	2	2	2	2	1	2	2	2	2		
ECE690.2	3	2	2	1	2	2	1	2	2	2	3		
ECE690.3	3	2	2	2	2	2	1	2	2	2	3		
ECE690.4	3	2	2	2	2	2	1	2	2	2	3		
ECE690.5	3	2	2	2	2	2	2	3	2	3	3		
ECE690	3	3	2	2	2	2	2	2	2	3	3		

School: SET		**Batch : 2019-21**
Program: M.Tech		**Current Academic Year: 2019-20**
Branch: D.C		**Semester: II**
1	Course Code	**ECE 669**
2	Course Title	Secured Communication
3	Credits	
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Department Elective
5	Course Objective	1. To introduce the basic concept encryption techniques 2. To familiarise with the concept of private key and public key cryptosystems.

		3. To introduce the concept of Elliptic curves	
6	Course Outcomes	After completing this course, students will be able to: 1. To Understand Cryptography attacks, Integer arithmetic, linear congruence 2. To Understand encryption techniques 3. To Understand Private key and public cryptosystem 4. To Understand Elliptica curves 5. Discrete logarithm problem on EC	
7	Course Description	The principles are tempered with their practical significance to cope up with the interest to both researchers and system designers. Learning is facilitated by streamlined derivations and assignments.	
8	Outline syllabus		CO Mapping
	Unit 1	Introduction	
	A	Security Goals, Cryptographic Attacks	CO1
	B	Services and Mechanisms, Integer Arithmetic	CO1
	C	Modular Arithmetic, Linear Congruence	CO1
	Unit 2	**Basic encryption techniques**	
	A	Concept of cryptanalysis ,Symmetric key ,Block ciphers	CO2
	B	Cryptographic algorithms , Features of DES, Stream ciphers, Pseudo random sequence generators, linear complexity	CO2
	C	Non-linear combination of LFSRs , Boolean functions	CO2
	Unit 3	**Private key and Public key cryptosystems**	
	A	Asymmetic Key, One way functions , Primality Testing, Factorization problem,Chinese Remainder Theorem ,RSA encryption	CO3
	B	Diffie Hellmann key exchange , Message authentication and hash functions	CO3
	C	Digital signatures, Secret sharing, features of visual cryptography , other applications of cryptography	CO3
	Unit 4	**Elliptic curves**	
	A	Basic theory, Weirstrass equation	CO4
	B	Group law, Point at Infinity	CO4
	C	Elliptic curves over finite fields	CO4
	Unit 5	**Discrete logarithm problem on EC**	CO5
	A	Elliptic curve cryptography	CO5
	B	Diffie Hellmann key exchange over EC	CO5
	C	Elgamal encryption over EC, ECDSA	CO5
	Mode of examination	Theory/Jury/Viva	
	Weightage Distribution	CA / MTE / ETE 30% / 20% / 50%	
	Text book/s*	***Text Books*** *Douglas A. Stinson, "Cryptography, Theory and Practice", 2nd edition, Chapman &Hall, CRC Press Company,*	

		Washington	
	Other References	*Lawrence C. Washington, " Elliptic Curves", Chapman & Hall, CRC Press Company,Washington* *David S. Dummit, Richard M. Foote, " Abstract Algebra", John Wiley & Sons*	

CO , PO & PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE669.1	3	3	2	3	2	2	2	3	2	2	3		
ECE669.2	3	3	2	3	2	2	2	3	2	2	3		
ECE669.3	3	3	3	3	2	2	2	3	3	2	3		
ECE669.4	3	2	1	3	2	2	2	3	3	2	3		
ECE669.5	3	2	3	3	2	2	2	3	3	2	3		
ECE669	3	3	2	3	2	2	2	3	3	2	3		

SET		**Batch : 2019-21**
M .Tech		**Current Academic Year: 2019-20**
ECP 684		**Semester: I**
1	Course Code	ECP 684
2	Course Title	Digital Signal Processing Lab
3	Credits	2
4	Contact Hours (L-T-P)	0-0-4
	Course Status	Compulsory
5	Course Objective	• To understand the concept of sampling and reconstruction of signals. • To implement various transforms (DFT, FFT and Z transform) in

		MATLAB and understand the concepts of these transforms. • To design and implement the various structures of FIR and IIR systems. • To design and implement FIR and IIR filters.	
6	Course Outcomes	CO1: To implement the concept of sampling and reconstruction. CO2: To implement DFT and FFT. CO3: To implement and understand the difference between linear and circular convolution. CO4: To implement the system function of a system using MATLAB. CO5: To implement IIR and FIR systems. CO6: To implement various types of structures for IIR systems.	
7	Course Description	This course includes the implementation of sampling and reconstruction of signals, DFT and FFT. It also focuses on implementation of system functions and the concepts of linear convolution. Implementation of various structures and design of IIR and FIR filters are also covered in this course.	
8	Outline syllabus		CO Mapping
	Unit 1	a-b) To understand the sampling theorem through the sampling and reconstruction of signals. c) To obtain DFT and IDFT of a sequence	**C01 ,CO2**
	Unit 2	a) To implement the FFT algorithm. b) To obtain the FFT of given 1-D signal and plot.	**CO2**
	Unit 3	a) To verify linear and circular convolution. b) To implement a system function and to plot the pole zero plot for same.	**CO3,C04**
	Unit 4	a-c) To obtain direct realization of FIR and IIR filters.	**CO5**
	Unit 5	a) To build a Filtering System Using Filter Coefficients b) To design FIR filters using windowing technique. c) To design IIR filters.	**C06**
	Mode of examination	Jury/Practical/Viva	
	Weightage Distribution	CA / MTE / ETE 60% / 0% / 40%	
	Text book/s*	1 .G. Proakis and D.G. Manolakis, "Digital Signal Processing, Principals, Algorithms, and Applications", Pearson Education.	
	Other References	1. A. Y. Oppenhein and R. W. Schater, "Digital Signal Processing", PHI 2. 2.A. Y. Oppenhein, R. W. Schater and J. R. Buck, "Discrete Time Signal Processing", PHI	

CO , PO & PSO MAPPING:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PSO 1	PSO 2	PSO 3
ECE684 .1	3	2	2	2	2	1	1	1	2	-	2		
ECE684 .2	3	1	2	2	2	1	1	1	2	-	2		
ECE684 .3	3	3	2	3	2	1	1	1	2	2	2		
ECE684 .4	3	3	2	3	2	1	1	1	2	-	2		
ECE684 .5	3	3	3	3	2	1	1	1	2	2	2		
ECE 684	3	2	2	3	2	1	1	1	1	1	2		

School: SET		**Batch : 2019-21**
Program: M.TECH		**Current Academic Year: 2019-20**
Branch:D.C		**Semester: II**
1	Course Code	ECE771
2	Course Title	Information Theory and Coding
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Elective
5	Course Objective	1. The main aim of this course is to make aware students with basics of probability theory. 2. Will have knowledge of information theory which includes Entropy, Channel Capacity & S/N Ratio. 3. Knowledge of various types of data compression techniques. 4. Learn about various coding techniques like Hamming Codes, Cyclic & Convolution Codes.
6	Course Outcomes	CO1: Understand Probability theory, Bayes Theorem, Poisson Distribution Functions. CO2: Comprehend to measure information & its rate, about Gaussian Channel & B/W-SNR Tradeoffs and various types of channels. CO3: Apply the use of various coding & decoding techniques. CO4:Design of various communication channel with various coding techniques CO5: Apply different information coding
7	Course Description	Offers an introduction to the quantitative theory of information and its applications to reliable, efficient communication systems. Topics include mathematical definition and properties of information, source coding theorem, lossless compression of data, optimal lossless coding, noisy communication channels, channel coding theorem, the source channel separation theorem, multiple access channels, broadcast channels, Gaussian noise, and time-varying channels.

8	Outline syllabus				CO Mapping
	Unit 1	**Probability theory**			
	A	Definition and properties of probability, conditional probability, Bayes theorem.			CO1, CO2
	B	Random Variable Types and Characteristics of Random Variable.			CO1, CO2
	C	Joint Distribution, Binomial, Poisson and Normal Distribution.			CO2
	Unit 2	**Information Theory**			CO2
	A	Uncertainty, Measure of information, Entropy and its properties, Rate of information.			CO1
	B	Joint Entropy and Conditional Entropy.			CO1, CO3
	C	Mutual Information, Channel Capacity.			CO3
	Unit 3	**Channel Capacity**			
	A	Channel Capacity for Gaussian Channel, B/W-SNR trade off.			CO1,CO3
	B	study of Channels BSC			CO3
	C	BEC, Cascaded Channel etc.			CO2
	Unit 4	**Data Compression**			
	A	Introduction, Variable Length Coding, Prefix Coding and Properties.			CO2
	B	Shannon Fano Coding.			CO1
	C	Huffman Coding (Binary, Ternary Coding).			CO3
	Unit 5	**Introduction to Coding**			
	A	Linear Block Codes Hamming Code , Single Parity Check bit Code .			CO5
	B	Cyclic Code: basic Definitions and Properties, Generation and decoding.			CO5
	C	Convolutional Code: basic Definitions and Properties, Generation and decoding.			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	*Haykin, Simon, "Digital Communication", Wiley Publishers,3rd Edition*			
	Other References	*1. Abramson," Information Theory and Coding, TMH, 2nd Edition* *2. Richard, Wesley Hamming, "Coding and Information Theory", Pearson Education, 2nd*			

CO , PO & PSO MAPPING:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE771.1	2	1	2	2	2	2	2	2	2	3	2		
ECE771.2	3	2	2	1	2	2	2	2	2	3	3		
ECE771.3	3	2	2	2	2	2	2	2	2	3	3		
ECE771.4	3	2	2	2	2	2	2	2	2	2	3		
ECE771.5	3	2	2	2	2	2	2	3	2	3	3		
ECE771	3	3	2	2	2	2	2	2	2	3	3		

School: SET		**Batch : 2019-21**	
Program: M. Tech		**Current Academic Year: 2019-20**	
Branch: D.C		**Semester: II**	
1	Course Code	ECE 687	
2	Course Title	**Broad band Transmission Network**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective	
5	Course Objective	1. To provide an overview of Wireless Communication networks area and its applications in communication engineering. 2. To appreciate the contribution of Wireless Communication networks to overall technological growth. 3. Analysing the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication Networks.	
6	Course Outcomes	CO1: Learning the main optical technologies such as SONET CO2: Learning the Network design SDH frame structures & SDH overhead. CO3: Learning WDM optical transmission technologies. CO4: Learning WDM optical transmission Networks. **CO5:** Learning DWDM transmission Technologies.	
7	Course Description	The continuous advance of current Information Society would not be possible without the adequate deployment of infrastructures such as broadband networks. This subject is aimed at analysing broadband communication technologies, networks and protocols employed for information transport and access.	
8	Outline syllabus		CO Mapping
	Unit 1	**SONET**	**CO1**
	A	Introduction, Synchronous and asynchronous SONET	CO1
	B	Frame structure	CO1
	C	SONET network configuration	CO1
	Unit 2	**SDH TECHNOLOGY**	
	A	Introduction, standards, features & management.	CO2
	B	Network design SDH frame structures	CO2
	C	Supporting different rates, SDH overhead	CO2
	Unit 3	**Wavelength Division Multiplexing**	
	A	WDM optical Transmission technologies, WDM conceptions	CO3
	B	Unidirectional, Bi-directional WDM	CO3
	C	WDM system composition, Advantages of WDM	CO3

	Unit 4	**WDM transmission Network**			
	A	Fiber dispersion chromatic dispersion			CO4
	B	Polarization mode dispersion			CO4
	C	Non-linearity effect of SMF, 4-wave mixing			CO4
	Unit 5	**DWDM key Technologies**			
	A	Optical amplifier			CO5
	B	Optical Multiplexer & Demultiplexer			CO5
	C	Optical supervisory channel, FEC technologies			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	• Loutfi Nuyami, "WiMAX - Technology for broadband access", John Wiley, 2007			
	Other References	**1. B. Gi Lee and W. Kim. "Integrated Broadband Networks - TCP/IP, SDH/SONET and WDM/optics". Artech House.** **2. H. Wang. "Packet Broadband Network Handbook". McGraw-Hill Professional.** **3. H.G. Perros. "Connection-Oriented Networks: SONET/SDH, ATM, MPLS and Optical Networks". Wiley.**			

CO , PO & PSO MAPPING:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE687.1	2	1	2	3	2	2	2	2	3	3	2		
ECE687.2	3	2	2	3	2	2	2	2	3	3	3		
ECE687.3	3	2	2	3	2	2	2	2	3	3	3		
ECE687.4	3	2	2	3	2	2	2	2	3	2	3		
ECE687.5	3	2	2	3	2	2	2	3	3	3	3		
ECE687	3	3	2	3	2	2	2	2	3	3	3		

School: SET		Batch: 2019-21	
Program: M. Tech		Current Academic Year: 2019-20	
Branch: D.C		Semester: II	
1	Course Code	**ECE 773**	
2	Course Title	**MODERN TELECOM SWITCHING SYSTEMS**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective	
5	Course Objective	1. Analysis of different basic components that are used in telephone exchanges 2. Recognize and analyze single stage and a multistage network. 3. Design of multistage network to reduce blocking of calls 4. Demonstration of different types switching techniques that are used in exchanges such as time division time switching, time division space switching and combination of both types of switching.	
6	Course Outcomes	On completion of this course, it is expected that the student will be able to CO1: Understand the main concepts of telecommunication network design. CO2: Analyze and evaluate fundamental telecommunication traffic models. CO3: Analyse the basic modern signalling system. CO4: Analyse traffic engineering CO5: Solve traditional interconnection switching system design problems. CO6: To compare telephone network, data network and integrated service digital network	
7	Course Description	INDIA'S telecommunication industry is the second largest in the world. Telecommunication networks carry information signals among entities, which are geographically far apart. The entities are involved in the process of information transfer, which may be in the form of a telephone conversation (telephony) or a file transfer between two computers or message transfer between two terminals. In modern circuit switches this is done electronically in digital switches. If no circuit is available when a call is made, it will be blocked (rejected). When a call is finished a connection teardown is required to make the circuit available for another user.	
8	Outline syllabus		CO Mapping
	Unit 1	**Electronic space Division switching**	
	A	Stored program control (SPC)	CO1, CO2
	B	switching matrices, multistage switching	CO1, CO2
	C	enhance services photonic switching	CO2

	Unit 2	**Time Division switching**			
	A	Time division space, and time switching, multiplexed switching, combination switching			CO1, CO3
	B	T -S, T -S- T, switching n-stage combination switching, PBX switching			CO3
	C	PBX networking, digital PBX			CO3
	Unit 3	**Traffic Engineering**			
	A	Traffic load, Grade of service			CO4
	B	Er. Jang's formulas			CO4
	C	blocking modelling switching systems, Blocking model			CO4
	Unit 4	**Subscriber Loop, Dialling Systems**			
	A	Switching hierarchy & routing, Transmission plan			CO5
	B	numbering plan, charging plan			CO5
	C	Signalling technique			CO5
	Unit 5	**Local Access Techniques**			
	A	Digital subscriber lines			CO6
	B	DSL, ADSL etc ." wireless for local telephone services.			CO6
	C	WLL, FIL." wireless for local telephone services.			CO6
	Mode of examination	Theory/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Telecomm. Switching systems & networks- Thaigrajan PHI			
	Other References	1. Comm, System - Taub & Schilling, Mc Graw Hill 2. Telecomm. & the Computers - James Martin - PHI 3. The Issential Guide to Telecomm - Pearson Educah - Annabelz Dodd.			

CO , PO & PSO MAPPING:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PSO 1	PSO 2	PSO 3
ECE 773. 1	2	3	2	3	3	2	2	2	3	3	2		
ECE 773. 2	3	3	2	3	3	2	2	2	3	3	3		
ECE 773. 3	3	3	2	3	3	2	2	2	3	3	3		
ECE 773. 4	3	3	2	3	3	2	2	2	3	2	3		
ECE 773. 5	3	3	2	3	3	2	2	3	3	3	3		
ECE 773	3	3	2	3	3	2	2	2	3	3	3		

School: SET		**Batch : 2019-21**	
Program: M.Tech		**Current Academic Year: 2019-20**	
Branch: All		**Semester: II**	
1	Course Code	**ECE820**	
2	Course Title	Computational Agents for Artificial Intelligence	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Department Elective	
5	Course Objective	**The objectives of this course are to:** 1. Provide fundamental knowledge about computational agents used for artificial intelligence. 2. Develop understanding of building blocks and logics used for systems based on artificial intelligence 3. Create system modelling and design skills for artificial intelligence	
6	Course Outcomes	**Upon successful completion of this subject, students should be able to:** 1. Demonstrate fundamental understanding of computational agents of artificial intelligence. 2. Apply problem solving agents as a tool to design artificial intelligence based systems. 3. Analyse algorithms of knowledge representation and reasoning for artificial intelligence. 4. Perform the design of knowledge based systems. 5. Comprehend the design of multiagent artificial intelligence systems	
7	Course Description	As with any science being developed, Artificial Intelligence (AI) has a coherent, formal theory and a rambunctious experimental wing. AI is the study of the design of intelligent computational agents. Through this course, the students will gain valuable skills at several levels ranging from expertise in the specification and design of intelligent agents to skills for implementing, testing, and improving real software systems for several challenging application domains	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to AI and its Agents**	**CO1**
	A	History of Artificial Intelligence, Applications of AI, Introduction to Intelligent Agents	
	B	Structure of Agents: Agent Program, Simple reflex, Model based, Goal based, Utility based, Learning agents	

	C	Designing Agents and Agent Design Space, Agent Systems, Agent Function, Hierarchical Control Prototypical Applications of AI			
	Unit 2	**Problem Solving Agents**			**CO2**
	A	Problem Solving Agents: Search Problems and Solutions, Formulating Problems, Examples of Standardized and Real World Problems			
	B	Problem Solving as Search, State Spaces, Graph Searching, Generic Search Algorithm			
	C	Uninformed Search Strategies: Breadth-First, Depth-First, Iterative Deepening, Lowest-Cost-First, Informed (Heuristic) Search Strategies: Greedy Best-First, A* Search, Pruning the Search Space			
	Unit 3	**Knowledge and Reasoning**			**CO3**
	A	Logical Agents – Knowledge-based Agents, The Wumpus World			
	B	Logic, Propositional Logic, Effective Propositional Model Checking			
	C	Agents based on Propositional Logic – complete backtracking algorithm, local search algorithm			
	Unit 4	**Ontologies and Knowledge-Based Systems**			**CO4**
	A	Knowledge sharing, Flexible Representations - Choosing Individuals and Relations, Graphical Representations			
	B	Classes, Ontologies and Knowledge Sharing - Uniform Resource Identifiers, Description Logic, Top-Level Ontologies			
	C	Implementing Knowledge-Based Systems - Base Languages and Metalanguages, A Vanilla Meta-Interpreter, Expanding the Base Language			
	Unit 5	**Multiagent Systems**			**CO5**
	A	Multiagent Framework, Representation of Games – Normal form, Extensive form			
	B	Multiagent Decision Network, Computing Strategies with Perfect Information			
	C	Reasoning with Imperfect Information, Computing Nash Equilibria, Group Decision Making, Mechanism Design			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Artificial Intelligence Foundations of Computational Agents by David L. Poole and Alan K. Mackworth, Cambridge University Press 2. Artificial Intelligence: A Modern Approach, 3rd Edition, by by Stuart Russell and Peter Norvig, Prentice Hall Series			
	Other	1. Artificial Intelligence By Example by Denis Rothman,			

	References	Ingram short title 2. A First Course in Artificial Intelligence by Deepak Khemani, McGraw Hill Education	

COURSE ARTICULATION MATRIX

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2	PSO 3
ECE820.1	2	1	1	2	2	2	1	3	1	1	2		2
ECE820.2	3	2	1	2	2	2	1	3	1	1	3		2
ECE820.3	3	2	1	2	2	2	1	3	1	1	3		2
ECE820.4	3	2	1	2	2	2	1	3	1	1	3		2
ECE820.5	3	2	2	2	2	2	2	3	2	3	3		3

School: SET		**Batch : 2019-21**
Program: M. Tech		**Current Academic Year: 2019-20**
Branch:All		**Semester:I**
1	Course Code	ECE 618
2	Course Title	Mobile and Wireless Communication
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Compulsory
5	Course Objective	1. Introduce students about the aspects related to evolution of mobile radio communication and its fundamental. 2. Explain interfernce and sysyem capacity and the techniques used for improving capacity in cellular systems. 3. Familiarize students about GSM and CDMA system, their architecture,services and features. 4. Explain the speech coding, mobile data networks, 4G and OFDM.
6	Course Outcomes	After completing this course students will be able to CO1: Develop deep understanding of various propagation models. CO2: Describe cellular concepts and its design, types of handoffs, and the relation between interference and system capacity and analyze the speech coding. CO3: Describe the speech coding CO4: Analyze GSM and CDMA system, their architecture, frame

		structure and forward and reverse CDMA channel and their specifications. CO5: Comprehend the mobile ad-hoc networks, new generation networks and the use of OFDM in 4G technique.	
7	Course Description	This course has been designed to provide a comprehensive approach towards the designing of cellular mobile communication systems. It begins with the basic cellular system modeling and then proceeds towards characterization and modeling of radio fading channels and other design aspects of a complete cellular system. Introduction to Wireless and Cellular Communications systems and services. The course will also cover Frequency Reuse, channel Assignment, Handoff Strategies, System Capacity, Turnking, Mobile Radio Wave propagation: large scale path loss and propagation mechanisms and model, Small-Scale fading and multipath, Rayleigh and Ricean Distributions, Multiple Access Techniques for wireless communications.	
8	Outline syllabus		CO Mapping
	Unit 1	**Mobile Radio Propagation**	
	A	Introduction to Radio Wave Propagation, Free Space Propagation Model, Three Basic Propagation Mechanisms- Reflection, Diffraction, Scattering	CO1
	B	Reflection- Reflection from Dielectrics, Ground Reflection Model, Diffraction- Fresnel Zone Geometry, Knife edge Diffraction Model	CO1
	C	Scattering- Radar Cross Section Model, Log distance Path Loss Model, Log Normal Shadowing	CO1
	Unit 2	**Cellular concepts**	
	A	Cellular concepts, Frequency reuse, channel assignment strategies.	CO2
	B	Handoff strategies, interference and system capacity.	CO2
	C	Improving coverage and capacity in cellular systems.	CO2
	Unit 3	**Speech Coding**	
	A	Characteristics of speech signals, Quantization Techniques	CO2
	B	Frequency Domain Coding of speech- Sub band Coding, Adaptive transform coding	CO2
	C	Vo-coders, Linear Predictive Coders, GSM Codec	CO2
	Unit 4	**GSM system for mobile**	
	A	GSM system for mobileServices and features, System Architecture, Radio Sub system Channel types.	CO3
	B	Frame Structure.CDMA Digital Cellular Standard (IS 95): Frequency and Channel specifications.	CO3
	C	Forward CDMA channel and reverse CDMA channel.	CO3
	Unit 5	**Mobile Adhoc Networks**	CO4

	A	Mobile data networks, wireless standards IMT2000.			CO4
	B	4G, OFDM.			CO4
	C	Concept of NGN.			CO4
	Mode of examination	Theory/Jury/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30	20	50	
	Text book/s*	*T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson, Second Edition (2009).*			
	Other References	*1. Andrea Goldsmith, "Wireless Communications", Cambridge University press.*			
		2. T L Singal ,"Wireless Communications ",McGraw Hill Publications			

CO , PO & PSO MAPPING:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE 618.1	2	3	2	3	3	2	2	2	3	3	2		
ECE 618.2	3	3	2	3	3	2	2	2	3	3	3		
ECE 618.3	3	3	2	3	3	2	2	2	3	3	3		
ECE 618.4	3	3	2	3	3	2	3	2	3	2	3		
ECE 618.5	3	3	2	3	3	2	3	3	3	3	3		
ECE 618	3	3	2	3	3	2	2	2	3	3	3		

School: SET		**Batch : 2019-21**
Program: M.Tech		**Current Academic Year: 2019-20**
Branch:All		**Semester:I/II**
1	Course Code	**ECE 612**
2	Course Title	**Nano Technology**
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Open-Elective
5	Course Objective	Paraphrase the importance of nanoelectronics, technology roadmap in nanoelectronics and limitations of existing CMOS technologies for design of electronic circuits. The course tabulates strong theoretical and analytical understanding of nano electronic devices and its applications in design of electronic circuits.
6	Course Outcomes	At the end of the course, students will demonstrate the ability to: CO1: Understand various aspects of nano-technology and the processes involved in making nano components and material CO2: Leverage advantages of the nano-materials and appropriate use in solving practical problems. CO3: Understand various aspects of nano-technology and the processes involved in making nano components and material CO4: Leverage advantages of the nano-materials and appropriate use in solving practical problems.
7	Course Description	Understand and appreciate the importance of nanoelectronics and its impact in next generation electronics and electronic products. Differentiate between MOS and emerging nanodevices technology, understand the advantages and limitations of MOS based circuit.
8	Outline syllabus	CO Mapping

	Unit 1	**Basics of Quantum Mechanics**			
	A	Introduction to nanotechnology, meso structures			CO1
	B	Schrodinger equation, Density of States.			CO1
	C	Particle in a box Concepts, Degeneracy			CO1
	Unit 2	**Nanoscale MOSFETs**			
	A	Shrink-down approaches, Introduction, CMOS Scaling			CO2
	B	The nanoscale MOSFET, Finfets			CO4
	C	Vertical MOSFETs			CO4
	Unit 3	**CLASSICAL PARTICLES**			
	A	limits to scaling, system integration limits (interconnect issues etc.)			CO2
	B	Resonant Tunneling Diode			CO3
	C	Coulomb dots, Quantum blockade			CO2
	Unit 4	**SINGLE-ELECTRON Devices**			
	A	Single electron transistors			CO3
	B	Carbon nanotube electronics			CO3
	C	Band-structure			CO1
	Unit 5	**FREE AND CONFINED ELECTRONS**			
	A	Transport devices, applications			CO4
	B	2D semiconductors and electronic devices			CO3
	C	Graphene, atomistic simulation			CO4
	Mode of examination	Theory/Jury/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30	20	50	
	Text book/s*	1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009. 2. W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Material and Novel Devices), Wiley-VCH, 2003			
	Other References	1. K.E. Drexler, Nanosystems, Wiley, 1992. 2. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998. 3. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003			

CO , PO & PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE 619.1	2	3	2	3	3	2	2	2	3	3	3		

ECE 619.2	3	3	3	3	3	2	2	2	3	3	3		
ECE 619.3	3	3	3	3	3	3	2	2	3	3	3		
ECE 619.4	3	3	2	3	3	3	2	2	3	2	3		
ECE 619.5	3	3	2	3	3	3	2	3	3	3	3		
CO2619	3	3	2	3	3	3	2	2	3	3	3		

School: SET		**Batch : 2019-21**
Program: M. Tech		**Current Academic Year: 2019-20**
Branch: D.C		**Semester: II**
1	Course Code	ECE 670
2	Course Title	**RF and Micro-MEMS**
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Open Elective
5	Course Objective	1. Emphasizes on developing components and systems that would significantly improve the performance of existing RF, microwave and millimetre wave components. 2. Fabrication of new components by a set of processes known as micromachining, primarily developed for conventional micro electromechanical systems (MEMS). 3. Categorize Micro-switches, Planar, on-chip components, Transmission lines and other components, 4. Classify Micromachined antennas, Micromachined phase shifters.
6	Course Outcomes	CO1: Introduction to MEMS, concepts on miniaturization and fabrication CO2: Objectives of RF MEMS Switches: Intro, fabrication & basic design guidelines CO3: Identify Micromachined passive components, theory, features, tunable capacitors, inductors. CO4: Analysing RF filters & phase shifters. CO5: Analysis of Reliability & packaging, RF MEMS Packaging
7	Course Description	The objective of this course is t to gain knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques. This enables them to design, analysis, fabrication and testing the MEMS based components.

8	Outline syllabus				CO Mapping
	Unit 1	**Introduction**			CO1
	A	RF MEMS for microwave applications, MEMS technology and fabrication			CO1
	B	Mechanical modeling of MEMS devices			CO1
	C	MEMS materials and fabrication techniques.			CO2
	Unit 2	**MEMS switches**			
	A	Introduction to MEMS switches			CO2
	B	Capacitive shunt and series switches: Physical description, circuit model and electromagnetic modelling			CO2
	C	Techniques of MEMS switch fabrication and packaging; Design of MEMS switches.			CO2
	Unit 3	**Inductors and Capacitors**			
	A	Micromachined passive elements			CO3
	B	Micromachined inductors: Effect of inductor layout, reduction of stray capacitance of planar inductors, folded inductors, variable inductors and polymer-based inductors			CO3
	C	MEMS Capacitors: Gap-tuning and area-tuning capacitors, dielectric tunable capacitors			CO3
	Unit 4	**RF Filters and Phase Shifters & Integration and Packaging**			
	A	Modeling of mechanical filters, micromachined filters, surface acoustic wave filters, micromachined filters for millimeter wave frequencies.			CO4
	B	Various types of MEMS phase shifters; Ferroelectric phase shifters			CO4
	C	Role of MEMS packages, types of MEMS packages, module packaging, packaging materials and reliability issues			CO5
	Unit 5	**Transmission Lines and Antennas**			
	A	Micromachined transmission lines, losses in transmission lines,			CO5
	B	coplanar transmission lines, micromachined waveguide components			CO5
	C	Micromachined antennas: Micromachining techniques to improve antenna performance, reconfigurable antennas.			CO5
	Mode of examination	**Theory**			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Varadan, V.K., Vinoy, K.J. and Jose, K.J., "RF MEMS and their Applications", John Wiley &			

		Sons.	
	Other References	1. Rebeiz, G.M., "MEMS: Theory Design and Technology", John Wiley & Sons. 2. De Los Santos, H.J, "RF MEMS Circuit Design for Wireless Communications", Artech House. 3. Trimmer, W., "Micromechanics & MEMS", IEEE Press 4. Madou, M., "Fundamentals o Microfabrication", CRC Press. 5. Sze, S.M., "Semiconductor Sensors", John Wiley & Sons.	

CO , PO & PSO MAPPING:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE 670.1	2	3	2	3	3	2	2	2	3	3	2		
ECE 670.2	3	3	2	3	3	2	2	2	3	3	3		
ECE 670.3	3	3	2	3	3	2	2	2	3	3	3		
ECE 670.4	3	3	2	3	3	2	2	2	3	2	3		
ECE 6705	3	3	2	3	3	2	2	3	3	3	3		
ECE 670	3	3	2	3	3	2	2	2	3	3	3		

School: SET		**Batch : 2019-21**	
Program: M.Tech		**Current Academic Year: 2019-20**	
Branch: All		**Semester: II**	
1	Course Code	ECE619	
2	Course Title	Internet of Things and Applications	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Compulsory	
5	Course Objective	1. Emphasize the application areas of IOT 2. Emphasize the blocks of Internet of Things 3. Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks 4. Introduction to core technologies-RFID, Sensor & Communication Networks	
6	Course Outcomes	CO1: Able to understand the vision of IoT from a global context CO2:. Able to Determine the Market perspective of IoT CO3: Able to know Key application areas CO4: Able to analyze various IoT Layers and their relative importance CO5: Able to understand basic IoT application solutions	
7	Course Description	IoT has become a game changer in the new economy where the customers are looking for integrated value & the IoT perspective in thinking and building solutions	
8	Outline syllabus		CO Mapping
	Unit 1	**Basics Internet of things**	
	A	Overview with application examples	CO1

	B	Design Principles for connected devices			CO1
	C	Physical &logical Design, M2M Communication			CO1
	Unit 2	**Basic Topologies & Network Toplogies**			
	A	LAN topologies; Role of data communication and network in industrial automation, ISO's seven-layer			CO4
	B	OSI model: significance, scope, functions of all layers; IEC's four layers EPA model: significance, functions of all layers.			CO4
	C	MAC techniques; Network protocol, special requirements of industrial network protocols.			CO4
	Unit 3	**Ethernet and Ethernet /IP**			
	A	Standard Ethernet for high-speed LANs, governing standard IEEE802.3			CO3
	B	Physical layer, data link layer (Frame Format and MAC)			CO3
	C	TCP/IP suit Ethernet/IP: Adaption of Common Industrial Protocol (CIP) to standard Ethernet, CIDP, comparison between standard Ethernet and Ethernet /IP.			CO3
	Unit 4	**Industrial Wireless Network Protocols**			
	A	Zigbee: Special features, data rates, full-function and reduced function devices			CO5
	B	PAN coordinator, MAC protocol and data transfer types, Zigbee network topologies			CO5
	C	Comparison of Zigbee with Wi-Fi and Bluetooth.			CO5
	Unit 5	**Illustrative application Scenarios & concepts**			
	A	Smart Waste management, Smart energy conservation			CO2
	B	Smart Urban planning, Sustainable urban Environment, Smart Medication &emergency handling			CO2
	C	Smart product management, Home automation			CO2
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. E-book-Designing of Internet of things by-Adrian McEwen, Hakim Cassimally, Wiley 2. *Internet of Things by-A Bahga &Vijay Madisetti,University Press*			

CO , PO & PSO MAPPING:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PSO 1	PSO 2	PSO 3
ECE 619. 1	2	3	2	3	3	2	2	2	3	3	2		
ECE 619. 2	3	3	2	3	3	2	2	2	3	3	3		
ECE 619. 3	3	3	2	3	3	2	2	2	3	3	3		
ECE 619. 4	3	3	2	3	3	2	2	2	3	2	3		
ECE 619. 5	3	3	2	3	3	2	2	3	3	3	3		
ECE 619	3	3	2	3	3	2	2	2	3	3	3		

School: SET		**Batch: 2019-21**	
Program: M.Tech		**Current Academic Year: 2019-20**	
Branch: DC		**Semester: II**	
1	Course Code	ECP 685	
2	Course Title	Communication Lab	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	lab course is associated with the theory course, on Introduction to the Principles of Optical Fiber Communication Systems. This laboratory course will enable students to relate what they have learnt in classroom to practical, handson experiments that will be performed in a fiber optic communication laboratory. Take away the "fear factor" by providing experience of operating various equipment.	
6	Course Outcomes	CO1: Analyzing the concept of analog communication CO2: Measure loss and dispersion in optical fibers CO3: Measure the performance of analog fiber links CO4: Analogies between electrical and optical communication system. CO5: Analyzing the concept of microwave bench.	
7	Course Description	This lab provides students with hands on practical exposure to optical fibers and show the practically the transfer of signal from one point to another and type of losses associate with it.	
8	Outline syllabus		CO Mapping
	Unit 1	**Analog Communication**	
		Amplitude shift keying Frequency Shift Keying Phase Shift Keying	CO1
	Unit 2	**Signal distortion in optical fibers**	
		Study of Bending Loss. Study of Propagation loss in optical fiber	CO2
	Unit 3	**Optical Detectors/Link Design**	

		Setting up Fiber optics voice link.			CO3
	Unit 4	**Optical Networks**			
		Setting up of Fiber Optic Voice Link using PWM. Construction of MUX and DEMUX for WDM systems			CO4
	Unit 5	**Microwave test bench**			
		Measurement of frequency and power in a microwave test bench using Klystrone Determination of coupling and isolation characteristics of a microstrip directional coupler			CO5
	Mode of examination	Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*				
	Other References	John M. Senior, "Optical Fiber Communications", PEARSON, 3rd Edition, 2010			

CO , PO & PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE685.1	2	3	2	3	3	2	2	2	3	3	2		
ECE 685.2	3	3	2	3	3	2	2	2	3	3	3		
ECE 685.3	3	3	2	3	3	2	2	2	3	3	3		
ECE 685.4	3	3	2	3	3	2	2	2	3	2	3		
ECE 685.5	3	3	2	3	3	2	2	3	3	3	3		
ECE 685	3	3	2	3	3	2	2	2	3	3	3		

School: SET		**Batch :2019-21**
Program: M.Tech		**Current Academic Year: 2019-20**
Branch: All		**Semester: I**
1	Course Code	ECE684
2	Course Title	Discrete Time Signal Processing
3	Credits	5
4	Contact Hours (L-T-P)	3-0-4
	Course Status	Compulsory
5	Course Objective	• The objective of DSP is usually to measure, filter and/or compress continuous real-world analog signals. • This course is the mathematical manipulation of an information signal to modify or improve it in some way. • This is characterized by the representation of discrete time, discrete frequency, or other discrete domain signals by a sequence of numbers or symbols.
6	Course Outcomes	After completing this course students will be able to 6. Apply real time processing of audio and speech signal. 7. Do the sonar and radar signal processing, sensor array processing, spectral estimation, statistical signal processing. 8. To develop the understanding about the mathematics behind signal processing, for communications, control of systems, biomedical signal processing, seismic data processing, digital image processing etc. 9. Use computing software package like MATLAB, and acquainted with digital processing tools available in MATLAB. 10. Develop a signal processing system to analyze, predict and manipulate real data.

7	Course Description	Digital Signal Processing (DSP) is concerned with the representation, transformation and manipulation of signals on a computer. After half a century advances, DSP has become an important field, and has penetrated a wide range of application systems, such as consumer electronics, digital communications, medical imaging and so on. With the dramatic increase of the processing capability of signal processing microprocessors, it is the expectation that the importance and role of DSP is to accelerate and expand. Discrete-Time Signal Processing is a general term including DSP as a special case. This course will introduce the basic concepts and techniques for processing discrete-time signal on a computer. By the end of this course, the students should be able to understand the most important principles in DSP	
8	Outline syllabus		CO Mapping
	Unit 1	**Realisation of FIR Filters & IIR Filters**	
	A	Implementation of Discrete-Time Systems Digital Filter Structure: Block Diagram representation.	CO1, CO2
	B	Signal Flow Graph Representation, FIR Digital Filter Structure.	CO1.CO3
	C	Direct-Form Structure, Cascade Form Structures.	CO2
	Unit 2	**Fundamentals of Multirate Digital Signal Procesing**	
	A	Basic Multirate operations- Decimation and Interpolation ,Sampling, Sampling Rate Conversion Digital Filter Banks,	CO2
	B	Two channel Quadrature Mirror Filter bank,	CO1, CO3
	C	Multilevel Filter Banks	CO1.CO4
	Unit 3	**Design of Digital Filters**	
	A	Design of Digital Filters Design of FIR Filters: Symmetric and Antisymmetric FIR Filters, Design of Linear phase FIR Filter using Windows and Frequency sampling method	CO1,CO3
	B	Introduction to Chebyshev and Butterworth Filter, Gibbs phenomenon, Design of Optimum Equiripple Linear-phase FIR Filters	CO4
	C	Design of IIR Filters: Design by Approximation of Derivatives	CO5
	Unit 4	**The Discrete Fourier Transform & Efficient Computation of the DFT: FFT Algorithm**	
	A	Basic elements of Digital Signal Processing, Ideal Sampling reconstruction and concept of aliasing, Introduction to CTFT and DTFT , Discrete Fourier Transform .	CO3,CO4
	B	Properties of DFT: Periodicity, Linearity, Symmetry, Multiplication of two DFT, Circular Convolution, circular correlation, multiplication of two sequences, Parseval's	CO4

		theorem.			
	C	Decimation-in-Time FFT algorithms & Decimation-in-frequency FFT algorithms			CO1,CO4
	Unit 5	**Adaptive Signal Processing and Applications.**			
	A	Adaptive systems - definitions and characteristics,			CO4
	B	Minimum Mean Square Error Critirean,The Window LMS Algortithm			CO41,CO4
	C	Introduction to filtering smoothing and prediction, Wiener – Hopf equation, Voice Processing, Application to Radar,DFT use in Spectral Estimation.			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	*References-* *1. A. Y. Oppenhein and R. W. Schater, "Digital Signal Processing", PHI 1975* *2. A. Y. Oppenhein, R. W. Schater and J. R. Buck, "Discrete Time Signal Processing", PHI 1999.*			
	Other References	*1.G. Proakis and D.G. Manolakis, "Digital Signal Processing, Principals, Algorithms, and Applications", Pearson Education, 4th ed., 2007.* 2.S.Salivahanan, A. Vallavaraj "Digital Signal Processing"Tata McGraw-Hill Education ,2007			

CO , PO & PSO MAPPING:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	**PSO3**
ECE 685.1	2	2	1	2	1	1	1	2	2	2	2		

ECE 685.2	3	3	3	2	2	2	2	3	2	2	2		
ECE 685.3	3	2	1	2	2	1	1	2	2	3	3		
ECE 685.4	3	2	3	2	2	1	1	2	2	2	3		
ECE 685.5	3	2	3	2	2	1	1	2	2	3	2		
ECE 685	2.8	1.8	1.2	2	2	2	1.2	3	1.2	1.4	2.4		

School: SET		**Batch : 2019-21**
Program: M.Tech		**Current Academic Year: 2019-20**
Branch: VLSI		**Semester : I**
1	Course Code	ECE 611
2	Course Title	Advanced Computer Architecture
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Department Elective
5	Course Objective	The aim of this course is to allow the students to develop an understanding of the design methods, implementation techniques, modeling techniques, and performance analysis of computer architectures.
6	Course Outcomes	After completing this course students should be able to CO1: Classify parallel computer architecture schemes CO2: Use instruction level parallelism to build components of a simple computer CO3: Explain how the various parts of a modern computer function CO4: Exploit the advantages of an advanced computer memory having virtual memory and cache CO5: Evaluate the performance of pipelined computers CO6: Describe the RISC characteristics of CPU
7	Course Description	An **overview** of **computer architecture**, which stresses the underlying design principles and the impact of these principles on**computer** performance. General topics include design methodology, processor design, control design, memory organization, system organization, and parallel processing
8	Outline syllabus	CO Mapping

	Unit 1	**Introductionto Computer architecture**			
	A	Parallel Computing, Parallel Computer Model, Program and Network Properties, Parallel Architectural Classification Schemes,Flynn's & Feng's Classification Performance Metrics and Measures,			CO1,CO2
	B	IEEE POSIX Threads, Thread Synchronization			CO1,CO2
	C	Pipelining and Memory Hierarchy, Basic and Intermediate Concepts, Instruction Set Principle;ILP: Basics, Exploiting ILP, Limits on ILP			CO1,CO2
	Unit 2	**Cache memory and Virtual memory**			
	A	Basic cache structure, Set associative caches, Evaluating Cache performances Determining Cache parameters,			**CO4**
	B	Replacement Policies, Implementing LRU, Replacement policies.			**CO4**
	C	Basic virtual memory structure, Translation look aside buffer, Segment tables, Replacement algorithms, Detail example of a virtual memory system.			**CO4**
	Unit 3	**Pipeline techniques**			
	A	Principles of Pipelined computers,			**CO5**
	B	Evaluating performance of pipelined, Computers, Reservation tables and collision vectors,			**CO5**
	C	Maximizing pipeline, Performance, Conditional branches in pipelined computers, Internal forwarding and deferred instructions.			**CO5**
	Unit 4	**Multiprocessors**			
	A	Flynn's classification of multiprocessors,			**CO3,CO4**
	B	Vector computers, Numerical algorithms on a vector computer, Pipelining in vector computers, Examples of vector computers, e.g. Cray			**CO3,CO4**
	C	Multiprocessor interconnections: General purpose multiprocessors, e.g. RP-1, HEP, Data flow computers			**CO3,CO4**
	Unit 5	**RISC computers**			
	A	Pipelined structure of the CPU,			**CO6**
	B	RISC characteristics.			**CO6**
	C	Case study of MIPS-64 processor			**CO6**
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	*Stallings, William, "Computer organization and architecture, designing for performance", Prentice Hall of India.*			
	Other References	*1. M. R. Bhujade, "Parallel Computing", Newage International Pvt. Ltd.* *2. J. L. Hennessy and D. A. Patterson, "Computer architecture: a quantitative approach", Harcourt Asia,*			

		Singapore. *3. Kain, "Advanced Computer Architecture: a system Design approach", PHI.*	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	**PSO3**
ECE611.1	3		2										
ECE611.2	1	3										3	
ECE611.3	3	1	1										
ECE611.4		2	2									3	
ECE611.5	2	1											
ECE6		3	1									2	

CO , PO & PSO MAPPING:

11.6													
ECE611	2	2	1									2	

1-Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

School: SET		**Batch : 2019-21**
Program: M.Tech		**Current Academic Year: 2019-20**
Branch:VLSI		**Semester:I**
1	Course Code	ECE 612
2	Course Title	Advanced Digital design using HDL
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Compulsory
5	Course Objective	The aim of this course are to develop advanced digital design skills, introduce a design approach based on programmable logic, allow students to gain experience in tackling both control and data oriented problems and to show the power of VHDL as a tool for advanced digital design. Students will also learn synthesis tools for direct digital implementation.
6	Course Outcomes	After completing this course students should be able to CO1: Explain the VHDL design flow and design entities.

		CO2: Analyze signal assignments with delay component declaration CO3: Describe the objects in VHDL and VHDL types CO4: Use effectively a modern hardware description language (VHDL) and computer aided design tools to implement designs in programmable chips. CO5: Use the Mentor Graphics Modelsim or Aldec for VHDL simulation also Explain Xilinx ISE for synthesis & implementation, Simulate for all the basic gate, multiplexor, encoder, decoder, half and full adder, subtractor.	
7	Course Description	**Advanced Digital Design** : **Advanced** techniques in the **design** of **digital** systems. Hardware **description** languages, combinational and sequential logic synthesis and optimization methods, partitioning, mapping to regular structures. Emphasis on reconfigurable logic as an implementation medium.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction and Hierarchy**	
	A	Origin of VHDL,VHDL basics, VHDL levels of abstraction, VHDL design flow, modeling hardware in VHDL,VHDL design entities, Entity declaration, Architecture, Using libraries and packages	**CO1,CO2**
	B	Concurrent signal assignments, signal assignments with delay Component declaration, component instantiation, named port mapping, positional port mapping,	**CO2**
	C	Direct instantiation, Configuration specifications, entity binding, port modes, VHDL process, processes sensitivity lists, test benches.	**CO2**
	Unit 2	**Data types and statements**	
	A	Objects in VHDL, Constants, variable & signals, VHDL types, scalar types, Arrays, Records, Custom types subtypes, Tristate and resolved types	CO3
	B	std_ulogic and std_logic, unsigned and signed ,attributes. Concurrent statements, Sequential statements, Conditional & selective signal assignments,	CO3
	C	Generate statements, signal and variable assignments, synthesis of statements, latch inference, for loop.	CO3
	Unit 3	**Simulation and Synthesis**	
	A	How a VHDL simulator works, Event driven simulation, Delta delay, transport delay, inertial delay, reject, Combinational logic in process, Synchronous(clocked) process.	CO5
	B	Basic gates like and, nor, xor etc multiplexor, encoder, decoder, half and full adder, half and full subtractor.	**CO4,CO5**
	C	Flip flop, latches, synchronous and asynchronous Flip Flop, Synchronous and asynchronous counter, loadable up and down counter.	**CO4,CO5**
	Unit 4	**Finite State Machine(FSMs)**	

	A	Review of Moore and Melay state machine, Finite state machines representation,			**CO4**
	B	use of enums to represent state like binary ,gray, one hot assignment.FSM VHDL code structure,			**CO4**
	C	FSM example :Sequence detector for different sequence like 1101,1001 etc, FSM for counter, FSM for flip flop and VHDL coding, Synthesis of FSMs.			**CO4**
	Unit 5	**Subprograms and Packages**			
	A	Subprograms, functions, procedures, Differences between functions and procedures, subprogram declarations, packages, package declaration, package body			**CO5**
	B	Generic parameters, generic mapping, Configuration declarations, default binding, Assertion			**CO3**
	C	Introduction to Mentor Graphics Modelsim or Aldec for VHDL simulation, Introduction to Xilinx ISE for synthesis & implementation,			**CO5**
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	*1 J.Bhasker, " AVHDL Primer" Prentice Hall*			
	Other References	*1-Peter J. Ashenden, "Designers guide to VHDL", Morgan Kaufman Publishers.* *2-Charles H Roth Jr, "Digital System Design using VHDL", Thomson Learning, 2002*			

CO , PO & PSO MAPPING:

1-

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE612.1	1	2	2										
.ECE612.2		3	2										
ECE612.3	2	1										2	
.ECE612.4		2	1									2	
ECE612.5		3	3										
.ECE612	2	3	2									1	

Slight (Low)
2-Moderate (Medium)
3-Substantial (High)

School: SET		**Batch :** 2019-21
Program: M. Tech.		**Current Academic Year:** 2019-20
Branch: VLSI		**Semester: II**
1	Course Code	**ECE826**
2	Course Title	**Low Power VLSI Design**
3	Credits	**4**
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Departmental Elective
5	Course Objective	**To expose the students to the low voltage device modeling, low voltage, low power VLSI CMOS circuit and system design.**

6	Course Outcomes	**CO1:** Explain the sources of power dissipation in CMOS **CO2:** Classify the special techniques to mitigate the power consumption in VLSI circuits **CO3:** Summarize the power optimization and trade-off techniques in digital circuits. **CO4:** Illustrate the power estimation at logic and circuit level **CO5:** Summarize the power optimization and trade-off techniques in semiconductor memories. **CO6:** Explain the software design for low power in various level	
7	Course Description	This is a course on the design and applications of low power integrated circuits. This course introduces various strategies and methodologies for designing low power circuit and systems. It describes the many issues facing designers at architectural, logic, circuit and device levels and presents some of the techniques that have been proposed to overcome these difficulties.	
8	Outline of the Syllabus		CO Mapping
	Unit 1		
	A	Fundamentals , Need for Low Power Circuit Design	**CO1, CO6**
	B	Sources of Power Dissipation–Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation	**CO1, CO6**
	C	Short Channel Effects–Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.	**CO1, CO6**
	Unit 2		
	A	Low-Power Design Approaches, Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits	**CO2, CO6**
	B	Architectural Level Approach–Pipelining and Parallel Processing Approaches.	**CO2, CO6**
	C	Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures	**CO2, CO6**
	Unit 3		
	A	Low-Voltage Low-Power Adders, Introduction, Standard Adder Cells, CMOS Adder's Architectures	**CO3, CO6**
	B	Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders	**CO3, CO6**
	C	Low Voltage Low-Power Design Techniques–Trends of Technology and Power Supply Voltage, Low Voltage Low-Power Logic Styles	**CO3, CO6**
	Unit 4		
	A	Introduction to Low-Voltage Low-Power Multipliers, Overview of Multiplication	**CO4, CO6**
	B	Types of Multiplier Architectures: Braun Multiplier, Baugh-Wooley Multiplier	**CO4, CO6**

	C	Types of Multiplier Architectures: Booth Multiplier, Introduction to Wallace Tree Multiplier			**CO4, CO6**
	Unit 5				
	A	Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs			**CO5, CO6**
	B	Basics of SRAM, Memory Cell, Pre-charge and Equalization Circuit, Low Power SRAM Technologies			**CO5, CO6**
	C	Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.			**CO5, CO6**
	Mode of examination	Theory/Jury/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. J. Rabaey, "Low Power Design Essentials (Integrated Circuits and Systems)", Springer, 2009. Print **ISBN 978-0-387-71712-8**, Online **ISBN 978-0-387-71713-5**. 2. J. B. Kuo & J. H. Lou, "Low-voltage CMOS VLSI Circuits", Wiley, 1999. 3. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", TMH, 2011. ISBN **978-0-070-53077-5**. 4. Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH Professional Engineering. ISBN **978-0-07-143786-8**.			
	Other References	1. Michael Keating et al. "Low Power Methodology Manual For System-on-Chip Design" Springer, 2008. E-Book **ISBN 978-0-387-71819-4,** Hardcover **ISBN 978-0-387-71818-7**. 2. A. Bellaouar & M. A. Elmasry," Low power Digital VLSI Design, Circuits and Systems", Kluwer, 1996. E-Book **ISBN 978-1-4615-2355-0** Hardcover **ISBN 978-0-7923-9587-4** 3. Anantha Chandrakasan, "Low Power CMOS Design", IEEE Press/Wiley International, 1998. **ISBN: 978-0-780-33429-8**. 4. Kaushik Roy, Sharat C. Prasad, "Low Power CMOS VLSI Circuit Design", John Wiley, & Sons, 2000. **ISBN: 978-0-471-11488-8**. 5. Gary K. Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Press, 2002. E-book **ISBN 978-1-4615-6065-4**, Hardcover **ISBN 978-0-7923-8009-2**.			

CO, PO & PSO MAPPING:

COs	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
ECE826.1	3	3	2	1	3	3	3	2	-	-	-	-	2	3	3
ECE826.2	3	3	3	3	3	-	3	3	1	-	2	3	3	2	3
ECE826.3	3	3	3	3	-	2	3	2	3	-	3	3	3	2	3
ECE826.4	3	3	3	3	3	2		3	2	-	3	3	2	3	2
ECE826.5	3	3	3	3	-	3		2	2	-	3	3	3	2	3
ECE826.6	-	-	-	-	3	3	2	3	3	-	3	3	2	3	2
ECE826	**2.5**	**2.5**	**2.3**	**2.2**	**2.0**	**2.2**	**2.5**	**2.5**	**2.0**	**-**	**2.3**	**2.5**	**2.5**	**2.5**	**2.7**

School: SET		**Batch : 2019-21**
Program: M.Tech		**Current Academic Year: 2019-20**
Branch: VLSI		**Semester:II**
1	Course Code	ECE 613
2	Course Title	Analog IC Design
3	Credits	3
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Elective
5	Course Objective	To learn fundamentals of CMOS and bipolar analog IC design and applications of analog integrated circuits. Design examples cover various common building blocks as well as complete power management applications including linear voltage regulators and PWM controllers for switched-mode power converters.
6	Course Outcomes	After completing this course students will be able to CO1: Analyze bias circuit using CMOS current mirror. CO2: Design feedback and differential operational amplifier. CO3: Analyze stability of operational amplifier and Apply frequency compensation techniques for Amplifiers CO4: Analyze basic operation of PLL CO5: Use the concepts of Switched-Capacitor Circuits for analog IC design
7	Course Description	This course will introduce advanced concepts in analog circuit design specifically relevant to CMOS IC design. It will cover circuit noise and

		mismatch, their analysis, and their impact on CMOS op-amp design. As prerequisites, the student is expected to have undergone a course on (a) basic circuit theory and analysis (b) signals and systems and (c) MOS analog circuits. At the end of this course, the student should be able to design and analyze several types of CMOS op-amps at the transistor level.	
8	Outline syllabus		CO Mapping
	Unit 1	**MOS Device Physics**	
	A	Basic MOS Device Physics: MOS IV Characteristics, Second order effects, Short-Channel Effects, MOS Device Models, Review of Small Signal MOS Transistor Models, MOSFET Noise.	CO1
	B	Analog MOS Process: Analog CMOS Process (Double Poly Process), Digital CMOS Process tailored to Analog IC fabrication, Fabrication of active devices, passive devices and interconnects, Analog Layout Techniques, Symmetry, Multi-finger Transistors,	CO1
	C	Passive Devices: Capacitors and Resistors, Substrate Coupling, Ground Bounce.	CO1
	Unit 2	**Amplifiers and their frequency response**	
	A	Single Stage Amplifiers: Common Source Stage, Source Follower, Common Gate Stage, Cascode, Folded Cascode.	CO2
	B	Differential Amplifier: Single ended and Differential Operation, Qualitative and Quantitative Analysis of Differential pair, Common Mode response, Gilbert Cell.	CO2,CO3
	C	Frequency Response of Amplifiers: Miller Effect, Association of Poles with nodes, Frequency Response of all single stage amplifiers.	CO2
	Unit 3	**Current sources and voltage references**	
	A	Current Sources and Mirrors: Current Sources, Basic Current Mirrors, Cascode Current Mirrors, Wilson Current Mirror, Large Signal and Small-Signal analysis.	CO3
	B	Voltage References: Different Configurations of Voltage References, Major Issues,	CO3
	C	Supply Independent Biasing, Temperature-Independent References.	CO3
	Unit 4	**Compensation in Operational amplifier**	
	A	Operational Amplifier: General Considerations, Theory and Design, Performance Parameters,	CO3
	B	Single-Stage Op Amps, Two-Stage Op Amps, Design of 2-stage MOS Operational Amplifier, Gain Boosting, Comparison of various topologies, slew rate, Offset effects, PSRR.	CO4
	C	Stability and Frequency Compensation: General Considerations, Multi-pole systems, Phase Margin, Frequency Compensation, Compensation Techniques.	CO3,C04
	Unit 5	**Introduction to switched-capacitor**	

	A	Switched-Capacitor Circuits: Sampling Switches, Speed Considerations, Precision Considerations, Charge Injection Cancellation,			CO4, CO5
	B	Switched-Capacitor Amplifiers, Switched- Capacitor Integrator,			CO5
	C	Switched-Capacitor Common-Mode Feedback.			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	*Razavi B., "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2008.* *2. 2.Allen P.E. and Holberg D.R., "CMOS Analog Circuit Design", Oxford University Press, 2nd ed., 2002.*			
	Other References	*Johns D.A. and Martin K., "Analog Integrated Circuit Design", John Wiley, 2008.* *2.Gray P.R., Hurst P.J., Lewis S.H. and Meyer R.G., "Analysis and Design of Analog Integrated Circuits", John Wiley, 5th ed., 2001.* *3. 3.Hastings A., The Art of Analog Layout, Prentice Hall, 2005.*			

CO , PO & PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
ECE 613.1	1	3										
.ECE613.2		3	2	2								2
ECE 613.3	1		2									
ECE 613.4	2		1									3
ECE 613.5	2	3	1	2								3
ECE 613	1	2	1	1								2

School: SET	**Batch : 2019-21**
Program: M.Tech	**Current Academic Year: 2019-20**
Branch: VLSI	**Semester:I**

1	Course Code	ECE 614
2	Course Title	Device Modeling and Circuit Simulation
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0

	Course Status	Elective
5	Course Objective	To expose students to the IC fabrication complexities and design methodologies of current and advanced IC design technologies using SPICE modelling
6	Course Outcome	After

	s	CO1: Explain the IC fabricati on steps for IC design, concepts of oxidatio

		n for silicon dioxide growth for thick and thin films and Develop the wafer using various depositio n techniqu es like CVD, PVD, MBE and their types CO2: Use the Photolith ography for IC design transfer on the wafer and Explain the of need for planariza tion and chemical mechani cal polishin g, CO3: Outline the NMOS, CMOS

		and Bipolar fabricati on process. create models of moderat ely sized BJT circuits that realize specified digital function s using SPICE CO4: Apply CMOS technolo gy-specific layout rules in the placeme nt and routing of transisto rs and intercon nect, and CO5: Apply the principle s of HBT and HEMT for design rule

		checks, timing verification, worst case delay simulation, setup and hold times for clocked devices
7	Course Description	This is a course on modelling of electronic devices with emphasis on applications in circuit simulation. The main topics are: Physical foundation of semiconductor devices; charge control; threshold voltage; sub-threshol

		d phenomena; mobility; velocity saturation; short-channel effects; parasitics; physically based modelling of common devices such as Si MOSFET (CMOS), GaAs MESFET, HEMT, and bipolar transistors; strength and weaknesses of the models; parameter extraction; application of the models in SPICE-type circuit

		simulators.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to IC technology**	
	A	IC fabrication steps, Wafer preparation,	**CO 1**
	B	Crystal growth techniques, wafer cleaning,	**CO 1**
	C	Clean room and safety requirements.	**CO 1**
	Uni	**IC Fabricatio**	

	t 2	**n proce sses**	
	A	Oxid ation: Kinet ics of Silico n dioxi de growt h both for thick, thin and ultra thin films, Deal-Grov e mode l. Diffu sion and Ion Impla ntatio n: Diffu sion proce ss, Ion impla ntatio n, mode ling of Ion impla ntatio	C O 2

		n and its types.	
	B	Deposition & Growth: Various deposition techniques CVD, PVD, MBE and their types. Etch and Cleaning: materials used in cleaning, various cleaning methods, Wet etch, Dry etch.	CO2
	C	Photolithography: Positive photo	CO2

		resist, negative photo resist, comparison of photo resists, need for masks and its types. Planarization Techniques: Need for planarization, Chemical Mechanical Polishing, NMOS, CMOS and Bipolar fabrication process.	
	Uni	**SPICE mode**	

	t 3	**ling**	
	A	Introduction to SPICE: AC, DC, Transient, noise, temperature extra analysis.	CO 3
	B	Junction Diodes: DC, small signal, large signal, high frequency and noise models of diodes. Measurement of diode model-parameters.	CO 3
	C	BJT:	C

		DC, small signal, high frequency and noise models of bipolar junction transistors. Extraction of BJT model parameters.	O3
	Unit 4	**MOS**	
	A	MOSFETs: DC, small signal, high frequency and noise models of MOSFETs	CO4

		. MOS Capacitors.	
	B	Device SCALING: short and narrow channel MOSFETs. MOSFET channel mobility model, DIBL, charge sharing and other non-linear effects.	CO4
	C	MOS Models: Level-1 and level-2	CO4

		large signal MOS FET models. Introduction to BSIM models. Extraction of MOS FET model parameters.	
	Unit 5	**HBTs**	
	A	Introduction: Principles of hetro junction devices, HBTs, HEMT	CO5
	B	Component mode	CO5

		l for ICs: Design rule checks, timing verification, worst case delay simulation, setup and hold times for clocked devices,	
	C	Behavior modeling, structural modeling, simulation with the physical model.	CO5
	Mode of	Theory	

	examination					
	Weightage Distribution	CA	MTE	ETE		
		30%	20%	50%		
	Textbook/s*	*S.M. Kang & Y. Leblibici, "CMOS Digital Integrated Circuits- Analysis &*				

		Design", TMH, Ed. 2003	
	Other References	*S.M. Sze, "Physics of semiconductor devices", Wiley Pub. S.M. Sze (Ed), "VLSI Technology", 2nd Edition, McGraw Hill, 1988*	

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
ECE 614.1	2	3	1									
ECE	2	3										3

CO , PO & PSO MAPPING:

614.2												
ECE 614.3	2											3
ECE 614.4		3	1		3							
ECE 614.5	2		2									
ECE 614	2	2	1		1							1

School: SET		**Batch: 2019-21**
Program: M.Tech		**Current Academic Year: 2019-20**
Branch:All		**Semester: I**
1	Course Code	ECP 651
2	Course Title	Digital System Design Lab
3	Credits	2
4	Contact Hours (L-T-P)	0-0-4

	Course Status	Compulsory	
5	Course Objective	Explain the elements of digital system abstractions such as digital representations of information, digital logic, Boolean algebra, state elements and finite state machine (FSMs). Design simple digital systems based on these digital abstractions, using the "digital paradigm" including discrete sampled information. Use the "tools of the trade": basic instruments, devices and design tools.	
6	Course Outcomes	CO1:Design, simulate and logic gates on Xilinx CO2:Design, simulate & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder, implement on FPGA. CO3:Design, simulate & analyze synchronous sequential logic circuits. CO4:Design, simulate & analyze finite state machines	
7	Course Description	Digital system modelling for simulation, synthesis, and rapid system prototyping. Structural and behavioral models, concurrent and sequential language elements, resolved signals, generics, configuration, test benches, processes and case studies	
8	Outline syllabus		CO Mapping
	Unit 1	**Practical based on basic gates**	
	A	Design, Simulate and analyze CMOS Inverter	CO1
	B	Design, Simulate and analyze NAND and EX-OR gate	CO1
	C	Design, Simulate and analyze NOR and Ex-NOR gate	CO1
	Unit 2	**Practical related to Combinational Logic Design**	
	A	Design, Simulate and analyze half Adder and Implement on FPGA	CO1, CO2
	B	Design, Simulate and analyze 3X8 Decoder and Implement on FPGA	CO1, CO2
	C	Design, Simulate and analyze 4-BIT Magnitude Comparator and Implement	CO1, CO2
	Unit 3	**Practical related toFlip Flops**	
	A	Design and simulate D & T Flip Flop	CO3

	B	Design and simulate SR Flip Flop			CO3
	C	Design and simulate JK Flip Flop			CO3
	Unit 4	**Practical related to Sequential Logic**			
	A	Design and simulate ALU.			CO2
	B	Design and simulate synchronous Decade Counter.			CO2
	C	Design and simulate asynchronous Decade Counter.			CO2
	Unit 5	**Practical related to Finite State Machines**			
	A	Design and Simulate asynchronous UP/DOWN Counter.			CO4
	B	Design and simulate Mealy Machine Modelling.			CO4
	C	Design and simulate Moore's Machine Modelling.			CO4
	Mode of examination	Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	- R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.			
	Other References	1. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002. 2. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006. 3. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989 4. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.			

CO , PO & PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
ECP651.1		3										2
ECP651.2	2	3										2
ECP651.3	2	1										2
ECP651.4		3	2									3
ECP651	2	3	2									2

School: SET		**Batch : 2019-21**	
Program: M.Tech		**Current Academic Year: 2019-20**	
Branch: VLSI		**Semester: II**	
1	Course Code	ECE 616	
2	Course Title	Advanced VLSI Design	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Compulsory	
5	Course Objective	To provide students a clear understanding of the fundamental concepts of modern CMOS VLSI design. Students will learn the design of complex and high performance CMOS systems from system level to circuit level.	
6	Course Outcomes	After completing this course students should be able to CO1: Explain the fundamental concepts of modern CMOS VLSI design And the complex and high performance CMOS systems CO2: Demonstrate a clear understanding of important concepts in CMOS technology and fabrication that affect design and Design a gate of any given arbitrary logic function at the transistor-level. layout a gate in CMOS VLSI technology. CO3: Size the gates of the given VLSI layout to minimize the delay and Design a network of complex gates with the ideal number of stages which computes the function with minimum delay. CO4: Apply technology mapping algorithms to transform the given logic network into an interconnection of components from a given library and Apply finite state machine minimization algorithms to minimize the number of states in a sequential circuit.	
7	Course Description	This course will cover historical Perspective of ***VLSI***, CMOS ***VLSI Design*** for Power and Speed consideration, Logical Efforts:***Designing*** Fast CMOS Circuits; Data path ***Design***, Interconnect aware ***design***, Hardware ***Description***Languages for ***VLSI Design***, FSM Controller/Data path and Processor ***Design***, ***VLSI Design***Automation.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to automation**	
	A	VLSI Physical Design Automation: VLSI design cycle, physical design cycle, design styles and system packaging styles ,design rules, layout of basic devices, CMOS layout. Cell generation and Programmable structures, Transistor chaining.	CO1
	B	Partitioning: Problem formulation, classification of partitioning algorithms and performance driven partitioning.	CO1
	C	Placement, floor planning and pin assignment: Placement,	CO1

		floor planning, pin assignment, integrated approach.			
	Unit 2	**Global Routing**			
	A	Problem formulation classification of global routing algorithms,			CO2,CO3
	B	Maze routing algorithms, line - probe algorithms, Shortest path based algorithms			CO2,CO3
	C	Steiner tree based algorithms, and integer programming based approach.			CO2,CO3
	Unit 3	**Scaling in MOSFET**			
	A	Supply voltage scaling approaches:, unit level voltage selection, clustered voltage scaling, level converters, multiple supplies inside a block, level shifters			CO3
	B	timing and power planning, choosing the high V_{TH} value, MTCMOS circuits using sleep transistors . supply voltage limitations, Optimum supply voltage, multiple device threshold, Technology level – feature size scaling, threshold voltage scaling,			CO3
	C	Transistor sizing for energy minimization, dynamic supply voltage scaling, dynamic threshold voltage scaling . Energy recovery, design with reversible logic, adiabatic logic, peripheral circuits, Dynamic voltage and frequency scaling.			CO3
	Unit 4	**Low power VLSI Techniques**			
	A	Introduction to pipelining and parallelism, VTCMOS, MTCMOS			CO3,CO4
	B	Reducing glitching through path balancing, clock gating, Power gating,			CO3,CO4
	C	Signal isolation, state retention and restoration, architectural issues for power gating, gate reorganization			CO3,CO4
	Unit 5	**Estimation and optimization**			
	A	Switching activity estimation in static and dynamic logic, Signal statistics, intersignal correlations, Reducing switching capacitance through transistor sizing, logic and architecture optimization,			CO4
	B	layout techniques, logic restructuring, input ordering, data representation, resource allocation, Behavioral level transforms, algorithm level transforms, architectural transformations			CO4
	C	Operation reduction and substitution, logic level optimization and technology mapping			CO4
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	*N. Weste and D. Harris, "CMOS VLSI Design: A Circuits and Systems Perspective", Third edition Addison Wesley, 2005*			

	Other References	• *Anantha Chandrakasan, Robert Brodersen, "Low-power CMOS design", IEEE press, 1998.* • *Kaushik Roy, Sharat C. Prasad, "Low-power CMOS VLSI Circuit Design", John Wiley & Sons, 2000.* • *A.Bellamour, M.I.Elmasri, "Low power VLSI CMOS Circuit Design", Kluwer Academic Press, 1995.* • *Naveed Sherwani, "Algorithms for VLSI physical design automation", Kluwer academic publisher – 1993.* *Douglas A. Pucknell & Kamran Eshraghian, "Basic VLSI Design", Prentice-Hall of India.*	

CO , PO & PSO MAPPING:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PSO 1	PS O2
C.EC E616 .1	2	3									1	3
C.EC E616 .2	2	3	2									
C.EC E616 .3	2	1										3
C.EC E616 .4	2	3	2								3	2
ECE 616. 5												3
ECE 616	2	3	2								2	3

School: SET		**Batch : 2019-21**	
Program: M.Tech		**Current Academic Year: 2019-20**	
Branch: VLSI		**Semester:II**	
1	Course Code	ECE 615	
2	Course Title	CMOS Digital VLSI Design, Testing and Verification	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Compulsory	
5	Course Objective	To introduce students to CMOS Digital VLSI design methodologies with emphasis on full-custom chip design. Students will learn IC design, layout simulation, and layout verification. Specific techniques for designing high-speed, low-power, and easily-testable circuits will also be covered.	
6	Course Outcomes	After completing this course students will be able to CO1: Explain the concepts of the MOS transistor and inverter CO2: Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and to verify the functionality, timing, power, and parasitic effects CO3: Create models of moderately sized CMOS circuits that realize specified digital functions CO4: Design static CMOS combinational and sequential logic at the transistor level, including mask layout CO5: Estimate and optimize combinational circuit delay using RC delay models and logical effort CO6: Understand the concepts of testing and verifying a VLSI chips.	
7	Course Description	This course provides an introduction to the design and implementation of VLSI circuits for complex digital systems. The focus is on CMOS technology. Issues to be covered include deep submicron design, clocking, power dissipation, CAD tools and algorithms, simulation, verification, testing, and design methodology. The course includes a computer lab component in which you will design and lay out a small 4-bit microprocessor	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to MOSFET**	
	A	MOS Transistor: I-V Characteristics, MOSFET Scaling and Small-Geometry Effects.	CO1
	B	The MOS Inverter: Inverter principle, Depletion and enhancement load inverters,	CO1
	C	The MOS Inverter: the basic CMOS inverter, transfer characteristics, logic threshold, Noise margins, and	CO1,CO2
		Dynamic behavior, Propagation Delay, Power Consumption.	
	Unit 2	**MOS Layout and Simulation**	
	A	MOS SPICE model, device characterization, Circuit	CO2,CO3

		Characterization interconnects simulation.			
	B	MOS device layout: Transistor layout, Inverter layout			CO2,CO3
	C	CMOS digital circuits' layout & simulation.			CO2,CO3
	Unit 3	**Combinational and dynamic logic styles**			
	A	Combinational MOS logic design: Complementary MOS, Ratioed logic, Pass Transistor logic			CO4,CO5
	B	complex logic circuits.			CO4,CO5
	C	Dynamic MOS design: Dynamic logic families and performances.			CO4,CO5
	Unit 4	**Sequential Logic design**			
	A	Sequential MOS Logic Design: Static latches; Flip flops & Registers,			CO4,CO5
	B	Dynamic Latches & Registers, CMOS Schmitt trigger,			CO4,CO5
	C	Monostable sequential Circuits, Astable Circuits. Memory Design: ROM & RAM cells design			CO4,CO5
	Unit 5	**Testing and verification**			
	A	Scope of testing and verification in VLSI design process, Issues in test and verification of complex chips, embedded cores and SOCs			CO6
	B	Testing: Fundamentals of VLSI testing Fault models. Automatic test pattern generation, Design for testability, Scan design, Test interface and boundary scan. System testing and test for SOCs. Delay fault testing.			CO6
	C	BIST for testing of logic and memories, Test automation, Verification: Functional verification, Timing verification, Formal verification, Basics of equivalence checking and model checking.			CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	*M. Bushnell and V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2000.*			
	Other References	*M. Abramovici, M. A. Breuer and A. D. Friedman, " Digital Systems Testing and Testable Design", IEEE Press, 1990.* *T.Kropf, "Introduction to Formal Hardware Verification", Springer Verlag, 2000.* *Weste, Eshraghian, "Principles of CMOS VLSI design", 2nd Edition Addison Wesley, 1994.* *Douglas A Pucknell and Kamaran Eshragian, "Basic VLSI design ", 3rd edition, PHI, 1994.*			

CO , PO & PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
.ECE615.1	3	1	2								1	3	
ECE615.2	1	2										3	
ECE615.3	3	1	1										
ECE615.4	2	2	3									3	
ECE615.5	2	1									1	2	
ECE615.6		3	1									2	
ECE615	2	3	2								2	3	

Branch: VLSI Technology		Semester:II	
1	Course Code	ECE 617	
2	Course Title	**Mixed Signal CMOS VLSI Design**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Compulsory	
5	Course Objective	The aim of this course is to provide an understanding of, and experience with, the basic design concepts for mixed signal VLSI circuits in CMOS technology.	
6	Course Outcomes	After completing this course students should be able to CO1: Design logic circuit layouts for both static CMOS and dynamic clocked CMOS circuits and Extract the analog parasitic elements from the layout and analyze the circuit timing using a logic simulator and an analog simulator. CO2: Build a cell library to be used by other chip designers and Analyze VLSI circuit timing using Logical Effort analysis. CO 3: Design elementary data paths for microprocessors, including moderate-speed adders, subtracters, and multipliers and Estimate and compute the power consumption of a VLSI chip and Assemble an entire chip and add the appropriate pads to a layout CO4 Explain the chip technology scaling process and Explain the basic design concepts for low power mixed signal VLSI circuits in CMOS technology. CO5: To understand the concept of Data converters.	
7	Course Description	This course builds the advanced CMOS analog IC design. The course is intended to teach undergraduate and graduate students. This course focuses on the concepts of mixed signal VLSI design. The course will give practical aspect of mixed signal VLSI blocks such as comparators, data converters, oscillators and phase locked loop. As a part of this course, the students will use industry standard software and tools such as Cadence's Virtuoso schematic, Spectre simulator and Mentor Graphics' Eldo and Calibre for post layout simulations along with the parasitic extractions. The design problems given in the form of assignments will be designed and simulated in a standard CMOS technology by students. The study will cover design issues on the PVT variations and statistical mismatches in temperature and process (Monte Carlo).	
8	Outline syllabus		CO Mapping
	Unit 1	**Current mirrors**	
	A	simple cmos current mirror, common source	CO1
	B	common gate amplifier with current mirror active load	CO1
	C	source follower with current mirror to supply bias current	CO1
	Unit 2	**Single stage and Muti-stage amplifiers**	

	A	Two stage CMOS operational amplifier, feedback and operational amplifier compensation			CO3
	B	advanced current mirrors, folded-cascade operational amplifier, current mirror operational amplifier			CO2,CO3
	C	fully differential operational amplifier, common mode feedback circuits, current feedback operational amplifier. Comparator, charge injection error, latched comparators			CO3
	Unit 3	**S/H and switched capacitor circuits**			
	A	MOS, CMOS and BIMOS			CO2
	B	sample and hold circuits ,switched capacitor circuits, basic operation and analysis first order, charge injection			CO2,CO4
	C	Switched capacitor gain circuit , correlated double sampling techniques, other switched capacitor circuits.			CO2
	Unit 4	**PLL**			
	A	Basic PLL topology, dynamics of simple PLL, Multiplier,			CO3
	B	EXOR and JK –flipflop phase detectors, lock acquisition			CO3
	C	Phase frequency detector, Loop filters, Charge Pump PLLs, non ideal effects in PLLs.			CO3
	Unit 5	**Data converters**			
	A	DC and dynamic specifications, quantization noise , Nyquist rate D/A converters, decoder based converters – binary scaled converters thermometer code converters , hybrid converters			CO4
	B	Nyquist rate A/D converters-Successive approximation, Flash, interpolating, Folding, Pipelined, Time-interleaved converters, Oversampling converters,			CO5
	C	Noise shaping modulators, Decimating filters and interpolating filters, Higher **order** modulators, Delta Sigma modulators with multibit quantizes- Delta Sigma D/A			C04,CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	*1. Behzad Razavi, "Design of Analog CMOS Integrated Circuit", Tata-Mc GrawHill, 2002.* *2. Rudy van de Plassche, "CMOS Integrated Analog to Digital and Digital to Analog Converters", Kluwer academic publishers, 2003*			
	Other References	*1.David Johns, Ken Martin, "Analog Integrated Circuit Design", John Wiley and Sons, 2001.* *2. D.A. John and Ken Martin, "Analog Integrated Circuit Design", John Wiley, 1st Edition, 1996.* *3. Mohamed Ismail, "Analog VLSI", Mc Graw Hill, 1st Edition, 1994*			

CO , PO & PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE617.1	2	3	2									2	
ECE617.2	2	3	2									2	
ECE617.3	2	1										2	
ECE617.4	2	3	2									3	
ECE617.5	2	3	2									3	
ECE617	2	3	2									3	

School: SET	**Batch : 2019-21**	
Program: B.Tech.	**Current Academic Year: 2019-20**	
Branch: ECE	**Semester:2**	
1	**Course Code**	**ECE827**
2	**Course Title**	**Advanced VLSI Using Verilog**
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Compulsory
5	Course Objective	The objectives of this subject are 1. To make the student understand advanced digital system design. 2. To understand HDL based IC design. 3. To understand Verilog programming. 4. To understand high level synthesis.

		5. To understand verification using Verilog HDL.	
6	Course Outcomes	Upon successful completion of this subject, students should be able to: CO1: Write efficient Verilog programme CO2: Design advanced digital system using Verilog HDL. CO3: Design FSM based system. CO4: Understand STA and high-level synthesis. CO5: Understand static timing analysis CO6: VLSI project using EDA software.	
7	Course Description	This course covers the systematic design of advanced digital systems using field-programmable gate arrays (FPGAs). The emphasis is on top-down design starting with a software application, and translating it to high-level models using a hardware description language (such as VHDL or Verilog). The course will focus on design for high-performance computing applications using streaming architectures.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	**VLSI Design** VLSI Design flow: Full Custom, ASIC and FPGA, VLSI CAD Tools: Applications of Simulation,SynthesisTools. Introduction to Hardware description languages (HDL)	CO1
	B	**Verilog HDL:**Abstraction levels, basic concepts, Verilog primitives, keywords, data types, nets and registers, Verilog MODULEs and ports; Lab Practice: Xilinx tool flow: simulation and synthesis	CO1
	C	**Verilog Operators :**Logical operators, Bitwise and reduction operators, Concatenation and conditional operators, Relational and arithmetic, Shift and equality operators, Operator execution order, Lab practice	CO1
	Unit 2		
	A	**Assignments:** Types of assignments, Continuous assignment,Proceduralassignments, Blocking and non-blocking assignments, Tasks and functions, Lab Practice	CO2
	B	**Verilog modeling**: gate type, design hierarchy, gate delay, propagation delay, logic simulation Dataflow-level modeling: assignments, Behavioralmodeling: Always block, FlowControl, If-else, case, case, while loop, for loop, repeat	CO2
	C	**Verilog for verification:**Design verification and testing,Testbenchwriting,Initialstatement, Verilog	CO2

		system tasks: $finish, $stop, $display, $monitor, $time, $realtime, $random, $save, $readmemh/$writememh, $fopen, $fclose, Compiler directives,ifdef, Array, multi-dimensional array. Memory modelling Lab practice			
	Unit 3				
	A	**Combinational Logic Circuit Design:** Logic synthesis, RTL synthesis, high-level synthesis, synthesis design flow, Design and analysis of combinational circuits, Synthesis of combinational circuits, Arithmetic circuits, Initial design and optimization.			CO3
	B	Encoder, decoder, de-multiplexer circuits, multiplexer circuits and their implementation using Verilog, Design of a 4-bit comparator, Design of a 32-bit ALU and a simple processor using Verilog. Lab Practice			CO3
	C	**Sequential Logic Circuit Design:** Synthesis of sequential circuits, Study of synchronous and asynchronous sequential circuits, Flip flops, ShiftRegisters,Counters and their design using Verilog. Lab practice			CO3
	Unit 4				
	A	**State Machine:** Basic Finite state machines (FSM) structures, Mealy and Moore type FSM, Mealy vs.Moore,Common FSM coding style,Serial adder design using FSM,			CO4
	B	FSM as an Arbiter circuit, FIFO, bus interfaces, Lab practice			CO4
	C	**High-level synthesis:** Basic concepts of high-level synthesis,Partitioning, scheduling,Allocation and binding, Technology mapping,			CO4
	Unit 5				
	A	**Static Timing Analysis:** Introduction to Static Timing Analysis, Timing path and constraints,Types of clock, Clock domain and variation, Clock distribution networks, How to fix timing failure?			CO5
	B	**Synthesis Coding Styles:** Registers in Verilog, Unwanted latches,RTL coding styles,Lab practice			CO5
	C	**Verilog Mini Projects:** Project specification analysis, Understanding the architecture, MODULE level implementation and verification, Building the top level MODULE,FPGA implementation of the design.			CO5,CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	

	Text book/s*	1. Verilog HDL: A Guide to Digital Design and Synthesis; Samir Palnitkar; 2nd edition, Pearson Education, 2011. 2. Verilog Digital System Design; ZainalabedinNavabi; 2nd edition, TMH,2012. 3. Advanced Chip Design: Practical Examples in Verilog, Kishore Kumar Mishra, CreateSpace Independent Publishing Platform	
	Other References	1. Verilog HDL Synthesis: A Practical Primer; J. Bhasker, BSP Publishers, 2008. 2. FPGA-Based System Design, Wayne Wolf, 1st edition, Pearson. 3. Advanced Digital Design with the Verilog HDL; Michael D. Ciletti; 2009,1st edition, PHI,2010	

Course Articulation Matrix

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO827.1	3	3	2	3	1	-	-	-	-	-	2	2
CO827.2	3	3	3	1	3	-	-	-	-	-	3	3
CO827.3	3	3	3	2	3	-	-	-	-	-	3	3
CO827.4	3	3	3	2	3	-	-	-	-	-	3	3
CO827.5	3	2	3	2	3	-	-	-	--	-	2	2
CO827.6	3	2	3	2	3	-	-	-	--	-	2	2
CO827	3	3	3	2	3	-	-	-	-	-	3	3

School: SET	**Batch : 2019-21**
Program: B.Tech.	**Current Academic Year: 2019-20**
Branch: ECE	**Semester:02**

1	**Course Code**	**ECP827**	
2	**Course Title**	**Advanced VLSI using VERILOG Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	The objectives of this subject are 1. To make the student understand advanced digital system design. 2. To understand HDL based IC design. 3. To understand Verilog programming. 4. To understand high level synthesis. 5. To understand verification using Verilog HDL.	
6	Course Outcomes	Upon successful completion of this subject, students should be able to: CO1: Write efficient Verilog programme CO2: Design advanced digital system using Verilog HDL. CO3: Design FSM based system. CO4: Understand STA and high-level synthesis. CO5: Understand static timing analysis CO6: VLSI project using EDA software.	
7	Course Description	This course covers the systematic design of advanced digital systems using field-programmable gate arrays (FPGAs). The emphasis is on top-down design starting with a software application, and translating it to high-level models using a hardware description language (such as VHDL or Verilog). The course will focus on design for high-performance computing applications using streaming architectures.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	FPGA based design flow using EDA software: simulation and synthesis	CO1
	B	Realization of Verilog operators and assignments.	CO1
	C	Implementation of different Verilog tasks and functions.	CO1
	Unit 2		

	A	Writing test bench for digital circuits and simulation	CO2
	B	Design and implementation of combinational circuits (adder, decoder) in gate level	CO2
	C	Design and implementation of multiplexer and comparator circuits in data-flow level	CO2
	Unit 3		
	A	Implementation of multiplexer, decoder in Behavioural level	CO3
	B	Design and implementation of ALU	CO3
	C	Implementation of D-FF and JK FF in behavioral level	CO3
	Unit 4		
	A	Design and implementation of shift register.	CO4
	B	Design and implementation asynchronous counter.	CO4
	C	Design and implementation of synchronous counter.	CO4
	Unit 5		
	A	Design and implementation of sequence detector in FSM	CO5
	B	Design and implementation of traffic light signal system in FSM	CO5
	C	**Minor Project**	CO5,CO6
	Mode of examination	Practical	
	Weightage Distribution	CA: 60% / ETE: 40%	
	Text book/s*	1. Verilog HDL: A Guide to Digital Design and Synthesis; Samir Palnitkar; 2nd edition, Pearson Education, 2011. 2. Verilog Digital System Design; ZainalabedinNavabi; 2nd edition, TMH,2012. 3. Advanced Chip Design: Practical Examples in Verilog, Kishore Kumar Mishra, CreateSpace Independent Publishing Platform	
	Other References	4. Verilog HDL Synthesis: A Practical Primer; J. Bhasker, BSP Publishers, 2008. 5. FPGA-Based System Design, Wayne Wolf, 1st edition, Pearson. 6. Advanced Digital Design with the Verilog HDL;	

		Michael D. Ciletti; 2009,1st edition, PHI,2010	

Course Articulation Matrix

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
CO827.1	3	3	2	3	1	-	-	-	-	-	2	1
CO827.2	3	3	3	1	3	-	-	-	-	-	3	3
CO827.3	3	3	3	2	3	-	-	-	-	-	3	3
CO827.4	3	3	3	2	3	-	-	-	-	-	3	3
CO827.5	3	2	3	2	3	-	-	-	--	-	2	3
CO827.6	3	2	3	2	3	-	-	-	--	-	2	3
CO827	3	3	3	2	3	-	-	-	-	-	3	3

School: SET		**Batch: 2019-21**	
Program: M.tech		**Current Academic Year: 2019-20**	
Branch: ECE		**Semester: II**	
1	Course Code		
2	Course Title	Electronics CAD Lab	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
	Course Status	Compulsory	
5	Course Objective	Objective is to make students prominent with the CAD tools and analysis practices.	
6	Course Outcomes	After the completion of lab students will be able to CO1:Design and analyze combinational logic circuits in ORCAD SPICE. CO2:Design & analyze various types of Inverters. CO3:To use various conditional statements of VHDL. CO4:To design and analyze layout of basic circuits.	
7	Course Description	This course will cover transistor and circuit-level aspects of digital integrated circuit design. Major topics will include: (a) logic gate design at the transistor level, (b) design and optimization of sequential systems and (c) physical design of integrated circuits, i.e. how to translate your transistorlevel designs into "blueprints" that can be used by fabrication engineers to build your design. The laboratory component of the course will use an industrial-grade CAD tool (Cadence) for schematic entry and simulation of your circuits, and for physical design, and will culminate in a group design project.	
8	Outline syllabus		CO Mapping
	Unit 1	**Practical based on SPICE simulation**	
	A	Transient analysis and simulation of CMOS inverter	CO1
	B	Transient and simulation analysis of NAND gate.	CO1
	C	Transient and simulation analysis of	CO1

		neither CMOS nor gate.			
	Unit 2	**Practical related to Various inverter Design**			
	A	Transient analysis and simulation of resistive load inverter.			CO1, CO2
	B	Transient analysis and simulation of NMOS inverter.			CO1, CO2
	C	Transient analysis and simulation of BJT inverter.			CO1, CO2
	Unit 3	**Practical related to various VHDL statements**			
	A	Design of 4:1 multiplexer using "with" statement			CO3
	B	Design of 4:1 multiplexer using "when" statement.			CO3
	C	Design of 4:1 multiplexer using "case" statement.			CO3
	Unit 4	**Practical related to Combinational logic design**			
	A	Design D flip-flop with "reset using VHDL".			CO3
	B	Design full adder using half adder for structural modelling.			CO3
	C	Design of 4-bit ripple carry adder using full adder as a component for structural modelling.			CO3
	Unit 5	**Practical related to Layout design**			
	A	Layout Design of NMOS and CMOS Inverter using Layout Generator.			CO4
	B	Layout Design of Two Input NAND Gate using Layout Generator.			CO4
	C	Cascade of two enhancement load NMOS inverter circuits using SPICE.			CO4
	Mode of examination	Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	SPICE for Circuits and Electronics Textbook by Muhammad H. Rashid			
	Other References	1. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002. 2. Charles Roth, "Digital System			

		Design using VHDL", Tata McGraw Hill 2nd edition 2012.	

School: SET **Batch : 2019-21** **Program: M.Tech** **Current Academic Year: 2019-20** **Branch:ECE** **Semester:II**			
1	Course Code	ECE811	
2	Course Title	**Communication Technology and System**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Compulsory	
5	Course Objective	• To provide students an understanding of analog and digital communication. • To understand multiplexing and multiple access techniques. • To implement the block of OFDM	
6	Course Outcomes	CO1: Enhancement of knowledge foranalog and digital communication CO2: understand multiplexing and multiple access techniques CO3: understand the basic concepts of OFDM CO4: implement OFDM system CO5:understand Long Term Evolution	
7	Course Description	In this course, The fundamentals of communication system like analog and digital modulation are explored. The various multiple access techniques which are used in telephony and other communication field are discussed. Some new technology like OFDM and LTE advanced, which are the core technology for now a days 3G and 4G telephony are discussed in detail with their architecture and area of application. The course will also include the Case study on OFDM, in which student can implement the OFDM practically and can use it for real time applications.	
8	Outline syllabus		CO Mapping
	Unit A	**Basics of Communication System**	
	Unit A Topic 1	Review of Analog Modulation Techniques	CO1
	Unit A	Pulse Code Modulation, Differential Code	CO1

	Topic 2	Modulation, Delta Modulation, Adaptive Delta Modulation			
	Unit A Topic 3	Digital Modulation Techniques: ASK, FSK,PSK, QPSK, DPSK			CO1
	Unit B	**Multiplexing and Multiple Access Techniques**			
	Unit B Topic 1	Time Division Multiplexing(TDM),Frequency Division Multiplexing(FDM)			CO2
	Unit B Topic 2	Multiple Access Techniques, TDMA, FDMA, SDMA, PDMA			CO2
	Unit B Topic 3	Spread Spectrum Technique, Use in CDMA			CO2
	Unit C	**Orthogonal Frequency Division Multiplexing**			
	Unit C Topic 1	Concept of MIMO, Importance of orthogonality, Comparision of FDM and OFDM,OFDM Transmitter, Orthogonality of Sub Carriers, Multipath Effect, Frequency Selective Fading, ISI, Cyclic Prefix			CO3
	Unit C Topic 2	Packet detection, Synchronization, Carrier Frequency Offset(CFO), Sampling Frequency Offset(SFO),Data Aided Phase Track			CO3
	Unit C Topic 3	Complete diagram of OFDM Transmitter and Receiver,			CO3
	Unit D	**Case Study on OFDM**			
	Unit D Topic 1	Analog OFDM System Implementation			CO4
	Unit D Topic 2	Simple OFDM implementation using FFT transforms			CO4
	Unit D Topic 3	802.11a OFDM Signal implementation			CO4
	Unit E	**Long Term Evolution**			
	Unit E Topic 1	Overview, Basic Parameters, Network Architecture, Roaming Architecture			CO5
	Unit E Topic 2	Numbering and Addressing, Radio Protocol Architecture, Protocol Stack Layers			CO5
	Unit E Topic 3	Layer Data Flow ,Communication channels, OFDM Technology			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	

	Text book	1. Simon Haykin, "Digital Communication", Wiley Publication, 2nd Edition 2. Yong Su Chu, "OFDM Wireless Communication using MATLAB", Wiley Publication, 20101. 3. StefaniaSesia, "LTE-The UMTS Long Term Evolution: From Theory to Practice", Wiley Pub.,2nd Ed.	
	References	B.P.Lathi, Zhi Ding, Hari M. Gupta, Modern Digital and Analog Communication Systems, oxford publication, 1st Edition.	

CO , PO & PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE811.1	2	1	1	2	2	2	2	2	1	1			2
ECE811.2	2	1	3	2	3	2	2	2	1	2			2
ECE811.3	2	2	1	2	2	2	1	2	1	2			1
ECE811.4	3	2	1	2	1	2	2	1	1	1			3
ECE811.5	3	2	3	2	2	2	2	3	1	1			2
ECE811	3	2	2	2	2	2	2	2	1	2			3

School: SET **Batch : 2019-21** **Program: MTECH** **Current Academic Year: 2019-20** **Branch:All** **Semester:I**		
1	Course Code	ECE814
2	Course Title	**Emerging Electronics Technologies**
3	Credits	
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Compulsory
5	Course Objective	• To make students familiar with different solid state light emitters and detectors. • To define different Acoustic transduction and different acoustic transducers. • To explain Eye anatomy and eye optics, Color vision basics . • To illustrate concepts of LED, LCD, OLED. • To illustrate various MAC protocols like GSM, Spread spectrum, CDMA, TDMA & Basic electronics components. Handset Specific operating systems • To explain Working principle of mobile handset & Components used in mobile handsets . • To illustrate Comparison of the essential characteristics of Android and iOS.
6	Course Outcomes	CO1: able to understand functioning of various optoelectronic devices and underlying principles. CO2: able to understand and differentiate among various acoustic systems. CO3: able to understand working principles of various display devices. CO4: able to understand Generations of mobile phones, CO5:able to handle hardware components of mobile handset and OS used in mobiles.
7	Course Description	In this course, the fundamentals of Optoelectronics like region of optical radiation, visible light and basic devices like LASER and LED etc. are described in detail. Basics of Acoustic engineering like vibration, acoustic, transmission and absorption are also explored .After that various display systems like LED, LCD and OLED are also described with their area of application. In subsequent chapter basic of generation of telephony like GSM, CDMA are discussed followed by the description of technology behind the Smart phone. At last the various operating systems used in smartphone's like Android and iOS are discussed in details. Comparative analysis of two OS is also done.

		Learning may be supplemented with periodic guest lectures by embedded systems engineers from industry.			
8	Outline syllabus				CO Mapping
	Unit A	**Optoelectronics**			
	Unit A Topic 1	The region of optical radiation and its properties, visible light emitting diodes, light emitting diodes, semiconductor diodes.			CO1
	Unit A Topic 2	Laser diodes, photo detection, photomultiplier, semiconductor photodiode.			CO1
	Unit A Topic 3	Schottky photodiode, CD records reader, laser printer, data transmission.			CO1
	Unit B	**Acoustics Engineering**			
	Unit B Topic 1	Fundamentals of vibration and acoustic wave equation.			CO2
	Unit B Topic 2	Transmission, absorption and attenuation of sound. Room and architectural acoustics.			CO2
	Unit B Topic 3	Acoustic transduction and different acoustic transducers.			CO2
	Unit C	**Display Technology**			
	Unit C Topic 1	How applications have been driving display developments? Evolution of display technology.			CO3
	Unit C Topic 2	Eye anatomy and eye optics, Color vision basics.			CO3
	Unit C Topic 3	Display system fundamentals and performance parameters-LED, LCD, OLED.			CO3
	Unit D	**Smartphone handset**			
	Unit D Topic 1	Introduction to mobile phones, Generations of mobile phones, FHSS networks.			CO4
	Unit D Topic 2	GSM, Spread spectrum, CDMA, TDMA & Basic electronics components. Handset Specific operating systems, Handset features & applications			CO4
	Unit D Topic 3	Working principle of mobile handset & Components used in mobile handsets.			CO4
	Unit E	**Smartphone OS**			
	Unit E Topic 1	Major features and functionalities of the Android and iOS OSs (Operating Systems) based on the Programming Language, Source model.			CO5
	Unit E Topic 2	Internet Browsing, Voice Commands, Video Chat, App Store, and Mobile Payments.			CO5
	Unit E Topic 3	Comparison of the essential characteristics of Android and iOS.			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	

	Text book	1.S.C.Gupta, Optoelectronics Devices and Systems, 3rd Edition, Prentice Hall India. 2. S.W. Rienstra& A. Hirschberg, "An Introduction to Acoustics". 3. Vinod Kumar Khanna,"Fundamentals of Solid-State Lighting", CRC Press.	
	References	*Joseph Annuzzi, Jr. Lauren Darcey Shane Conder, Introduction to Android Application Development, Fourth Edition, Addision Wesley.*	

CO , PO & PSO MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
ECE814.1	2	1	1	2	2	2	2	2	1	1			2
ECE814.2	2	1	3	2	3	2	2	2	1	2			2
ECE814.3	2	2	1	2	2	2	1	2	1	2			1
ECE814.4	3	2	1	2	1	2	2	1	1	1			3
ECE814.5	3	2	3	2	2	2	2	3	1	1			2
ECE814	3	2	2	2	2	2	2	2	1	2			3

School: SET **Batch : 2019-21** **Program: M.TECH** **Current Academic Year: 2019-20** **Branch: Embedded System** **Semester:I**			
1	Course Code	ECE815	
2	Course Title	**Method for Product Development for Electronics Subsystems**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Compulsory /Elective/Open Elective	
5	Course Objective	To understand the various processes and systems to address human needs by creating tangible Electronic Products. To pursue learners with emphasis on learning-by-doing and following a comprehensive process of design, engineering and producing products and systems	
6	Course Outcomes	**On a successful completion of this course students will be able to** C0 1. Design electronic products using user centered design process CO2. Develop sketches, virtual and physical appearance models to communicate proposed designs CO3. Refine product design considering engineering design & manufacturing requirements and constraints. CO4. Make mock-up model and working prototype along with design documentation CO5. Understand Manufacturing Setup including Test Setup	
7	Course Description	Product development and design processes and methods, including product specifications, concept development, engineering drawings, design for prototyping, and manufacturing	
8	Outline syllabus		CO Mapping
	Unit 1	**Concept: Product Development from Concept through Manufacturing**	
	A	The stage of idea for a new product, a variation on an existing product,	CO1, CO2
	B	The identification of a need for an undefined product causes	CO1, CO2
	C	Research to define a product, a market, and an approach for manufacturing this product.	CO1, CO2
	Unit 2	**Research & Circuit Design**: **Gated Product**	

		Development Process & Requirements and Conceptual Design			
	A	Stage for product concept, identifying the technology, methods, and vendors involved in producing the product..			CO1, CO3
	B	The stage for detailed design specification: used to cost the design process, the estimated manufactured cost of the product.			CO1, CO3
	C	Stage for a schematic diagram (usually via computer drafting software) and a preliminary parts list for costing and prototyping the product.			CO1, CO3
	Unit 3	**Packaging and Printed Circuit Design**			
	A	Stage to design, suitable enclosure designed or selected. Selection, connectors, controls, and displays printed circuit layout commences. First step in designing printed circuits, the mechanical pattern or outline of the board assembly itself.			CO4
	B	.The mechanical drawing ,drawing supplied by the manufacturer. Nomenclature and graphics of designed, labels, overlays, silk screens, or a combination.			CO4
	C	Processing of the printed circuit artwork, used by a manufacturer to etch printed circuit boards for the board assembler.			CO4
	Unit 4	**Prototyping or Trial Production & Design Review**			
	A	Schematic design. Electrical stimulation. PCB placement, routing, and BOM check.			CO3.CO1
	B	Firmware and software development, Mechanical design. Industrial design.			CO3.CO1
	C	Testing and analysis, Prototype ,Design verification/validation			CO3.CO1
	Unit 5	Manufacturing Setup including Test Setup & Documentation &Manufacturing and Supply Chain Management**:**			
	A	Component Procurement. Quick Turn Prototyping Design for Manufacturability (DFMA).Design for Testability (DFTA) Regulatory Compliance Testing, Analysis, and Certification			CO5
	B	Custom Enclosure Development Quality and Reliability Assurance Functional Test Fixture Requirements and Design			CO3.CO5
	C	Documentation, Agency Compliance Follow-up.			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	

	Text book/s*	Cross N. "Engineering Design Methods: Strategies for Product Design", Willey.(2000) Otto K. and Wood K., "Product design: Techniques in Reverse Engineering and New Product development ", Prentice Hall. (2001) Chakrabarty D., "Indian Anthropometric Dimensions for Ergonomic Design Practice", NID, Ahmedabad(1999). . Norman D. A. , "The design of everyday things, Basic Books."(2002	
	LINKS	https://www.industrologic.com/gtepdad.htm http://www.stilwellbaker.com/capabilities/electronic-product-development	

CO , PO & PSO MAPPING:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2	PSO 3
ECE815.1	2	1	1	-	2	-	1	1	1	1	2		1
ECE815.2	2	2	1	-	2	-	1	2	1	1	3		2
ECE815.3	3	1	1	-	2	-	1	2	1	1	2		2
ECE815.4	2	2	1	-	2	-	1	3	1	1	1		2
ECE815.5	2	2	1	-	2	-	1	3	1	1	1		2
ECE815	3	2	1		2		1	3	1	1	2		2

School: SET		**Batch : 2019-21**	
Program: M.Tech		**Current Academic Year: 2019-20**	
Branch: ECE		**Semester: II**	
1	Course Code	ECE824	
2	Course Title	Sensors and Network	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Department Elective	
5	Course Objective	1. Knowledge of mobile ad hoc networks, design and implementation issues, and available solutions. 2. Knowledge of routing mechanisms and the three classes of approaches: proactive, on-demand, and hybrid. 3. Knowledge of clustering mechanisms and the different schemes that have been employed, e.g., hierarchical, flat, and leaderless. 4. Knowledge of the 802.11 Wireless LAN (WiFi) and Bluetooth standards. This includes their designs, operations, plus approaches to interoperability.	
6	Course Outcomes	After completion of this course student will able to: CO1: Identify emerging research areas in the field of sensor networks CO2: Identify the issues and challenges in WSN CO3: make use of MAC protocols for communication in WSN CO4: Explore various dissemination protocols for WSN CO5: analyse the design principles of wireless sensor networks for a given application CO6: Design wireless sensor networks for a various application	
7	Course Description	A wireless sensor network (WSN) generally consists of compact low power sensors, which collect information and pass the information via wireless networks to achieve a high level of desired monitoring and control in coordinated manners. WSN applications can be found in areas such as environmental monitoring, smart energy systems, battle field surveillance, home automation, medical monitoring, mobile computing, etc. WSN has integrated network engineering, embedded system engineering and sensor technology.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Sensor Networks**	
	A	Introduction to Sensor Networks, unique constraints and challenges	CO1, CO2
	B	Advantage of Sensor Networks, Applications of Sensor Networks	CO1
	C	Types of wireless sensor networks	CO1
	Unit 2	**Issues and challenges in wireless sensor networks**	

	A	Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks			CO1, CO3
	B	Enabling technologies for Wireless Sensor Networks			CO1, CO3
	C	Issues and challenges in wireless sensor networks			CO1
	Unit 3	**Routing protocols**			
	A	Routing protocols, MAC protocols: Classification of MAC Protocols,			CO2
	B	S-MAC Protocol, B-MAC protocol,			CO2
	C	IEEE 802.15.4 standard and Zig Bee			CO2
	Unit 4	**Dissemination protocol for large sensor network**			
	A	Dissemination protocol for large sensor network. Quality of a sensor network			CO3
	B	Data dissemination, data gathering, and data Fusion			CO3
	C	Real-time traffic support and security protocols.			CO3
	Unit 5	**Design Principles for WSNs**			
	A	Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication			CO4
	B	Single-node architecture, Hardware components & design constraints			CO4
	C	Operating systems and execution environments, introduction to TinyOS and nesC.			CO4
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Waltenegus Dargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks Theory And Practice”, By John Wiley & Sons Publications ,2011			
	Other References	1. Sabrie Soloman, “Sensors Handbook" by McGraw Hill publication. 2009 2. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, Elsevier Publications,2004 3. Kazem Sohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Inter science 4. Philip Levis, And David Gay "TinyOS Programming” by Cambridge University Press 2009			

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3

ECE824.1	1	-	-	1	-	1	-	-	-	-	1	-	-	1	-
ECE824.2	1	-	-	1	-	1	-	-	-	-	1	-	-	2	-
ECE824.3	2	-	-	2	1	2	1	-	-	-	1	-	2	2	-
ECE824.4	2	-	1	3	1	1	3	-	-	-	2	-	2	2	2
ECE824.5	1	1	3	3	2	1	3	-	-	-	3	1	3	3	3
ECE824.6	3	1	3	3	2	1	3	-	-	-	3	1	3	3	3
ECE824															

School: SET **Batch : 2019-21** **Program: MTECH** **Current Academic Year: 2019-20** **Branch:ECE** **Semester:I/II**		
1	Course Code	ECE825
2	Course Title	**Embedded Architecture and Programming**
3	Credits	5
4	Contact Hours (L-T-P)	3-0-4
	Course Status	Compulsory
5	Course Objective	• Embedded Systems and design issues • Advanced Computer Architecture • Embedded System Installation/ Configuration using AVR microcontroller • Development of Embedded Firmware using AVR microcontroller

		• Troubleshooting and Maintenance of embedded system	
6	Course Outcomes	CO1:Explain Embedded Systems and design issues CO2:Apply and illustrate advanced Computer architecture CO3:Embedded System Installation/ Configuration using AVR microcontroller CO4:Development of Embedded Firmware using AVR microcontroller CO5: Apply Embedded tools in Real Time Applications	
7	Course Description	In this course, the fundamentals of embedded system hardware and firmware design will be explored. Issues such as embedded processor selection, hardware/firmware partitioning, glue logic, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging will be discussed. The Intel 8051, a very popular microcontroller family, will be studied. The architecture and instruction set of the microcontroller will be discussed, and a wire wrapped microcontroller board will be built and debugged by each student. The course will culminate with a significant final project which will extend the concepts covered earlier in the course. Learning may be supplemented with periodic guest lectures by embedded systems engineers from industry	
8	Outline syllabus		CO Mapping
	Unit –A	**Embedded Systems**	
	Unit A Topic 1	Introduction of Embedded Systems, Embedded Design development life cycle	CO1, CO2
	Unit A Topic 2	Embedded Systems Design Issues, Introduction to Embedded Development tools	CO1
	Unit A Topic 3	Assemblers, Compilers, Linkers, Loaders, Debuggers, Embedded In-Circuit Emulators and JTAG	CO1
	Unit –B	**Advanced Computer Architecture**	
	Unit B Topic 1	RISC architecture, Pipelining, Principles of Pipelined computers	CO1, CO3
	Unit B Topic 2	Parallel Computing, Parallel Computer Model, Flynn's &Feng's Classification Performance Metrics and Measures	CO1, CO3
	Unit B Topic 3	Basic cache structure, Set associative caches, Evaluating Cache performances Determining Cache parameters, Replacement Policies, Implementing LRU	CO1
	Unit –C	**AVR Microcontoller**	
	Unit C Topic 1	Introduction to AVR, Series of AVR controllers	CO2
	Unit C Topic 2	Pin Configuration of AVR, Architecture of AVR,	CO2
	Unit C Topic	Registers of AVR, Different ports and DDR register	CO2

	3				
	Unit –D	**Programming of AVR**			
	Unit DTopic 1	The AVR Instruction Set			CO3
	Unit D Topic 2	Literal and control Operations, Watchdog timer, Interrupts, Timers/ counter			CO3
	Unit D Topic 5	Memory Paging, Addressing modes			CO3
	Unit –E	**CASE STUDY**			CO4
	Unit E Topic 1	Use programming tools Aurdino IDE, Integrated design environments for HW-SW co-design			CO4, CO5
	Unit E Topic 2	Code firmware for Aurdinoboardes			CO4, CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book	1. *Stallings, William, "Computer organization and architecture, designing for performance", Prentice Hall of India.* 2. Gadre, Dhananjay V., 2001, Programming and Customizing the AVR Microcontroller, McGraw-Hill, ISBN: 0-07-134666-X			
	References	1.Morton, John, 2002, AVR: An Introductory Course, 1st Edition, Elsevier ISBN-10: 0-7506-5635-2 (ISBN-13: 978-0-7506-5635-2) 2. Barnett, R., O'Cull, L., Cox, S., 2007, Embedded C Programming for the Atmel AVR, Thompson-Delmar Learning, ISBN: 1-4180-3959-4			

CO , PO & PSO MAPPING:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PSO 1	PSO 2	PSO 3
ECE825.1	2	1	1		2		1	1	1	1	2		1
ECE825.2	2	2	1		2		1	2	1	1	3		2
ECE825.3	3	1	1		2		1	2	1	1	2		2
ECE825.4	2	2	1		2		1	3	1	1	1		2
ECE825.5	2	2	1		2		1	3	1	1	1		2

ECE825	2	2	1		2		1	2	1	1	2		2

School: SET **Batch :2019-21** **Program: M.TECH** **Current Academic Year: 2019-20** **Branch:ES** **Semester:II**			
1	Course Code	ECE 812	
2	Course Title	**Quality Management of Electronic Systems**	
3	Credits		
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Compulsory /Elective/Open Elective	
5	Course Objective	1.This course aims to introduce the need for Quality Management of Electronics Systems 2.explain the need to higher quality the system and components 3.Elaborates system reliability and reliability techniques 4.Challenges of Quality Management	
6	Course Outcomes	After completing this course students should be able to CO1: Explain the mechanism of quality control and its proto type. CO2: Estimate the quality management organization structure and design CO3: Use k-out of n system for analysis of complex reliability structures CO4: Apply the Markovian Techniques for reliability prediction CO5: Application of Quality Management in Real Time Project	
7	Course Description	This course aims to introduce the need for Quality Management of Electronics Systemsand explain the need to higher qualitythe system and components because of the increasing complexities of electronic products.	
8	Outline syllabus		CO Mapping
	Unit 1	**Quality Concepts**	
	A	*Evolution of Quality Control*, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type.	CO1,

	B	*Control on Purchased Product* Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure**.**			CO1
	C	*Manufacturing Quality* Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.			CO1
	Unit 2	**Quality Management**			
	A	Quality Management Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company.			CO2
	B	Economics of quality value and contribution, quality cost, optimizing quality cost, seduction program.			CO2
	C	Human Factor in quality Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.			CO2
	Unit 3	**System Reliability**			
	A	System reliability modeling,			CO3
	B	k-out of n system, analysis of complex reliability structures			CO3
	C	System reliability estimation.			CO3
	Unit 4	**Reliability Techniques**			
	A	Reliability prediction, cut set, tie set, FME set, PTA,			CO4
	B	Markovian Techniques			CO4
	C	Monte Carlo Simulation, application to electronic systems.			CO4
	Unit 5	**Challenges of Quality Management:** A Case Study at Electronics Manufacturing Services Company			
	A	High employee turnover rate due to job dissatisfaction			CO5
	B	Unreliable, slow and inaccurate quality information system			CO3
	C	Wrong perception about quality management			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Lt. Gen. H. Lal, "Total Quality Management", Eastern Limited, 1990. 2. Lewis, "Introduction to reliability engineering", Wiley international, 2nd edition.			
	Other References	1. Greg Bounds, "Beyond Total Quality Management", McGraw Hill, 1994. 2. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992. 3. O'Connor, P.D.T., "Practical reliability engineering", Hayden Book Company.			

CO , PO & PSO MAPPING:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PSO 1	PSO 2	PSO 3
ECE812. 1	2	1	1	-	2	-	1	1	1	1	2		1
ECE812. 2	2	2	1	-	2	-	1	2	1	1	3		2
ECE812. 3	3	1	1	-	2	-	1	2	1	1	2		2
ECE812. 4	2	2	1	-	2	-	1	3	1	1	1		2
ECE812. 5	2	2	1	-	2	-	1	3	1	1	1		2
ECE812	2	2	2		2		1	3	1	1	2		2