

# **Program and Course Structure**

**School of Engineering Technology**

**Department of 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 -2020-2022**

  
HOD-EECE

## **1. Standard Structure of the Program at University Level**

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### **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

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### **Vision of the School**

To become a globally acclaimed institution of higher learning in Digital Communication and 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.

### 1.2.1 Vision and Mission of the Department of Electronics and Communication Engineering

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#### **Vision of the Department**

To establish itself among internationally acclaimed destinations of academic eminence in the discipline of Digital Communication, promoting research, innovation and entrepreneurship, to serve the society.

#### **Mission of the Department**

**M1-** To offer a curriculum of Electronics and Communication Engineering that enables students with knowledge, skills and lifelong learning for exploring professional practices.

**M2-** To foster the students for accepting challenges of industry driven real time problems to provide solutions to meet the globally growing societal needs.

**M3-** To create an environment for multi- and interdisciplinary research, innovations and entrepreneurship among students to serve society with latest technologies

**M4-** To develop core values and professional ethics through counseling as well as mentoring for higher education

### **1.3 Program Educational Objectives (PEO)**

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#### **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:

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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:

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<b>PEO Statements</b>	<b>Department Mission 1</b>	<b>Department Mission 2</b>	<b>Department Mission 3</b>	<b>Department Mission 4</b>
<b>PEO1</b>	3	3	3	3
<b>PEO2</b>	3	2	2	2
<b>PEO3</b>	2	1	3	2
<b>PEO4</b>	1	1	2	1
<b>PEO5</b>	2	2	1	1

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



### 1.3.3 Program Outcomes (PO's)

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- 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 Electronic System Designing and Management

**PSO3:** knowledge and application of recent trends in electronic system design and applications.

### 1.3.4 Mapping of Program Outcome Vs Program Educational Objectives

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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)**

### 1.3.5 The components of the curriculum

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<b>Course Component</b>	<b>Curriculum Content (% of total number of credits of the program)</b>	<b>Total number of contact hours</b>	<b>Total number of credits</b>
AECC	18.05	17	13
DSE	40.27	31	29
SEC	41.66	60	30

AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

### 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
ECE68 7	3	2	2	2	2	2	2	3	1	1	2		
ECE68 4	3	2	1	2	2	2	1	3	1	1	3		
ECE68 5	3	2	1	2	2	2	1	3	1	1	2		
ECE68 8	3	2	2	2	2	2	2	2	2	2	2		
ECE68 6	3	3	2	2	2	2	2	2	2	2	2		
ECE68 9	3	3	2	2	2	2	2	2	2	2	2		
ECE61 6	3	3	2	2	2	2	2	2	2	2	2		
ECE69 1	3	3	2	2	2	2	2	2	2	2	2		
ECE66 7	3	3	2	2	2	2	2	2	2	3	3		
ECE66 7	3	3	2	2	2	2	2	2	2	3	3		
ECE69 0	3	3	2	2	2	2	2	2	2	3	3		
ECE66 9	3	3	2	3	2	2	2	3	2	2	3		
ECE68 4	3	2	2	3	2	1	1	1	1	1	2		
ECE77 1	3	3	2	2	2	2	2	2	2	3	3		
ECE68 7	3	3	2	3	2	2	2	2	3	3	3		
ECE77 3	3	3	2	3	3	2	2	2	3	3	3		
ECE61 8	3	3	2	3	3	2	2	2	3	3	3		
ECE61 9	3	3	2	3	3	3	2	2	3	3	3		
ECE67 0	3	3	2	3	3	2	2	2	3	3	3		
ECE61 5	3	3	2	3	3	2	2	2	3	3	3		

<b>ECE68 5</b>	3	3	2	3	3	2	2	2	3	3	3		
<b>ECE68 7</b>	3	2	2	2	2	2	2	3	1	1	2		
<b>ECE611</b>	2	2	1									2	
<b>ECE612</b>	2	3	2									1	
<b>ECE613</b>	1	2	1	1								2	
<b>ECE614</b>	2	2	1		1							1	
<b>ECE615</b>	2	3	2									3	
<b>ECE616</b>	2	3	2									3	
<b>ECE617</b>	2	3	2									3	
<b>ECE81 1</b>	3	2	2	2	2	2	2	2	1	2			3
<b>ECE81 2</b>	2	2	2		2		1	3	1	1	2		2
<b>ECE81 3</b>	2	2	1		2		1	2	1	1	2		2
<b>ECE81 4</b>	3	2	2	2	2	2	2	2	1	2			3
<b>ECE81 5</b>	3	2	1		2		1	3	1	1	2		2

**1-Slight (Low)**

**2-Moderate (Medium)**

**3-Substantial (High)**

**School of Engineering and Technology**  
**M.Tech in ECE**  
**Batch: 2019-2021**  
**TERM: I**

S. No.	Subject Code	Subjects	Teaching Load			Credits	Pre-Requisite/Co Requisite	Type of Course <sup>1</sup> : 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
<b>Practical/Viva-Voce/Jury</b>								
7.	ECP 684	Discrete Time Signal Processing Lab	0	0	4	2		AECC
<b>TOTAL CREDITS</b>						<b>21</b>		

<sup>1</sup> 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: 2019-2021**  
**TERM: II**

S. No.	Course Code	Course	Teaching Load			Credits	Pre-Requisite/Co Requisite	Type of Course <sup>2</sup> : 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		

<sup>1</sup> 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: 2019-2021**  
**TERM: III**

S. No.	Course Code	Course	Teaching Load			Credits	Pre-Requisite/Co Requisite	Type of Course <sup>3</sup> : 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		

<sup>3</sup> 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: 2019-2021**

**TERM: IV**

S. No.	Course Code	Course	Teaching Load			Credits	Pre-Requisite/Co Requisite	Type of Course <sup>4</sup> : 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		

<sup>4</sup> CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

## 2.1 Syllabus for Theory Subjects

### Computational Methods for Communication

<b>School: SET</b>		<b>Batch : 2018-2022</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year: 2018</b>	
<b>Branch: DC</b>		<b>Semester: I</b>	
1	Course Code	ECE687	
2	Course Title	<b>Computational Methods for Communication</b>	
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
	<b>Unit 1</b>	<b>Introduction to probability theory</b>	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

	<b>Unit 2</b>	<b>Random variables, Distributions, Density functions</b>			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
	<b>Unit 3</b>	<b>Characteristics Functions</b>			
	A	Probability generating functions			CO3
	B	Moment generating function			CO3
	C	Engineering applications			CO3
	<b>Unit 4</b>	<b>Random process</b>			
	A	Definition and characterisation			CO4
	B	Mathematical tools for studying random processes			CO4
	C	Stationery and Ergodic random processes, Properties of ACF			CO4
	<b>Unit 5</b>	<b>Types of Random Process</b>			
	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, " <b>Probability and random processes: application to signal processing and communication</b> ", Academic press/Elsevier 2004. 2. A.Papoullis and S.U.Pillai, " <b>Probability, random variables and stochastic processes</b> ", McGraw Hill 2002			
	Other References	1. Peyton Z. Peebles, " <b>Probability, Random variables and random signal principles</b> ", TMH, 4th edition, 2007. 2. H Stark and Woods, " <b>Probability, random processes and application</b> ", 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)**

### Discrete Time Signal Processing

<b>School: SET</b>		<b>Batch : 2018-2022</b>
<b>Program: M.Tech</b>		<b>Current Academic Year: 2018</b>
<b>Branch: DC</b>		<b>Semester: I</b>
1	Course Code	ECE684
2	Course Title	Discrete Time Signal Processing
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Compulsory
5	Course Objective	<ul style="list-style-type: none"><li>• The objective of DSP is usually to measure, filter and/or compress continuous real-world analog signals.</li><li>• This course is the mathematical manipulation of an information signal to modify or improve it in some way.</li><li>• This is characterized by the representation of discrete time, discrete frequency, or other discrete domain signals by a sequence of numbers or symbols.</li></ul>
6	Course Outcomes	After completing this course students will be able to <ol style="list-style-type: none"><li>1. Apply real time processing of audio and speech signal.</li><li>2. Do the sonar and radar signal processing, sensor array processing, spectral estimation, statistical signal processing.</li><li>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.</li><li>4. Use computing software package like MATLAB, and acquainted with digital processing tools available in MATLAB.</li><li>5. Develop a signal processing system to analyze, predict and manipulate real data.</li></ol>
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
	<b>Unit 1</b>	<b>Realisation of FIR Filters &amp; IIR Filters</b>			
	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
	<b>Unit 2</b>	<b>Fundamentals of Multirate Digital Signal Processing</b>			
	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
	<b>Unit 3</b>	<b>Design of Digital Filters</b>			
	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
	<b>Unit 4</b>	<b>The Discrete Fourier Transform &amp; Efficient Computation of the DFT: FFT Algorithm</b>			
	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
	<b>Unit 5</b>	<b>Adaptive Signal Processing and Applications.</b>			
	A	Adaptive systems - definitions and characteristics,			CO4
	B	Minimum Mean Square Error Criterean,The Window LMS Algoritthm			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	CA	MTE	ETE	

	Distribution	30%	20%	50%	
	Text book/s*	<b>References-</b> 1. A. Y. Oppenheim and R. W. Schater, “Digital Signal Processing”, PHI 1975 2. A. Y. Oppenheim, 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
<b>ECE684 .1</b>	2	1	1	2	2	2	1	3	1	1	2		
<b>ECE684 .2</b>	3	2	1	2	2	2	1	3	1	1	3		
<b>ECE684 .3</b>	3	2	1	2	2	2	1	3	1	1	3		
<b>ECE684 .4</b>	3	2	1	2	2	2	1	3	1	1	3		
<b>ECE684 .5</b>	3	2	2	2	2	2	2	3	2	3	3		
<b>ECE684</b>	3	2	1	2	2	2	1	3	1	1	3		

**1-Slight (Low)**

**2-Moderate (Medium)**

**3-Substantial (High)**

### Advanced Digital Communication

<b>School: SET</b>		<b>Batch : 2018-20</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year:</b>	
<b>Branch: DC</b>		<b>Semester: I</b>	
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	<ul style="list-style-type: none"> <li>Fundamentals of digital communication</li> <li>Multiple access techniques-system</li> </ul>	
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
	<b>Unit 1</b>	<b>Detection and Estimation</b>	
	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
	<b>Unit 2</b>	<b>Multiplexing and multiple access</b>	
	A	Multiple access techniques-system and architecture	CO2
	B	Access algorithms-multiple access techniques for INTELSAT	CO2
	C	Multiple access techniques for LAN	CO2
	<b>Unit 3</b>	<b>Spread spectrum Techniques</b>	
	A	Spread spectrum overview-PN sequences	CO3
	B	DS spread Spectrum-Frequency hopping synchronization	CO3
	C	Jamming considerations- commercial applications-cellular systems	CO3



	<b>Unit 4</b>	<b>Digital Communications through Fading Channels</b>			
	A	Path loss model, Shadow Fading			CO4
	B	Fading-signal time spreading			CO4
	C	Time variance caused by motion			CO4
	<b>Unit 5</b>	<b>Equaliser</b>			
	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*	<i>Bernard Sclar and Pabitra kumar Ray “Digital Communications Fundamentals and Applications”, Pearson Education, 2nd edition, 2001</i>			
	Other References	1. Simon Haykin, “Digital Communications”, John Wiley and sons, 1998 2. I. 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
<b>ECE685.1</b>	2	2	1	2	1	1	1	2	2	2	2		
<b>ECE685.2</b>	3	3	3	2	2	2	2	3	2	2	2		
<b>ECE685.3</b>	3	2	1	2	2	1	1	2	2	3	3		
<b>ECE685.4</b>	3	2	3	2	2	1	1	2	2	2	3		
<b>ECE685.5</b>	3	2	3	2	2	1	1	2	2	3	2		
<b>ECE685</b>	3	2	1	2	2	2	1	3	1	1	3		

## Neural Network

<b>School: SET</b>		<b>Batch: 2018-2022</b>	
<b>Program: M. Tech</b>		<b>Current Academic Year: 2018</b>	
<b>Branch: DC</b>		<b>Semester: I</b>	
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
	<b>Unit 1</b>	<b>Neurons and Neural Networks</b>	
	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
	<b>Unit 2</b>	<b>Single Layer Perceptrons</b>	
	A	Least mean square algorithm	CO3
	B	Learning curve	CO3
	C	Learning rates, Perceptron	CO3
	<b>Unit 3</b>	<b>Multilayer Perceptrons</b>	CO4
	A	The XOR problem	CO4
	B	Back-propagation algorithm	CO4
	C	Heuristic for improving the back-propagation algorithm	CO4

	<b>Unit 4</b>	<b>Radial-Basis Function Networks</b>			CO5
	A	Interpolation			CO5
	B	Regularisation			CO5
	C	Learning strategies			CO5
	<b>Unit 5</b>	<b>Kohonen Self-Organising Maps</b>			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*	<ul style="list-style-type: none"> <li><b>S. Haykin</b>, <i>Neural Networks: A Comprehensive Foundation</i> 2nd edition, (Prentice Hall, 1999)</li> <li><b>K. Mehrotra, C. Mohan, and S. Ranka</b>, <i>Elements of Artificial Neural Networks</i>, MIT Press, 1997.</li> </ul>			
	Other References	<ol style="list-style-type: none"> <li>The Essence of Neural Networks, R. Callan, Prentice Hall Europe, 1999.</li> <li>Introduction to Neural Networks, R. Beale and T. Jackson, IOP Press, 1990</li> <li>An Introduction to Neural Network, K Gurney, UCL Press, London, 1997</li> </ol>			

### CO , PO & PSO MAPPING:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
<b>ECE688.1</b>	2	2	1	2	2	2	2	2	2	1	2		
<b>ECE688.2</b>	3	3	3	2	2	2	2	2	2	2	2		
<b>ECE688.3</b>	3	2	1	2	2	2	2	2	2	2	2		
<b>ECE688.4</b>	3	2	3	2	2	2	2	2	2	2	2		
<b>ECE688.5</b>	3	2	3	2	2	2	2	2	2	2	2		
<b>ECE688</b>	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)**

## Microwave Communication

<b>School: SET</b>		<b>Batch : 2018-22</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year: 2018</b>	
<b>Branch: D.C</b>		<b>Semester:I</b>	
1	Course Code	<b>ECE686</b>	
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
	<b>Unit 1</b>	<b>Microwave and millimetre wave devices</b>	
	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
	<b>Unit 2</b>	<b>Microwave and mm wave circuits</b>	
	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

	<b>Unit 3</b>	<b>Antennas</b>			
	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
	<b>Unit 4</b>	<b>Microwave and mm wave propagation</b>			
	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
	<b>Unit 5</b>	<b>Effect of atmosphere on radio wave propagation</b>			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*	<i>P Bhartia &amp; I J Bahl, Millimeter wave engineering and Applications, John Wiley &amp; Sons</i>			
	Other References	<i>David M Pozar, Microwave Engineering, John Wiley &amp; Sons</i>			
		<i>R E Collin, Antenna &amp; Radio wave Propagation, McGraw Hill Book Co.</i>			

### **CO , PO & PSO MAPPING:**

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

### Design of Communication Networks

<b>School: SET</b>		<b>Batch : 2018-22</b>	
<b>Program: M. Tech</b>		<b>Current Academic Year:</b>	
<b>Branch:D.C</b>		<b>Semester:II</b>	
1	Course Code	ECE 687	
2	<b>Course Title</b>	<b>Design of Communication Networks</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Department Elective	
5	Course Objective	<ol style="list-style-type: none"> <li>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</li> <li>2. primary focus of the course would be the Internet</li> <li>3. models developed in this course will be motivated by emerging protocols and services in the Internet such as RED, ECN and Diff Serv</li> </ol>	
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
	<b>Unit 1</b>	<b>Overview and Taxonomy of Communication Networks</b>	CO1
	A	circuit switched networks	CO1
	B	virtual-circuit switched networks	CO1
	C	Internet congestion control	CO1
	<b>Unit 2</b>	<b>Elements of Queueing Theory</b>	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

	<b>Unit 3</b>	<b>Internet Congestion Control</b>	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
	<b>Unit 4</b>	<b>Stochastic and Deterministic Traffic Modeling</b>	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
	<b>Unit 5</b>	<b>Stochastic dynamic programming</b>	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 30%	MTE 20%
			ETE 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:**

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



## Image Processing

<b>School: SET</b>		<b>Batch : 2018-2020</b>	
<b>Program: M.TECH</b>		<b>Current Academic Year:</b>	
<b>Branch:D.C</b>		<b>Semester</b>	
1	Course Code	ECE 690	
2	Course Title	<b>Image Processing</b>	
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
	<b>Unit 1</b>	<b>Pattern recognition fundamentals</b>	
	A	Basic concepts of pattern recognition, fundamental problems in pattern recognition	CO1,CO2

		system			
	B	design concepts and methodologies, example of automatic pattern recognition systems	CO1.CO3		
	C	A simple automatic pattern recognition model.	CO2		
	<b>Unit 2</b>	<b>Bayesian decision theory</b>			
	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		
	<b>Unit 3</b>	<b>Maximum-likelihood and Bayesian parameter estimation</b>			
	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		
	<b>Unit 4</b>	<b>Sequential Models</b>			
	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		
	<b>Unit 5</b>	<b>Unsupervised learning and clustering</b>			
	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	1. Pattern Recognition principles: Julius T. Tou			

	book/s*	and Rafel C. Gonzalez, Addison –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
<b>ECE690.1</b>	3	3	2	2	2	2	2	2	2	2	2		
<b>ECE690.2</b>	3	3	2	2	2	2	2	2	2	2	2		
<b>ECE690.3</b>	3	3	3	2	2	2	2	2	2	2	2		
<b>ECE690.4</b>	3	2	1	2	2	2	2	2	2	2	3		
<b>ECE90.5</b>	3	2	3	2	2	2	2	2	2	2	3		
<b>ECE690</b>	3	3	2	2	2	2	2	2	2	2	2		

## Data Communication

<b>School: SET</b>		<b>Batch: 2018-2020</b>	
<b>Program: M. TECH</b>		<b>Current Academic Year:</b>	
<b>Branch:D.C</b>		<b>Semester:I</b>	
1	Course Code	ECE 667	
2	Course Title	<b>Data Communication</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Departmental Elective	
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
	<b>Unit 1</b>	<b>Introduction</b>	
	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
	<b>Unit 2</b>	<b>Baseband Data Transmission</b>	
	A	Baseband Data Transmission, Baseband pulse shaping	CO2
	B	Dubinary Baseband PAM, System many signaling schemes	CO2
	C	Equalization Synchronisation Scrambler .Unscrambler	CO2
	<b>Unit 3</b>	<b>Band Pass Data Transmission System</b>	
	A	Band Pass Data Transmission System ASK,PSK,	CO3

		FSK	
	B	DPSK & PSK, MSK, Modulation schemes	CO3
	C	Coherent and non-coherent detector Probability of Error (PE), Performance Analysis and comparison	CO3
	<b>Unit 4</b>	<b>Error Detection and correction codes</b>	
	A	Error Detection and correction codes Linear block Encoding	CO4
	B	Algebraic Codes Cyclic codes	CO4
	C	Convolution codes, Performance codes	CO4
	<b>Unit 5</b>	<b>Synchronous and Asynchronous transmission</b>	
	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 30%	MTE 20%
			ETE 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
<b>ECE667.1</b>	3	3	2	2	2	2	2	2	2	3	2		
<b>ECE667.2</b>	3	3	2	2	2	2	2	2	2	3	3		
<b>ECE667.3</b>	3	3	3	2	2	2	2	2	2	3	3		
<b>ECE667.4</b>	3	2	1	2	2	2	2	2	2	3	3		
<b>ECE667.5</b>	3	2	3	2	2	2	2	2	2	3	3		
<b>ECE667</b>	3	3	2	2	2	2	2	2	2	3	3		

## Cryptography

<b>School: SET</b>		<b>Batch : 2018-20</b>	
<b>Program: M. Tech</b>		<b>Current Academic Year: 2018</b>	
<b>Branch:D.C</b>		<b>Semester:I</b>	
1	Course Code	ECE 690	
2	Course Title	<b>Cryptography</b>	
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
	<b>Unit 1</b>	<b>Basic symmetric-key encryption</b>	
	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
	<b>Unit 2</b>	<b>Message integrity</b>	
	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
	<b>Unit 3</b>	<b>Public key cryptography</b>	
	A	Arithmetic modulo primes	CO3
	B	Cryptography using arithmetic modulo primes	CO3

		(vanilla key exchange (Diffie-Hellman); the CDH and discrete-log assumptions)			
	C	Public key encryption (semantically secure ElGamal encryption; CCA security)			CO3
	<b>Unit 4</b>	<b>Digital signatures</b>			
	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
	<b>Unit 5</b>	<b>Challenge response authentication</b>			
	A	Identification protocols: Password protocols, salts; one time passwords (S/Key and Secur ID); challenge response authentication.			CO5
	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*	<a href="#"><i>Introduction to Modern Cryptography</i></a> (2nd edition) by J. Katz and Y. Lindell.			
	Other References	<b>Boneh-Shoup :</b> <a href="#"><i>A Graduate Course in Applied Cryptography</i></a> (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
<b>ECE690.1</b>	2	1	2	2	2	2	1	2	2	2	2		
<b>ECE690.2</b>	3	2	2	1	2	2	1	2	2	2	3		
<b>ECE690.3</b>	3	2	2	2	2	2	1	2	2	2	3		
<b>ECE690.4</b>	3	2	2	2	2	2	1	2	2	2	3		
<b>ECE690.5</b>	3	2	2	2	2	2	2	3	2	3	3		
<b>ECE690</b>	3	3	2	2	2	2	2	2	2	3	3		

<b>School: SET</b>		<b>Batch : 2018-22</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year: 2018</b>	
<b>Branch: D.C</b>		<b>Semester:I</b>	
1	Course Code	<b>ECE 669</b>	
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
	<b>Unit 1</b>	Introduction	
	A	Security Goals, Cryptographic Attacks	CO1
	B	Services and Mechanisms, Integer Arithmetic	CO1
	C	Modular Arithmetic, Linear Congruence	CO1
	<b>Unit 2</b>	<b>Basic encryption techniques</b>	
	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
	<b>Unit 3</b>	<b>Private key and Public key cryptosystems</b>	
	A	Asymmetric 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
	<b>Unit 4</b>	<b>Elliptic curves</b>	
	A	Basic theory, Weirstrass equation	CO4



	B	Group law, Point at Infinity			CO4
	C	Elliptic curves over finite fields			CO4
	<b>Unit 5</b>	<b>Discrete logarithm problem on EC</b>			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	CA	MTE	ETE	
	Distribution	30%	20%	50%	
	Text book/s*	<b>Text Books</b> <i>Douglas A. Stinson, “Cryptography, Theory and Practice”, 2nd edition, Chapman &amp;Hall, CRC Press Company, Washington</i>			
	Other	<i>Lawrence C. Washington, “ Elliptic Curves”, Chapman &amp; Hall, CRC Press Company,Washington</i> <i>David S. Dummit, Richard M. Foote, “ Abstract Algebra”, John Wiley &amp; Sons</i>			
	References				

### **CO , PO & PSO MAPPING:**

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

### Digital Signal Processing Lab

<b>SET</b>		<b>Batch : 2018-2020</b>
<b>M .Tech</b>		<b>Current Academic Year: 2018-2019</b>
<b>ECP 684</b>		<b>Semester: I</b>
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	<ul style="list-style-type: none"> <li>To understand the concept of sampling and reconstruction of signals.</li> <li>To implement various transforms (DFT, FFT and Z transform) in MATLAB and understand the concepts of these transforms.</li> <li>To design and implement the various structures of FIR and IIR systems.</li> <li>To design and implement FIR and IIR filters.</li> </ul>
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
	<b>Unit 1</b>	a-b) To understand the sampling theorem through the sampling and reconstruction of signals. c) To obtain DFT and IDFT of a sequence <b>C01 ,C02</b>
	<b>Unit 2</b>	a) To implement the FFT algorithm. b) To obtain the FFT of given 1-D signal and plot. <b>CO2</b>
	<b>Unit 3</b>	a) To verify linear and circular convolution. b) To implement a system function and to plot the pole zero plot for same. <b>CO3,C04</b>
	<b>Unit 4</b>	a-c) To obtain direct realization of FIR and IIR filters. <b>CO5</b>
	<b>Unit 5</b>	a) To build a Filtering System Using Filter Coefficients b) To design FIR filters using windowing technique. <b>C06</b>

		c) To design IIR filters.			
	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. Oppenheim and R. W. Schater, "Digital Signal Processing", PHI 2. 2.A. Y. Oppenheim, 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	PO10	PSO 1	PSO 2	PSO 3
<b>ECE684 .1</b>	3	2	2	2	2	1	1	1	2	-	2		
<b>ECE684 .2</b>	3	1	2	2	2	1	1	1	2	-	2		
<b>ECE684 .3</b>	3	3	2	3	2	1	1	1	2	2	2		
<b>ECE684 .4</b>	3	3	2	3	2	1	1	1	2	-	2		
<b>ECE684 .5</b>	3	3	3	3	2	1	1	1	2	2	2		
<b>ECE 684</b>	3	2	2	3	2	1	1	1	1	1	2		

### Information Theory and Coding

<b>School: SET</b>		<b>Batch : 2018-2020</b>
<b>Program: M.TECH</b>		<b>Current Academic Year: 2018</b>
<b>Branch:D.C</b>		<b>Semester:II</b>
1	ECEurse 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	<ol style="list-style-type: none"><li>1. The main aim of this course is to make aware students with basics of probability theory.</li><li>2. Will have knowledge of information theory which includes Entropy, Channel Capacity &amp; S/N Ratio.</li><li>3. Knowledge of various types of data compression techniques.</li><li>4. Learn about various coding techniques like Hamming Codes, Cyclic &amp; Convolution Codes.</li></ol>
6	Course Outcomes	<p>CO1: Understand Probability theory, Bayes Theorem, Poisson Distribution Functions.</p> <p>CO2: Comprehend to measure information &amp; its rate, about Gaussian Channel &amp; B/W-SNR Tradeoffs and various types of channels.</p> <p>CO3: Apply the use of various coding &amp; decoding techniques.</p> <p>CO4:Design of various communication channel with various coding techniques</p> <p>CO5: Apply different information coding</p>
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
	<b>Unit 1</b>	<b>Probability theory</b>		
	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
	<b>Unit 2</b>	<b>Information Theory</b>		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
	<b>Unit 3</b>	<b>Channel Capacity</b>		
	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
	<b>Unit 4</b>	<b>Data Compression</b>		
	A	Introduction, Variable Length Coding, Prefix Coding and Properties.		CO2
	B	Shannon Fano Coding.		CO1
	C	Huffman Coding (Binary, Ternary Coding).		CO3
	<b>Unit 5</b>	<b>Introduction to Coding</b>		
	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		
	Weight age Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	<i>Haykin, Simon, "Digital Communication", Wiley Publishers, 3<sup>rd</sup> Edition</i>		
	Other References	1. <i>Abramson, "Information Theory and Coding, TMH, 2<sup>nd</sup> Edition</i> 2. <i>Richard, Wesley Hamming, "Coding and Information Theory", Pearson Education, 2<sup>nd</sup></i>		

**CO , PO & PSO MAPPING:**

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

### Broad band Transmission Network

<b>School: SET</b>		<b>Batch : 2018-22</b>	
<b>Program: M. Tech</b>		<b>Current Academic Year: 2018</b>	
<b>Branch: D.C</b>		<b>Semester:II</b>	
1	Course Code	ECE 687	
2	Course Title	<b>Broad band Transmission Network</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective	
5	Course Objective	<ol style="list-style-type: none"> <li>1. To provide an overview of Wireless Communication networks area and its applications in communication engineering.</li> <li>2. To appreciate the contribution of Wireless Communication networks to overall technological growth.</li> <li>3. Analysing the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Wireless Communication Networks.</li> </ol>	
6	Course Outcomes	<p>CO1: Learning the main optical technologies such as SONET</p> <p>CO2: Learning the Network design SDH frame structures &amp; SDH overhead.</p> <p>CO3: Learning WDM optical transmission technologies.</p> <p>CO4: Learning WDM optical transmission Networks.</p> <p>CO5: Learning DWDM transmission Technologies.</p>	
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
	<b>Unit 1</b>	<b>SONET</b>	<b>CO1</b>
	A	Introduction, Synchronous and asynchronous SONET	CO1
	B	Frame structure	CO1
	C	SONET network configuration	CO1
	<b>Unit 2</b>	<b>SDH TECHNOLOGY</b>	
	A	Introduction, standards, features & management.	CO2
	B	Network design SDH frame structures	CO2
	C	Supporting different rates, SDH overhead	CO2
	<b>Unit 3</b>	<b>Wavelength Division Multiplexing</b>	
	A	WDM optical Transmission technologies, WDM conceptions	CO3

	B	Unidirectional, Bi-directional WDM	CO3
	C	WDM system composition, Advantages of WDM	CO3
	<b>Unit 4</b>	<b>WDM transmission Network</b>	
	A	Fiber dispersion chromatic dispersion	CO4
	B	Polarization mode dispersion	CO4
	C	Non-linearity effect of SMF, 4-wave mixing	CO4
	<b>Unit 5</b>	<b>DWDM key Technologies</b>	
	A	Optical amplifier	CO5
	B	Optical Multiplexer & Demultiplexer	CO5
	C	Optical supervisory channel, FEC technologies	CO5
	Mode of examination	Theory	
	Weightage Distribution	CA 30%	MTE 20%
			ETE 50%
	Text book/s*	<ul style="list-style-type: none"> <li>Loutfi Nuyami, "WiMAX - Technology for broadband access", John Wiley, 2007</li> </ul>	
	Other References	<ol style="list-style-type: none"> <li>B. Gi Lee and W. Kim. "Integrated Broadband Networks - TCP/IP, SDH/SONET and WDM/optics". Artech House.</li> <li>H. Wang. "Packet Broadband Network Handbook". McGraw-Hill Professional.</li> <li>H.G. Perros. "Connection-Oriented Networks: SONET/SDH, ATM, MPLS and Optical Networks". Wiley.</li> </ol>	

### CO , PO & PSO MAPPING:

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



## Modern Telecom Switching Systems

<b>School: SET</b>		<b>Batch: 2018-20</b>	
<b>Program: M. Tech</b>		<b>Current Academic Year: 2018-19</b>	
<b>Branch: D.C</b>		<b>Semester: II</b>	
1	Course Code	<b>ECE 773</b>	
2	Course Title	<b>MODERN TELECOM SWITCHING SYSTEMS</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective	
5	Course Objective	<ol style="list-style-type: none"> <li>1. Analysis of different basic components that are used in telephone exchanges</li> <li>2. Recognize and analyze single stage and a multistage network.</li> <li>3. Design of multistage network to reduce blocking of calls</li> <li>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.</li> </ol>	
6	Course Outcomes	<p>On completion of this course, it is expected that the student will be able to</p> <p>CO1: Understand the main concepts of telecommunication network design.</p> <p>CO2: Analyze and evaluate fundamental telecommunication traffic models.</p> <p>CO3: Analyse the basic modern signalling system.</p> <p>CO4: Analyse traffic engineering</p> <p>CO5: Solve traditional interconnection switching system design problems.</p> <p>CO6: To compare telephone network, data network and integrated service digital network</p>	
7	Course Description	<p>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.</p> <p>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.</p>	
8	Outline syllabus	CO Mapping	
	<b>Unit 1</b>	<b>Electronic space Division switching</b>	
	A	Stored program control (SPC)	CO1, CO2

	B	switching matrices, multistage switching	CO1, CO2
	C	enhance services photonic switching	CO2
	<b>Unit 2</b>	<b>Time Division switching</b>	
	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
	<b>Unit 3</b>	<b>Traffic Engineering</b>	
	A	Traffic load, Grade of service	CO4
	B	Er. Jang's formulas	CO4
	C	blocking modelling switching systems, Blocking model	CO4
	<b>Unit 4</b>	<b>Subscriber Loop, Dialling Systems</b>	
	A	Switching hierarchy & routing, Transmission plan	CO5
	B	numbering plan, charging plan	CO5
	C	Signalling technique	CO5
	<b>Unit 5</b>	<b>Local Access Techniques</b>	
	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 30%	MTE 20%
			ETE 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:**

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

## Mobile and Wireless Communication

<b>School: SET</b>		<b>Batch : 2018-22</b>
<b>Program: M. Tech</b>		<b>Current Academic Year:</b>
<b>Branch:</b>		<b>Semester:II</b>
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	Elective
5	Course Objective	<ol style="list-style-type: none"><li>1. Introduce students about the aspects related to evolution of mobile radio communication and its fundamental.</li><li>2. Explain interference and sysyem capacity and the techniques used for improving capacity in cellular systems.</li><li>3. Familiarize students about GSM and CDMA system, their architecture,services and features.</li><li>4. Explain the speech coding, mobile data networks, 4G and OFDM.</li></ol>
6	Course Outcomes	<p>After completing this course students will be able to</p> <p>CO1: Develop deep understanding of various propagation models.</p> <p>CO2: Describe cellular concepts and its design, types of handoffs, and the relation between interference and system capacity and analyze the speech coding.</p> <p>CO3: Describe the speech coding</p> <p>CO4: Analyze GSM and CDMA system, their architecture, frame structure and forward and reverse CDMA channel and their specifications.</p> <p>CO5: Comprehend the mobile ad-hoc networks, new generation networks and the use of OFDM in 4G technique.</p>
7	Course Description	<p>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.</p>
8	Outline syllabus	CO

				Mapping
	<b>Unit 1</b>	<b>Mobile Radio Propagation</b>		
	A	Introduction to Radio Wave Propagation, Free Space Propagation Model, Three Basic Propagation Mechanisms- Reflection, Diffraction, Scattering		
	B	Reflection- Reflection from Dielectrics, Ground Reflection Model, Diffraction- Fresnel Zone Geometry, Knife edge Diffraction Model		
	C	Scattering- Radar Cross Section Model, Log distance Path Loss Model, Log Normal Shadowing		
	<b>Unit 2</b>	<b>Cellular concepts</b>		
	A	Cellular concepts, Frequency reuse, channel assignment strategies.		
	B	Handoff strategies, interference and system capacity.		
	C	Improving coverage and capacity in cellular systems.		
	<b>Unit 3</b>	<b>Speech Coding</b>		
	A	Characteristics of speech signals, Quantization Techniques		
	B	Frequency Domain Coding of speech- Sub band Coding, Adaptive transform coding		
	C	Vo-coders, Linear Predictive Coders, GSM Codec		
	<b>Unit 4</b>	<b>GSM system for mobile</b>		
	A	GSM system for mobile Services and features, System Architecture, Radio Sub system Channel types.		
	B	Frame Structure.CDMA Digital Cellular Standard (IS 95): Frequency and Channel specifications.		
	C	Forward CDMA channel and reverse CDMA channel.		
	<b>Unit 5</b>	<b>Mobile Adhoc Networks</b>		
	A	Mobile data networks, wireless standards IMT2000.		
	B	4G, OFDM.		
	C	Concept of NGN.		
	Mode of examination	Theory/Jury/Viva		
	Weightage Distribution	CA	MTE	ETE
		30	20	50
	Text book/s*	<i>T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson, Second Edition (2009).</i>		
	Other References	<i>1. Andrea Goldsmith, "Wireless Communications", Cambridge University press.</i>		
		<i>2. T L Singal , "Wireless Communications ", McGraw Hill Publications</i>		

**CO , PO & PSO MAPPING:**

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

## Nano Technology

<b>School: SET</b>		<b>Batch : 2018-20</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year:</b>	
<b>Branch:</b>		<b>Semester:</b>	
1	Course Code	<b>ECE 619</b>	
2	Course Title	<b>Nano Technology</b>	
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
	<b>Unit 1</b>	<b>Basics of Quantum Mechanics</b>	
	A	Introduction to nanotechnology, meso structures	CO1
	B	Schrodinger equation, Density of States.	CO1
	C	Particle in a box Concepts, Degeneracy	CO1
	<b>Unit 2</b>	<b>Nanoscale MOSFETs</b>	
	A	Shrink-down approaches, Introduction, CMOS Scaling	CO2
	B	The nanoscale MOSFET, Finfets	CO4

	C	Vertical MOSFETs	CO4
	<b>Unit 3</b>	<b>CLASSICAL PARTICLES</b>	
	A	limits to scaling, system integration limits (interconnect issues etc.)	CO2
	B	Resonant Tunneling Diode	CO3
	C	Coulomb dots, Quantum blockade	CO2
	<b>Unit 4</b>	<b>SINGLE-ELECTRON Devices</b>	
	A	Single electron transistors	CO3
	B	Carbon nanotube electronics	CO3
	C	Band-structure	CO1
	<b>Unit 5</b>	<b>FREE AND CONFINED ELECTRONS</b>	
	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 30	MTE 20
			ETE 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
<b>ECE 619.1</b>	2	3	2	3	3	2	2	2	3	3	3		
<b>ECE 619.2</b>	3	3	3	3	3	2	2	2	3	3	3		
<b>ECE 619.3</b>	3	3	3	3	3	3	2	2	3	3	3		
<b>ECE 619.4</b>	3	3	2	3	3	3	2	2	3	2	3		
<b>ECE 619.5</b>	3	3	2	3	3	3	2	3	3	3	3		
<b>CO2619</b>	3	3	2	3	3	3	2	2	3	3	3		



## RF and Micro-MEMS

<b>School: SET</b>		<b>Batch : 2018-22</b>
<b>Program: M. Tech</b>		<b>Current Academic Year:</b>
<b>Branch: D.C</b>		<b>Semester:II</b>
1	Course Code	ECE 670
2	Course Title	<b>RF and Micro-MEMS</b>
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Open Elective
5	Course Objective	<ol style="list-style-type: none"> <li>1. Emphasizes on developing components and systems that would significantly improve the performance of existing RF, microwave and millimetre wave components.</li> <li>2. Fabrication of new components by a set of processes known as micromachining, primarily developed for conventional micro electromechanical systems (MEMS).</li> <li>3. Categorize Micro-switches, Planar, on-chip components, Transmission lines and other components,</li> <li>4. Classify Micromachined antennas, Micromachined phase shifters.</li> </ol>
6	Course Outcomes	<p>CO1: Introduction to MEMS, concepts on miniaturization and fabrication</p> <p>CO2: Objectives of RF MEMS Switches: Intro, fabrication &amp; basic design guidelines</p> <p>CO3: Identify Micromachined passive components, theory, features, tunable capacitors, inductors.</p> <p>CO4: Analysing RF filters &amp; phase shifters.</p> <p>CO5: Analysis of Reliability &amp; packaging, RF MEMS Packaging</p>
7	Course Description	The objective of this course is 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	
	<b>Unit 1</b>	<b>Introduction</b>
	A	RF MEMS for microwave applications, MEMS technology and fabrication
	B	Mechanical modeling of MEMS devices
	C	MEMS materials and fabrication techniques.
		CO Mapping
		CO1
		CO1
		CO1
		CO2

	<b>Unit 2</b>	<b>MEMS switches</b>			
	A	Introduction to MEMS switches			CO2
	B	Capacitive shunt and series switches: Physical description, circuit model and electromagnetic modeling			CO2
	C	Techniques of MEMS switch fabrication and packaging; Design of MEMS switches.			CO2
	<b>Unit 3</b>	<b>Inductors and Capacitors</b>			
	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
	<b>Unit 4</b>	<b>RF Filters and Phase Shifters &amp; Integration and Packaging</b>			
	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
	<b>Unit 5</b>	<b>Transmission Lines and Antennas</b>			
	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	<b>Theory</b>			
	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.	
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**CO , PO & PSO MAPPING:**

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

### Internet of Things and Applications

<b>School: SET</b>		<b>Batch : 2018-2020</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year:</b>	
<b>Branch:DC</b>		<b>Semester: II</b>	
1	Course Code	ECE615	
2	Course Title	Internet of Things and Applications	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Open Elective	
5	Course Objective	<ol style="list-style-type: none"> <li>1. Emphasize the application areas of IOT</li> <li>2. Emphasize the blocks of Internet of Things</li> <li>3. Able to realize the revolution of Internet in Mobile Devices, Cloud &amp; Sensor Networks</li> <li>4. Introduction to core technologies-RFID, Sensor &amp; Communication Networks</li> </ol>	
6	Course Outcomes	<p>CO1: Able to understand the vision of IoT from a global context</p> <p>CO2: Able to Determine the Market perspective of IoT</p> <p>CO3: Able to know Key application areas</p> <p>CO4: Able to analyze various IoT Layers and their relative importance</p> <p>CO5: Able to understand basic IoT application solutions</p>	
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
	<b>Unit 1</b>	<b>Basics Internet of things</b>	
	A	Overview with application examples	CO1
	B	Design Principles for connected devices	CO1
	C	Physical & logical Design, M2M Communication	CO1
	<b>Unit 2</b>	<b>Basic Topologies &amp; Network Topologies</b>	
	A	LAN topologies; Role of data communication and	CO4

		network in industrial automation, ISO's seven-layer	
	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
	<b>Unit 3</b>	<b>Ethernet and Ethernet /IP</b>	
	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
	<b>Unit 4</b>	<b>Industrial Wireless Network Protocols</b>	
	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
	<b>Unit 5</b>	<b>Illustrative application Scenarios &amp; concepts</b>	
	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 30%	MTE 20%
			ETE 50%
	Text book/s*	1. E-book-Designing of Internet of things by- Adrian McEwen, Hakim Cassimally, Wiley 2. <i>Internet of Things</i> by-A Bahga & Vijay Madisetti, University Press	

**CO , PO & PSO MAPPING:**

<b>COs</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO1 0</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>ECE 615. 1</b>	2	3	2	3	3	2	2	2	3	3	2		
<b>ECE 615. 2</b>	3	3	2	3	3	2	2	2	3	3	3		
<b>ECE 615. 3</b>	3	3	2	3	3	2	2	2	3	3	3		
<b>ECE 615. 4</b>	3	3	2	3	3	2	2	2	3	2	3		
<b>ECE 615. 5</b>	3	3	2	3	3	2	2	3	3	3	3		
<b>ECE 615</b>	3	3	2	3	3	2	2	2	3	3	3		

### Communication Lab

<b>School: SET</b>		<b>Batch:</b>
<b>Program: M.Tech</b>		<b>Current Academic Year: 2018-22</b>
<b>Branch: DC</b>		<b>Semester: II</b>
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
	<b>Unit 1</b>	<b>Analog Communication</b>
		Amplitude shift keying Frequency Shift Keying Phase Shift Keying
	<b>Unit 2</b>	<b>Signal distortion in optical fibers</b>
		Study of Bending Loss. Study of Propagation loss in optical fiber
	<b>Unit 3</b>	<b>Optical Detectors/Link Design</b>
		Setting up Fiber optics voice link.
	<b>Unit 4</b>	<b>Optical Networks</b>

		Setting up of Fiber Optic Voice Link using PWM. Construction of MUX and DEMUX for WDM systems	CO4
	<b>Unit 5</b>	<b>Microwave test bench</b>	
		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 60%	MTE 0%
		ETE 40%	
	Text book/s*		
	Other References	John M. Senior, "Optical Fiber Communications", PEARSON, 3rd Edition, 2010	

#### **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
<b>ECE685.1</b>	2	3	2	3	3	2	2	2	3	3	2		
<b>ECE 685.2</b>	3	3	2	3	3	2	2	2	3	3	3		
<b>ECE 685.3</b>	3	3	2	3	3	2	2	2	3	3	3		
<b>ECE 685.4</b>	3	3	2	3	3	2	2	2	3	2	3		
<b>ECE 685.5</b>	3	3	2	3	3	2	2	3	3	3	3		
<b>ECE 685</b>	3	3	2	3	3	2	2	2	3	3	3		



## 2.1 Template A1: Syllabus for Theory/Practical Subjects

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<b>School: SET</b>		<b>Batch :2019-2021</b>
<b>Program: M.Tech</b>		<b>Current Academic Year: 2019</b>
<b>Branch: DC</b>		<b>Semester: I</b>
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	<ul style="list-style-type: none"><li>• The objective of DSP is usually to measure, filter and/or compress continuous real-world analog signals.</li><li>• This course is the mathematical manipulation of an information signal to modify or improve it in some way.</li><li>• This is characterized by the representation of discrete time, discrete frequency, or other discrete domain signals by a sequence of numbers or symbols.</li></ul>
6	Course Outcomes	<p>After completing this course students will be able to</p> <ol style="list-style-type: none"><li>6. Apply real time processing of audio and speech signal.</li><li>7. Do the sonar and radar signal processing, sensor array processing, spectral estimation, statistical signal processing.</li><li>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.</li><li>9. Use computing software package like MATLAB, and acquainted with digital processing tools available in MATLAB.</li><li>10. Develop a signal processing system to analyze, predict and manipulate real data.</li></ol>

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
	<b>Unit 1</b>	<b>Realisation of FIR Filters &amp; IIR Filters</b>	
	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
	<b>Unit 2</b>	<b>Fundamentals of Multirate Digital Signal Processing</b>	
	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
	<b>Unit 3</b>	<b>Design of Digital Filters</b>	
	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
	<b>Unit 4</b>	<b>The Discrete Fourier Transform &amp; Efficient Computation of the DFT: FFT Algorithm</b>	
	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
	<b>Unit 5</b>	<b>Adaptive Signal Processing and Applications.</b>	
	A	Adaptive systems - definitions and characteristics,	CO4
	B	Minimum Mean Square Error Criterean, The Window LMS Algorithm	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 30%	MTE 20%
			ETE 50%
	Text book/s*	<i>References-</i> 1. A. Y. Oppenheim and R. W. Schater, “Digital Signal Processing”, PHI 1975 2. A. Y. Oppenheim, 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
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	2.8	1.8	1.2	2	2	2	1.2	3	1.2	1.4	2.4		

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

<b>School: SET</b>		<b>Batch : 2019-2021</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year: 2019-2020</b>	
<b>Branch: ECE(VLSI Technology)</b>		<b>Semester:I</b>	
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	Compulsory	
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 <b>overview</b> of <b>computer architecture</b> , which stresses the underlying design principles and the impact of these principles on <b>computer</b> performance. General topics include design methodology, processor design, control design, memory organization, system organization, and parallel processing	
8	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to Computer architecture</b>	
	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
	<b>Unit 2</b>	<b>Cache memory and Virtual memory</b>	
	A	Basic cache structure, Set associative caches, Evaluating Cache performances Determining Cache parameters,	<b>CO4</b>
	B	Replacement Policies, Implementing LRU, Replacement policies.	<b>CO4</b>
	C	Basic virtual memory structure, Translation look aside buffer, Segment tables, Replacement algorithms, Detail example of a virtual memory system.	<b>CO4</b>
	<b>Unit 3</b>	<b>Pipeline techniques</b>	
	A	Principles of Pipelined computers,	<b>CO5</b>
	B	Evaluating performance of pipelined, Computers, Reservation tables and collision vectors,	<b>CO5</b>
	C	Maximizing pipeline, Performance, Conditional branches in pipelined computers, Internal forwarding and deferred instructions.	<b>CO5</b>
	<b>Unit 4</b>	<b>Multiprocessors</b>	
	A	Flynn's classification of multiprocessors,	<b>CO3,CO4</b>
	B	Vector computers, Numerical algorithms on a vector computer, Pipelining in vector computers, Examples of vector computers, e.g. Cray	<b>CO3,CO4</b>
	C	Multiprocessor interconnections: General purpose multiprocessors, e.g. RP-1, HEP, Data flow computers	<b>CO3,CO4</b>
	<b>Unit 5</b>	<b>RISC computers</b>	
	A	Pipelined structure of the CPU,	<b>CO6</b>
	B	RISC characteristics.	<b>CO6</b>
	C	Case study of MIPS-64 processor	<b>CO6</b>
	Mode of examination	Theory	
	Weightage Distribution	CA 30%	MTE 20%
			ETE 50%
	Text book/s*	<i>Stallings, William, "Computer organization and architecture, designing for performance", Prentice Hall of India.</i>	
	Other References	<i>1. M. R. Bhujade, "Parallel Computing", Newage International Pvt. Ltd.</i> <i>2. J. L. Hennessy and D. A. Patterson, "Computer architecture: a quantitative approach", Harcourt Asia, Singapore.</i> <i>3. Kain, "Advanced Computer Architecture: a system Design approach", PHI.</i>	

**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	PSO 2	PS O3
ECE61 1.1	3		2										
ECE61 1.2	1	3										3	
ECE61 1.3	3	1	1										
ECE61 1.4		2	2									3	
ECE61 1.5	2	1											
ECE61 1.6		3	1									2	
ECE61 1	2	2	1									2	

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

<b>School: SET</b>		<b>Batch : 2019-2021</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year: 2019-2020</b>	
<b>Branch: ECE(VLSI Technology)</b>		<b>Semester:I</b>	
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	<b>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.</b>	
8	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction and Hierarchy</b>	
	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	<b>CO1,CO2</b>
	B	Concurrent signal assignments, signal assignments with delay Component declaration, component instantiation, named port mapping, positional port mapping,	<b>CO2</b>

	C	Direct instantiation, Configuration specifications, entity binding, port modes, VHDL process, processes sensitivity lists, test benches.	CO2
	<b>Unit 2</b>	<b>Data types and statements</b>	
	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
	<b>Unit 3</b>	<b>Simulation and Synthesis</b>	
	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
	<b>Unit 4</b>	<b>Finite State Machine(FSMs)</b>	
	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
	<b>Unit 5</b>	<b>Subprograms and Packages</b>	
	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 30%	MTE 20%
			ETE 50%
	Text book/s*	<i>I J.Bhasker, “ AVHDL Primer” Prentice Hall</i>	
	Other References	<i>I-Peter J. Ashenden, “Designers guide to VHDL”, Morgan Kaufman Publishers.</i>	



		2-Charles H Roth Jr, “Digital System Design using VHDL”, Thomson Learning, 2002	
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**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	PSO 2	PSO 3
ECE6 12.1	1	2	2										
.ECE6 12.2		3	2										
ECE6 12.3	2	1										2	
.ECE6 12.4		2	1									2	
ECE6 12.5		3	3										
.ECE6 12	2	3	2									1	

**1-Slight (Low)**

**2-Moderate (Medium)**

**3-Substantial (High)**

<b>School: SET</b>		<b>Batch : 2019-2021</b>
<b>Program: M.Tech</b>		<b>Current Academic Year: 2019-2020</b>
<b>Branch: ECE(VLSI Technology)</b>		<b>Semester:II</b>
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	
	<b>Unit 1</b>	<b>MOS Device Physics</b>
	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.
	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,
		CO Mapping
		CO1
		CO1

	C	Passive Devices: Capacitors and Resistors, Substrate Coupling, Ground Bounce.	CO1
	<b>Unit 2</b>	<b>Amplifiers and their frequency response</b>	
	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
	<b>Unit 3</b>	<b>Current sources and voltage references</b>	
	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
	<b>Unit 4</b>	<b>Compensation in Operational amplifier</b>	
	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,CO4
	<b>Unit 5</b>	<b>Introduction to switched-capacitor</b>	
	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 30%	MTE 20%
			ETE 50%
	Text book/s*	Razavi B., "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2008. 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.	

		<p>2.Gray P.R., Hurst P.J., Lewis S.H. and Meyer R.G.,  <i>“Analysis and Design of Analog Integrated Circuits”</i>, John Wiley, 5th ed., 2001.</p> <p>3. 3.Hastings A., <i>The Art of Analog Layout</i>, Prentice Hall, 2005.</p>	
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**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	PSO 2
ECE6 13.1	1	3										
.ECE6 13.2		3	2	2								2
ECE6 13.3	1		2									
ECE6 13.4	2		1									3
ECE6 13.5	2	3	1	2								3
ECE6 13	1	2	1	1								2

<b>School: SET</b>		<b>Batch : 2019-2021</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year: 2019-2020</b>	
<b>Branch: ECE(VLSI Technology)</b>		<b>Semester:I</b>	
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 Outcomes	<p>After completing this course students should be able to</p> <p>CO1: Explain the IC fabrication steps for IC design, concepts of oxidation for silicon dioxide growth for thick and thin films and Develop the wafer using various deposition techniques like CVD, PVD, MBE and their types</p> <p>CO2: Use the Photolithography for IC design transfer on the wafer and Explain the of need for planarization and chemical mechanical polishing,</p> <p>CO3: Outline the NMOS, CMOS and Bipolar fabrication process. create models of moderately sized BJT circuits that realize specified digital functions using SPICE</p> <p>CO4: Apply CMOS technology-specific layout rules in the placement and routing of transistors and interconnect, and</p> <p>CO5: Apply the principles of HBT and HEMT for design rule checks, timing verification, worst case delay simulation, setup and hold times for clocked devices</p>	
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-threshold 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
	<b>Unit 1</b>	<b>Introduction to IC technology</b>	
	A	IC fabrication steps, Wafer preparation,	<b>CO1</b>
	B	Crystal growth techniques, wafer cleaning,	<b>CO1</b>

	C	Clean room and safety requirements.	CO1
	<b>Unit 2</b>	<b>IC Fabrication processes</b>	
	A	Oxidation: Kinetics of Silicon dioxide growth both for thick, thin and ultra thin films, Deal-Grove model. Diffusion and Ion Implantation: Diffusion process, Ion implantation, modeling of Ion implantation and its types.	CO2
	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 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.	CO2
	<b>Unit 3</b>	<b>SPICE modeling</b>	
	A	Introduction to SPICE: AC, DC, Transient, noise, temperature extra analysis.	CO3
	B	Junction Diodes: DC, small signal, large signal, high frequency and noise models of diodes. Measurement of diode model-parameters.	CO3
	C	BJT: DC, small signal, high frequency and noise models of bipolar junction transistors. Extraction of BJT model parameters.	CO3
	<b>Unit 4</b>	<b>MOS Models</b>	
	A	MOSFETs: DC, small signal, high frequency and noise models of MOSFETs. MOS Capacitors.	CO4
	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 large signal MOSFET models. Introduction to BSIM models. Extraction of MOSFET model parameters.	CO4
	<b>Unit 5</b>	<b>HBTs</b>	
	A	Introduction: Principles of hetero junction devices, HBTs, HEMT	CO5
	B	Component model for ICs: Design rule checks, timing verification, worst case delay simulation, setup and hold times for clocked devices,	CO5
	C	Behavior modeling, structural modeling, simulation with the physical model.	CO5
	Mode of examination	Theory	
	Weightage Distribution	CA 30%	MTE 20%
			ETE 50%
	Text book/s*	<i>S.M. Kang &amp; Y. Leblebici, "CMOS Digital Integrated</i>	

		<i>Circuits-Analysis &amp; Design”, TMH, Ed. 2003</i>	
	Other References	<i>S.M. Sze, “Physics of semiconductor devices”, Wiley Pub. S.M. Sze (Ed), “VLSI Technology”, 2nd Edition, McGraw Hill, 1988</i>	

### **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	PSO 2
ECE6 14.1	2	3	1									
ECE6 14.2	2	3										3
ECE6 14.3	2											3
ECE6 14.4		3	1		3							
ECE6 14.5	2		2									
ECE6 14	2	2	1		1							1

<b>School: SET</b>		<b>Batch: 2019-2021</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year: 2019-2020</b>	
<b>Branch: ECE</b>		<b>Semester: I</b>	
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
	<b>Unit 1</b>	<b>Practical based on basic gates</b>	
	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	CO1



		Ex-NOR gate			
	<b>Unit 2</b>	<b>Practical related to Combinational Logic Design</b>			
	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
	<b>Unit 3</b>	<b>Practical related to Flip Flops</b>			
	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
	<b>Unit 4</b>	<b>Practical related to Sequential Logic</b>			
	A	Design and simulate ALU.			CO2
	B	Design and simulate synchronous Decade Counter.			CO2
	C	Design and simulate asynchronous Decade Counter.			CO2
	<b>Unit 5</b>	<b>Practical related to Finite State Machines</b>			
	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, 2 <sup>nd</sup> 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	P O 1	P O 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PSO 1	PSO 2
ECP651.1		3										2
ECP651.2	2	3										2
ECP651.3	2	1										2
ECP651.4		3	2									3
ECP651	2	3	2									2

<b>School: SET</b>		<b>Batch : 2019-2021</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year: 2019-2020</b>	
<b>Branch: ECE(VLSI Technology)</b>		<b>Semester:II</b>	
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	<p>After completing this course students should be able to</p> <p>CO1: Explain the fundamental concepts of modern CMOS VLSI design And the complex and high performance CMOS systems</p> <p>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.</p> <p>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.</p> <p>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.</p>	
7	Course Description	<p>This course will cover historical Perspective of <b>VLSI</b>, CMOS <b>VLSI Design</b> for Power and Speed consideration, Logical Efforts:<b>Designing</b> Fast CMOS Circuits; Data path <b>Design</b>, Interconnect aware <b>design</b>, Hardware <b>Description</b> Languages for <b>VLSI Design</b>, FSM Controller/Data path and Processor <b>Design</b>, <b>VLSI Design</b> Automation.</p>	
8	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to automation</b>	
	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	CO1

		partitioning.	
	C	Placement, floor planning and pin assignment: Placement, floor planning, pin assignment, integrated approach.	CO1
	<b>Unit 2</b>	<b>Global Routing</b>	
	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
	<b>Unit 3</b>	<b>Scaling in MOSFET</b>	
	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
	<b>Unit 4</b>	<b>Low power VLSI Techniques</b>	
	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
	<b>Unit 5</b>	<b>Estimation and optimization</b>	
	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 30%	MTE 20%
			ETE 50%
	Text book/s*	<i>N. Weste and D. Harris, “CMOS VLSI Design: A Circuits</i>	

		<i>and Systems Perspective”, Third edition Addison Wesley, 2005</i>	
	Other References	<ul style="list-style-type: none"> <li>• <i>Anantha Chandrakasan, Robert Brodersen, “Low-power CMOS design”, IEEE press, 1998.</i></li> <li>• <i>Kaushik Roy, Sharat C. Prasad, “Low-power CMOS VLSI Circuit Design”, John Wiley &amp; Sons, 2000.</i></li> <li>• <i>A.Bellamour, M.I.Elmasri, “Low power VLSI CMOS Circuit Design”, Kluwer Academic Press, 1995.</i></li> <li>• <i>Naveed Sherwani, “Algorithms for VLSI physical design automation”, Kluwer academic publisher – 1993.</i></li> </ul> <p><i>Douglas A. Pucknell &amp; Kamran Eshraghian, “Basic VLSI Design”, Prentice-Hall of India.</i></p>	

### **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	PSO 2
C.ECE 616.1	2	3									1	3
C.ECE 616.2	2	3	2									
C.ECE 616.3	2	1										3
C.ECE 616.4	2	3	2								3	2
ECE6 16.5												3
ECE6 16	2	3	2								2	3

<b>School: SET</b>		<b>Batch : 2019-2021</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year: 2019-2020</b>	
<b>Branch: ECE(VLSI Technology)</b>		<b>Semester:II</b>	
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
	<b>Unit 1</b>	<b>Introduction to MOSFET</b>	
	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
SU/SEC/M.Tech-ECE		The MOS Inverter: the basic CMOS inverter, transfer characteristics, logic threshold, Noise margins, and Dynamic behavior, Propagation Delay, Power Consumption.	CO1, CO2

	<b>Unit 2</b>	<b>MOS Layout and Simulation</b>			
	A	MOS SPICE model, device characterization, Circuit Characterization interconnects simulation.			CO2,CO3
	B	MOS device layout: Transistor layout, Inverter layout			CO2,CO3
	C	CMOS digital circuits' layout & simulation.			CO2,CO3
	<b>Unit 3</b>	<b>Combinational and dynamic logic styles</b>			
	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
	<b>Unit 4</b>	<b>Sequential Logic design</b>			
	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
	<b>Unit 5</b>	<b>Testing and verification</b>			
	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*	<i>M. Bushnell and V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2000.</i>			
	Other References	<i>M. Abramovici, M. A. Breuer and A. D. Friedman, "Digital Systems Testing and Testable Design", IEEE Press, 1990.</i> <i>T.Kropf, "Introduction to Formal Hardware Verification", Springer Verlag, 2000.</i> <i>Weste, Eshraghian, "Principles of CMOS VLSI design", 2<sup>nd</sup> Edition Addison Wesley, 1994.</i> <i>Douglas A Pucknell and Kamaran Eshragian, "Basic VLSI design ", 3<sup>rd</sup> edition, PHI, 1994.</i>			

**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	PSO 2	PSO 3
.ECE6 15.1	3	1	2								1	3	
ECE6 15.2	1	2										3	
ECE6 15.3	3	1	1										
ECE6 15.4	2	2	3									3	
ECE6 15.5	2	1									1	2	
ECE6 15.6		3	1									2	
ECE6 15	2	3	2								2	3	



<b>School: SET</b>		<b>Batch : 2019-2021</b>	
<b>Program: M.Tech</b>		<b>Current Academic Year: 2019-2020</b>	
<b>Branch: ECE(VLSI Technology)</b>		<b>Semester:II</b>	
1	Course Code	ECE 617	
2	Course Title	<b>Mixed Signal CMOS VLSI Design</b>	
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	<p>After completing this course students should be able to</p> <p>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.</p> <p>CO2: Build a cell library to be used by other chip designers and Analyze VLSI circuit timing using Logical Effort analysis.</p> <p>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</p> <p>CO4 Explain the chip technology scaling process and Explain the basic design concepts for low power mixed signal VLSI circuits in CMOS technology.</p> <p>CO5: To understand the concept of Data converters.</p>	
7	Course Description	<p>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).</p>	
8	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Current mirrors</b>	
	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
	<b>Unit 2</b>	<b>Single stage and Multi-stage amplifiers</b>	
	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
	<b>Unit 3</b>	<b>S/H and switched capacitor circuits</b>	
	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
	<b>Unit 4</b>	<b>PLL</b>	
	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
	<b>Unit 5</b>	<b>Data converters</b>	
	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 <b>order</b> modulators, Delta Sigma modulators with multibit quantizes- Delta Sigma D/A	CO4,CO5
	Mode of examination	Theory	
	Weightage Distribution	CA 30%	MTE 20%
			ETE 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, 1 <sup>st</sup> Edition, 1996. 3. Mohamed Ismail, “Analog VLSI”, Mc Graw Hill, 1 <sup>st</sup>	

**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	PSO 2	PSO 3
ECE6 17.1	2	3	2									2	
ECE6 17.2	2	3	2									2	
ECE6 17.3	2	1										2	
ECE6 17.4	2	3	2									3	
ECE6 17.5	2	3	2									3	
ECE6 17	2	3	2									3	

<b>School: SET</b>		<b>Batch: 2018-2022</b>	
<b>Program: M.tech</b>		<b>Current Academic Year: 2019-2020</b>	
<b>Branch: ECE</b>		<b>Semester: II</b>	
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
	<b>Unit 1</b>	<b>Practical based on SPICE simulation</b>	
	A	Transient analysis and simulation of CMOS inverter	CO1
	B	Transient and simulation analysis of NAND gate.	CO1
	C	Transient and simulation analysis of neither CMOS nor gate.	CO1

	<b>Unit 2</b>	<b>Practical related to Various inverter Design</b>			
	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
	<b>Unit 3</b>	<b>Practical related to various VHDL statements</b>			
	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
	<b>Unit 4</b>	<b>Practical related to Combinational logic design</b>			
	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
	<b>Unit 5</b>	<b>Practical related to Layout design</b>			
	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.	
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## 2.1 Template A1: Syllabus for Theory Subjects

### Communication Technology and System

<b>School: SET</b> <b>Batch : 2018-22</b> <b>Program: M.Tech</b> <b>Current Academic Year: 2018-2019</b> <b>Branch:ECE</b> <b>Semester:II</b>		
1	Course Code	ECE811
2	Course Title	<b>Communication Technology and System</b>
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Compulsory
5	Course Objective	<ul style="list-style-type: none"> <li>To provide students an understanding of analog and digital communication.</li> <li>To understand multiplexing and multiple access techniques.</li> <li>To implement the block of OFDM</li> </ul>
6	Course Outcomes	CO1: Enhancement of knowledge for analog 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
	<b>Unit A</b>	<b>Basics of Communication System</b>
	Unit A	Review of Analog Modulation Techniques CO1

	Topic 1			
	Unit A Topic 2	Pulse Code Modulation, Differential Code Modulation, Delta Modulation, Adaptive Delta Modulation	CO1	
	Unit A Topic 3	Digital Modulation Techniques: ASK, FSK,PSK, QPSK, DPSK	CO1	
	<b>Unit B</b>	<b>Multiplexing and Multiple Access Techniques</b>		
	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	
	<b>Unit C</b>	<b>Orthogonal Frequency Division Multiplexing</b>		
	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	
	<b>Unit D</b>	<b>Case Study on OFDM</b>		
	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	
	<b>Unit E</b>	<b>Long Term Evolution</b>		
	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	<ol style="list-style-type: none"> <li>1. Simon Haykin, “Digital Communication”, Wiley Publication, 2<sup>nd</sup> Edition</li> <li>2. Yong Su Chu, “OFDM Wireless Communication using MATLAB”, Wiley Publication, 2010.</li> <li>3. Stefania Sesia, “LTE-The UMTS Long Term Evolution: From Theory to Practice”, Wiley Pub., 2<sup>nd</sup> Ed.</li> </ol>	
	References	B.P.Lathi, Zhi Ding, Hari M. Gupta, Modern Digital and Analog Communication Systems, oxford publication, 1 <sup>st</sup> 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

## Emerging Electronics Technologies

**School: SET**

**Batch : 2018-22**

**Program: MTECH**

**Current Academic Year: 2018-2019**

**Branch:ECE**

**Semester:I**

1	Course Code	ECE814
2	Course Title	<b>Emerging Electronics Technologies</b>
3	Credits	
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Compulsory
5	Course Objective	<ul style="list-style-type: none"> <li>• To make students familiar with different solid state light emitters and detectors.</li> <li>• To define different Acoustic transduction and different acoustic transducers.</li> <li>• To explain Eye anatomy and eye optics, Color vision basics .</li> <li>• To illustrate concepts of LED, LCD, OLED.</li> <li>• To illustrate various MAC protocols like GSM, Spread spectrum, CDMA, TDMA &amp; Basic electronics components. Handset Specific operating systems</li> <li>• To explain Working principle of mobile handset &amp; Components used in mobile handsets .</li> <li>• To illustrate Comparison of the essential characteristics of Android and iOS.</li> </ul>
6	Course Outcomes	<p>CO1: able to understand functioning of various optoelectronic devices and underlying principles.</p> <p>CO2: able to understand and differentiate among various acoustic systems.</p> <p>CO3: able to understand working principles of various display devices.</p> <p>CO4: able to understand Generations of mobile phones,</p> <p>CO5:able to handle hardware components of mobile handset and OS used in mobiles.</p>
7	Course Description	<p>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</p>

		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	<b>Optoelectronics</b>		
	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	<b>Acoustics Engineering</b>		
	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	<b>Display Technology</b>		
	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	<b>Smartphone handset</b>		
	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	<b>Smartphone OS</b>		
	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	CA	MTE	ETE

	Distribution	30%	20%	50%	
	<i>Text book</i>	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.			
	<i>References</i>	<i>Joseph Annuzzi, Jr. Lauren Darcey Shane Conder, Introduction to Android Application Development, Fourth Edition, Addison Wesley.</i>			

### **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

## Method for Product Development for Electronics Subsystems

<b>School: SET</b> <b>Batch : 2018-2020</b> <b>Program: M.TECH</b> <b>Current Academic Year:</b> <b>Branch:ESD</b> <b>Semester:I</b>			
1	Course Code	ECE815	
2	Course Title	<b>Method for Product Development for Electronics Subsystems</b>	
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	<b>On a successful completion of this course students will be able to</b> CO 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
	<b>Unit 1</b>	<b>Concept: Product Development from Concept through Manufacturing</b>	
	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
	<b>Unit 2</b>	<b>Research &amp; Circuit Design: Gated Product</b>	

		<b>Development Process &amp; Requirements and Conceptual Design</b>			
	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
	<b>Unit 3</b>	<b>Packaging and Printed Circuit Design</b>			
	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
	<b>Unit 4</b>	<b>Prototyping or Trial Production &amp; Design Review</b>			
	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
	<b>Unit 5</b>	<b>Manufacturing Setup including Test Setup &amp; Documentation &amp;Manufacturing and Supply Chain Management:</b>			
	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	<a href="https://www.industrologic.com/gtepdad.htm">https://www.industrologic.com/gtepdad.htm</a> <a href="http://www.stilwellbaker.com/capabilities/electronic-product-development">http://www.stilwellbaker.com/capabilities/electronic-product-development</a>	

### **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

## Embedded Systems

**School: SET**  
**Batch : 2018-20**  
**Program: MTECH**  
**Current Academic Year: 2018-2022**  
**Branch:ECE**  
**Semester:I/II**

1	Course Code	ECE813
2	Course Title	<b>Embedded Systems</b>
3	Credits	
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Compulsory
5	Course Objective	<ul style="list-style-type: none"> <li>• Embedded Systems and design issues</li> <li>• Advanced Computer Architecture</li> <li>• Embedded System Installation/ Configuration using AVR microcontroller</li> <li>• Development of Embedded Firmware using AVR microcontroller</li> <li>• Troubleshooting and Maintenance of embedded system</li> </ul>
6	Course Outcomes	<p>CO1:Explain Embedded Systems and design issues</p> <p>CO2:Apply and illustrate advanced Computer architecture</p> <p>CO3:Embedded System Installation/ Configuration using AVR microcontroller</p> <p>CO4:Development of Embedded Firmware using AVR microcontroller</p> <p>CO5: Apply Embedded tools in Real Time Applications</p>
7	Course Description	<p>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</p>
8	Outline syllabus	CO Mapping
	<b>Unit –A</b>	<b>Embedded Systems</b>



	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
	<b>Unit –B</b>	<b>Advanced Computer Architecture</b>			
	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
	<b>Unit –C</b>	<b>AVR Microcontoller</b>			
	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 3	Registers of AVR, Different ports and DDR register			CO2
	<b>Unit –D</b>	<b>Programming of AVR</b>			
	Unit D Topic 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
	<b>Unit –E</b>	<b>CASE STUDY</b>			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	
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**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
ECE813. 1	2	1	1		2		1	1	1	1	2		1
ECE813. 2	2	2	1		2		1	2	1	1	3		2
ECE813. 3	3	1	1		2		1	2	1	1	2		2
ECE813. 4	2	2	1		2		1	3	1	1	1		2
ECE813. 5	2	2	1		2		1	3	1	1	1		2
ECE813	2	2	1		2		1	2	1	1	2		2

## Quality Management of Electronic Systems

<b>School: SET</b> <b>Batch :2018-2020</b> <b>Program: M.TECH</b> <b>Current Academic Year: 2018-19</b> <b>Branch:ESD</b> <b>Semester:II</b>		
1	Course Code	ECE 812
2	Course Title	<b>Quality Management of Electronic Systems</b>
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 Systems and explain the need to higher quality the system and components because of the increasing complexities of electronic products.
8	Outline syllabus	CO Mapping
	<b>Unit 1</b>	<b>Quality Concepts</b>
	A	<i>Evolution of Quality Control</i> , concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type.

	B	<i>Control on Purchased Product</i> Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.			CO1
	C	<i>Manufacturing Quality</i> Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.			CO1
	<b>Unit 2</b>	<b>Quality Management</b>			
	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
	<b>Unit 3</b>	<b>System Reliability</b>			
	A	System reliability modeling,			CO3
	B	k-out of n system, analysis of complex reliability structures			CO3
	C	System reliability estimation.			CO3
	<b>Unit 4</b>	<b>Reliability Techniques</b>			
	A	Reliability prediction, cut set, tie set, FME set, PTA,			CO4
	B	Markovian Techniques			CO4
	C	Monte Carlo Simulation, application to electronic systems.			CO4
	<b>Unit 5</b>	<b>Challenges of Quality Management: A Case Study at Electronics Manufacturing Services Company</b>			
	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, 2 <sup>nd</sup> 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

	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	3. A. Y. Oppenheim and R. W. Schater, “Digital Signal Processing”, PHI 4. 2.A. Y. Oppenheim, 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	PO10	PSO 1	PSO 2	PSO 3
ECP684.1	3	2	2	2	2	1	1	1	2	-	2		2
ECP684.2	3	1	2	2	2	1	1	1	2	-	2		3
ECP684.3	3	3	2	3	2	1	1	1	2	2	2		3
ECP684.4	3	3	2	3	2	1	1	1	2	-	2		3
ECP684.5	3	3	3	3	2	1	1	1	2	2	2		3
ECP684	3	2.4	2.2	2.6	2	1	1	1	1	0.8	2		2.8







	<b>Unit 3</b>	<b>Ethernet and Ethernet /IP</b>			
	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
	<b>Unit 4</b>	<b>Industrial Wireless Network Protocols</b>			
	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
	<b>Unit 5</b>	<b>Illustrative application Scenarios &amp; concepts</b>			
	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*	3. E-book-Designing of Internet of things by- Adrian McEwen, Hakim Cassimally, Wiley 4. <i>Internet of Things by-A Bahga&amp;Vijay Madiseti,University Press</i>			
	Other References	1. Free E book-Enabling Things to talk-by Alessandro Bassi • Martin Bauer • Martin Fiedler • Thorsten Kramp • Rob van Kranenburg • Sebastian Lange • Stefan Meissner, Springer 2. E-book (Business edition)-Internet of Things by Mirko Presser, The Alexandra Institute 3. .Mini S. Thomas and John D. McDonald, Power System SCADA and Smart Grids, CRC Press. 4. David Bailey and Edwin Wright, Practical SCADA for Industry, Newnes. 5. Raj Kamal, Internet of Things Architecture and Design and Principles, McGraw Hill Education, 2017.			

**COURSE ARTICULATION MATRIX**

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

