Course Structure and Syllabus

SITE-21

Electronics and Communication Engineering

Course Structure for

B. Tech (Electronics and Communication Engineering)

Semester I (First year)

S.No	Subject Code	Course	L	T	P	C
1	21CMEGT1010	Technical English	3	0	0	3
2	21CMMAT1020	Engineering Mathematics-I	3	0	0	3
3	21CMEET1030	Basic Electrical Engineering	3	0	0	3
4	21CMCST1040	Programming for Problem Solving	3	0	0	3
5	21ECMEL1050	Computer Aided Engineering Graphics	2	0	2	3
6	21CMEGL1060	English Communication Skills Lab	0	0	3	1.5
7	21CMEEL1070	Basic Electrical Engineering Lab	0	0	3	1.5
8	21CMCSL1080	Programming for Problem Solving Lab	0	0	3	1.5
9	21CMESN1090	Environmental Science	2	0	0	0
Total Semester Credits						**19.5**

S.No	Subject Code	Course	L	T	P	C
1	21CMMAT2010	Engineering Mathematics - II	3	0	0	3
2	21ECPHT2020	Engineering Physics	3	0	0	3
3	21CMCHT2030	Engineering Chemistry	3	0	0	3
4	21CMCST2040	Python Programming	1	0	4	3
5	21ECECT2050	Network Analysis	3	0	0	3
6	21ECPHL2060	Engineering Physics Lab	0	0	3	1.5
7	21CMEEL2070	Engineering Chemistry Lab	0	0	3	1.5
8	21ECMEL2080	Engineering Workshop	0	0	3	1.5
9	21CMMSN2090	Constitution of India, Professional Ethics & Human Rights	2	0	0	0

Total Semester Credits				**19.5**

Semester II (First year)

Course Structure for

B. Tech (Electronics and Communication Engineering)

Semester III (Second year**)**

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECMAT3010	Engineering Mathematics - III	3	0	0	3
2	21ECECT3020	Probability Theory & Stochastic Processes	3	0	0	3
3	21ECECT3030	Semiconductor Devices	3	0	0	3
4	21ECECT3040	Digital System Design	3	0	0	3
5	21ECECT3050	Signals & Systems	3	0	0	3
6	21ECECL3060	Semiconductor Devices Lab	0	0	3	1.5
7	21ECECL3070	Digital System Design Lab	0	0	3	1.5
8	21ECECL3080	Electrical Circuits Lab	0	0	3	1.5
9	21ECECS3090	Data Science using Python (Skill Oriented Course-1)	1	0	2	2
Total Semester Credits						**21.5**

Semester IV (Second year**)**

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21CMMST4010	Management Science	3	0	0	3
2	21ECECT4020	EM Waves & Transmission Lines	3	0	0	3
3	21ECECT4030	Principles of Communication Theory	3	0	0	3
4	21ECECT4040	Electronic Circuit Analysis	3	0	0	3
5	21ECECT4050	Control Systems	3	0	0	3
6	21ECECL4060	Principles of Communication Theory Lab	0	0	3	1.5
7	21ECECL4070	Electronic Circuit Analysis Lab	0	0	3	1.5
8	21ECECL4080	Signals & Systems Lab	0	0	3	1.5
9	21ECECS4090	FPGA Architecture and Programming Using Verilog/ Matlab for Engineers (Skill Oriented Course-2)	1	0	2	2
10	21ECECN40A0	Pulse & Digital Circuits	2	0	0	0
Total Semester Credits						**21.5**

H/M	Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	4	0	0	4

Course Structure for

B. Tech (Electronics and Communication Engineering)

III B.Tech. V-Semester

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECT5010	Digital Modulation and Coding	3	0	0	3
2	21ECECT5020	Antenna Theory and Design	3	0	0	3
3	21ECECT5030	Linear IC Applications	3	0	0	3
4	21ECECP504X	Professional Elective-1	3	0	0	3
5	21ECXXO505X	Open Elective - 1	3	0	0	3
6	21ECECL5060	Digital Modulation and Coding Lab	0	0	3	1.5
7	21ECECL5070	Linear IC Applications Lab	0	0	3	1.5
8	21CMAHS5080	Skill advanced course/ soft skill course-3* (Soft Skills & Aptitude Builder-1).	1	0	2	2
9	21ECECN5090	Biology for Engineers	2	0	0	0
10	21ECECR50A0	Summer Internship - 2 Months (Mandatory) after second year (to be evaluated during V semester	0	0	3	1.5
Total Semester Credits						**21.5**
11		Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	4	0	0	4

Professional Elective-I

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECP504A	Computer Architecture & Organization	3	0	0	3
2	21ECECP504B	Introduction to Machine Learning	3	0	0	3
3	21ECECP504C	System Design through Verilog	3	0	0	3

Open Elective-I

Candidate should select the subject from list of subjects offered by other departments

Course Structure for
B. Tech (Electronics & Communication Engineering)

III B.Tech. VI-Semester

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECT6010	Digital Signal Processing	3	0	0	3
2	21ECECT6020	VLSI Design	3	0	0	3
3	21ECECT6030	Microprocessors & Microcontrollers	3	0	0	3
4	21ECECP604X	Professional Elective-II	3	0	0	3
5	21ECXXO605X	Open Elective – II	3	0	0	3
6	21ECECL6060	Digital Signal Processing Lab	0	0	3	1.5
7	21ECECL6070	VLSI Design Lab	0	0	3	1.5
8	21ECECL6080	Microprocessors & Microcontrollers Lab	0	0	3	1.5
9	21CMAHS6090	Skill advanced course/ soft skill course-4* Soft Skills and Aptitude Builder-2	1	0	2	2
10	21ECECN6100	Essence of Indian Traditional Knowledge	2	0	0	0
						21.5
10	H/M	Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	4	0	0	4

Professional Elective-II

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECP604A	Soft Computing Techniques	3	0	0	3
2	21ECECP604B	Cellular and Mobile Communications	3	0	0	3
3	21ECECP604C	Microwave Engineering	3	0	0	3

Open Elective-II

Candidate should select the subject from list of subjects offered by other departments

Course Structure for

B. Tech (Electronics & Communication Engineering)

IV B.Tech. VII-Semester

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECP701X	Professional Elective-III	3	0	0	3
2	21ECECP702X	Professional Elective-IV	3	0	0	3
3	21ECECP703X	Professional Elective-V	3	0	0	3
4	21ECECO704X	Open Elective – III	3	0	0	3
5	21ECXXO705X	Open Elective – IV	3	0	0	3
6	21ECXXO706X	Humanities and Social Science Elective	3	0	0	3
7	21ECECS707A	Microwave Circuits and Antenna Design using HFSS	1	0	2	2
	21ECECS707B	Deep Learning for Image Processing Applications				
	21ECECS707C	Internet of Things and its Applications				
8	21ECECR7080	Research Internship - 2 Months (Mandatory) after Third year (to be evaluated during V semester	0	0	6	3
						23
9	H/M	Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	4	0	0	4

Professional Elective-III

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECP701A	Digital Image Processing	3	0	0	3
2	21ECECP701B	Low Power VLSI Design	3	0	0	3
3	21ECECP701C	Wireless Sensor Networks	3	0	0	3

Professional Elective-IV

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECP702A	Embedded and Real-Time Systems	3	0	0	3
2	21ECECP702B	Testing & Testability	3	0	0	3
3	21ECECP702C	Optical Communication	3	0	0	3

Professional Elective-V

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECP703A	Radar Systems	3	0	0	3
2	21ECECP703B	Internet of Things	3	0	0	3
3	21ECECP703C	Embedded System Design	3	0	0	3

Open Elective-III

Candidate should select the subject from list of subjects offered by other departments

Open Elective-IV

Candidate should select the subject from list of subjects offered by other departments

Course Structure for

B. Tech (Electronics & Communication Engineering)

IV B.Tech. VIII-Semester

Si.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECR8010	Project - Project work, seminar and internship in industry	0	0	24	12
Total						**12**

Open Elective Course Offered by ECE to other departments

Open Elective-I (Semester-V)

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21XXECOX0XA	Fundamentals of Integrated Circuits	3	0	0	3
2	21XXECOX0XB	Fundamentals of Microprocessors and Microcontrollers	3	0	0	3
3	21XXECOX0XC	Fundamentals of Digital Signal Processing	3	0	0	3

Open Elective-II (Semester-VI)

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21XXECO605A	Fundamentals of Digital Image Processing	3	0	0	3
2	21XXECO605B	Transducers and Sensors	3	0	0	3
3	21XXECO605C	Embedded Systems	3	0	0	3

Open Elective-III (Semester-VII)

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21XXECO704A	Fundamentals of Internet of Things	3	0	0	3
2	21XXECO704B	Introduction to Cellular and Mobile Communications	3	0	0	3
3	21XXECO704C	Consumer Electronics	3	0	0	3

Open Elective-IV (Semester-VII)

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21XXECO705A	Embedded and Real-Time Concepts	3	0	0	3

2	21XXECO705B	Low Power VLSI	3	0	0	3
3	21XXECO705C	Wireless Sensor Networks	3	0	0	3

Course Structure for

B. Tech (Electronics and Communication Engineering)

COURSES OFFERED FOR HONORS PROGRAMME

POOL-1

Embedded Systems: (any four of the following subjects which are not chosen as professional electives are to be considered for Honors Degree)

S.No.	Subject Code	Subject	L-T-P	Credits
1	21ECECHXXXX	Embedded System Design	3-1-0	4
2	21ECECHXXXX	Advanced Embedded Controllers	3-1-0	4
3	21ECECHXXXX	Parallel Processing	3-1-0	4
4	21ECECHXXXX	Embedded Systems for Biomedical applications	3-1-0	4
5	21ECECHXXXX	Internet of Things Fundamentals	3-1-0	4
6	21ECECHXXXX	Communication Protocols for Internet of Things	3-1-0	4
7	21ECECHXXXX	Industrial Internet of Things	3-1-0	4
8	21ECECHXXXX	Sensor Networks and Internet of Things	3-1-0	4
In addition to any of the four subjects, MOOC/NPTEL Courses for 04 credits (02 courses@ 2 credits each) are compulsory in the domain of Electronics and Communication Engineering				

POOL-2

Integrated circuits and Systems: (any four of the following subjects which are not chosen as professional electives are to be considered for Honors Degree)

S.No.	Subject Code	Subject	L-T-P	Credits
1	21ECECHXXXX	VLSI Technology and Design	3-1-0	4
2	21ECECHXXXX	CMOS Analog IC Design	3-1-0	4
3	21ECECHXXXX	CMOS Digital IC design	3-1-0	4
4	21ECECHXXXX	Design for Testability	3-1-0	4

5	21ECECHXXXX	System on Chip	3-1-0	4
6	21ECECHXXXX	Programmable Logic Devices and ASIC	3-1-0	4
7	21ECECHXXXX	Scripting Language	3-1-0	4
8	21ECECHXXXX	Low Power VLSI Design	3-1-0	4
In addition to any of the four subjects, MOOC/NPTEL Courses for 04 credits (02 courses@ 2 credits each) are compulsory in the domain of Electronics and Communication Engineering				

Course Structure for

B. Tech (Electronics and Communication Engineering)

POOL-3

Communication Engineering: (any four of the following subjects which are not chosen as a professional electives are to be considered for Honors Degree)

S.No.	Subject Code	Subject	L-T-P	Credits
1	21ECECHXXXX	Wireless Sensor Networks	3-1-0	4
2	21ECECHXXXX	Software defined radio	3-1-0	4
3	21ECECHXXXX	Data Communications & Computer Networks	3-1-0	4
4	21ECECHXXXX	Cognitive radio	3-1-0	4
5	21ECECHXXXX	5G Communications	3-1-0	4
6	21ECECHXXXX	Satellite communication	3-1-0	4
7	21ECECHXXXX	Optical Communication	3-1-0	4
8	21ECECHXXXX	Global navigational satellite systems	3-1-0	4
In addition to any of the four subjects, MOOC/NPTEL Courses for 04 credits (02 courses@ 2 credits each) are compulsory in the domain of Electronics and Communication Engineering				

POOL-4

Digital Signal processing: (any four of the following subjects which are not chosen as a professional electives are to be considered for Honors Degree)

S.No.	Subject Code	Subject	L-T-P	Credits
1	21ECECHXXXX	Speech Signal Processing	3-1-0	4
2	21ECECHXXXX	Video Signal Processing	3-1-0	4
3	21ECECHXXXX	Adaptive Signal Processing	3-1-0	4
4	21ECECHXXXX	Bio- Medical Signal Processing	3-1-0	4

5	21ECECHXXXX	DSP Processors and Architectures	3-1-0	4
6	21ECECHXXXX	Wavelet Theory	3-1-0	4
7	21ECECHXXXX	Multirate Systems And Filter Banks	3-1-0	4
8	21ECECHXXXX	Mathematical methods for signal processing	3-1-0	4
In addition to any of the four subjects, MOOC/NPTEL Courses for 04 credits (02 courses@ 2 credits each) are compulsory in the domain of Electronics and Communication Engineering				

MOOC/NPTEL Courses for Honor program:

	Course Name		**Tentative period**	**Duration**	**Course Link**
Honors Program	Track-1 Embedded Systems	Embedded System Design With ARM	July-Sept	08	https://onlinecourses.nptel.ac.in/noc22_cs93/preview
		Fabrication Techniques for MEMs-based sensors: clinical perspective	July-Oct	12	https://onlinecourses.nptel.ac.in/noc22_ee76/preview
		Introduction To Industry 4.0 And Industrial Internet of Things	July-Oct	12	https://onlinecourses.nptel.ac.in/noc22_cs95/preview
		Sensors and actuators	Jan-April	12	https://onlinecourses.nptel.ac.in/noc21_ee32/preview
	Track-2 Integrated circuits and Systems	VLSI Interconnects	July-Sept	08	https://onlinecourses.nptel.ac.in/noc22_ee125/preview
		Hardware Modelling Using Verilog	July-Sept	08	https://onlinecourses.nptel.ac.in/noc22_cs94/preview
		Architectural Design of Digital Integrated Circuits	Jan-April	12	https://onlinecourses.nptel.ac.in/noc22_ee58/preview
		Design and Analysis of VLSI Subsystems	Jan-April	12	https://onlinecourses.nptel.ac.in/noc22_ee44/preview
	Track-3	Principles of Signal Estimation for	July-Sept	12	https://onlinecourses.nptel.ac

	Communication Engineering	MIMO/ OFDM Wireless Communication			.in/noc22_ee72/preview
		Evolution Of Air Interface Towards 5G	Jan-April	08	https://onlinecourses.nptel.ac.in/noc22_ee56/preview
		Optical Wireless Communications for Beyond 5G Networks and IoT	Jan-April	12	https://onlinecourses.nptel.ac.in/noc23_ee61/preview
		Spread Spectrum Communications and Jamming	Jan-April	12	https://onlinecourses.nptel.ac.in/noc20_ee34/preview
	Track-4 Digital Signal Processing	Signal Processing for mm Wave communication	July-Oct	12	https://onlinecourses.nptel.ac.in/noc22_ee102/preview
		Pattern recognition and Application	July-Oct	12	https://onlinecourses.nptel.ac.in/noc22_ee119/preview
		VLSI Signal Processing	Jan-April	12	https://onlinecourses.nptel.ac.in/noc20_ee44/preview
		Multirate DSP	Jan-April	12	https://archive.nptel.ac.in/courses/108/106/108106136/

Course Structure for

B. Tech (Electronics and Communication Engineering)

COURSES OFFERED FOR MINORS PROGRAMME

S.No.	Subject Code	Subject	L-T-P	Credits
1	21ECECMXXXX	Electronics Devices and Basic Circuits	3-1-0	4
2	21ECECMXXXX	Digital Electronics	3-1-0	4
3	21ECECMXXXX	Principles of Communication Systems	3-1-0	4
4	21ECECMXXXX	Signal Analysis	3-1-0	4
In addition to any of the four subjects, MOOC/NPTEL Courses for 04 credits (02 courses@ 2 credits each) are compulsory in the domain of Electronics and Communication Engineering				

Swayam/NPTEL Courses for Minor program:

	Course Name	Tentative period	Duration	Course Link
Minors Program	Modern Digital Communication Techniques	July-Oct	12	https://swayam.gov.in/explorer?searchText=Modern+Digital+Communication+Techniques
	System Design Through VERILOG	July-Sept	08	https://swayam.gov.in/explorer?searchText=System+Design+Through+VERILOG
	Analog Electronic Circuits	Jan-April	12	https://onlinecourses.nptel.ac.in/noc23_ee77/preview
	Digital Signal Processing	Jan-April	12	https://nptel.ac.in/courses/117102060

<table>
<tr><td colspan="4">TECHNICAL ENGLISH
SEMESTER I</td></tr>
<tr><td>Subject Code</td><td>21CMEGT1010</td><td>IA Marks</td><td>30</td></tr>
<tr><td>Number of Lecture Hours/ Week</td><td>03</td><td>Exam Marks</td><td>70</td></tr>
<tr><td>Total Number of Lecture Hours</td><td>50</td><td>Exams Hours</td><td>03</td></tr>
<tr><td colspan="4">Credits -03</td></tr>
<tr><td colspan="4">Course Objectives:
To enable the students to learn and apply fundamental principles in Technical English & Communication by focusing on:
1. Technical English Vocabulary
2. Writing Skills
3. Common Errors in Writing
4. Nature and Style of Sensible Technical Writing
5. Writing Technical Reports and Letters</td></tr>
<tr><td colspan="4">Unit I</td></tr>
<tr><td colspan="3">Principles of Scientific Vocabulary
• Principles of Scientific vocabulary: short and simple words-compact substitutes for wordy phrases- redundant words and Expressions-Avoid hackneyed and stilted phrases, verbosity and incorrect use of words
• The role of roots in word building, prefixes and suffixes, confusing words and expressions.</td><td>10 hours</td></tr>
<tr><td colspan="4">Unit II</td></tr>
<tr><td colspan="3">Writing Skills
• Distinguishing between academic and personal styles of writing
• Use of clauses in technical phrases and sentences
• Techniques of Sentence and paragraph writing
• Measuring the clarity of a text through Fog Index or Clarity Index</td><td>10 hours</td></tr>
<tr><td colspan="4">Unit III</td></tr>
<tr><td colspan="3">Common Errors in Writing
• Subject-verb agreement and concord of nouns, pronouns and possessive adjectives
• Common errors in the use of articles, prepositions, adjectives and adverbs
• Punctuation
• Technical Guidelines for Communication
• Avoiding the pitfalls</td><td>10 hours</td></tr>
<tr><td colspan="4">Unit IV</td></tr>
<tr><td colspan="3">Nature and Style of Sensible Technical Writing
• Academic Writing Process
• Describing, processes and products
• Defining, Classifying
• Effective use of charts, graphs, and tables</td><td>10 hours</td></tr>
</table>

Unit V	
Report writing and Letter writing • Writing Technical Reports, Précis writing ,Letter Writing & Essay writing	10 Hours

COURSE OUTCOMES

On Completion of the course student will acquire

1. Ability to understand Scientific vocabulary and use them confidently
2. Familiarity with the basic principles of writing clear sentences and paragraphs
3. Ability to write error free simple technical passages
4. Knowledge of writing different writing styles
5. Confidence to write letters and technical reports clearly and coherently

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books

1. Effective Technical Communication by Barun K Mitra, Oxford University Publication

Non-detailed Text

1. Karmayogi: A Biography of E Sreedharan by M S Ashokan

Reference Books

1. *Communication Skills* by Sanjay Kumar & Pushpa Latha, OUP
2. Study Writing by Liz Hamp-Lyons and Ben Heasly, Cambridge University Press.
3. Remedial English Grammar by F T Wood, Macmillian 2007
4. *Practical English Usage* by Michael Swan Oxford University Press
5. *English Collocations in Use* by Michael McCarthy & Felicity O'Dell
6. *Effective Technical Communication* by Arsahf Rizvi,
7. *Essential English Grammar by Raymond Murphy, CUP, 2017*

Unit	Title	Text books/Reference Books
I	Principles of Scientific Vocabulary	Text Book 1/Reference Book 5
II	Writing Skills	Text Book 1Reference Book 2 Reference Book 6
III	Common Errors in Writing	Text Book 1, Reference Book 3 Reference Book 4,Reference Book 7
IV	Nature and Style of Sensible Technical Writing	Text Book 1, Reference Book 1 Reference Book 2
V	Report writing and Letter writing	Text Book 1, Reference Book 1 Reference Book 2

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-
Cours	-	-	-	-	-	-	-	-	-	**2**	-	-	-	-	-

ENGINEERING MATHEMATICS-I (Calculus & Differential Equations) Common to all the branches SEMESTER I			
Subject Code	21CMMAT1010	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Course Objectives:

1. To solve the differential equations related to various engineering fields
2. To enlighten the learners in the concept of differential equations.
3. To familiarize with functions of several variables which is useful in optimization
4. To solve the partial partial differential equations of first order
5. To apply double integration techniques in evaluating areas bounded by region.

Unit -1	**Hours**
Differential Equations of first order and first degree: Linear differential equations - Bernoulli's equations – Exact equations and Equations reducible to exact form. Applications: Newton's law of cooling - Law of natural growth and decay - Orthogonal trajectories.	**10**
Unit -2	
Linear differential equations of higher order: Homogeneous and Non-homogeneous differential equations of higher order with constant coefficients – with non-homogeneous term of the type e^{ax}, sin ax, cos ax, polynomials in x^n, e^{ax} V(x) and x^n V(x) – Method of Variation of parameters. Applications: LCR circuit.	**10**
Unit – 3	
Partial differentiation: Introduction – Homogeneous function – Euler's theorem– Total derivative– Chain rule– Jacobian – Functional dependence –Taylor's and MacLaurin's series expansion of functions of two variables. Applications: Maxima and Minima of functions of two variables without constraints and Lagrange's method.	**10**
Unit – 4	
PDE of first order: Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of first order linear (Lagrange) equation and nonlinear (standard types) equations.	**08**
Unit – 5	

Multiple integrals: Double and Triple integrals – Change of order of integration in double integrals – Change of variables to polar, cylindrical and spherical coordinates. Applications: Finding Areas and Volumes.	**12**

Course outcomes:

On completion of this course, students are able to

1. Solve the differential equations related to various engineering fields (L3)
2. Solve the differential equations of higher order related to various engineering fields (L3)
3. familiarize with functions of several variables which is useful in optimization (L3)
4. Solve the partial partial differential equations of first order (L3)
5. Apply double integration techniques in evaluating areas bounded by region (L3).

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. Joel Hass, Christopher Heil and Maurice D. Weir, Thomas calculus, 14thEdition, Pearson.
3. Lawrence Turyn, Advanced Engineering Mathematics, CRC Press, 2013.
4. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	3	-	-	-	-	-	-	-	-	-	-
2	3	3	-	-	-	-	-	-	-	-	-	-
3	3	3	-	-	-	-	-	-	-	-	-	-
4	3	3	-	-	-	-	-	-	-	-	-	-
5	3	3	-	-	-	-	-	-	-	-	-	-
Course	3	3	-	-	-	-	-	-	-	-	-	-

BASIC ELECTRICAL ENGINEERING SEMESTER I **(Common to All)**			
Subject Code	21CMEET1030	IA Marks	30
Number of Lecture Hours/Week	3L + 1T	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits-03			

Course Objectives:

This course will enable student to

1. Understand basic electrical circuit operation.
2. Understand the concept of Alternating Voltage and Current.
3. Understand the operation of DC machines.
4. Understand the working of measuring instruments.
5. Understand the operation of different types of ac machines.
6. Understand the concept of Electrical Safety.

Unit -1	**Hours**
Basic Electrical Circuits: Basic definitions(Electric Charge, Current, Electro Magnet Force, Potential Difference; Electric Power and Energy) – types of network elements – Ohm's Law – Kirchhoff's Laws –series & parallel circuits - network theorems (Super position, Thevinen's, Norton's, Maximum power transfer theorems)	**10**
Unit -2	
AC Fundamentals & Basic Electromagnetic Laws: Study of AC Voltage and Current, RMS and Average Values, three phase Star-Delta connections, Alternating Voltage applied to Pure Resistance, Inductance, Capacitance and their combinations, Concept of Power and Power Factor in AC Circuit. Concept of Magnetic Field, Magneto Motive Force (MMF), Permeability; Self and Mutual Induction, Basic Electromagnetic laws,	**10**
Unit – 3	
DC Machines: DC Machine -Principle of operation & construction – emf equation-torque equation - speed control methods – losses and efficiency – brake test. Applications of DC motors.	**10**
Unit – 4	
AC Machines: Single Phase Transformers - Construction and Operation- Principles - Classification - Applications-OC & SC test of single phase transformer-regulation & Efficiency. Three Phase Induction Motors: working principle- construction, speed- torque characteristics-losses and efficiency.	**10**
Unit – 5	
Electrical Safety: Electrical Shock and Precautions against it, Treatment of Electric Shock; Concept of Fuses and Their Classification, Selection and Application; Concept of Earthing.	**10**

Course Outcomes: The student should be able to

1. Understand basic electrical circuit operation.
2. Understand the concept of Alternating Voltage and Current.
3. Understand the operation of DC machines.
4. Understand the working of measuring instruments.
5. Understand the operation of different types of ac machines.
6. Understand the concept of Electrical Safety.

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

i. Electrical Circuit Theory and Technology by John Bird, Routledge Taylor &Francis Group.
ii. Principles of Electrical Machines by V.K. Mehta & Rohit Mehta, S.Chand and Company Limited.

Reference Books:

i. Theory and Performance of Electrical Machines by J.B. Gupta, S.K.Kataria & Sons.
ii. A Textbook of Electrical Technology – Volume II: AC & DC Machines by B.L.Theraja & A.K. Theraja, S.Chand and Company Limited.
iii. Basic Electrical Engineering by Nagsarkar, Sukhija, Oxford Publications, 2nd edition.
iv. Basic Electrical Engineering by M.S.Naidu and S.Kamakshiah, TMH Publications
v. Fundamentals of Electrical Engineering by Rajendra Prasad, PHI Publications, 2nd edition.
vi. Electrical Technology by Surinder Pal Bali, Pearson Publications.

COURSE-OUTCOMES-TO-PROGRAM-OUTCOMES-MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	2	2	1	-	-	-	-	-	-	-	-	-
2	2	2	1	-	-	-	-	-	-	-	-	-
3	2	2	1	-	-	-	-	-	-	-	-	-
4	2	2	1	-	-	-	-	-	-	-	-	-
5	2	2	1	-	-	-	-	-	-	-	-	-
Course	2	2	1	-	-	-	-	-	-	-	-	-

PROGRAMMING FOR PROBLEM SOLVING SEMESTER I (Common to All)			
Subject Code	21CMCST1040	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

COURSE OBJECTIVES:

The Objectives of Programming for problem solving are:

- To learn about C programming language syntax, semantics, and the runtime environment
- To be familiarized with general computer programming concepts like data types, conditional statements, loops and functions.
- To be familiarized with general coding techniques and procedure-oriented programming.

Unit -1	**Hours**
History & Hardware: (TB 1: 1-22) Computer Hardware, Components, Types of Software, Memory Units. **Introduction to Problem solving**: (TB1:33-50) Algorithm, Characteristics of Algorithms, PseudoCode, Flowchart, Types of Languages, Relation between Data, Information, Input and Output. **Basics of C**: (TB1:58-67)History and Features of C, Importance of C, Procedural Language, Compiler versus Interpreter, Structure of C Program, Program Development Steps, Programming Errors.	**10**
Unit -2	
Overview of C: (TB:68-125) Character Set, C-Tokens, Data Types, Variables, Constants, Operators, Operator Precedence and Associativity, Evaluation of C-Expressions, Input/output Functions. **Conditional Branching: (TB1:143-152)** if statement, if...else statement, Nested if...else statement, If…else…if ladder, switch statement. **Unconditional Branching: (TB1:174-175)** go to**. Control flow Statements:** break, continue**. Looping Constructs:** (TB1:156-170) do-while statement, while statement, for statement	**10**
Unit -3	
Arrays: (TB1:188-222) Introduction,1-DArrays, Character arrays and string representation, 2-D Arrays(Matrix), Multi-Dimensional Arrays. **Strings**: Working with Strings, String Handling Functions (both library and user defined). **Functions:** (TB1:230-260) Basics, Necessity and Advantages, Types of Functions, Parameter Passing Mechanisms, Recursion, Storage Classes, Command Line Arguments, Conversion from Recursion toIteration and Vice-Versa.	**10**
Unit -4	

Pointers: (TB1:288-347) Understanding Pointers, Pointer Expressions, Pointer and Arrays,Pointers and Strings, Pointers to Functions. **Dynamic Memory Allocation:** Introduction to Dynamic Memory Alloca-tion- malloc(), calloc(), realloc(), free(). **Structures and Unions:** (TB1:370-394) Defining a Structure, typedef, Advantage of Structure, NestedStructures, Arrays of Structures, Structures and Arrays, Structures and Functions, Structures and Pointers, Defining Unions, Self-Referential Structures, Bitfields, Enumerations.	**10**
Unit -5	
Preprocessing Directives: (TB2:325-333) Macro Substitution, File Inclusion, ConditionalCompilation and Other Directives. **File Management In C:** (TB1:408-422) Introduction to File Management, Modes andOperations on Files, Types of Files, Error Handling during I/O Operations.	**10**

COURSE OUTCOMES:

On completion of the course student will be able to

- Demonstrate computer components, algorithms, translate them into programs.
- Choose the suitable control structures for the problem to be solved.
- Make use of arrays, pointers, structures, and unions effectively.
- Organize reusable code in a program into functions.
- Demonstration of file operations.

Question paper pattern:

1 Question paper consists of 10 questions.
2 Each full question carrying 14 marks.
3 Each full question will have sub question covering all topics under a unit.
4 The student will have to answer 5 full questions selecting one full question from each unit.

TEXT BOOKS:

1) Programming in C ,Pradip Dey , Manas Ghosh, OXFORD
2) Programming in ,C Reema Thareja,Second Edition, OXFORD
3) Programming for Problem Solving, Behrouz A. Forouzan, Richard F.Gilberg,CENGAGE.

REFERENCE BOOKS:

1) Computer Fundamentals and Programming, Sumithabha Das, Mc GrawHill.
2) Programming in C, Ashok N. Kamthane, Amit Kamthane, Pearson.

COURSE-OUTCOMES-TO-PROGRAM-OUTCOMES-MAPPING:

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 1 0	PO 1 1	PO 1 2	PSO 1	PSO 2
1	2				3					2				3
2	2				3					2				3
3	2				3					2				3
4	2				3					2				3
5	2				3					2				3
Course	**2**				**3**					**2**				**3**

COMPUTER AIDED ENGINEERING GRAPHICS
(Common to AI&M, CSE, CST, ECE, ECT & IT)

Subject Code	21ECMEL1050	IA Marks	30
Number of Lecture Hours/Week	1(L)+0(T)+4(P)	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	3

Credits – 03

COURSE OBJECTIVES: On successful completion of this course, Students should be able to

1. draw engineering objects with appropriate lettering and dimensioning using various commands of AutoCAD
2. draw geometric constructions, polygons, various types of curves and scales
3. construct multi views of points, lines and planes
4. construct multi views of solids by orthographic projection method
5. convert the orthographic views into isometric views and vice versa by 2D- Commands in AutoCAD

Unit -1: INTRODUCTION	**Teaching Hours**
Introduction to Engineering Graphics, sheet sizes & layouts (ISO), line types with application, scales, drawing sheet sizes, title block, sheet markings, dimensioning **AutoCAD:** Overview of Computer Graphics, starting with autoCAD, templates, menu- bar, drawing area, option buttons (drawing settings), command line area, draw commands (point, line, polyline, circle, circular arc, ellipse, elliptical arc, spline fit, spline CV, rectangle & polygon), modify commands (move, rotate, trim/extend, erase, copy, mirror, chamfer/ fillet, explode, stretch, scale, array & offset), layers (layering, setting up and use of layers, layers to create drawings and create, edit and use customized layers) & annotation commands (applying dimensions/ annotations to drawings), drawing settings (grid, snap-mode, ortho, polar tracking, object snap, iso-draft), dimension settings (edit/ modify dimension style: text size & style, arrow size & style, line types & thickness and setting other parameters of dimension text, dimension lines & extension lines) Printing documents to paper and to PDF using plot command.	12
Unit -2: CONICS AND SCALES	
Geometrical constructions, polygons, conic sections – ellipse, parabola, hyperbola (Eccentricity method only); scales – plain, diagonal and vernier scales**.**	10
Unit – 3: ORTHOGRAPHIC PROJECTION OF POINTS, LINE AND PLANES	
Principles of Orthographic Projections, Projections of Points, projection of lines (inclined to HP & VP); Projections of planes (inclined to one reference plane).	10
Unit – 4: ORTHOGRAPHIC PROJECTION OF SOLIDS	
Projections of Regular Solids- Prisms, Pyramids, Cylinder & Cone (simple position and inclined to one reference plane only)	8
Unit-5: ISOMETRIC PROJECTIONS AND ORTHOGRAPHIC VIEWS	

Isometric Projections and orthographic views: Principles of isometric projection – isometric scale, isometric views, conventions; isometric views of lines, planes, simple solids, Conversion of Isometric Views to Orthographic Views and vice-versa	10

COURSE OUTCOMES: On successful completion of this course, students will be able to

1. understand the BIS conventions of engineering drawing with basic concepts & draw engineering objects with appropriate lettering and dimensioning using various commands of AutoCAD
2. construct polygons, various types of Curves and scales used engineering application like maps, buildings, bridges
3. draw multi views of points, lines and planes by orthographic projection method
4. draw multi views of solids by orthographic projection method
5. convert the orthographic views into isometric views and vice versa by 2D- Commands in AutoCAD

Text Books

1. N.D. Bhatt & V.M. Panchal, Engineering Drawing, 48th edition, 2005, Charotar Publishing House, Gujarat
2. R.B.Choudary, Engineering Drawing with AutoCAD 2008, Anuradha Publishers

Reference Books

1. S. Trymbaka Murthy, Computer Aided Engineering Drawing, I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition 2006.
2. K.R. Gopalkrishna, Engineering Graphics, 32nd edition, 2005 Subash Publishers, Bangalore

COs VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

PO / CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
1	2				3					2				3
2	2				3					2				3
3	2				3					2				3
4	2				3					2				3
5	2				3					2				3
Course	**2**				**3**					**2**				**3**

ENGLISH COMMUNICATION SKILLS LAB			
Subject Code	21CMEGL1060	IA Marks	15
Number of Practical Hr./week	02	Exam Marks	35
Total Number of Practical Hr	32	Exam Hours	03

Credits – 01

Objectives: To enable the students to learn communication skills of Listening, Speaking, Reading and Writing by focusing on:

- Listening Comprehension
- Pronunciation
- Functional English in formal and Informal Situations
- Interpersonal Communication Skills
- Presentation Skills

List of Experiments

UNIT I: Listening Comprehension

UNIT II: Pronunciation, Stress, Intonation & Rhythm

UNIT III: Common Everyday Situations: Conversations & Dialogues, Communication at Workplace

UNIT IV: Interpersonal Communication Skills- Group discussions and debates

UNIT V: Formal Presentations

Outcomes:

By the end of the course the students will be able to acquire basic Proficiency in English by practicing the following:

- Listening Comprehension
- Pronunciation
- Dialogues
- Interpersonal Communication Skills
- Presentation Skills
- Discussions and Debates

Learning Resources:

- Interact – English Lab Manual for Undergraduate Students by Orient Black Swan
- Ted Talks, Interviews with Achievers and select movies
- Toastmaster's speeches and table topics
- Book Reviews and movie reviews
- Exercises in Spoken English Parts: I-III, CIEFL, Hyderabad.
- Oxford Guide to Effective Writing and Speaking by John Seely
- https://www.ted.com/talk

Course Outcomes Vs Program Outcomes Mapping

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

6	-	-	-	-	-	-	-	-	-	2	-	-

BASIC ELECTRICAL ENGINEERING LABORATORY (Common to All)			
Subject Code	21CMEEL1070	IA Marks	15
Number of Lecture Hours/Week	3P	Exam Marks	35
Total Number of Lecture Hours	36	Exam Hours	03
Credits-1.5			

Course Objectives:

This course will enable the student to

1. Verify the Kirchhoff's laws, network theorems for a given circuit.
2. Analyze the performance of DC shunt generator.
3. Control the speed of DC motor.
4. Predetermine the efficiency DC machine.
5. Analyze performance of three phase induction motor.
6. Determine the regulation of an alternators.

List of Experiments (Any ten experiments must be conducted)

1. Verification of Kirchoff's laws.
2. Verification of Thevenin's Theorem.
3. Verification of Norton's Theorem.
4. Verification of Superposition theorem.
5. Verification of Maximum Power Transfer Theorem.
6. Speed control of D.C. shunt motor.
7. Brake test on DC shunt motor.
8. Calibration of wattmeter.
9. OC & SC tests on single-phase transformer.
10. Brake test on 1-phase Induction motor.
11. Brake test on 3-phase Induction motor.
12. Study experiment on Ear thing.

COURSE OUTCOMES:

On completion of the course student will be able to:

1. Verify the Kirchoff's laws.
2. Verify network theorems for a given circuit.
3. Control the speed of DC motor.
4. Analyze performance of single phase induction motor
5. Analyze performance of three phase induction motor.
6. Identify different types of earthling's

Question paper pattern:

Examination is evaluated for 35 marks and as follows:

Ten questions are given, and student should choose one question (blind option), which carries 35 marks in total.

a. 10 marks are allotted for procedure including circuit diagrams and model graphs.
b. 10 marks for conduction of the experiment.
c. 05 marks for results and conclusions.
d. 10 marks for viva voce.

The internal 15 marks shall be awarded as follows:

a. 05 marks-day to day evaluation and submission of record.
b. 10 marks to be awarded by conducting an internal laboratory test.

COURSE-OUTCOMES-TO-PROGRAM-OUTCOMES-MAPPING:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1			2												
2			2												
3			2												
4			2												
5			2												
6			2												
Overall Course			**2**												

PROGRAMMING FOR PROBLEM SOLVING LAB (Common to All) SEMESTER I			
Subject Code	21CMCSL1080	Internal Marks	15
Number of Lecture Hours/Week	3	External Marks	35
Total Number of Hours	36	Exam Hours	03
Credits – 1.5			

Course Objectives:

This course will enable students to

1. To understand the various steps in Program development.
2. To understand the basic concepts in C Programming Language.
3. To learn how to write modular and readable C Programs.
4. To learn to write programs (using structured programming approach) in C to solve problems.
5. To introduce basic data structures such as lists, stacks and queues.

Exercise 1 (Familiarization with programming environment)

a) Familiarization of CODE BLOCKS C++ Editor to edit, compile, Execute, Test and debugging C programs

b) Familiarization of RAPTOR Tool to draw flow charts and understand flow of control. Acquaintance with basic LINUX commands.

Exercise 2 (Simple computational problems using arithmetic expressions)

a) Write a C Program to display real number with 2 decimal places.

b) Write a C Program to convert Celsius to Fahrenheit and vice versa.

c) Write a C Program to calculate the area of triangle using the formula

area = $\sqrt{}$ (s(s−a)(s−b)(s −c) where =a+b+c/2

d) Write a C program to find the largest of three numbers using ternary operator.

e) Write a C Program to swap two numbers without using a temporary variable.

Exercise 3 (Problems involving if-then-else structures)

a) Write a C Program to check whether a given number is even or odd using bitwise operator, shift operator and arithmetic operator.

b) Write a C program to find the roots of a quadratic equation.

c) Write a C Program to display grade based on 6 subject marks using if…else…if ladder.

d) Write a C program, which takes two integer operands and one operator form the user, performs the operation & then prints the result using switch control statement.(Consider the operators +, -,*,/, %)

Exercise 4 (Iterative problems)

a) Write a C Program to count number of 0's and 1's in a binary representation of a given number.

b) Write a C program to generate all the prime numbers between two numbers supplied by the user.

c) Write a C Program to print the multiplication table corresponding to number supplied as input

Exercise 5 (Iterative problems)

a) Write a C Program to Find Whether the Given Number is i) Armstrong Number ii) Palindrome Number

b) Write a C Program to print sum of digits of a given number

Exercise 6 (Series examples)

a) Write a C Program to calculate sum of following series

b) 1+2+3+…. n b) 1+1/2+1/3+……+1/n c)1+x+x2+x3……+xn

Exercise 7 (1D Array manipulation)

a) Write a C program to interchange the largest and smallest numbers in the array.
b) Write a C program to search an element in an array (linear search).
c) Write a C Program to print the following pattern using a character array SA SASSASI

Exercise 8 (Matrix problems, String operations)

a) Write a C program to add two matrices.
b) Write a C program to multiply two matrices if they are compatible or print an error message **"Incompatible matrix sizes" otherwise.**
c) Write a C program to check given matrix is symmetric or not.

Implement the following string operations with and without library functions. i)copy ii) concatenate iii) length iv) compare

Exercise 9 (Simple functions)

a) Write a C Program demonstrating the following function types
b) With arguments and with return value.
c) With arguments and without return alue
d) Without arguments and without return value.
e) Without arguments and with return value.
f) Write a C Program illustrating call by reference

Exercise 10 (Recursive functions)

Write a C Program illustrating the following with Recursion without Recursion
a)Factorial b) GCD c) Power d) Fibonacci

Exercise 11(Pointers and structures)

a) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using malloc () function.
b) Write a C program to find sum of n elements entered by user. To perform this program, allocate memory dynamically using calloc () function. Note: Understand the difference between the above two programs.
c) Write a C Program to read and print student details using structures.

Exercise 12 (File operations)

a) Write a C program to open a file and to print it contents on screen.
b) Write a C program to copy files
c) Write a C program merges two files onto a new file.
d) Write a C program to delete a file.

Course outcomes:

Question paper pattern:

Examination is evaluated for 35 marks and as follows:

Ten questions are given, and student should choose one question (blind option), which carries 35 marks in total.

a. 10 marks are allotted for procedure including circuit diagrams and model graphs.
b. 10 marks for conduction of the experiment.
c. 05 marks for results and conclusions.
d. 10 marks for viva voce.

The internal 15 marks shall be awarded as follows:

a. 05 marks-day to day evaluation and submission of record.
b. 10 marks to be awarded by conducting an internal laboratory test.

Text Books:

1. Computer Programing ANSI C, E Balagurusamy, Mc Graw HillEducation(Private), Limited (TB1)
2. Programming in C, ReemaThareja, Second Edition, Oxford Higher Education (TB2)

Reference Books:

1. Computer Basics and C Programming, V Raja Raman, Second Edition, PHI (RB1) Course Outcomes:
2. Attain knowledge on using CODE BLOCKS and RAPTOR tools in solving problems. Examine and analyze alternative solutions to a problem.
3. Design an algorithmic solution to a problem using problem decomposition and step- wise refinement.
4. Demonstrate conversion of iterative functions to recursive and vice-versa.
5. Implement the concepts of arrays, structures, Unions and files.

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
1	3	3	3										3		-
2	3	3	3		2								3		-
3	3	3	3		2								3		-
4	3	3	3		2								3		-
5	3	3	3		2								3		-
6	**3**	**3**	**3**		**2**								**3**		-
Cours	3	3	3										3		-

ENVIRONMENTAL SCIENCE			
Subject Code	21CMCHN1090	IA Marks	30
Number of Lecture Hours/Week	2	Exam Marks	70
Total Number of Lecture Hours	32	Exam Hours	03
Credits – 00			

COURSE OBJECTIVES:

The objectives of this course, help the students to

1. Acquire knowledge on global environmental challenges.
2. Learn different types of natural resources
3. Create awareness on biodiversity and ecology.
4. Gain scientific knowledge on environmental pollution
5. Acquire knowledge on water conservation methods and environmental legislation

Unit -1	**Hours**
MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES **Environment -** Definition, Introduction - Scope and Importance - Global environmental challenges, global warming & climate change - Acid rains, ozone layer depletion - Role of Information Technology in Environment and human health.	**6**
Unit -2	
NATURAL RESOURCES Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use, deforestation - Timber extraction – Mining, dams and other effects on forest and tribal people Water resources – Floods, drought, , dams – benefits and problems Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food resources: Effects of modern agriculture - fertilizer-pesticide problems, water logging, eutrophication, biological magnification and salinity. Energy resources: Renewable and non-renewable energy resources Role of an individual in conservation of natural resources.	**6**
Unit – 3	
ECOSYSTEM AND BIODIVERSITY **Ecosystem** - Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of the Forest and grassland ecosystem. **Biodiversity** - Introduction - Definition: genetic, species and ecosystem diversity. – Value of biodiversity: consumptive use, productive use, social, ethical and optional values - Hot-spots of biodiversity - Threats to biodiversity: habitat loss - Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	**8**
Unit – 4	
ENVIRONMENTAL POLLUTION Definition, Cause, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Noise pollution e. Nuclear hazards Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution.	**6**
Unit – 5	
SOCIAL ISSUES AND THE ENVIRONMENT	**6**

Urban problems related to energy -Water conservation, rain water harvesting, Resettlement and rehabilitation of people its problems and concerns. Environment Protection Act - Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act .	

COURSE OUTCOMES:

On completion of the course student will be able to

1. Obtain knowledge on global warming & climate change - Acid rains, ozone layer depletion.
2. Preserve several natural resources
3. Summarize the concept of ecosystem
4. Control different types of pollution
5. Understand social issues and environmental legislation

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

TEXT BOOKS:

1. E. Bharucha (2003), "Environmental Studies", University Publishing Company, New Delhi.
2. J.G. Henry and G.W. Heinke (2004), "Environmental Science and Engineering", Second Edition, Prentice Hall of India, New Delhi.
3. G.M. Masters (2004)" Introduction to Environmental Engineering and Science", Second Edition, Prentice Hall of India, New Delhi

REFERENCE BOOKS:

1. Text Book of Environmental Studies by Deeksha Dave & P. Udaya Bhaskar, Cengage Learning.
2. Environmental Studies by K.V.S.G. Murali Krishna, VGS Publishers, Vijayawada.
3. Environmental Studies, P.N. Palaniswamy, P. Manikandan, A. Geeta and K. Manjula Rani, Pearson Education, Chennai.

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
1	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
5	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
6	2	3	2	-	-	-	2	-	-	-	-	-	-	-	-
Cours	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-

ENGINEERING MATHEMATICS-II (Linear algebra, Laplace transforms & Numerical Methods) Common to all the branches			
Subject Code	21CMMAT2010	IA Marks	30
Number of Lecture Hours/Week	03	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Course objectives:

To enable students to apply the knowledge of Mathematics in various engineering fields by making them to learn the following'

1. To develop the use of matrix algebra techniques that is needed by engineers for practical applications and solve system of linear equations
2. To find the inverse and power of a matrix by Cayley-Hamilton theorem and reduce the Quadratic form
3. To solve initial value problems by using Laplace transforms
4. To find the solution of algebraic/ transcendental equations and also interpolate the functions.
5. To apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations.

Unit -1	**Hours**
Solving systems of linear equations: Rank of a matrix by echelon form and normal form – Solving system of homogeneous and non-homogeneous linear equations – Gauss Elimination method- Jacobi and Gauss-Seidel methods for solving system of equations numerically.	**10**
Unit -2	
Eigen values and Eigen vectors, Cayley–Hamilton theorem and Quadratic forms: Eigen values and Eigen vectors and properties- Cayley-Hamilton theorem (without proof) – Reduction to Diagonal form – Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to canonical forms by orthogonal transformation, Diagonalisation and Lagrange's reduction	**10**
Unit – 3	
Laplace Transforms: Laplace transforms – Definition and Laplace transforms of some certain functions– Shifting theorems – Transforms of derivatives and integrals – Unit step function –Dirac's delta function Periodic function – Inverse Laplace transforms– Convolution theorem (without proof). Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.	**10**
Unit – 4	
Numerical Methods: Introduction - Method of false position - Newton-Raphson method (One Variable) Introduction– Errors in polynomial interpolation – Finite differences– Forward differences– Backward differences –Central differences – Relations between operators – Newton's forward and backward formulae for interpolation – Interpolation with unequal intervals – Lagrange's interpolation formula.	**10**
Unit – 5	
Numerical integration, Solution of ordinary differential equations with initial conditions: Trapezoidal rule - Simpson's 1/3rd and 3/8th rule - Solution of initial value problems by Taylor's series– Picard's method of successive approximations– Euler's method – Runge -Kutta method (second and fourth order).	**10**

Course outcomes:

On completion of this course, students are able to,

1. Develop the use of matrix algebra techniques that is needed by engineers for practical applications and solve system of linear equations (L6)

2. Find the inverse and power of a matrix by Cayley-Hamilton theorem and reduce the Quadratic form (L3)
3. Solve initial value problems by using Laplace transforms (L3)
4. Find the solution of algebraic/ transcendental equations and also interpolate the functions(L3)
5. Apply different algorithms for approximating the solutions of ordinary differential equations with initial conditions to its analytical computations (L3).

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. B. S. Grewal," Higher Engineering Mathematics", Khanna publishers, 44th Edition, 2016.
2. Kreyszig, "Advanced Engineering Mathematics " - Wiley, 9th Edition, 2013.
3. B.V.Ramana "Higher Engineering M athematics" Tata Mc Graw-Hill, 2006

Reference Books:

1. Dr.K.V.Nageswara Reddy and Dr.B.Rama Bhupal Reddy, "Engineering Mathematics, Volume II" Scitech Publications, 2017.
2. Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineering and Science, Tata McGraw Hill Education, 4th Edition, 2018
3. M. K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International Publications, 3rd Edition, 2020.
4. Lawrence Turyn, Advanced Engineering Mathematics, CRC Press, 1st Edition 2014.

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	3	-	-	-	-	-	-	-	-	-	-
2	3	3	-	-	-	-	-	-	-	-	-	-
3	3	3	-	-	-	-	-	-	-	-	-	-
4	3	3	-	-	-	-	-	-	-	-	-	-
5	3	3	-	-	-	-	-	-	-	-	-	-
Course	3	3	-	-	-	-	-	-	-	-	-	-

ENGINEERING PHYSICS (Introduction to Electromagnetic Theory)			
Subject Code	21ECPHT2020	IA Marks	30
Number of Lecture HR/Week	03	Exam Marks	70
Total Number of Lecture Hr	50	Exam Hours	03
Credits – 03			

COURSE OBJECTIVES:

The objectives of this course, help the students:

- **To impart** the knowledge of Electrostatics and Magneto statics in vacuum and in dielectric medium.
- **To impart** the knowledge of Maxwell's equations to understanding the propagation of EM waves.

Unit -1	**Hours**
Electrostatics in vacuum: Coulomb's law, Electrostatic field (E) and Electrostatic potential or Scalar potential (V) due to a point charge, Equipotential surfaces, Relation between E&V, Gauss law in electrostatics, Applications of Gauss law-Calculation of Electric field strength and potential due to the uniform charge distribution over a (i) wire (ii) sheet (c) solid sphere and (e) solid cylinder, Divergence and Curl of electrostatic field, Energy of a discrete and continuous charge distribution.	**10**
Unit -2	
Electrostatics in dielectric medium: Electrostatic field and potential due to a Electric dipole, Types of dielectrics, Electric displacement (D), Dielectric polarization (P), Dielectric polarizability, Susceptibility and Dielectric constant, Relation between D, E and P, Bound charge due to electric polarization, Boundary conditions at interface of dielectric media, Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field-Clausius-Mossotti equation.	**10**
Unit – 3	
Magneto statics: Biot- Savart's law, Magnetic field due to long straight current carrying conductor, Magnetic field on the axis of a current loop, Helmholtz coils, Magnetic field induction due to a solenoid, Divergence of magnetic field (Gauss law in magneto statics), Curl of Magnetic field (Ampere's circuital law); Magnetic Scalar and Vector potential, Motion of charged particle in electrical field and in a magnetic field, Hall effect.	**11**
Unit – 4	
Electromagnetic induction: Electromotive force, Faradays laws of electromagnetic induction, Differential form of Faraday's law, motional EMF; Relation between electric potential and magnetic vector potential using faraday's law, Lenz's law, Self-inductance of Solenoid, Energy density stored in an inductor, Continuity equation for current densities; Displace current; Modified Amperes circuital law.	**10**
Unit – 5	
Maxwell's equations and EM waves: Maxwell's equation in vacuum and non-conducting medium; Wave equation of EM waves; Plane electromagnetic waves in vacuum, their transverse nature; Relation between electric and magnetic fields of an electromagnetic wave; Energy density in EM fields, Pointing Theorem, polarization of EM waves, Momentum carried by electromagnetic waves and radiation pressure.	**9**

COURSE OUTCOMES:

On completion of the course student will able to

1. **Formulate** the electric field and electric potential using fundamental laws in electrostatics.

2. **Understand** the microscopic behavior of dielectrics in electrical field**.**
3. **Calculate** the static magnetic fields due to current carrying conductors.
4. **Estimate** the physical parameters of a system using the basic laws of electricity and magnetism.
5. **Recognize** the relation between electrical fields and time varying magnetic fields.
6. **Apply** Maxwell's equations for the propagation of EM waves.

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

TEXT BOOKS:

1. Saroj K. Dash, Smaruti R. Khuntia, Fundamentals of Electromagnetic theory.
2. David Griffiths, Introduction to Electrodynamics.

REFERENCE BOOKS:

1. W. Saslow, Electricity, magnetism and light.
2. S.L Gupta& D.L. Gupta, Unified physics.
3. Ch. Srinivas, Ch. Seshubabu, Engineering Physics, Cengage learning.

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	-	2	-	-	-	-	-	-	-	-	-
2	3	-	2	1	-	-	-	-	-	-	-	-
3	3	-	2	1	-	-	-	-	-	-	-	-
4	3	-	2	1	-	-	-	-	-	-	-	-
5	3	-	2	1	-	-	-	-	-	-	-	-
6	3	-	2	-	-	-	-	-	-	-	-	-
Course	**3**	**-**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

ENGINEERING CHEMISTRY			
Subject Code	21CMCHT2030	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Credits – 03			

COURSE OBJECTIVES:

The objectives of this course, help the students to

1. Explain the mechanism of corrosion
2. Interpret various boiler troubles and importance of water quality standards.
3. Learn preparation of semiconducting materials, nano materials and liquid crystals – their applications
4. Acquire knowledge on nonconventional energy resources and different types of batteries
5. Know various spectroscopic techniques.
6. Acquire knowledge on volumetric analysis.

Unit -1	**Hours**
Electrochemistry and Corrosion **Electro chemistry:** Introduction, electrode potential, standard electrodes – Hydrogen and Calomel electrodes, Nernst equation and applications. **Corrosion:** Introduction, Mechanism of Wet chemical corrosion, control methods – proper designing, cathodic protection- Sacrificial anodic and impressed current cathodic protection.	**9**
Unit -2	
Water Chemistry and Surface Properties **Water chemistry:** Surface and subsurface water quality parameters – turbidity, pH, total dissolved salts, chloride content, Hardness of water, Temporary and Permanent hardness, Units, determination of hardness by complex metric method. Boiler troubles, Caustic Embrittlement, Priming and foaming, Boiler corrosion. Break point chlorination. **Surface properties:** Determination of surface tension and viscosity of liquids.	**9**
Unit -3	
Material Chemistry **Non-elemental semiconducting materials:** Stoichiometric, controlled valency and chalcogen photo/semiconductors and preparation of semiconductors (distillation, zone refining, Czochralski crystal pulling, epitaxy, diffusion and ion implantation). **Liquid crystals:** Introduction, types and applications. **Nanoparticles**: Introduction, preparation methods – Sol-gel method, Chemical reduction method – Preparation of carbon nanotubes (Arc discharge, chemical vapour deposition and laser ablation methods) properties and applications.	**10**
Unit -4	

ENERGY SOURCES: **Non-conventional energy sources,** Design, working, schematic diagram, advantages and disadvantages of photovoltaic cell, hydropower, geothermal power, tidal and wave power, ocean thermal energy conversion. **Batteries and fuel cells:** Primary and secondary batteries - Dry cell, Lead Acid Cell, Lithium ion battery and Zinc air cells and fuel cells - H_2-O_2, CH_3OH-O_2, Phosphoric acid and molten carbonate.	**10**
Unit -5	
SPECTROSCOPY AND CHROMATOGRAPHY TECHNIQUES Regions of electromagnetic spectrum - Principles of vibrational and rotational spectroscopy. Vibrational and rotational spectroscopy of diatomic molecules: Rigid diatomic molecules - selection rule - simple Harmonic Oscillator - diatomic vibrating rotator. Nuclear magnetic resonance – Principle and Instrumentation. Principles of chromatography – Thin Layer & Paper Chromatography.	**10**

COURSE OUTCOMES:

On completion of the course student will be able to

1. Interpret the mechanism of corrosion
2. Summarize the problems faced in industries due to boiler troubles.
3. Recall the properties and applications of advanced materials.
4. Summarize the advantages of non-conventional energy resources and batteries.
5. Able to gain knowledge on spectroscopic techniques and the ranges of the electromagnetic spectrum used for exciting different molecular energy levels.
6. Determine the strength of acid, base and some elements by volumetric and instrumental analysis.

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

TEXT BOOKS:

1. P.C. Jain and M. Jain "**Engineering Chemistry**", 15/e, Dhanpat Rai & Sons, Delhi, (Latest edition).
2. Shikha Agarwal, "**Engineering Chemistry**", Cambridge University Press, New Delhi, (2019).
3. S.S. Dara, "**A Textbook of Engineering Chemistry**", S.Chand & Co, (2010).
4. Shashi Chawla, "Engineering Chemistry", Dhanpat Rai Publicating Co. (Latest edition).
5. Fundamentals of Molecular Spectroscopy, by C. N. Banwell.

REFERENCE BOOKS:

1. K. Sesha Maheshwarammam and Mridula Chugh, "**Engineering Chemistry**", Pearson India Edn.
2. O.G. Palana, "**Engineering Chemistry**", Tata McGraw Hill Education Private Limited, (2009).
3. CNR Rao and JM Honig (Eds) "**Preparation and characterization of materials**" Academic press, New York (latest edition)

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	-	-	-	-	-	-	-	-	-	-	-
2	-	3	-	-	-	-	-	-	-	-	-	-
3	-	3	-	-	-	-	-	-	-	-	-	-
4	-	3	-	-	-	-	-	-	-	-	-	-
5	-	-	3	-	-	-	-	-	-	-	-	-
6	3	-	-	-	-	-	-	-	-	-	-	-
Course	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

PYTHON PROGRAMMING Common to All SEMESTER II			
Subject Code	21CMCST2040	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite		Credits – 03	

The Objectives of Python Programming are:

- To learn about Python programming language syntax, semantics, and the runtime environment
- To be familiarized with general computer programming concepts like data types, conditionalstatements, loops and functions.
- To be familiarized with general coding techniques and object-oriented programming andGraphical User Interfaces.

Unit -1	**Hours**
Introduction:(TB1:22-30,TB2:1.1-1.4,TB2:1.21-1.33) Introduction Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Variables, Reading Input fromthe Keyboard, Operators. **Data Types, and Expression: (TB1:41-59)** Strings Assignment, and Comment, Numeric Data Types andCharacter Sets, Type conversions, Expressions, Using functions and Modules. **Decision Structures and Boolean Logic:(TB1:77-85)** if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables.	08
Unit -2	
Control Statement:(TB1:65-72, TB1:86-91) Definite iteration for Loop Formatting Text for output, Selection if and if else Statement ConditionalIteration, The While Loop, Nested Loops. **Strings and Text Files:(TB1:103-125)** Accessing Character and Substring in Strings, Data Encryption,Strings and Number Systems, String Methods, Text Files.	10
Unit -3	
List and Dictionaries:(TB1:135-145, TB1:153-158) Lists, Tuples, Sets, Dictionaries. **Design with Function:(TB1:146-149, TB1:169-190)** Functions as Abstraction Mechanisms, Problem Solving with Top Down Design, Design with Recursive Functions, Case Study Gathering Informationfrom a File System. **Modules**: **(TB2:8.1-8.5)** Modules, Standard Modules, Packages.	12
Unit – 4	
File Operations:(TB1:122-123) Reading config files in python, Writing log files in python, Understanding read functions, read (), readline() and readlines(), Understanding write functions, write() and writelines (). **Object Oriented Programming:(TB2:5.1-5.20, TB2:6.1-6.17)** Concept of class, object and instances,Constructor, class attributes and destructors, Inheritance. **Design with Classes:(TB1:294-301, TB1:309-330)** Objects and Classes, Data modeling Examples, CaseStudy an ATM.	12
Unit – 5	
Errors and Exceptions:(TB2:7.1-7.8) Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions,User-defined Exceptions, Defining Clean-up Actions, Redefined Clean-up Actions**.** **Graphical User Interfaces:(TB1:245-288)** The Behavior of Terminal Based Programs and GUI -Based Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources.	8

Course outcomes:

On completion of the course student will be able to

- Able to learn the fundamental concepts in the Python language
- Implementation of python iterative statements and strings
- Demonstrate python lists, dictionaries and functions
- Understand the concepts of modules and packages in python
- Complete coding challenges relating to object-oriented programming's essential concepts and techniques.
- Apply variety of error handling and GUI programming techniques

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books

1. Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage.
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.

Reference Books:

1)Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press.

2)Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

E-Resources:

https://www.tutorialspoint.com/python3/python_tutorial.pdf

Course Outcomes to Program Outcomes mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
3	2	2	3	-	2	-	-	-	-	-	-	-	-	-	3
4	3	2	3	-	3	-	-	-	-	-	-	-	-	-	2
5	3	3	3	-	2	-	-	-	-	-	-	-	-	-	2
6	3	2	3	-	3	-	-	-	-	-	-	-	-	-	3
Cours	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

NETWORK ANALYSIS			
Subject Code	21ECECT2050	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite		Credits – 03	

COURSE OBJECTIVES:

- To understand the basic concepts on RLC circuits.
- To know the behavior of the steady states and transients states in RLC circuits.
- To know the basic Laplace transforms techniques in periods' waveforms.
- To understand the two port network parameters.
- To understand the properties of LC networks and filters.

Unit -1	**Hours**
Fundamentals and Network Topology: Definitions of branch, node, tree, planar, non-planar graph, incidence matrix, basic tie set schedule, basic cut set schedule. Definitions of terms associated with periodic functions: Time period, Angular velocity and frequency, RMS value, Average value, Form factor and peak factor- problem solving, Phase angle, Phasor representation, Addition and subtraction of phasors, mathematical representation of sinusoidal quantities, explanation with relevant theory, problem solving. Principal of Duality with examples.	08
Unit -2	
Electric Circuits: Review of Kirchhoff's laws, Mesh analysis and Nodal analysis problem solving including dependent sources also. **Network Theorems:** Thevinin's, Norton's, Milliman's, Reciprocity, Compensation, Substitution, Superposition, Max Power Transfer, Tellegens- problem solving using dependent sources also.	10
Unit -3	
Steady State Analysis of A.C Circuits: Impedance concept, phase angle, series R-L, R-C, R-L- C circuits problem solving. Complex impedance and phasor notation for R-L, R-C, R-L-C problem solving using mesh and nodal analysis, Star-Delta conversion, problem solving. **Transients:** First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, evaluating initial conditions procedure, second order differential equations, homogeneous, non-homogenous, problem solving using R-L-C elements with DC excitation and AC excitation, Response as related to s-plane rotation of roots. Solutions using Laplace transform method.	12
Unit – 4	
Resonance: Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance, Condition for maximum impedance, current in anti-resonance, Bandwidth of parallel resonance, general case-resistance present in both branches, anti-resonance at all frequencies. **Coupled Circuits:** Coupled Circuits: Self-inductance, Mutual inductance, Coefficient of coupling, analysis of coupled circuits, Natural current, Dot rule of coupled circuits, Conductively coupled equivalent circuits- problem solving.	12
Unit – 5	
Two-port Networks: Relationship of two port networks, Z-parameters, Y-parameters, Transmission line parameters, h-parameters, Inverse h-parameters, Inverse Transmission line parameters, Relationship between parameter sets, Parallel connection of two port networks, Cascading of two port networks, series connection of two port networks, problem solving including dependent sources also.	8

Course outcomes:

On completion of the course student will be able to

1. Gain the knowledge on basic network elements.
2. Will analyze the RLC circuits' behavior in detailed.
3. Analyze the performance of periodic waveforms.
4. Gain the knowledge in characteristics of two port network parameters (Z,Y,ABCD,h&g).
5. Analyze the filter design concepts in real world applications.

Question paper pattern:

1. Question paper consists of 10 questions.
2. Each full question carrying 14 marks.
3. Each full question will have sub question covering all topics under a unit.
4. The student will have to answer 5 full questions selecting one full question from each unit.

Text Books:

1. Network Analysis – ME Van Valkenburg, Prentice Hall of India, 3rdEdition,2000.
2. Network Analysis by K.Satya Prasad and S Sivanagaraju,CengageLearning
3. Electric Circuit Analysis by Hayt andKimmarle,TMH

Reference Books:

1. Network lines and Fields by John. D. Ryder 2ndedition, Asiapublishinghouse.
2. Basic Circuit Analysis by DR Cunninghan, Jaico Publishers. 3.Network Analysis and Filter Design by Chadha,UmeshPublications.

Course Outcomes to Program Outcomes mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3
3	2	2	3	-	2	-	-	-	-	-	-	-	-	-	3
4	3	2	3	-	3	-	-	-	-	-	-	-	-	-	2
5	3	3	3	-	2	-	-	-	-	-	-	-	-	-	2
6	3	2	3	-	3	-	-	-	-	-	-	-	-	-	3
Course	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**

S.No.	Unit Name	Text Book/ Reference	Chapter No.
1.	Fundamentals and Network Topology	T2 &R1	1
2.	Electric Circuits and Network Theorems	T2&R1	2 &3
3.	Steady State Analysis of A.C Ckts &Transient	T2,T1,R2	4,5 &6
4.	Resonance and Coupled Circuits	T2,R2	6,7& 8
5.	Two-port Networks	T1	4 & 5

ENGINEERING PHYSICS LAB (Common for ECE &ECT)			
Subject Code	21ECPHL2060	IA Marks	15
Number of Practice Hours/Week	03	Exam Marks	35
Total Number of Practice Hours	36	Exam Hours	03
Credits – 1.5			

COURSE OBJECTIVES:

The objectives of this course, help the students

- **To apply** the theoretical knowledge of Physics through hands on the experimental instruments
- **To improve** the experimental knowledge in the later studies
- **To understand** the basic need of experiment**s.**
- **To know** how to measure the different physical quantities.
- **To acquire** ability to use instrumentation techniques.
- **To train** the students to develop techniques based on the principles related to various devices or components.

List of Experiments

1. Determination of the dielectric constant of the dielectric material in the given capacitor using a RC charging and discharging circuit.
2. Measuring of the magnetic field induction of circular coil-Stewart-Gee's experiment.
3. Determination of the horizontal component of earth magnetic field using Helmholtz coil galvanometer..
4. Study of the motion of charged particle in electric and magnetic fields and determine the value of e/m by magnetic focusing.
5. Determination of the frequency of the AC Source using Sonometer.
6. Determination of the electromotive force (emf) of an unknown cell using a stretched wire potentiometer.
7. Study of the particle behavior of EM wave and estimation of Planck's constant using photocell.
8. Determination of the frequency of electrical vibrator-Melde's experiment.
9. Determination of the wavelength and frequency of the electromagnetic wave using diffraction.
10. Verification of laws of transverse waves in a stretched string.

Demonstration experiments:

1. Estimation of Hall coefficient and estimate the concentration of charge carriers using Hall Effect.
2. Determination of the self-inductance and resistance of a coil with air core.

COURSE OUTCOMES:

On completion of the course student will able to

1. **Compare** the theory and correlated with experiments
2. **Design** experiments
3. **Analyze** the experimental result
4. **Apply** appropriate techniques to perform the experiments
5. **Apply** the fundamental laws in electromagnetism to understand the behavior of electromagnetic fields.
6. **Calculate** the frequency and wavelength of EM Waves**.**

Question paper pattern:

Examination is evaluated for 35 marks and as follows:

Ten questions are given, and student should choose one question (blind option), which carries 35 marks in total.

a. 10 marks are allotted for procedure including circuit diagrams and model graphs.
b. 10 marks for conduction of the experiment.
c. 05 marks for results and conclusions.

d. 10 marks for viva voce.

The internal 15 marks shall be awarded as follows:

a. 05 marks-day to day evaluation and submission of record.

b. 10 marks to be awarded by conducting an internal laboratory test.

TEXT BOOKS:"*Physics Laboratory Manual"* Prepared by Department of Physics, SITE.

REFERENCE BOOKS:

1. S. Balasubrahmanian, M.N. Srinivasan ''A Text book of Practical Physics''- S. Chand Publishers, 2017.
2. Advanced Practical Physics Vol 1& 2 SP Singh & M.S Chauhan Pragati Prakashan, Meerut

WEB SOURCES:http://vlab.amrita.edu/index.php -Virtual Labs, Amrita University.

COURSE OUTCOMES TO PROGRAM OUTCOMES MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2	-	2	-	-	-	-	-	-	-	-
2	2	1	-	3	-	-	-	-	-	-	-	-
3	2	2	-	3	-	-	-	-	-	-	-	-
4	3	1	-	3	-	-	-	-	-	-	-	-
5	3	2	-	3	-	-	-	-	-	-	-	-
6	**3**	**2**	-	**3**	-	-	-	-	-	-	-	-
Course	**3**	**2**	-	**3**	-	-	-	-	-	-	-	-

ENGINEERING CHEMISTRY LABORATORY
(Common to All)

Subject Code	21CMCHL2070	IA Marks	15
Number of Practice Hr/Week	3	Exam Marks	35
Total Number of Practice Hr	36	Exam Hours	03

Credits – 1.5

List of Experiments
(Any 10 experiments must be conducted)

1. Determination of HCl using standard Na2CO3 solution
2. Determination of alkalinity of a sample containing Na2CO3 and NaOH
3. Determination of surface tension
4. Determination of viscosity of a liquid by Ostwald viscometer
5. Determination of chloride content of water
6. Determination total hardness of water by EDTA.
7. Determination of Mg^{+2}using standard oxalic acid solution.
8. Determination of Cu^{+2}using standard hypo solution.
9. Determination of the rate constant of first order reaction (Ester hydrolysis)
10. Determination of strength of strong acid using conductometeric titration.
11. Determination of strength of weak acid using conductometeric titration .
12. Determination of Ferrous iron using potentiometer.
13. Chemical oscillations- Iodine clock reaction
14. Estimation of Vitamin C.

Demonstration Experiments

1. Thin Layer Chromatography
2. Determination of $Fe^{+3}$by a colorimetric method.

Question paper pattern:

Examination is evaluated for 35 marks and as follows:

Ten questions are given, and student should choose one question (blind option), which carries 35 marks in total.

a. 10 marks are allotted for procedure including circuit diagrams and model graphs.
b. 10 marks for conduction of the experiment.
c. 05 marks for results and conclusions.
d. 10 marks for viva voce.

The internal 15 marks shall be awarded as follows:

a. 05 marks-day to day evaluation and submission of record.
b. 10 marks to be awarded by conducting an internal laboratory test.

ENGINEERING WORKSHOP LAB			
Subject Code	21ECMEL2080	IA Marks	15
Number of Lecture Hours/Week	L(0)+T(0)+P(3)	Exam Marks	35
Total Number of Lecture Hours	36	Exam Hours	3
Credits – 1.5			

Course objectives: On completion of the course students should be able to

1. Learn basic use of hand tools along with the techniques and methods applicable to the carpentry trade
2. Learn basic use of hand tools along with the techniques and methods applicable to the fitting trade
3. Learn basic use of hand tools along with the techniques and methods applicable to the forging trade
4. Learn basic use of hand tools along with the techniques and methods applicable to the casting trade
5. Learn basic use of hand tools along with the techniques and methods applicable to the welding trade

EXPERIMENTS

1. Preparation of T Lap joint using carpentry.
2. Preparation of Cross Lap joint using carpentry.
3. Preparation of Square fit using mild steel specimen.
4. Preparation of V fit using mild steel specimen.
5. Conversion of round rod to square rod by forging operation.
6. Preparation of *S* hooks by forging operation.
7. Preparation of green sand mould for a single piece pattern
8. Preparation of green sand mould for a split piece pattern
9. Preparation of a Butt joint using arc welding
10. Preparation of a Lap joint using arc Welding

ADDITIONAL EXPERIMENTS

1. Preparation of electrical wiring connections using wiring (one lamp controlled by one switch)

Course outcomes: On successful completion of this course, the students will be able to

1. Perform the joinery work of wooden pieces using carpentry.
2. Perform the joinery work of metallic pieces using fitting.
3. Produce the required shaped metallic products using black smithy.
4. Make the green sand moulds using different patterns
5. Fabricate different components using welding.

Question paper pattern:

Examination is evaluated for 35 marks and as follows:

Ten questions are given, and student should choose one question (blind option), which carries 35 marks in total.

a. 10 marks are allotted for procedure including circuit diagrams and model graphs.
b. 10 marks for conduction of the experiment.
c. 05 marks for results and conclusions.
d. 10 marks for viva voce.

The internal 15 marks shall be awarded as follows:

a. 05 marks-day to day evaluation and submission of record.
b. 10 marks to be awarded by conducting an internal laboratory test.

COs vs POs MAPPING (HIGH: 3; MEDIUM: 2; LOW: 1)

COs / POs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2								2					
CO2	2								2				2	
CO3	2								2				2	
CO4	2								2				2	
CO5	2								2					
CO6	1								1				1	
Course	**2**								**2**				**2**	

CONSTITUTION OF INDIA, PROFESSIONAL ETHICS & HUMAN RIGHTS (Common to all Branches)			
Subject Code	21CMMSN2090	IA Marks	30
Number of Lecture Hr/week	03	Exam Marks	70
Total Number of Lecture Hr	50	Exam Hours	03
Credits – 00			

COURSE OBJECTIVES:

The objectives of this course help the students to

1. To provide basic information about Indian constitution.
2. To identify individual role and ethical responsibility towards society.
3. To understand human rights and its implications.

Unit - I	**Hours**
Introduction to the Constitution of India, The Making of the Constitution and Salient features of the Constitution. Preamble to the Indian Constitution Fundamental Rights & its limitations.	**10**
Unit - II	
Directive Principles of State Policy & Relevance of Directive Principles State Policy Fundamental Duties. Union Executives – President, Prime Minister Parliament Supreme Court of India.	**10**
Unit – III	
State Executives – Governor, Chief Minister, State Legislature High Court of State. Electoral Process in India, Amendment Procedures, 42nd, 44th, 74th, 76th, 86th &91st Amendments.	**10**
Unit –IV	
Special Provision for SC & ST Special Provision for Women, Children & Backward Classes Emergency Provisions. Human Rights –Meaning and Definitions, Legislation Specific Themes in Human Rights- Working of National Human Rights Commission in India Powers and functions of Municipalities, Panchyats and Co - Operative Societies.	**10**
Unit – V	
Scope & Aims of Engineering Ethics, Responsibility of Engineers Impediments to Responsibility. Risks, Safety and liability of Engineers, Honesty, Integrity & Reliability in Engineering.	**10**

COURSE OUTCOMES:

On completion of the course student will

1. Have general knowledge and legal literacy and thereby to take up competitive examinations.
2. Understand state and central policies, fundamental duties.
3. Understand Electoral Process, special provisions.
4. Understand powers and functions of Municipalities, Panchayats and Co-operative Societies, and
5. Understand Engineering ethics and responsibilities of Engineers
6. Understand Engineering Integrity & Reliability

Question paper pattern:

1 Question paper consists of 10 questions.
2 Each full question carrying 14 marks.
3 Each full question will have sub question covering all topics under a unit.
4 The student will have to answer 5 full questions selecting one full question from each unit.

TEXT BOOKS:

1. Durga Das Basu: **"Introduction to the Constitution on India",** (Students Edn.) Prentice –Hall EEE, 19th / 20th Edn., 2001

2. Charles E. Haries, Michael S Pritchard and Michael J. Robins **"Engineering Ethics"** Thompson Asia, 2003-08-05.

REFERENCE BOOKS:

1. M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
2. M.Govindarajan, Natarajan, V.S.Senthilkumar, **"Engineering Ethics",** Prentice –Hall of India Pvt. Ltd. New Delhi, 2004
3. Brij Kishore Sharma,**" Introduction to the Constitution of India"**, PHI Learning Pvt. Ltd., New Delhi, 2011.
4. Latest Publications of Indian Institute of Human Rights, New Delhi

Course Structure for
B. Tech (Electronics and Communication Engineering)

Semester III (Second year)

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECMAT3010	Engineering Mathematics - III	3	0	0	3
2	21ECECT3020	Probability Theory & Stochastic Processes	3	0	0	3
3	21ECECT3030	Semiconductor Devices	3	0	0	3
4	21ECECT3040	Digital System Design	3	0	0	3
5	21ECECT3050	Signals & Systems	3	0	0	3
6	21ECECL3060	Semiconductor Devices Lab	0	0	3	1.5
7	21ECECL3070	Digital System Design Lab	0	0	3	1.5
8	21ECECL3080	Electrical Circuits Lab	0	0	3	1.5
9	21ECECS3090	Data Science using Python (Skill Oriented Course-1)	1	0	2	2
Total Semester Credits						**21.5**

Semester IV (Second year)

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21CMMST4010	Management Science	3	0	0	3
2	21ECECT4020	EM Waves & Transmission Lines	3	0	0	3
3	21ECECT4030	Principles of Communication Theory	3	0	0	3
4	21ECECT4040	Electronic Circuit Analysis	3	0	0	3
5	21ECECT4050	Control Systems	3	0	0	3
6	21ECECL4060	Principles of Communication Theory Lab	0	0	3	1.5
7	21ECECL4070	Electronic Circuit Analysis Lab	0	0	3	1.5
8	21ECECL4080	Signals & Systems Lab	0	0	3	1.5
9	21ECECS4090	FPGA Architecture and Programming Using Verilog/ Matlab for Engineers (Skill Oriented Course-2)	1	0	2	2
10	21ECECN40A0	Pulse & Digital Circuits	2	0	0	0
Total Semester Credits						**21.5**
H/M	Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)		4	0	0	4

ENGINEERING MATHEMATICS-III Common to ECE, EEE, ECT SEMESTER - III			
Subject Code	21CMMAT3010	IA Marks	30
Number of Lecture Hours/Week	3	Exam Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable the students

1. To verify vector integral theorems.
2. To find Fourier series of a periodic function and to determine the Fourier transform of a function
3. To apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic
4. To find the differentiation and integration of complex functions used in engineering problems
5. To make use of the Cauchy residue theorem to evaluate certain integrals

Unit -1	**Hours**
Vector calculus: Vector Differentiation: Gradient– Directional derivative – Divergence– Curl– Scalar Potential Vector Integration: Line integral – Work done – Area– Surface and volume integrals – Vector integral theorems: Greens, Stokes and Gauss Divergence theorems (without proof) and problems on above theorems.	**10**
Unit -2	
Fourier Series: Periodic functions, Dirichlet's condition, Fourier Series of periodic functions with period 2π and with arbitrary period. Fourier series of even and odd functions, Half range Fourier Series. **Fourier Transforms**: Infinite Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier transforms.	**10**
Unit – 3	
Function of a complex variable Introduction –continuity –differentiability- analyticity – properties – Cauchy – riemann equations in Cartesian and polar coordinates. Harmonic and conjugate harmonic functions – Milne – Thompson method.	**10**
Unit – 4	
Integration and series expansions Complex integration: Line integral – Cauchy's integral theorem, Cauchy's in integral formula, generalized integral formula (all without proofs) Radius of convergence – expansion in Taylor's series, Maclaurin's series and Laurent series.	**10**
Unit – 5	
Singularities and Residue Theorem Zeros of an analytic function, Singularity, Isolated singularity, Removable singularity, Essential singularity, pole of order m, simple pole, Residues, Residue theorem, Calculation of residues, Residue at a pole of order m**,** Evaluation of real definite integrals: Integration around the unit circle**,** Integration around semi-circle, Indenting the contours having poles on the real axis.	**10**
Total	**50**

Course outcomes:

On completion of this course, students are able to

1. Verify vector integral theorems
2. Find Fourier series of a periodic function and to determine the Fourier transform of a function
3. Apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic (L3)

4. Find the differentiation and integration of complex functions used in engineering problems (L3)
5. Make use of the Cauchy residue theorem to evaluate certain integrals (L3)

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. B. V. Ramana, Higher Engineering Mathematics, 2007 Edition, Tata Mc. Graw Hill Education.

Reference Books:

1. Erwin Kreyszig,Advanced Engineering Mathematics, 10th Edition, Wiley-India.
2. Srimantha Pal, S C Bhunia, Engineering Mathematics, Oxford University Press.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 9th edition,
4. N.P.Bali and Manish Goyal, "A text book of Engineering mathematics", Laxmi publications, 7th Edition.
5. H.K. Dass and Er. RajnishVerma, "Higher Engineerig Mathematics", S.Chand publishing, 1st edition, 2011.

PROBABILITY THEORY & STOCHASTIC PROCESSES Common to ECE & ECT SEMESTER III			
Subject Code	21ECECT3020, 21ETETT3020	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Engineering Mathematics	**Credits – 03**	

Course Objectives:

This course will enable students

1. To understand the concepts of Probability Theory and Random Variables.
2. To apply statistical operations and transformations on one Random Variable.
3. To extend the concept of one random variable to multiple random variables and Apply statistical operations and transformations on multiple Random Variables.
4. To characterize the random processes in the time domain.
5. To characterize the random processes in the frequency domain and analyze the LTI systems with random inputs.

Unit -1	**Hours**
Review of Probability Theory: Introduction, Review of Probability Theory, Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete, Continuous and Mixed Random Variables, Distribution and Density functions, Properties, Poisson, Gaussian, Rician and Rayleigh Distributions.	**8**
Unit -2	
Operation on One Random Variable – Expectations: Introduction, Expected Value of a Random Variable, Function of a Random Variable, Moments about the Origin, Central Moments, Variance and Skew, Chebychev's Inequality, Characteristic Function, Moment Generating Function, Transformations of a Random Variable: Monotonic Transformations for a Continuous Random Variable, Non monotonic Transformations of Continuous Random Variable. Transformation of a Discrete Random Variable.	**10**
Unit – 3	
Multiple Random Variables: Vector Random Variables, Joint Distribution Function, Properties ofJoint Distribution, Marginal Distribution Functions, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem: Unequal Distribution, Equal Distributions. **Operations on Multiple Random Variables**: Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variables case, Properties, Transformations of Multiple Random Variables.	**10**
Unit – 4	
Random Processes – Temporal Characteristics: The Random Process Concept, Classificationof Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, Concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second-order and Wide-Sense Stationarity, N^{th}-order and Strict-Sense Stationarity, Time Averages and Ergodicity, Autocorrelation Function and its Properties, Cross-Correlation Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.	**10**
Unit – 5	
Random Processes – Spectral Characteristics: The Power Density Spectrum: Properties, Relationship between Power Density Spectrum and Autocorrelation Function, The Cross-Power Density Spectrum, Properties, Relationship between Cross-Power Density Spectrum and Cross-Correlation Function. **Linear Systems With Random Inputs:** Random Signal Response of Linear Systems: System Response – Convolution, Mean and Mean-squared Value of System Response, Autocorrelation Function of Response, Cross-Correlation Functions of Input and Output,	**10**

Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross-Power Density Spectra of Input and Output	
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Understand the concepts of Probability Theory and Random Variables.
2. Apply statistical operations and transformations on one Random Variable.
3. Extend the concept of one random variable to multiple random variables and Apply statistical operations and transformations on multiple Random Variables.
4. Characterize the random processes in the time domain.
5. Characterize the random processes in the frequency domain and analyze the LTI systems with random inputs.

Text Books:

1. Peyton Z. Peebles, Probability, "Random Variables & Random Signal Principles", 4th Edition, TMH, 2001.
2. Papoulis and S.Unnikrisha, "Probability, Random Variables and Stochastic Processes", 4th Edition, PHI, 2002.

Reference Books:

1. Henry Stark and John W. Woods, "Probability and Random Processes with Applications to Signal Processing", 3rd Edition, Pearson Education.
2. Gardener W.A, "Introduction to Random Processes with Applications to Signals and Systems", 2nd Edition, McGraw-Hill.

Web References:

1. https://nptel.ac.in/courses/117105085/
2. https://ocw.mit.edu/courses/mathematics/18-440-probability-and-random-variables-spring-2014/

SEMICONDCUTOR DEVICES
Common to ECE & ECT
SEMESTER III

Subject Code	21ECECT3030, 21ETETT3030	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Engineering Physics	**Credits – 03**	

Course Objectives:

This course will enable students to

1. The basic concepts of semiconductor physics are to be reviewed.
2. Study the physical phenomena such as conduction, transport mechanism and electrical characteristics of various PN Junction diodes.
3. The application of diodes as rectifiers with their operation and characteristics with and without filters are discussed.
4. The principal of working and operation of different Transistors and their characteristics are explained.
5. The need of transistor biasing and its significance is explained.

Unit -1	**Hours**
Semi-Conductor Physics : Energy band diagram of Insulators, Semi-conductors and conductors, Intrinsic and extrinsic semiconductors, electrons and holes in intrinsic semi-conductors and extrinsic semi-conductors, Carrier transport: diffusion current, drift current, mobility and resistivity; charge densities in semiconductors, Poisson and continuity equations, law of junction, Fermi Dirac function, Fermi level in intrinsic and extrinsic Semiconductors, Hall effect.	09
Unit -2	
Junction Diode Characteristics: Open circuited p-n junction, Biased p-n junction, p-n junction diode, current components in PN junction Diode, diode equation, V-I Characteristics, temperature dependence on V-I characteristics, static and dynamic resistance, transition and diffusion capacitance, energy band diagram of PN junction Diode, Breakdown mechanisms, Construction and operation of Zener Diode, Varactor diode and Tunnel Diode, Zener diode as a voltage regulator.	10
Unit -3	
Transistor Characteristics: Bipolar Junction transistor, transistor current components, transistor equation, transistor configurations, common Base, common Emitter and common Collector configurations, Ebers-Moll model of a transistor, punch through/ reach through, typical transistor junction voltage values, FET types, construction, operation, characteristics, parameters, MOSFET-types, construction, operation, characteristics, Construction and operation of SCR, UJT and IGBT.	11
Unit – 4	
Building blocks of regulated power supply: Block diagram of regulated power supply, half wave rectifier, full wave rectifier, bridge rectifier, rectifier circuits-operation, input and output waveforms, different parameters of rectifiers, Inductor filter, Capacitor filter, L- section filter, Π- section filter, Multiple L- section and Multiple Π section filter, comparison of various filter circuits, series and shunt voltage regulators.	11
Unit – 5	
Transistor Biasing and Thermal Stabilization: Need for biasing, operating point, load line analysis, BJT biasing- methods, basic stability, fixed bias, collector to base bias, self-bias, Stabilization against variations in V_{BE}, I_{co}, and β, Stability factors, (S, S' , S''), Compensation Techniques, Thermal runaway, Thermal stability. FET Biasing-methods and stabilization.	09
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Understand the basic concepts of semiconductor physics.
2. Understand the working of different types of diodes.
3. Understand the construction, principle of operation and V-I characteristics of various Transistors.
4. Know the construction, working principle of rectifiers with and without filters.
5. Know the need of transistor biasing and various biasing techniques for BJT and FET.

Text Books:

1. Jacob Millman, C. Halkies, C.D.Parikh, "Integrated Electronics", Tata Mc-Graw Hill, 2009.
2. G. Streetman and S. K. Banerjee, "Solid State Electronic Devices", 2nd edition, Pearson, 2014.

Reference Books:

1. Robert L Boyelstad, LovisNashelsky, "Electronic Devices & Theory", 10th edition
2. David A Bell, "Electronic Devices and Circuits", 5th Edition, Oxford Publications
3. J. Millman, C. Halkias, "Electronic Devices and Circuits", 3rd Edition, Tata Mc-Graw Hill.
4. Salivahanan, Kumar, Vallavaraj, "Electronic Devices and Circuits", 2nd Edition, Tata Mc-Graw Hill.

DIGITAL SYSTEM DESIGN

Common to ECE & ECT

SEMESTER III

Subject Code	21ECECT3040, 21ETETT3040	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	---	**Credits – 03**	

Course Objectives:

This course will enable students to

1. Learn the basic concepts of number systems and their conversions
2. Learn the Boolean algebra and digital logic minimization techniques
3. Understand the VHDL programming for the design and implementation of combinational logic circuits
4. Design and analyze Sequential logic circuits
5. Design various digital systems with the help of FSM using HDL

Unit -1	**Hours**
Digital Fundamentals : Analog Vs Digital; Merits of Digital System; Number systems; Base conversions; Number representations: Binary, Integer and Floating point; Complements of numbers; Weighted and Unweighted codes; Boolean algebra; Logic gates; Canonical and Standard forms; Minimization and realization of switching functions using Boolean theorems, NAND – NAND, NOR-NOR Implementations.	08
Unit -2	
Combinational Logic Design-I: K-Map (up to 5 variables), Design of Half adder, full adder, half subtractor, full subtractor, applications of full adders; 4-bit adder-subtractor circuit, BCD adder circuit, Excess 3 adder circuit and carry look-ahead adder circuit, Design code converts using Karnaugh method and draw the complete circuit diagrams. **VHDL Coding styles:** Lexical Conventions, Basic Architecture, Operators, Gate Level Modelling, Data Flow Modelling and Behavioral level Modelling of Adders and code converters	10
Unit -3	
Combinational Logic Design - II: Design of encoder, decoder, multiplexer and de-multiplexers, Implementation of higher order circuits using lower order circuits. Realization of Boolean functions using decoders and multiplexers. Design of Priority encoder, 4-bit digital comparator and Seven segment decoder. **INTRODUCTION OF PLD's :** PROM, PAL, PLA -Basics structures, realization of Boolean functions, Programming table Gate Level Modelling, Data Flow Modeling and Behavioral level Modelling of decoders, encoders, multiplexers and de-multiplexers using VHDL	12
Unit – 4	
Sequential Logic Design: Operation of NAND & NOR Latches and flip-flops; truth tables and excitation tables of RS flip-flop, JK flipflop, T flip-flop, D flip-flop with reset and clear terminals. Conversion of flip- flops. Design of ripple counters, design of synchronous counters, Johnson counter, ring counter. Design of registers - shift register, universal shift, register. Gate Level Modeling and Behavioral level Modeling of counters and registers using VHDL	10
Unit – 5	
Finite State Machines, Logic Families: State diagram, state assignment, state minimization, Design of Mealy and Moore FSM - Sequence Detection. Behavioral level Modeling of Mealy and Moore FSM using VHDL	10

Logic Families: Characteristic parameters, Transistor-Transistor logic, TTL subfamilies, CMOS logic family, Implementation of Boolean function using CMOS logic	
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Understand the basic number systems and conversions.
2. Apply the Boolean algebra to optimize the logic functions using K-maps and to understand the basic concepts of VHDL.
3. To design and analyze combinational logic circuits, PLDs
4. To design and analyze sequential logic circuits.
5. To design combinational and sequential logic circuits using mealy and more machines using VHDL and to understand various logic families

Text Books:

1. Morris Mano, Michael D Ciletti , "Digital Design" , 4thEdition, PEA
2. John F. Wakerly, "Digital Design Principles & Practices", 3rdEdition PHI/ Pearson Education Asia, 2005.
3. C.H. Roth Jr and L.L. Kinney, "Fundamentals of Logic Design", 7th edition, Cengage Learning, 2014.

Reference Books:

1. W R.P. Jain, "Modern Digital Electronics", Tata McGraw-Hill, 4th edition, 2008.
2. C.H. Roth Jr, "Digital System Design using VHDL", Indian Edition, Thomson Books, 2006.
3. Stephen Brown, ZvonkocVranesic, "Fundamentals of Digital Logic with VHDL Design", TMH, 2nd Edition., IEEE Press, 2004.

Simulation Books

1. R.S.Sandige, M.L.Sandige, "Fundamentals of Digital and Computer Design with VHDL", TMH, First edition, 2012.
2. J Baskar, "VHDL Primer", Prentice Hall, 3rd edition, 2002.

SIGNALS & SYSTEMS Common to ECE & ECT SEMESTER III			
Subject Code	21ECECT3050, 21ETETT3050	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	48	Exam Hours	03
Pre-requisite	Engineering Mathematics-III	**Credits – 03**	

Course Objectives:

This course will enable students to:

1. Know the concepts of signals and systems and perform operations on LTI systems.
2. Analyze frequency domain representation of signals and systems using transforms.
3. Learn the process of sampling and various sampling techniques.

Unit -1	**Hours**
Introduction: Introduction to Signals and Systems, Singularity functions and related functions-Exponential and Sinusoidal signals. Operations on Signals, Classification of Signals, Classification of Systems. Analogy between vectors and signals, Orthogonal signal space, Signal approximation using Orthogonal functions, Mean square error, Closed or complete set of Orthogonal functions, Orthogonality in complex functions.	**10**
Unit -2	
Fourier Series: Fourier Series representation of continuous time periodic signals, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series Representations, Properties of Fourier series, Relation between Trigonometric and Exponential Fourier series. **Fourier Transform**: Complex Fourier spectrum, Deriving Fourier transform from Fourier series, Fourier transform of standard signals, Properties of Fourier transforms Fourier transform of periodic signals, Introduction to Hilbert Transform.	**12**
Unit – 3	
Analysis of Linear Systems: Introduction**, I**mpulse response, Response of a linear system, Linear Time Invariant (LTI) systems. Concept of Convolution in time domain and frequency domain, Graphical representation of Convolution, Transfer function of a LTI system. **Correlation:** Cross-correlation and Auto-correlation of functions, Properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between auto correlation function and energy/power spectral density function. Relation between Convolution and Correlation. Detection of periodic signals in the presence of noise by Correlation.	**10**
Unit – 4	
Sampling Theorem: Representation of Band limited CT signal by its samples: The Sampling theorem, Impulse sampling, Natural and Flat-top Sampling, Reconstruction of signal from its samples, effect of under sampling –Aliasing, Introduction to Band Pass sampling. Review of Laplace Transforms, Properties of Laplace Transforms, Relation between LT and FT of a signal.	**8**
Unit – 5	
Z-Transforms: Discrete time Complex Exponential and Sinusoidal signals, Periodicity properties of discrete time Complex Exponential signal. Concept of Z-Transform of a discrete time sequence. Region of convergence (ROC) of Z-Transform and Properties of ROC for various classes of signals. Properties of Z-Transforms. Inverse Z-Transform. Distinction between Laplace, Fourier and Z-Transforms.	**8**
Total	**48**

Course outcomes:

On completion of the course student will be able to

1. Illustrate various signals and systems and their properties.
2. Make use of Fourier analysis for frequency domain representation of signals
3. Solve the response of LTI system through Convolution and Correlation.
4. Construct Sampling theorem for signal conversion.
5. Apply Z-Transform for the analysis of discrete-time signals.

Text Books:

1. A.V. Oppenheim, A.S. Willsky and S.H. Nawab, "Signals and Systems", 2nd Edition, PHI, 2009.
2. B.P. Lathi, "Signal Processing & Linear Systems", 1st Edition, Oxford University Press, 2006.
3. A. Anand Kumar, "Signals and Systems", 3rd Edition, PHI Publications, 2013.

Reference Books

1. Simon Haykin and Van Veen, "Signals & Systems", 2nd Edition, John Wiley India, 2011.
2. M. J. Roberts, "Analysis using Transform methods and MATLAB", 1st Edition, TMH, 2005.

Web References:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011/lecture-videos/
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/
3. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/lecture-notes/
4. https://nptel.ac.in/courses/117104074/

SEMICONDUCTOR DEVICES LAB
Common to ECE & ECT
SEMESTER III

Subject Code	21ECECL3060, 21ETETL3060	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Hours	36	Exam Hours	03

Credits – 1.5

Course Objectives:
This course will enable students to
1. Identification and testing various passive components and active devices.
2. Study the operation of multimeter, function generator, regulated power supply and CRO.
3. Explain the operation of various diodes and their applications
4. Understand the operation and characteristics of different transistor configurations.
5. Perform soldering and DE soldering of different components and wires.

Unit -1	**Hours**
List of Experiments: 1. Identification and testing of various components. 2. Study the operation of multimeter, function generator, regulated power supply and Cathode Ray Oscilloscope. 3. PN junction diode characteristics. 4. Zener Diode Characteristics. 5. Half-wave Rectifier with and without filter. 6. Full-wave Rectifier with and without filter. 7. Common Emitter configuration: Input and Output characteristics. 8. Common source configuration: Drain and Transfer characteristics. 9. Transistor Biasing. 10. Soldering Practice. 11. Design of Printed Circuits Board for Regulated Power supply. 12. Design of Printed Circuits Board for CE Amplifier.	**36**

Course outcomes:
On completion of the course student will be able to
1. Identify different components and know the operation of multimeter, function generator, regulated power supply and CRO
2. Analyze the characteristics of Semiconductor diodes
3. Analyze the working of rectifier circuits with and without filters
4. Analyze V-I characteristics of transistor and construct various biasing circuits
5. Construct Printed Circuit Board (PCB) for the given electronic circuits.

DIGITAL SYSTEM DESIGN LAB
Common to ECE & ECT
SEMESTER III

Subject Code	21ECECL3070, 21ETETL3070	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Hours	36	Exam Hours	03

Credits – 1.5

Course Objectives:
This course will enable students to
1. Understand logic gates and code converters
2. Analyze basic arithmetic logic circuits.
3. Design various combinational circuits using logic gates.
4. Design various sequential circuits using logic gates.
5. Understand the use of VHDL in Digital systems design.

List of Experiments:	**Hours**
1. Realization of Logic Gates. 2. Design of code converters 3. Adders 4. Subtractors 5. Multiplexers. 6. Encoders 7. Decoders 8. D Flip-Flop. 9. Synchronous and Asynchronous counters 10. Shift registers. 10. SRAM 12. Sequence Detector 13. ALU Design	**36**

Course outcomes:
On completion of the course student will be able to
1. Design of Logic Gates and code converters
2. Design and analysis of basic arithmetic logic circuits.
3. Design and analysis of combinational logic circuits
4. Design and analysis of Sequential logic circuits
5. Design of complex logic circuits using Finite State Machines

ELECTRICAL CIRCUITS LAB
Common to ECE & ECT
SEMESTER III

Subject Code	21ECECL3080, 21ETETL3080	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Hours	36	Exam Hours	03
Credits – 1.5			

Course Objectives:
This course will enable students to
1. Understand the concepts of design and analysis of Electrical circuits.
2. Analyze the electrical circuits using various circuit analysis techniques
3. Determine the transient response of R-L-C Networks
4. Analyze two port networks and determine filter characteristics

The students are required to design the electrical circuits to verify the laws, theorems, two port parameters, time response of AC circuits and have to experimentally find the results. Experimental results should be verified with theoretical values.	**Hours**
List of Experiments: **Part-A: Computation of two port network parameters and transients** 1. Two port network parameters – Z-Y Parameters and analytical verification. 2. Two port network parameters – Hybrid & ABCD parameters, Analytical verification. 3. Transient response of RL & RC Networks for DC and AC Inputs 4. Transient response of RLC Circuit for DC and AC inputs. **Part-B: Simulation of electrical networks using PSPICE** 5. Introduction to PSPICE and verification of Kirchhoff's laws for basic electrical networks. 6. Simulation of DC Electrical circuits and verification using Kirchhoff's laws 7. Simulation of AC Electrical circuits and verification using Kirchhoff's laws 8. Verification of Thevenin's and Norton's equivalent circuits using PSPICE. Verification on DC with Resistive loads 9. Verification of Thevenin's and Norton's equivalent circuits using PSPICE. Verification on AC with Reactive loads 10. Transient Response of RLC Circuits for DC and AC Inputs 11. Determination of Two port network parameters 12. Low pass and High Pass Filter characteristics	**36**

Course outcomes:
On completion of the course student will be able to
1. Analyze complex DC and AC linear circuits.
2. Apply concepts of electrical circuits across engineering.
3. Analyze the given electrical network by using PSPICE Simulation tool.
4. Analyze the transient response of R-L-C Networks
5. Analyze two port networks and determine filter characteristics

DATA SCIENCE USING PYTHON **(Skill Oriented Course-I)** SEMESTER III			
Subject Code	21ECECS3090	Internal Marks	---
Number of Lecture Hours/Week	03	External Marks	50
Total Number of Practical Hours/Week	36	Exam Hours	03
Credits – 02			

Course Objectives:

The main objective of the course is to inculcate the basic understanding of Data Science and it's practical implementation using Python. on.

Course Outcomes:	**Teaching Hours**
On the completion of this laboratory course, the students will be able to Upon successful completion of the course, the student will be able to: • Perform various operations on numpy arrays. • Importing data from different file formats using pandas. • Draw different types of charts using matplotlib.	**36**

	List of Experiments:
1	Creating a NumPy Array a. Basic ndarray b. Array of zeros c. Array of ones d. Random numbers in ndarray e. An array of your choice f. Imatrix in NumPy g. Evenly spaced ndarray
2	The Shape and Reshaping of NumPy Array a. Dimensions of NumPy array b. Shape of NumPy array c. Size of NumPy array d. Reshaping a NumPy array e. Flattening a NumPy array f. Transpose of a NumPy array
3	Expanding and Squeezing a NumPy Array a. Expanding a NumPy array b. Squeezing a NumPy array c. Sorting in NumPy Arrays
4	Indexing and Slicing of NumPy Array a. Slicing 1-D NumPy arrays b. Slicing 2-D NumPy arrays c. Slicing 3-D NumPy arrays d. Negative slicing of NumPy arrays
5	. Stacking and Concatenating Numpy Arrays a. Stacking ndarrays b. Concatenating ndarrays c. Broadcasting in Numpy Array
6	Perform following operations using pandas a. Creating dataframe b. concat() c. Setting conditions d. Adding a new column

7	Perform following operations using pandas a. Filling NaN with string b. Sorting based on column values c. groupby()
8	Read the following file formats using pandas a. Text files b. CSV files c. Excel files d. JSON files
9	Read the following file formats a. Pickle files b. Image files using PIL c. Multiple files using Glob d. Importing data from database
10	Demonstrate web scraping using python
11	Perform following preprocessing techniques on loan prediction dataset a. Feature Scaling b. Feature Standardization c. Label Encoding d. One Hot Encoding
12	Perform following visualizations using matplotlib a. Bar Graph b. Pie Chart c. Box Plot d. Histogram e. Line Chart and Subplots f. Scatter Plot

Web References:

1. https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/
2. https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes-guide-to-key-concepts/
3. https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/
4. https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/

MANAGEMENT SCIENCE

(Common to ECE, CSE, ECT, IT& EEE) SEMESTER IV			
Subject Code	21CMMST4010	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Course objectives:

This course will enable the students to

1. To define the Basic Concepts of Management and organization
2. To summarize the different layouts for production, statistical quality control, methods of inspection importance of inventory management in operations
3. To identify the consumer behavior and Human Resource contribution in the development of organizations.
4. To apply the techniques of project management PERT, CPM to complete the project within optimal time and cost.
5. To identify various strategies used for organizational development

Unit -I	**Hours**
Introduction to Management: Concept –nature and importance of Management – Functions of Management – Evaluation of Management thought- Theories of Motivation – Decision making process-Designing organization structure- Principles of organization - Types of organization structure.	**10**
Unit –II	
Operations Management: Principles and Types of Layouts – Work study- Statistical Quality Control- Control charts (P-chart, R-chart, and C chart). Simple problems- Material Management: Need for Inventory control- EOQ, ABC analysis (simple problems) and Types of ABC analysis (HML, SDE, VED, and FSN analysis).	**10**
Unit-III	
Functional Management & **Strategic Management**: **Functional Management**: Concept of HRM, HRD and PMIR- Functions of HRM - Marketing Management- Functions of Marketing, Marketing strategies based on product Life Cycle, Channels of distributions. **Strategic Management**: Vision, Mission, Goals, Strategy – Elements of Corporate Planning Process – Environmental Scanning – SWOT analysis- Steps in Strategy Formulation and Implementation, Generic Strategy alternatives	**12**
Unit –IV	
Project Management: **(PERT/CPM):** Development of Network – Difference between PERT and CPM Identifying Critical Path- Probability- Project Crashing (Simple Problems).	**10**
Unit-V	
Contemporary Management Practices: Basic concepts of MIS, MRP, Justin- Time (JIT) system, Total Quality Management (TQM), Six sigma , Supply Chain Management, Enterprise Resource Planning (ERP), Business Process outsourcing (BPO), Business process Re-engineering and Bench Marking, Balanced Score Card.	**08**
Total	**50**

Course outcomes:

On completion of the course student will be able to:

1. Execute the functions of Management, Principles of Management & Leadership styles.
2. Examine Statistical Quality Control Techniques, Methods of inspection, the concept of Inventory Management and Control
3. Identify different Strategies for the Development of the Organization.
4. Analyze Project Management Techniques like CPM, PERT and Crashing.
5. Apply various contemporary issues in Management Practices like TQM, Business Process Reengineering and BPO etc.

Text Books:

1. Dr. A. R. Aryasri – Management Science, TMH 2011.
2. Dr. P.G.Ramanujam,Dr. B.V.R.Naidu and Prof. P.V.Rama Sastry: Management Science, Himalaya Publishing House 2013.

Reference Books:

1. Koontz & Weihrich: 'Essentials of Management' TMH 2011.
2. Seth & Rastogi: Global Management Systems, Cengage Learning, Delhi, 2011.
3. Robbins: Organizational Behaviors, Pearson Publications, 2011

Web References:

1. https://www.managementstudyguide.com/management_principles.htm
2. https://businessjargons.com/strategic-management.html

ELECTROMAGNETIC WAVES AND TRANSMISSION LINES
Common to ECE & ECT
SEMESTER IV

Subject Code	21ECECT4020, 21ETETT4020	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Engineering Physics	**Credits – 03**	

Course Objectives:
This course will enable students to
To gain conceptual and basic mathematical understanding of electrical and magnetic fields in free space and in materials with the help of Maxwell equations

1. To understand the significance of Maxwell's Equations
2. To understand wave propagation in lossless and in lossy media
3. To introduce the various types of transmission lines and to discuss the losses associated
4. To provide thorough understanding about impedance transformation and matching.
5. To give insight about the usage of Smith chart in problem solving

Unit -1	**Hours**
TIME VARYING FIELDS AND MAXWELL'S EQUATIONS: Review of vector analysis and coordinate systems, Faraday's Law – Transformer and Motional Electromotive Forces – Displacement current – Generalized forms of Maxwell's equation in final forms, Electromagnetic boundary conditions.	9
Unit -2	
PROPAGATION OF UNIFORM PLANE WAVES: The wave equation- uniform plane waves, Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Pointing vector	9
Unit -3	
REFLECTION AND REFRACTION OF PLANE WAVES: Reflection and refraction of plane waves at plane boundaries under normal and oblique incidence on the surface of perfect dielectric, perfect conductor, Wave impedance. **TRANSMISSION LINE THEORY**: Transmission Line Model- Line of Cascaded T sections, General theory of Transmission lines, Transmission line equations at radio frequencies, Primary and secondary constants, The infinite line - Input and transfer impedance, Waveform distortion, Distortion-less lines, methods of loading	14
Unit – 4	
HIGH FREQUENCY TRANSMISSION LINES: Input impedance, Open and short circuited lines, wavelength, velocity of propagation, Reflection coefficient - calculation of current, voltage and power delivered, Standing Wave Ratio, Reflection losses on unmatched line.	9
Unit – 5	
IMPEDANCE MATCHING IN HIGH FREQUENCY LINES: Impedance matching: Quarter-wave line and applications, Smith chart – Smith circle equations, Determination of Load impedance, input impedance, Reflection coefficient, VSWR, V_{min} and V_{max} using Smith chart Half-wave line, Impedance matching by stubs - Single stub and double stub matching, Single stub matching using Smith chart.	9
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Demonstrate knowledge and understanding of fundamental electromagnetic laws and concepts
2. Understand the EM wave propagation in a medium and through boundaries
3. Analyze the various types of transmission lines and to discuss the losses associated.
4. Comprehend the working of transmission line at radio frequencies
5. Analyze the problems in RF line and stub matching using Smith chart

Text Books:

1. D.K. Cheng, "Field and Wave Electro Magnetics", Pearson (India), 2 nd Edition, 1989.
2. John D Ryder, "Networks lines and fields", Prentice Hall of India, 2005

Reference Books:

1. W.H. Hayt and J.A. Buck, "Engineering electro magnetics", McGraw-Hill (India), 7 th Edition, 2006
2. E.C.Jordan and K.G. Balmain, “Electromagnetic Waves and Radiating Systems”, PHI, 2011.
3. Mathew.N.O.Sadiku, “Elements of Electromagnetics”, Oxford University Press, 6 th Edition, 2015.
4. Kraus, Fleisch, “Electromagnetics with Applications”, McGraw-Hill, 5 th Edition, 2010.
5. R. K. Shevgaonkar, “Electromagnetic Waves”, Tata McGraw Hill Publications, 2006
6. UmeshSinha, Transmission Lines and Networks: Networks, Filters & Transmission Lines, SathyaPrakash, 2010.

PRINCIPLES OF COMMUNICATION THEORY
Common to ECE & ECT
IV SEMESTER

Subject Code	21ECECT4030, 21ETETT4030	Internal	30
Number of Lecture Hours/Week	03	External	70
Total Number of Lecture Hours	50	Exam	03
Pre-requisite	Signals & Systems	**Credits – 03**	

Course Objectives:
The student will be able to
1. Understand the concept of modulation and learn continuous wave modulation and pulse modulation techniques.
2. Understand Modulation & demodulation techniques of DSB, SSB &VSB
3. Understand Modulation & demodulation techniques of FM
4. To acquire knowledge to analyze the noise performance of analog modulation techniques.
5. To understand the pulse modulation techniques.

Unit -1	**Hours**
Amplitude Modulation: Introduction to communication system, Need formodulation, Amplitude Modulation, Definition, Time domain and frequency domain description, single tone modulation, power relations in AM waves, Generation of AM waves, square law Modulator, Switching modulator, Detection of AM Waves; Square law detector, Envelope detector.	**10**
Unit -2	
DSB & SSB Modulation: Generation of DSBSC Waves, Balanced Modulators, Ring Modulator, Coherent detection of DSB-SC Modulated waves, COSTAS Loop, and Phase discrimination method Frequency discrimination for generating AM SSB Modulated waves, Demodulation of SSB Waves, Vestigial side band modulation, Design /Demonstrate the use of digital formatting in Multiplexers, Vocoders and Video transmission.	**10**
Unit – 3	
Angle Modulation: Introduction, Mathematical analysis of FM and PM, Modulation index for FM and PM, Frequency spectrum and bandwidth of FM, Narrow band and wide band FM, Direct, FM generation, Detection of FM Waves: Balanced Frequency discriminator, Phase locked loop, Comparison of AM, FM and PM. **NOISE:** Review of noise and noise sources, noise figure, Noise in Analog communication Systems, Noise in AM System, Noise in Angle Modulation Systems, Threshold effect in Angle Modulation System, Pre-emphasis & de-emphasis	**10**
Unit – 4	
PULSE ANALOG MODULATION: Introduction, Digitize Analog Sources The Low Pass Sampling Process Pulse Amplitude Modulation, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves. **Multiplexing:** frequency division multiplexing, Time division multiplexing, wavelength division multiplexing and comparison.	**10**
Unit – 5	
PULSE DIGITAL MODULATION : The Quantization Random Process, Quantization Noise, Pulse-Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Differential PCM, Applications examples- , Video + MPEG , Vocoders.	**10**
Total	**50**

Course outcomes:

After going through this course the student will be able to

1. Understand the concept of modulation and amplitude modulation.
2. Differentiate various schemes of amplitude modulation and demodulation techniques.
3. Understand the fundamentals of angle modulation and demodulation techniques.
4. Analyze noise characteristics of various analog modulation methods.
5. Analyze the concepts of pulse modulation schemes.

Text Books:

1. Simon Haykin, **"**Principles of Communication Systems", 2nd Ed, John Wiley.
2. Modern Digital and Analog Communication Systems –B.P. Lathi, Zhi Ding, Hari Mohan Gupta, Oxford University Press, 4th Edition, 2017

References Books:

1. B.P. Lathi, "Communication Systems", BS Publication, 2006.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. H. Taub and D. Schilling, "Principles of Communication Systems", TMH, 2003

Web References:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-02-introduction-to-eecs-ii-digital-communication-systems-fall-2012/lecture-videos/
2. https://nptel.ac.in/courses/117102059/
3. https://www.youtube.com/watch?v=TPm0XSPxld8

ELECTRONIC CIRCUIT ANALYSIS Common to ECE & ECT SEMESTER IV			
Subject Code	21ECECT4040, 21ETETT4040	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Electronic Devices	**Credits – 03**	

Course Objectives:

This course will enable the students to:

1. Understand analysis of small signal BJT and FET amplifier circuits
2. Understand the small signal high frequency amplifiers and the effect of Cascading on single stage amplifiers.
3. Understand the concept of feedback on amplifiers and oscilators
4. Derive the efficiency of different Power amplifiers
5. Understand the concept of tuned amplifiers

Unit -1	**Hours**
Small Signal Low Frequency Transistor Amplifier Models: **BJT:** Two port network, Transistor hybrid model,h-parameters, conversion of h-parameters, generalized analysis of transistor amplifier model using h-parameters, Analysis of CB, CE and CC amplifiers, Comparison of transistor amplifiers. **FET:** Small signal model of a MOSFET, Analysis of CG, CS and CD amplifiers, comparison of FET amplifiers.	**8**
Unit -2	
Small Signal High Frequency Transistor Amplifier models: **BJT:** Transistor at high frequencies: Hybrid- π CE transistor model, Hybrid π conductances, Hybrid π capacitances, validity of hybrid π model, CE short circuit current gain, current gain with resistive load, cut-off frequencies, single stage CE transistor amplifier response and gain bandwidth product. **FET:** Analysis of common Source and common drain Amplifier circuits at high frequencies	**12**
Unit – 3	
Feedback Amplifiers: Classification of Amplifiers, Feedback concept, feedback topologies, General Characteristics of negative feedback amplifiers, Method of analysis of feedback amplifiers **Oscillators:** Condition for oscillations, RC-phase shift and Wien bridge oscillators with BJT and analysis, General form of oscillator circuit, Hartley and Colpitts oscillators with BJT and analysis.	**10**
Unit-4	
Power Amplifiers: Transformer coupled Class A power Amplifier and its efficiency, Class B amplifier and its efficiency, Class AB amplifier, Complementary symmetry push pull amplifier, Class-C power amplifier, Thermal stability and Heat sinks.	**10**
Unit-5	
Tuned Amplifiers : Introduction, Q-Factor, small signal tuned amplifier, capacitance single tuned amplifier, double tuned amplifiers, effect of cascading single tuned amplifiers on band width, effect of cascading double tuned amplifiers on band width, staggered tuned amplifiers, stability of tuned amplifiers, wideband amplifiers	**10**
Total	**50**

Course outcomes:

On completion of the course student will be able to:

1. Perform the analysis of small signal amplifier circuits using BJT and FET
2. Design small signal high frequency amplifiers and estimate the effects of cascading
3. Design different types of feedback amplifier and oscillator circuits
4. Design a power amplifier with the required efficiency
5. Design the tuned amplifiers and the effect of cascading

Text Books:

1. Microelectronic Circuits - A.S. Sedra and K.C. Smith, 5th edition
2. Integrated Electronics- Jacob Millman, C. Halkies, Tata McGraw Hill Electronic

Reference Books:

1. Electronic Devices and Circuits -David A. Bell, 5th Edition Oxford University press
2. Electronic Devices and Circuits Theory – Robert L. Boylestad and Louis Nashelsky, Pearson/Prentice Hall, Tenth Edition.

CONTROL SYSTEMS Common to ECE & ECT SEMESTER IV			
Subject Code	21ECECT4050, 21ETETT4050	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Mathematics-III	**Credits – 03**	

Course Objectives:

This course will enable the students to:

1. Understand concepts of the mathematical modelling of Control System.
2. Understand the time response analysis on first and second order systems
3. Analyze the system stability using Routh Hurwitz and Root locus techniques
4. Analyze the system stability using Time & Frequency response analysis
5. Analyze the system with state variable analysis techniques.

Unit -1	**Hours**
Introduction: System, Control System, Open Loop Control System, Closed loop Control System, Different Examples, Effects of Feedback, Feedback Characteristics and its advantages. **Mathematical models of Physical Systems:** Differential equations of physical systems, Transfer functions of Electrical, mechanical translational and rotational systems. Block diagram Algebra, Signal flow graph	**12**
Unit -2	
Controller Components: DC Servomotor (Armature Controlled and Field Controlled) with necessary derivation for transfer function, AC Servomotor and its transfer function, AC Tachometer, Potentiometer, Synchros. **Time Response Analysis:** Standard test Signals, Time response of first and second order systems, steady state errors and error constants, Design specifications of second order systems, controllers and Compensators	**10**
Unit – 3	
Concepts of Stability and Algebraic Criteria: The concept of Stability, Necessary Conditions for Stability, Routh Hurwitz Stability Criterion, Relative stability analysis **The Root Locus Technique:** Introduction, The Root Locus concepts, Construction of Root Loci, Effect of adding poles and zeros to a system	**10**
Unit – 4	
Frequency response analysis: Introduction, Correlation between time and frequency response, Polar Plots, Bode Plots, Nyquist Stability Criterion, Performance specifications in frequency-domain.	**10**
Unit – 5	
State Variable Analysis and Design: Introduction, Concepts of State, State Variables and State models, State models for linear continuous-time systems, Solution of state equations and Concepts of Controllability and Observability	**8**
Total	**50**

Course outcomes:

On completion of the course student will be able to:

1. Characterize a control system and effects of feedback
2. Apply time response analysis on first and second order systems
3. Analyze the system stability using Routh Hurwitz and Root locus techniques
4. Analyze the system stability using frequency response analysis
5. Apply state variable analysis to continuous time systems and obtain the relationship between

state variable representation and transfer functions.
Text Books: 1. I.J.Nagarath and M.Gopal, "Control Systems", New Age International Publishers, 5th Edition, 2014 2. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 4th Edition, 2012
Reference Books: 1. Ambikapathy, "Control Systems", Khanna Book Publishing Co. (P) Ltd., Delhi 2. Anand Kumar, "Control Systems", 2nd Edition, PHI learning PVT. Ltd,2014
Web References: 1. https://nptel.ac.in/courses/108101037/ 2. http://www.ee.surrey.ac.uk/Projects/CAL/control/index.htm

PRINCIPLES OF COMMUNICATION THEORY LAB

Common to ECE & ECT SEMESTER IV			
Subject Code	21ECECL4060, 21ETETL4060	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Hours	36	Exam Hours	03
Credits – 1.5			

Course Objectives:

This course will enable students to

1. Perform the continuous wave modulation and demodulation techniques
2. Verify Sampling Theorem
3. Simulate modulation Techniques.
4. Understand operation of FM demodulation using PLL IC-565
5. Understand the operation of communication link principle

List of Experiments:	**Hours**
1. Amplitude Modulation - Modulation & Demodulation. 2. AM – DSBSC - Modulation & Demodulation. 3. Frequency Modulation & Demodulation. 4. Diode Detector. 5. Pre-emphasis & De-emphasis 6. AGC Circuits. 7. Verification of Sampling Theorem 8. Pulse Amplitude Modulation & Demodulation 9. PWM, PPM–Modulation & Demodulation 10. PLL IC-565 as FM demodulator 11. Pulse Code Modulation and Demodulation 12. Communication link simulation	**36**

Course outcomes:

On completion of the course student will be able to

1. Infer the modulation and demodulation techniques for continuous wave.
2. Understand the operation of demodulation techniques
3. Illustrate the significance of the sampling theorem.
4. Analyze various pulse modulation and demodulation techniques
5. Analyze and simulate communication link

ELECTRONIC CIRCUIT ANALYSIS LAB

Common to ECE & ECT

SEMESTER IV

Subject Code	21ECECL4070, 21ETETL4070	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Lecture Hours	36	Exam Hours	03

Credits – 1.5

Course objectives:

The objective of the course is to make students to understand the concepts of Basic Amplifiers, Oscillators, Feedback amplifiers

List of Experiments:	**Hours**
For the following amplifier circuits, Frequency response and frequency of oscillations needs to be executed both in hardware and Multisim software. 1. BJT CE Amplifier 2. Emitter follower-CC Amplifier 3. FET CS Amplifier 4. Two Stage RC Coupled Amplifier 5. Voltage-Series Feedback Amplifier 6. Current-Shunt Feedback Amplifier 7. RC Phase Shift Oscillator 8. Wien Bridge Oscillator 9. Hartley and Colpitts Oscillator 10. Class A Series-fed Power Amplifier 11. Complementary Symmetry Class B Push-Pull Power Amplifier 12. Single Tuned Voltage Amplifier	**36 Hours**

Course outcomes:

After completing this course, students will be able to:

1. Design CE amplifier and analyze frequency response at low, mid and high frequencies
2. Design two stage amplifier and analyze frequency response at low, mid and high frequencies
3. Design feedback amplifiers and oscillator circuits to analyze its frequency response
4. Design different Power amplifiers and evaluate the efficiency
5. Design tuned amplifier and evaluate the resonant frequency

Hardware/Software Requirements:

Equipment required

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. Analog/Digital Function Generators
4. Digital Multimeters
5. Decade Résistance Boxes/Rheostats
6. Decade Capacitance Boxes
7. Ammeters (Analog or Digital)
8. Voltmeters (Analog or Digital)
9. Active & Passive Electronic Components

Software:

1. Multisim/ Equivalent Industrial Standard Licensed simulation software tool.
2. Computer Systems with required specifications.

SIGNALS AND SYSTEMS LAB

Common to ECE & ECT

SEMESTER IV

Subject Code	21ECECL4080, 21ETETL4080	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Hours	36	Exam Hours	03
Credits – 1.5			

Course Objectives:

This course will enable students to

1. Generate fundamental Continuous time and discrete time signals.
2. Analyze the continuous time signals using Fourier Series and Fourier Transform.
3. Extend the properties of systems to LTI Systems.
4. Verify the sampling theorem.
5. Generation and standard operations on Random signals.

The programs shall be implemented in MATLAB software and student has to perform at least TEN Experiments.	**Hours**
List of Experiments: 1. Introduction to MATLAB and structure of a MATLAB program. 2. Generation of Continuous Time and Discrete Time signals. 3. Perform standard operations on signals. 4. Check the properties of Systems. 5. Exponential Fourier series representation of a periodic Fullwave rectified signal. 6. Determine Fourier Transform and Inverse Fourier Transform of a CT signal. 7. Perform Linear convolution between two signals. 8. Determine Autocorrelation and Cross correlation between signals. 9. Verification of the Sampling theorem. 10. Generate a uniformly distributed random sequence in the range (0,1) and compute it's Mean and Variance. Also plot the Histogram. 11. Generate a discrete time sequence of length N with i.i.d uniformly distributed random numbers in the interval (-0.5,-0.5) and compute the autocorrelation of the sequence. 12. Calculate Probability Distribution and Probability Density functions of a Random variable.	**36**

Course outcomes:

1. Experiment with Generation of fundamental signals.
2. Analyze the fundamental signals in frequency domain.
3. Inspect the system properties for a LTI system
4. Construct the Sampling theorem.
5. Construct Random signals and compute various parameters related to random signals

FPGA ARCHITECTURE AND PROGRAMMING USING VERILOG
(Skill Oriented Course-II)
SEMESTER IV

Subject Code	21ECECS4090	Internal Marks	---
Number of Lecture Hours/Week	03	External Marks	50
Total Number of Hours	36	Exam Hours	03

Credits – 2

Course Objectives:
This course will enable students to
1. To familiarize students with Verilog Programming constructs
2. To learn different levels of abstractions in Verilog HDL
3. To enable the students to implement the designs in FPGA

Prerequisites: Digital System Design

List of Experiments:	**Hours**
Part-A (Perform Any 6 Experiments) 1. Simulate the behavior of several logic gates 2. Design of Half adder and Full adder using two half adders 3. Implement the full adder using 3 to 8 decoder 4. Design 4 to 2 Priority encoder. Write an Verilog code and simulate the behavior 5. Implement the full adder using 4 to 1 and 8 to 1 multiplexers 6. Design BCD to 2424 converter. Write an Verilog code in Structural model. Observe the outputs with the help of FPGA 7. Construct BCD to 7 Segment Decoder and write Verilog code in behavioral model 8. Design 4-bit prime number detector and write Verilog code in Dataflow model. Observe the outputs with the help of FPGA. **Part-B (Perform Any 6 Experiments)** 9. Describe D flip-flop and JK flip-flop in Verilog HDL and Capture the waveforms 10. Differentiate Synchronous and Asynchronous sequential logic with the help of T-flip-flop and Capture the waveforms 11. Design 8-bit Up, Down and UP-Down counters in Verilog HDL. Observe the outputs with the help of FPGA. 12. Develop Verilog code for 4-bit Johnson counter. Show that it can produce 8 trigger pulses with the help of Testbench. 13. Design a frequency divider which can divides the output frequency by 2, 4 and 8. (Hint use T Flip-flops). 14. Design a SISO shift register in Verilog HDL. Observe the outputs with the help of Testbench 15. Design an 8-bit Synchronous RAM in Verilog HDL. Verify its outputs using Testbench. 16. Design 8-bit Parity Generator and checker in Verilog HDL. Observe the outputs with the help of FPGA.	**36**

Course outcomes:

On completion of the course student will be able to

1. Demonstrate knowledge on HDL design flow and identify the suitable abstraction level of a particular design
2. Design and develop the combinational and sequential circuits using dataflow, Structural and Behavioral modeling
3. Analyze the process of synthesizing the combinational and sequential descriptions
4. Implement the digital systems using FPGA

Text Books

1. J Cavanagh, "Digital Design and Verilog HDL Fundamentals" CRC Press, 2nd edition, 2008.
2. S Brown, Z Vranesic, "Fundamentals of Digital Logic with Verilog HDL" TMH, 3rd edition, 2014.

REFERENCE BOOKS

1. J Baskar, "Verilog HDL Primer" TMH, 3rd edition, 1998.
2. C Roth Jr, L John and B Lee, "Digital System Design using Verilog" Cengage Learning, First edition, 2016

MATLAB FOR ENGINEERS
(Skill Oriented Course-II)
SEMESTER IV

Subject Code	21ECECS4090	Internal Marks	---
Number of Lecture Hours/Week	03	External Marks	50
Total Number of Hours	36	Exam Hours	03

Credits – 2

Course Objectives:
This course will enable students to
1. To learn features of MATLAB as a programming tool.
2. To promote new teaching model that will help to develop programming skills and technique to solve mathematical problems.
3. To understand MATLAB graphic feature and its applications.
4. To use MATLAB as a simulation tool.
5. To learn mathematical computing using MATLAB

List of Experiments:	**Hours**
1. Introduction to MATLAB • The MATLAB Environment • MATLAB Basics – Variables, Numbers, Operators, Expressions, Input and output Vectors, Arrays – Matrices **2. MATLAB Functions** • Built-in Functions • User defined Functions **3. Graphics with MATLAB** • Files and File Management – Import/Export • Basic 2D, 3D plots • Graphic handling **4. Programming with MATLAB** • Conditional Statements, Loops • MATLAB Programs – Programming and Debugging. • Applications of MATLAB Programming **5. Mathematical Computing with MATLAB** • Algebraic equations • Basic Symbolic Calculus and Differential equations • Numerical Techniques and Transforms	**36**

Course outcomes:
On completion of the course student will be able to

1. Understand MATLAB environment, variables and arrays
2. Understand MATLAB Functions includes user defined and built-in functions
3. Use graphics, 2D, 3D Plotting and handling graphics
4. Programme using MATLAB – conditional statements, programming and Debugging, applications.
5. Understand mathematical computing with MATLAB

REFERENCE BOOKS

1. “A Guide to MATLAB - for Beginners and Experienced Users”, 2nd Ed., Brian R. Hunt, Ronald L. Lipsman, Jonathan M. Rosenberg, Cambridge University Press, (2006).
2. “Essentials of MATLAB Programming”, 2nd Ed., Stephen J. Chapman, Cengage Learning, (2009).
3. “MATLAB Demystified”, David McMahon, The McGraw-Hill Companies, (2007).
4. “MATLAB® for Engineers”, 3rd Ed., Holly Moore, Pearson Education, Inc., (2012).
5. “Engineering computation with MATLAB”, 2nd Ed., David M. Smith, Pearson Education, Inc.,

PULSE & DIGITAL CIRCUITS

Common to ECE & ECT

SEMESTER IV

Subject Code	21ECECN40A0, 21ETETN40A0	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Semiconductor Devices	**Credits - 0**	

Course Objectives:

This course will enable students to

1. Understand Wave shaping circuits.
2. Analyze switching characteristics of electronic devices.
3. Understand the characteristics of switching circuits
4. Design multivibrators and time base generators.
5. Explain different types of voltage time base generators

Unit -1	**Hours**
Linear Wave Shaping: High pass, low pass RC circuits, their response for sinusoidal, step, pulse, square, ramp and exponential inputs. RC network as differentiator and integrator; Attenuators, its applications in CRO probe, RL and RLC circuits and their response for step input, Ringing circuit.	10
Unit -2	
Non-Linear Wave Shaping: Diode clippers, Transistor clippers, clipping at two independent levels, transfer characteristics of clippers, Emitter coupled clipper; Clamping operation, clamping circuits using diode with different inputs, clamping circuit theorem, practical clamping circuits, effect of diode characteristics on clamping voltage, Transfer characteristics of clampers.	12
Unit – 3	
Switching Characteristics of Devices: Diode as a switch, piecewise linear diode characteristics, Design and analysis of Transistor as a switch, Break down voltage consideration of transistor, saturation parameters of Transistor and their variation with temperature, Design of transistor switch, transistor switching times. **Bistable Multivibrator:** Analysis And Design of Fixed Bias, Self-Bias Bistable Multi Vibrator, Collector Catching Diodes, Commutating Capacitors, Triggering of Binary Circuits, Emitter Coupled Bistable Multivibrator (Schmitt Trigger).	12
Unit – 4	
Monostable Multivibrator: Analysis and Design of Collector Coupled Monostable Multi vibrator, Triggering of Monostable Multivibrator, Applications of Monostable Multivibrator. **Astable Multivibrator:** Analysis and Design of Collector Coupled Astable Multivibrator, Application of Astable Multivibrator as a Voltage to Frequency Converter.	9
Unit – 5	
Voltage Time Base Generators: General features of a time base signal, Methods of generating time base waveform Exponential Sweep Circuits, Negative Resistance Switches, basic principles in Miller and Bootstrap time base generators, Transistor Miller time base generator, Transistor Bootstrap time base generator.	7
Total	**50**

Course outcomes:

On completion of the course, student will be able to

1. Analyze linear wave shaping circuits with different inputs.
2. Design Nonlinear wave shaping circuits.
3. Design switching circuits.
4. Design different multivibrators
5. Understand different types of time base generators

Text Books:

1. A. Anand Kumar, “Pulse and Digital Circuits”, PHI, 2005

Reference Books:

2. J. Millman and H. Taub, Mothiki S Prakash Rao, “Pulse, Digital and Switching Waveforms”, McGraw-Hill, Second Edition, 2007.
3. Venkata Rao,K,Ramasudha K, Manmadha Rao,G, “Pulse & Digital Circuits”, Pearson,2010
4. J. Millman and H. Taub, Pulse, “Digital and Switching Waveforms”, McGrawHill

Web References:

1. http://www.iitg.ac.in/apvajpeyi/ph218/Lec-18.pdf
2. http://www.nptelvideos.in/2012/12/digital-circuits-and-systems.html
3. http://www.allaboutcircuits.com/video-lectures/

Course Structure for

B. Tech (Electronics and Communication Engineering)

III B.Tech. V-Semester

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECT5010	Digital Modulation and Coding	3	0	0	3
2	21ECECT5020	Antenna Theory and Design	3	0	0	3
3	21ECECT5030	Linear IC Applications	3	0	0	3
4	21ECECP504X	Professional Elective-1	3	0	0	3
5	21ECXXO505X	Open Elective - 1	3	0	0	3
6	21ECECL5060	Digital Modulation and Coding Lab	0	0	3	1.5
7	21ECECL5070	Linear IC Applications Lab	0	0	3	1.5
8	21CMAHS5080	Skill advanced course/ soft skill course-3* (Soft Skills & Aptitude Builder-1).	1	0	2	2
9	21ECECN5090	Biology for Engineers	2	0	0	0
10	21ECECR5100	Summer Internship - 2 Months (Mandatory) after second year (to be evaluated during V semester	0	0	3	1.5
Total Semester Credits						**21.5**
11		Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	4	0	0	4

Professional Elective-I

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECP504A	Computer Architecture & Organization	3	0	0	3
2	21ECECP504B	Introduction to Machine Learning	3	0	0	3
3	21ECECP504C	System Design through Verilog	3	0	0	3

Open Elective-I

Candidate should select the subject from list of subjects offered by other departments

III B.Tech. VI-Semester

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECT6010	Digital Signal Processing	3	0	0	3
2	21ECECT6020	VLSI Design	3	0	0	3
3	21ECECT6030	Microprocessors & Microcontrollers	3	0	0	3
4	21ECECP604X	Professional Elective-II	3	0	0	3
5	21ECXXO605X	Open Elective – II	3	0	0	3
6	21ECECL6060	Digital Signal Processing Lab	0	0	3	1.5
7	21ECECL6070	VLSI Design Lab	0	0	3	1.5
8	21ECECL6080	Microprocessors & Microcontrollers Lab	0	0	3	1.5
9	21CMAHS6090	Skill advanced course/ soft skill course-4* Soft Skills and Aptitude Builder-2	1	0	2	2
10	21ECECN6100	Essence of Indian Traditional Knowledge	2	0	0	0
						21.5
10	H/M	Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	4	0	0	4

Professional Elective-II

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECP604A	Soft Computing Techniques	3	0	0	3
2	21ECECP604B	Cellular and Mobile Communications	3	0	0	3
3	21ECECP604C	Microwave Engineering	3	0	0	3

Open Elective-II

Candidate should select the subject from list of subjects offered by other departments

DIGITAL MODULATION AND CODING
SEMESTER V

Subject Code	21ECECT5010	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Principles of Communication Theory	**Credits – 03**	

Course Objectives:
This course will enable students to:

4. Interpret various digital modulation techniques and able to analyze various systems for their performance in terms of probability of error.
5. Illustrate the concepts of information theory and need for source coding.
6. Explain Block codes, cyclic codes and convolution codes.

Unit -1	**Hours**
DIGITAL MODULATION TECHNIQUES: Introduction to digital communication: Elements of digital communication systems, advantages of digital communication systems, Digital modulation techniques: ASK, FSK, PSK, DPSK, QPSK, M-ary PSK, M-ary ASK, M-ary FSK.	**10**
Unit -2	
DATA TRANSMISSION : Base band signal receiver, probability of error, the optimum filter, matched filter, probability of error using matched filter, coherent reception, non-coherent detection of FSK, calculation of error probability of ASK, BPSK.	**10**
Unit – 3	
INFORMATION THEORY: Discrete messages, concept of amount of information and its properties. Average information, Entropy and its properties. Information rate **SOURCE CODING:** Introductions, Advantages, Shannon's theorem, Shanon-Fano coding, Huffman coding, efficiency calculations, channel capacity of discrete and analog Channels, capacity of a Gaussian channel, bandwidth –S/N trade off.	**12**
Unit – 4	
LINEAR BLOCK CODES: Introduction, Matrix description of Linear Block codes, Error detection and error correction capabilities of Linear block codes, Hamming codes, Binary cyclic codes.	**9**
Unit – 5	
CONVOLUTION CODES: Introduction, convolution codes- time domain approach, transform domain approach. Graphical approach: state, tree and trellis diagram, decoding using Viterbi algorithm.	**9**
Total	**50**

Course outcomes:
On completion of the course student will be able to

1. Demonstrate various Digital Modulation Techniques.
2. Solve the probability of error in the data transmission.
3. Illustrate various source coding techniques.
4. Interpret the Linear Block codes.
5. Demonstrate the Convolution Codes.

Text Books:

1. Digital communications - Simon Haykin, John Wiley,2005
2. Digital and Analog Communication Systems - Sam Shanmugam, John Wiley,2005

Reference Books

1. Principles of Communication Systems – H. Taub and D. Schilling, TMH,2003
2. Digital Communications – John Proakis, TMH, 1983. Communication Systems Analog&Digital – Singh &Sapre, TMH,2004.
3. Modern Digital and Analog Communication Systems – B.P.Lathi, Zhi Ding, Hari Mohan Gupta, Oxford University Press,4 th Edition,2017
4. Analog & Digital Communication - Dr. Sanjay Sharma, S.K. Kataria & Sons, 3rd Edition.

Web References:

1. https://nptel.ac.in/courses/117101051
2. https://archive.nptel.ac.in/courses/108/101/108101113/
3. https://archive.nptel.ac.in/courses/117/105/117105144/
4. https://archive.nptel.ac.in/courses/108/102/108102120/

ANTENNA THEORY AND DESIGN SEMESTER V			
Subject Code	21ECECT5020	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Electromagnetic waves and Transmission Lines	**Credits – 03**	

Course Objectives:

This course will enable students to

1. Understand the basic radiation principle and antenna parameters
2. Compute various antenna parameters for basic wire-type antennas
3. Explain operation and design procedures of various types of antennas
4. Design and analyze different types antenna arrays

Unit -1	**Hours**
ANTENNA FUNDAMENTALS: Introduction, Radiation Mechanism – single wire, 2 wire, dipoles, Current Distribution on a thin wire antenna. Antenna Parameters - Radiation Patterns, pattern Lobes, Beamwidths, Beam Area, Radiation Intensity, Beam Efficiency, Antenna efficiency, Directivity, Gain, , Antenna Apertures, Aperture Efficiency, Effective Height, Bandwidth, Antenna polarization.	10
Unit -2	
THIN LINEAR WIRE ANTENNAS: Retarded Potentials, Radiation from Small Electric Dipole, Half-wave Dipole, and Quarter-wave Monopole – Current Distributions, Evaluation of Field Components, Power Radiated, Radiation Resistance, Beamwidths, Directivity, Effective Area and Effective Height. Loop Antennas: Small Loops - Field Components, Comparison of far fields of small loop, D and Rr relations for small loops.	10
Unit -3	
BROADBAND ANTENNAS: Introduction, Helical Antennas – Significance, Geometry, basic properties; Design considerations for monofilar helical antennas in Axial Mode and Normal Modes (Qualitative Treatment). **VHF, UHF AND MICROWAVE ANTENNAS**: Reflector Antennas: Flat Sheet and Corner Reflectors. Paraboloidal Reflectors – Geometry, characteristics, types of feeds, F/D Ratio, Spill Over, Back Lobes, Aperture Blocking, Off-set Feeds, Cassegrain Feeds. Horn Antennas – Types, Optimum Horns, Design Characteristics of Pyramidal Horns.	10
Unit – 4	
PLANAR ANTENNAS AND ANTENNA MEASUREMENTS: Microstrip Antennas-Introduction, Features, Advantages and Limitations, Feeding techniques, Rectangular Patch Antennas –Geometry and Parameters, Impact of different parameters on characteristics, TL model, Design procedure. Measurements – Patterns Required, Set Up, Distance Criterion, Directivity and Gain Measurements (Comparison, Absolute and 3-Antenna Methods).	10
Unit – 5	
ANTENNA ARRAYS: Introduction, 2 element arrays – different cases, N element Uniform Linear Arrays – Broadside, End-fire Arrays, EFA with Increased Directivity, Derivation of their characteristics and comparison; Concept of Scanning Arrays. Directivity Relations (no derivations), Non-	10

uniform current distribution-Binomial Arrays, Arrays with Parasitic Elements-Yagi-Uda Array.	
Total	**50**

Course outcomes:

On completion of the course students will be able to

1. Understand radiation principle and various antenna parameters.
2. Solve radiation fields and various antenna parameters of thin-wire antennas
3. Construct different types of antennas for broadband, VHF, UHF, and Microwave applications
4. Apply design procedure to model microstrip antennas for the given specifications.
5. Analyze various types of antenna arrays

Text Books:

1. Antenna Theory - C.A. Balanis, John Wiley and Sons, 2nd Edition, 2001.
2. Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd Edition, 2000.

Reference Books:

1. Antennas for All Applications – John D. Kraus and Ronald J. Marhefka, 3rd Edition, TMH, 2003.
2. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications, New Delhi, 2001.

LINEAR IC APPLICATIONS SEMESTER V			
Subject Code	21ECECT5030	IA Marks	30
Number of Lecture Hours/ Week	03	Exam Marks	70
Total Number of Lecture Hours	50	Exams Hours	03
Pre-requisite	Semiconductor Devices and Electronic Circuit Analysis	**Credits – 03**	

Course Objectives:

This course will enable the students to

1. Understand the basic operation and performance parameters of differential amplifiers.
2. Understand the measuring techniques and performance parameters of op-amp.
3. Learn linear and non-linear applications of operational amplifiers.
4. Understand and design active filters using op-amps and applications of IC555 timer and PLL.
5. Learn the internal structure and operation of various DACs and ADCs.

Unit I	
DIFFERENTIAL AMPLIFIERS: Differential Amplifier- DC and AC Analysis of Dual Input Balanced Output Configuration, Properties of Other Differential Amplifier Configuration: Dual Input Unbalanced Output, Single Ended Input Balanced and Unbalanced Output, DC Coupling and Cascaded Differential Amplifier Stages, Level Translator.	10
Unit II	
CHARACTERISTICS OF OP-AMPS: Integrated Circuits Types, Classification, Package Types and Temperature Ranges, Power Supplies, Op-amp Block Diagram, Ideal and Practical Op-amp Specifications, 741 Op-amp & its Features, Op-Amp Parameters and Measurement, DC and AC Characteristics: Input and Output Offset Voltages and Currents, Slew Rate, CMRR, PSRR, Drift, Frequency Compensation Techniques.	10
Unit III	
LINEAR APPLICATIONS OF OP-AMPS: Inverting and Non-inverting Amplifier, Integrator and Differentiator, Difference Amplifier, Instrumentation Amplifier, AC Amplifier, V to I, I to V Converters. **NON-LINEAR APPLICATIONS OF OP-AMPS:** Comparators, Multivibrators, Function Generators: Triangular and Square Wave Generators, Log and Anti-log Amplifiers, Precision Rectifiers.	10
Unit IV	
ACTIVE FILTERS: Design and Analysis of Butterworth Active filters: 1st order, 2nd order LPF, HPF, Band Pass, Band Reject and All Pass Filters, Sample & Hold Circuits. **TIMERS AND PHASE LOCKED LOOPS:** IC 555 Timer Functional Diagram, Monostable and Astable Operations and Applications, Schmitt Trigger, Phase Locked Loop (PLL), 565 PLL, Frequency Multiplication and Frequency Translation using PLL, Applications of VCO (566).	10
Unit V	
DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS: Basic DAC Techniques, Weighted Resistor DAC, R-2R Ladder DAC, Inverted R-2R DAC, IC1408 DAC, Parallel Comparator type ADC, Counter type ADC,	10

Successive Approximation and Dual Slope ADC, DAC and ADC Specifications, Specifications of AD 574 (12 bit ADC).	

Course Outcomes

On Completion of the course, student will be able to

1. Illustrate basic operation and performance parameters of differential amplifiers.
2. Demonstrate the performance parameters of operational amplifier.
3. Develop linear and non-linear applications of operational amplifier.
4. Build different active filters, timer and PLL applications.
5. Construct various DAC and ADC circuits.

Text Books

1. Linear Integrated Circuits by D. Roy Choudhury, New Age International (p) Ltd, 4th Edition, 2015.
2. Op-Amps and Linear ICs by Ramakanth A. Gayakwad, PHI, 1987.

Reference Books

1. Operational Amplifiers and Linear Integrated Circuits by Sanjay Sharma, SK Kataria & Sons, 2nd Edition, 2010.
2. Operational Amplifiers and Linear ICs by David A Bell, Oxford Uni. Press, 3rd Edition.

COMPUTER ARCHITECTURE & ORGANIZATION

SEMESTER V

(Professional Elective-1)

Subject Code	21ECECP504A	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Digital Logic Design	**Credits – 03**	

Course Objectives:

This course will enable students to

1. Principles and the Implementation of Computer Arithmetic
2. Operation of CPUs including RTL, ALU, Instruction Cycle and Busses
3. Fundamentals of different I/O Devices
4. Memory System and Mapping functions
5. Principles of Operation of Multiprocessor Systems and Pipelining

Unit -1	**Hours**
Basic Structure of Computers: Functional unit, Basic Operational concepts, Bus structures, System Software, Performance, The history of computer development. Processor organization, Information representation, number formats. Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats.	10
Unit -2	
Machine Instruction and Programs: Instruction and Instruction Sequencing: Register Transfer Notation, Assembly Language Notation, Basic Instruction Types, Addressing Modes, Basic Input/output Operations, The role of Stacks and Queues in computer programming equation. Component of Instructions: Arithmetic Instructions, Logic Instructions, shift and Rotate Instructions, Branch Instructions.	10
Unit -3	
Input/ Output Organization: Accessing I/O Devices, Interrupts: Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Direct Memory Access. **Buses:** Synchronous Bus, Asynchronous Bus, Interface Circuits, Standard I/O Interface: Peripheral Component Interconnect (PCI) Bus, Universal Serial Bus (USB).	10
Unit – 4	
The Memory Systems: Basic memory circuits, Memory System Consideration, Read-Only Memory: ROM, PROM, EPROM, EEPROM, Flash Memory. Cache Memories: Mapping Functions, Interleaving, Secondary Storage: Magnetic Hard Disks, Optical Disks.	10
Unit – 5	
Multi-processors: Introduction, Characteristics of Multi-processors, Interconnection Structures, Inter-processor Arbitration. Pipeline: Parallel Processing, Pipelining, Instruction Pipeline, RISC Pipeline, Array Processor.	10
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Demonstrate basic structure of computers.
2. Explain operation of CPUs including RTL, ALU, Instruction Cycle and Busses.
3. Illustrate various I/O Devices.
4. Build memory organization and mapping functions.
5. Illustrate concepts of parallel processing, pipelining and inter processor communication.

Text Books:

1. M. Morris Mano, Computer System Architecture, Third Edition, Pearson, 2008.
2. Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5/e, McGraw Hill, 2002.

Reference Books:

1. William Stallings, Computer Organization and Architecture, 6/e, Pearson, 2006.
2. Andrew S. Tanenbaum,Structured Computer Organization, 4/e, Pearson, 2005.

INTRODUCTION TO MACHINE LEARNING SEMESTER V (Professional Elective-1)			
Subject Code	21ECECP504B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Python Programming, Linear Algebra	**Credits – 03**	

Course Objectives:

This course will enable students to

1. Learn the Machine Learning Models
2. Know the classification and SVM Model
3. Build unsupervised and Ensemble models
4. Train the neural networks to deep learning applications
5. Build convolution neural networks to a variety of images

Unit -1	**Hours**
Introduction: Introduction, Types of machine learning, Supervised learning, Unsupervised learning, Linear Regression, Cost function, Gradient descent, Learning Rate. Regression with Multiple input Variables, Vectorization, Feature Scaling, Applications of Machine Learning.	10
Unit -2	
Classification: Logistic regression, Decision boundary, Cost function for logistic regression, Gradient Descent, overfitting, Regularized logistic regression, Polynomial regression, SVMs for classification.	10
Unit -3	
Unsupervised learning-part-1: K-means algorithm, Optimization objective, Gaussian (normal) distribution. **Unsupervised learning-part-2:** Clustering, types of clustering, Decision tree model, Random forest algorithm, Ensemble Models: XGBoost.	10
Unit – 4	
Neural Networks: Introduction, Neurons and the brain, Neural network layer, complex neural networks, Building a neural network, Forward propagation, Back propagation, activation functions, Multi-Layered Perceptron (MLP), Vanishing Gradient problem, Bias-Variance tradeoff.	10
Unit – 5	
Convolution Neural Networks: Edge Detection on Images. Padding, Strides, Convolution Layer, Max pooling, Data Augmentation, Transfer Learning, RNN, LSTM, Applications of AlexNet, VGGNet.	10
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Explain the machine learning models.
2. Describe the classification and SVM models.
3. Identify the Unsupervised algorithms and Ensemble models.
4. Classify the neural networks to deep learning applications.
5. Construct the Convolutional Neural Networks to a variety of images.

Text Books:

1. Machine Learning, Tom Mitchell, c Graw Hill.
2. Simon Haykin, "Neural Networks: A comprehensive foundation", Second Edition, Pearson Education Asia.

Reference Books:

1. Introduction to Machine Learning with Python: A Guide for Data Scientists, Andreas C. Müller and Sarah Guido, O'Reilly
2. Machine Learning, The Art and Science of Algorithms that Make Sense of Data, Peter Flach, Cambridge press.

SYSTEM DESIGN THROUGH VERILOG

SEMESTER V

(Professional Elective-1)

Subject Code	21ECECP504C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre requisite	Digital System Design	**Credits – 03**	

Course Objectives:

Enable the students to

1. Understand basic language constructs of Verilog HDL
2. Design the digital circuits using Verilog HDL
3. Verifying and synthesizing the digital circuits using CAD tools
4. Design simple digital systems based on digital abstractions.

Unit -1	**Hours**
Introduction to Verilog HDL: Verilog as HDL, HDL Design flow, Levels of Design Description, Simulation and Synthesis, Functional Verification **Language Constructs**: Introduction, Module, Keywords, Identifiers, White Space, Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators.	**10**
Unit -2	
Gate Level Modeling: Introduction, Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Design of Flip-flops with Gate Primitives, Delays, Strengths and Contention Resolution, Net Types, Switch Level Modeling – CMOS Switches.	**10**
Unit – 3	
Data flow Modeling: Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators. **Behavioral Modeling:** Introduction, Types of Assignments, Initial Construct, Always Construct, Examples, Assignments with Delays, Blocking and Non-blocking Assignments, The case statement, if and if-else constructs, for loop, while loop, forever loop, wait construct.	**10**
Unit – 4	
Implementation of Combinational Circuits: Verilog implementation of combinational logic circuits- Full Adders, Full Subtractors, encoders, decoders, multiplexers and magnitude comparators.	**10**
Unit – 5	
Implementation of Sequential Circuits: - Verilog implementation of sequential logic circuits- latches, Flip-flops, Shift registers, Synchronous counters, Design and analysis of clocked sequential circuits- Sequence detector.	**10**
Total	**50**

Course outcomes:

At the end of the course, students will be able to:

1. Understand Verilog HDL fundamentals.
2. Construct various syntaxes in Gate level modeling.
3. Construct various syntaxes in data flow and behavioral modeling.
4. Examine various combinational circuits.
5. Examine various sequential circuits.

Text Books:

1. Design through Verilog HDL – T.R. Padmanabhan and B. Bala Tripura Sundari, WSE, IEEE Press, 2004.
2. Verilog HDL - Digital Design and Modelling– Joseph. Cavanagh, CRS Press, 2007.

Reference Books:

1. A Verilog Primier – J. Bhasker, BSP, 2003.
2. Samir Palnitkar - Verilog HDL, 2nd edition, Pearson Education, 2003

DIGITAL MODULATION AND CODING LAB SEMESTER V			
Subject Code	21ECECL5060	Internal Marks	15
Number of Lecture Hours/Week	02	External Marks	35
Total Number of Hours	36	Exam Hours	03
			Credits – 1.5

Course Objectives:

This course will enable students to

1. Know Multiplexing Scheme
2. Know the Digital Modulation Schemes
3. Know the Analog to Digital Conversion Techniques.

List of Experiments:	**Hours**
Students have to perform a minimum of 10 Experiments using MATLAB programming or MATLAB Simulink 1. Time Division Multiplexing 2. Differential Pulse Code Modulation 3. Amplitude Shift Keying 4. Frequency Shift Keying 5. Phase Shift Keying 6. Differential Phase Sift Keying 7. Quadrature Phase Shift Keying (QPSK) 8. Implementation of Source Coding Techniques – HuffmanCoding, 9. Implementation of Source Coding Techniques – Shannon – Fanocoding 10. Linear Block Code – Encoder and Decoder 11. Binary Cyclic Code – Encoder and Decoder 12. Single bit error detection and correction using Hamming code 13. Convolution Code - Encoder and Decoder	**36**

Course outcomes:

On completion of the course student will be able to:

1. Illustrate Multiplexing schemes.
2. Analyze different Digital Modulation & Demodulation schemes.
3. Evaluate various Source & Channel Coding Techniques.
4. Demonstrate the Analog to Digital Conversion techniques.
5. Make an effective report based on experiments.

LINEAR IC APPLICATIONS LAB SEMESTER V			
Subject Code	21ECECL5070	IA Marks	15
Number of Lecture Hours/ Week	03	Exam Marks	35
Total Number of Lecture Hours	36	Exams Hours	03
			Credits -1.5

Course Objectives:

This lab will enable the students to

1. Study basic parameters and specifications of various ICs related to Linear ICs.
2. Analyze basic application of IC 741.
3. Understand various filters and timer.
4. Understand the operation of PLL and VCO.
5. Learn the operation of DAC.

List of Experiments:	**Hours**
List of Experiments: **Conduct any ten experiments using Multisim software.** 1. Study of IC 741, IC 555, IC 565 and IC 566 and their functioning, parameters and Specifications. 2. Adder, Subtractor and Comparator using IC 741. 3. Integrator and Differentiator using IC 741. 4. Function Generator using IC 741. 5. Low Pass and High Pass Filters (first order) using IC 741. 6. Monostable Multivibrator using IC 555. 7. Astable Multivibrator using IC 555. 8. Schmitt Trigger Circuits using IC 741 and IC 555. 9. IC 565 PLL Applications. 10. IC 566 VCO Applications. 11. 4-bit DAC using Op-amps. 12. Voltage Regulator using IC 723.	**36**

Course Outcomes:

On Completion of the lab, student will be able to

1. Understand specifications of Linear ICs.
2. Construct various applications using IC 741.
3. Design various filters and timer based applications.
4. Construct various applications of PLL and VCO.
5. Make an effective report based on experiments.

SOFT SKILLS & APTITUDE BUILDER – 1 SEMESTER V			
Subject Code	21CMAHS5080	IA Marks	---
Number of Practice Hours/Week	4	Exam Marks	50
Total Number of Practice Hours	64	Exam Hours	3
Credits - 2			
Section A **Soft Skills**			
Unit – 1: Intrapersonal Communication			**Hours**
Introduction to Soft Skills and its Significance **Personal Effectiveness**: Who am I and What am I; My Strengths and Weaknesses; SWOT Analysis; SMART Goal Setting; Being Proactive **Principles of Personal Vision**: Beginning with the End in Mind; Time Management: Understanding Priorities; Put First-Things-First **Activity**: Psychometric Tests and SWOT Analysis, SMART Goal Setting			**11**
Unit 2: Interpersonal Communication			
Principles of Creative Cooperation and Organisation Skills: Think Win-Win; Seek First to Understand then to be Understood; Synergize; Life-Long Learning **Emotional Intelligence**: Self-Awareness, Self-Regulation, Empathy, Assertiveness, Adoptability, Managing Emotions **Activity**: Resolving a Conflict with your Friend/Colleague/Family Member; Group Discussions & Debates			**11**
Unit – 3: 21st Century Skills			
What are 21st Century Skills? Learning Skills- Digital Literacy- Life Skills **Critical Thinking**: Active Listening, Observation, Introspection, Analytical Thinking, Open Mindedness **Problem Solving**: Understanding the Complexity of the Problem, Defining the Problem, Cause and Effect Analysis, Exploring Possible Solutions, Planning Actions, Analysing Results of your Actions, Getting Feedback, Redefining the Problem, The Problem Solving Cycle **Decision Making**: Managing Conflict, Conflict Resolution, Methods of Decision Making, Effective Decision Making in Teams – Methods & Styles **Activity**: Case Study			**10**
Section B **Aptitude Builder**			
Unit – 4: Ratios & Percentages			
Definition of Ratio, Properties of Ratios, Comparison of Ratios, Problems on Ratios, Compound Ratio, Problems on Proportion, Mean Proportional and Continued Proportion. **Partnership:** Introduction, Relation between Capitals, Period of Investments and Shares **Number System:** Classification of Numbers, Divisibility Rules, Finding the Units Digit, Finding Remainders in Divisions Involving Higher Powers, LCM and HCF Models **Percentages:** Introduction, converting a Percentage into Decimals, Converting a Decimal into Percentage, Percentage Equivalent of Fractions, Problems on Percentages **Profit And Loss:** Problems on Profit and Loss Percentage, Relation between Cost Price and Selling Price, Discount and Marked Price, Two Different Articles Sold at Same Cost Price, Two Different Articles Sold at Same Selling Price Gain% / Loss% on Selling Price **Problems on Ages:** Introduction, Problems based on Ages **Averages:** Definition of Average, Rules of Average, Problems on Average, Problems on Weighted Average, Finding Average using Assumed Mean Method			**16**

Alligation and Mixture: Problems on Mixtures, Alligation Rule, Problems on Alligation	
Unit – 5: Mental Ability	
Difference Series, Product Series, Squares Series, Cubes Series, Alternate Series Combination Series, Miscellaneous Series, Place Values of Letters **Number and Letter Analogies:** Definition of Analogy, Problems on Number Analogy, Problems on Letter Analogy, Problems on Verbal Analogy **Odd Man Out:** Problems on Number Odd Man Out, Problems on Letter Odd Man Out, Problems on Verbal Odd Man Out **Coding and Decoding:** Coding using Same Set of Letter, Coding using Different Set of Letters, Coding into a Number, Problems on R-Model **Blood relations:** Defining the Various Relations among the Members of a Family, Solving Blood Relation Puzzles, Solving the Problems on Blood Relations using Symbols and Notations **Direction Sense:** Solving Problems by Drawing the Paths, Finding the Net Distance Travelled, Finding the Direction, Problems on Clocks ,Problems on Shadows	**16**

Section-A: Text (T) / Reference (R) Books:	
For Units 1, 2, & 3	
T1	English and Soft Skills, Dr. S. P. Dhanvel, Orient Blackswan, 2011
R1	Seven Habits of Highly Effective People, Stephen R Covey
R2	Emotional Intelligence, Daniel Goleman, Bantom Book, 2006
R3	21st Century Skills: Learning for Life in our Times, Bernie Trilling, Charles Fadel; John Wiley & Sons
For Units 4&5	
T1	R S Agarwal, S Chand, 'Quantitative Aptitude'
T2	R S Agarwal, S.Chand , 'A Modern Approach to Logical Reasoning'
R1	Quantitative Aptitude for CAT By Arun Sharma
R2	GL Barrons, Mc Graw Hills, Thorpe's Verbal Reasoning, LSAT Materials
Course Outcomes: On completion of this course, students can	
Section A: Soft Skills	
CO1	re-engineer attitude and understand its influence on behaviour
CO 2	develop interpersonal skills and be an effective goal oriented team player
CO 3	develop holistic personality with a mature outlook to function effectively in different circumstances
Section B: Aptitude Builder	
CO 4	solve the real-time problems for performing job functions easily
CO 5	analyse the problems logically and critically

BIOLOGY FOR ENGINEERS
SEMESTER V

Subject Code	21CMMSN5090	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	**Natural Science**	Credits – 00	

Course Objectives:
This course will enable students to
1. Understand biology as an independent scientific discipline.
2. Understand the Hierarchy of life forms at various phenomenological level
3. Understand molecules of life and enzymes
4. Understand proteins and enzymology
5. Understand microbiology and metabolism

Unit -1	**Hours**
Introduction- Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology. How biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor.	8
Unit -2	
Classification- Hierarchy of life forms at phenomenological level- classification based on (a) cellularity- Unicellular or multicellular (b) ultra-structure- prokaryotes or eucaryotes. (c) energy and Carbon utilization - Autotrophs, heterotrophy, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureoteli (e) Habitata - acquatic or terrestrial (f) Molecular taxonomy- three major kingdoms of life. Model organisms for the study of biology come from different groups. E. coli, S.cerevisiae, D.Melanogaster, C. elegance, A. Thaliana, M. Musculus	10
Unit -3	
Genetics - Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be given not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about single gene disorders in humans. Discuss the concept of complementation using human genetics. **Molecules of life** Monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.	10
Unit – 4	
Enzymes: How to monitor enzyme catalyzed reactions. How does an enzyme catalyze reactions - Enzyme classification- Mechanism of enzyme action. -examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis. **Proteins:** Proteins- structure and function. Hierarchy in protein structure. Primary secondary, tertiary and Quaternary structure. Proteins as enzymes, transporters, receptors and structural elements. **Information Transfer:** The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosides. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination	12
Unit-5	

Microbiology & Metabolism: Thermodynamics as applied to biological systems - Exothermic and endothermic versus undergone and exergonic reactions. Concept of Keq and its relation to standard free energy - Spontaneity - ATP as an energy currency. This should include the breakdown of glucose to CO2 + H2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO2 and H2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge **Concept of single celled organisms**. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics	10
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Able to describe how biological observations of 18th Century that lead to major discoveries.
2. Able to convey that classification per se is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological
3. Able to demonstrate the highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring.
4. Able to convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine.
5. Able to classify enzymes and distinguish between different mechanisms of enzyme action.

Text Books:

1. Campbell, N. A, Reece, J. B, Urry, Lisa Cain, M, L. Wasserman, S. A. Minorsky, P. V. Jackson, R. B, Biology: A Global Approach: Pearson Education. Pearson Publishers, 11th Edition,2017
2. Conn, E.E, Stumpf, P.K, Bruening, G. Doi, R.H, Outlines of Biochemistry, John Wiley and Sons, 1987
3. L.M J.P. Harley and C.A. Klein, Microbiology, C. Brown Publishers, 2nd Edition, 1995.

Reference Books:

1. Nelson, D. L. andCox, M. M, Principles of Biochemistry, W.H. Freeman and Company, 7th Edition, 2017
2. Stent, G. S, Richard Calender, Molecular Genetics: An Introductory Narrative, W.H. Freeman and Co., 1978

DIGITAL SIGNAL PROCESSING
SEMESTER VI

Subject Code	21ECECT6010	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Signals and Systems	Credits – 03	

Course Objectives:

This course will enable students to

1. Analyze the Discrete time signals.
2. Compute DFT of a signal using different FFT algorithms.
3. Learn the IIR and FIR filter design procedures.
4. Understand the need of Multirate signal Processing.
5. Understand the basics of DSP Processors.

Unit -1	**Hours**
Introduction: Introduction to Digital Signal Processing: Discrete-time signals, Classification of Discrete-time systems, Stability of LTI systems, Response of LTI systems to arbitrary inputs. Solution of linear constant coefficient difference equations. Frequency domain representation of discrete-time signals and systems. Review of Z-transforms, Solution of difference equations using Z-transforms, System function.	10
Unit -2	
Discrete Fourier Series & Fourier Transforms: Discrete Fourier Series: DFS representation of periodic sequences Properties of DFS. Discrete Fourier transforms: Properties of DFT, Linear filtering methods based on DFT, Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT.	10
Unit -3	
Design of IIR Digital Filters & Realizations: Analog filter approximations – Butter worth and Chebyshev, Design of IIR Digital filters from analog filters, Design Examples, Analog and Digital frequency transformations. Basic structures of IIR systems, Transposed forms. **Design of FIR Digital Filters & Realizations:** Characteristics of FIR Digital Filters, Frequency response. Design of FIR Digital Filters using Window Techniques and Frequency Sampling technique, Comparison of IIR & FIR filters, Basic structures of FIR systems, Lattice structures.	12
Unit – 4	
Multirate Digital Signal Processing: Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Implementation of sampling rate conversion. Applications of Multirate signal processing: Sub-band Coding of Speech Signals.	10
Unit – 5	
DSP Processors: Introduction to programmable DSPs: Multiplier and Multiplier Accumulator, Modified bus structures and memory access schemes in P-DSPs, Multiple Access Memory, Multi-ported memory, VLIW architecture, Pipelining, Special addressing modes, On-Chip Peripherals.	8
Total	**50**

Course outcomes:

On completion of the course, student will be able to

1. Illustrate the Discrete-time signals and systems.
2. Apply the FFT algorithm for solving the DFT of a given signal.
3. Construct a Digital IIR and FIR filter for the given specifications.
4. Apply Multirate signal Processing concepts in various applications.
5. Apply the signal processing concepts on DSP Processor.

Text Books:

1. John G. Proakis, Dimitris G. Manolakis, Digital Signal Processing, Principles, Algorithms, and Applications, Pearson Education, 2007.
2. A.V. Oppenheim and R.W. Schaffer, Discrete Time Signal Processing, PHI, 3rd Edition, 2010.
3. Venkataraman, Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, TATA McGraw Hill, 2002.

Reference Books:

1. A Anand Kumar, Digital Signal Processing, PHI.
2. Robert J. Schilling, Sandra L. Harris, Fundamentals of Digital Signal Processing using MATLAB, Thomson, 2007.

VLSI DESIGN SEMESTER VI			
Subject Code	21ECECT6020	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable students to

1. Learn about MOS and CMOS circuit's features and characteristics.
2. Know fabrication principles of CMOS.
3. Implement CMOS logic circuit and draw the stick diagrams and Layouts.
4. Estimate the Short Channel effects of MOSFETs.
5. Study the functioning of FinFETs.

Unit -1	**Hours**
Introduction to MOS Devices: MOS characteristics: NMOS characteristics, inverter action – CMOS characteristics, inverter action – models and second order effects of MOS transistors – Current equation – MOSFET Capacitances – MOS as Switch, CMOS logic, CMOS steady state and dynamic electrical behavior, CMOS logic families.	10
Unit -2	
MOS Fabrication: CMOS Fabrication – n-well, p-well, twin-tub processes – fabrication steps – crystal growth (wafer preparation, polysilicon film deposition) – photolithography – oxidation – diffusion – Ion implantation – etching – metallization.	10
Unit -3	
CMOS Logic Circuits: Implementation of logic circuits using nMOS and CMOS, Pass transistor and transmission gates Aspects of MOS transistor Threshold Voltage, MOS transistor Transconductance, Output Conductance and Figure of Merit. **Layout & Scaling of MOS Circuits:** MOS Layers, Stick Diagrams, Layout Diagrams of NAND and NOR gates and CMOS inverter. Scaling models and scaling factors, Scaling factors for device parameters.	12
Unit – 4	
Short Channel MOSFETs: Technology node, channel length and MOS width in cross section, Layout, Technology node shrinking, Short channel Devices, Silicon on Insulator MOSFET, Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.	10
Unit – 5	
FinFETs: MOSFET restructuring, Trigate FET construction, advent of FinFET, FinFET vs TrigateFET, FinFET fabrication	08
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Understand the insights of the MOS devices and its characteristics.
2. Appreciate the different VLSI process technologies.
3. Design the CMOS combinational logic circuits, stick diagram and its layout.
4. Analyze the Short Channel effects of MOSFETs.
5. Understand the functioning of FinFETs.

Text Books:

1. Kamran Eshraghian, Douglas and A. Pucknell and SholehEshraghian, Essentials of VLSI Circuits and Systems, Prentice-Hall of India Private Limited,2005 Edition.

2. Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design, Tata McGrawHill Education, 2003.
3. Alan Hastings ,The Art of Analog Layout, Pearson; 2nd edition,2005.
4. Vinod Kumar Khanna ,Integrated Nanoelectronics, Springer, India, Private Ltd,2016

Reference Books:

1. Analysis and Design of Digital Integrated Circuits in Deep Submicron Technology, 3rd edition, David Hodges.
2. Behzad Razavi, Design of Analog CMOS Integrated Circuits,, McGraw Hill Education , Second edition,2015
3. A. Shanthi and A. Kavita, VLSI Design, New Age International Private Limited, 2006 First Edition.

MICROPROCESSORS & MICROCONTROLLERS SEMESTER VI			
Subject Code	21ECECT6030	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Digital System Design	Credits – 03	

Course Objective This course will enable students to:

1. Understand the internal architecture and functional description of the 8086 microprocessors.
2. Interpret the concept of 8051 microcontroller internal architecture.
3. Apply the programming model of the 8051 Microcontroller using embedded C.
4. Apply interfacing concepts of 8051 with other peripherals.
5. Discuss the operational aspects of advanced Processors.

Unit -1: 8086 Architecture and Programming	**Hours**
Introduction to 8-bit Processors, Features, Pin Description, 8086 Microprocessor Family, 8086 Internal Architecture, Interrupts, Minimum Mode and Maximum Mode Configuration of 8086.8087 Coprocessor.8086 Programming-Instruction set, Addressing Modes, Assembler Directives, Writing Simple Programs with an Assembler, Assembly Language Program Development Tools. Semiconductor memories interfacing (RAM,ROM),	**12**
Unit-2: **Intel 8051 Microcontroller Architecture:**	
Introduction to Microcontrollers (8051): Microprocessors & Microcontrollers Comparison, Overview of 8051 Microcontroller, Internal Block Diagram of 8051, Pin Diagram of 8051, Memory Organization, Internal RAM Memory Structure, External Memory interfacing.	**8**
Unit-3: Intel 8051 Components and Programming	
8051 Components- Input/output ports and circuits, counters/timers, serial data input/output, Interrupts. Instruction syntax, addressing modes with examples **8051 Programming Concepts-**Assembler directives, Classification of Instructions& basic 8051 Assembly Language Programs using Data Transfer and arithmetic Instructions.	**10**
Unit – 4: 8051 **I/O Interfacing**:	
Introduction to Embedded C. LEDs & switches interfacing, keypad interfacing, Seven Segment Display interfacing, ADC & DAC interfacing, 2X16 LCD interfacing stepper motor interfacing, serial port interfacing, high power devices. Embedded C programming for above interfacings.	**10**
Unit – 5 Advanced Processors:	
Introduction to RISC & CISC Processors, features of 16/32 Bit processors. **ARM :** Introduction to ARM Processor Families, ARM Pipelining operation, ARM 7 (LPC2148) architecture and organization, ARM / Thumb instruction set & programming model. ARM 7 GPIO programming using Embedded C.	**10**
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Understand the internal operation and programming concepts of 8086 microprocessor
2. Interpret the basic concept of 8051 microcontrollers.
3. Learn the internal concepts and programming models of Timer/Counter, I/O ports, etc with 8051.
4. Understand the ADC and DAC and other interfacing concepts with 8051.

5. Learn the operational aspects of advanced Processors.

Text Books:

1. Advanced Microprocessors and Peripherals by A. K. Ray, K. M. Bhurchandi, Tata McGraw Hill Education Private Limited, Second Edition
2. The 8051 Microcontroller and Embedded Systems Using Assembly and C by Muhammad Ali Mazidi, Rolin mckinlay Janice Gillispie Mazidi, Pearson, Second Edition.
3. A.Sloss, D.Symes, C.Wright, (2003), "ARM system Developers Guide: Designing and Optimizing System Software", Morgan Kaufmann publishers.(Unit-V).

Reference Books:

1. Microprocessors and Interfacing – Programming and Hard ware by Douglas V Hall, SSSP Rao, Tata McGraw Hill Education Private Limited, 3rd Edition.
2. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.
3. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996

Web References:

1. http://www.slideshare.net/harinder0884/evolution
2. http://nptel.ac.in/courses/106108100/
3. http://nptel.ac.in/courses/117106111/

SOFT COMPUTING TECHNIQUES

(Professional Elective-II)

SEMESTER VI

Subject Code	21ECECP604A	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite		Credits – 03	

Course Objectives:

This course will enable students to

1. Acquire the knowledge on Soft Computing Concepts
2. Introduce the foundations of Artificial Neural Networks.
3. Introduce and use the idea of fuzzy logic
4. Learn various types of Genetic algorithms and its applications.
5. Gain knowledge to apply optimization strategies

Unit -1	**Hours**
Introduction to Soft Computing: Evolutionary Computing, "Soft" computing versus "Hard" computing, Soft Computing Methods, Recent Trends in Soft Computing, Characteristics of Soft Computing, Applications of Soft Computing Techniques.	8
Unit -2	
Artificial Neural Networks and Paradigms: Introduction to Neuron Model, Neural Network Architecture, Learning Rules, Perceptron, Single Layer Perceptron, Multilayer Perceptron, Backpropagation Networks, Kohnen's self-organizing networks, Hopfield network, Applications of NN..	12
Unit -3	
Introduction to Fuzzy Logic: Introduction, Fuzzy sets and Fuzzy reasoning, Basic functions on fuzzy sets, and relations. **Fuzzy Logic Systems:** Rule-based models and linguistic variables, fuzzy controls, Fuzzy decision making, applications of fuzzy logic.	12
Unit – 4	
Genetic Algorithms: Introduction, Genetic Algorithm, Fitness Computations, Cross Over, Mutation, Evolutionary Programming, Classifier Systems, Genetic Programming Parse Trees, Variants of GA, Applications.	10
Unit – 5	
Modern Methods of Optimization: Introduction, Simulated Annealing, Particle Swarm Optimization and its variants, Ant Colony Optimization, Harmony search algorithm, Gravitational search algorithm, Artificial bee colony algorithm.	8
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Understand the concept of Soft Computing techniques
2. Identify the difference between Conventional Artificial Intelligence to Computational Intelligence
3. Understand fuzzy logic and reasoning to handle and solve engineering problems
4. Apply various operations of genetic algorithms
5. Classify Biologically inspired optimization algorithms

Text Books:

1. S. N. Sivanandam & S. N. Deepa" Principles of Soft Computing" Wiley – India, 2nd Edition, 2007.
2. Soft Computing – Advances and Applications - Jan 2015 by B.K. Tripathy and J. Anuradha – Cengage Learning

Reference Books:

1. Simon S. Haykin, Neural Networks, Prentice Hall, 2nd edition.
2. S. Rajasekaran & G. A. Vijayalakshmi Pai "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications", PHI,2003.
3. Singiresu S. Rao, "Engineering Optimization: Theory and Practic", Fourth Edition John Wiley & Sons, 2009.
4. M. Asghar Bhatti, "Practical Optimization Methods: with Mathematics Applications", Springer Verlag Publishers, 2000.

CELLULAR AND MOBILE COMMUNICATIONS (Professional Elective-II) SEMESTER-VI			
Subject Code	21ECECP604B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Antennas and Wave Propagation	Credits – 03	

Course Objectives:

This course will enable students to

1. Design and analyze Basic Cellular System
2. Know of frequency reuse and Co-channel Interference, Non co-channel Interference
3. Know the concepts Cell coverage for signal and Antennas
4. Apply the different methods of Channel Assignment and Handoff mechanisms
5. Explore the implementation of these wireless technologies in cellular and mobile communications

Unit -1	**Hours**
Cellular Mobile Radio Systems: Introduction to Cellular Mobile System, basic cellular system, operation of cellular systems, Hexagonal shaped cells, Cellular traffic: trunking and blocking, Grade of Service, uniqueness of mobile radio environment, Analog and Digital Cellular systems. Cellular structures: macro, micro, pico and femto cells; Cell splitting, Cell sectoring.	10
Unit -2	
Elements of Cellular Radio System Design: General Description of the Problem, Concept of Frequency Reuse, Desired C/I from a normal case in an Omni-directional Antenna System. **Interference:** Co-Channel Interference, Co-Channel Interference Reduction Factor, Real Time Co-Channel Interference Measurement at mobile radio transceivers, Design of an Omni Directional Antenna System in the worst case, Design of a Directional Antenna System, Lowering the Antenna height.	10
Unit -3	
Cell Coverage for Signal and Traffic: General Introduction, Obtaining the Mobile Point-to-Point Model (Lee Model), Propagation over Water or Flat Open Area, Foliage Loss, Propagation in Near-in Distance, Long Distance Propagation, Obtain Path Loss from a Point-to-Point Prediction. **Cell Site and Mobile Antennas:** Sum and Difference Patterns and their Synthesis, Antennas at Cell Site, Omni-directional Antennas, Directional Antennas for Interference Reduction.	12
Unit – 4	
Frequency Management and Channel Assignment: Frequency Management, Frequency Spectrum Utilization, Set-up Channels, Channel Assignments to Cell Sites and Mobile Units, Fixed Channel Assignment, Channel Sharing and Borrowing, Underlay-Overlay arrangement. **Handoff:** Value of Implementing Handoffs, Why handoffs, Types of Handoff, Initiation of a Handoff, Delaying a Handoff, Forced Handoffs, Mobile Assisted Handoff(MAHO) and Soft Handoff,, Intersystem Handoff,	10
Unit – 5	
Digital Cellular Networks: GSM- Architecture, Channels, Multiple access schemes- TDMA, FDMA, CDMA. Radio resource management, Mobility management, Communication management, Network management, and Architecture.	8
Total	**50**

Course outcomes:

On completion of the course, student will be able to

1. Understand the operation of cellular systems
2. Knowledge the concepts of cellular communication
3. Recognize the cell coverage for signal and traffic
4. Apply the different methods of Handoff mechanisms
5. Implement wireless technologies in cellular and mobile communications

Text Books:

1. William C. Y. Lee (2006), Mobile Cellular Telecommunications, 2nd edition, Tata McGraw Hill, India.
2. Theodore S. Rappaport (2002), Wireless Communications, 2nd edition, Pearson education, India.

Reference Books:

1. Gordon L. Stuber (2007), Principles of Mobile Communication, 2nd edition, Springer International, India.
2. William C. Y. Lee (2006), Wireless and Cellular Telecommunications, 3rdedition, McGraw Hill, New Delhi.

MICROWAVE ENGINEERING
(Professional Elective-II)
SEMESTER-VI

Subject Code	21ECECP604C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	EM Waves and Transmission Lines	Credits – 03	

Course Objectives:

This course will enable students to

1. Understand the concepts of Rectangular waveguides, microstrip lines, and cavity resonators
2. Analyze the passive components for microwave systems and obtain the characteristics of these components
3. Analyze microwave O-type vacuum tubes
4. Understand the generation & amplification of the microwave signals and obtain the characteristics of O & M Type Tubes.
5. Understand the microwave measurement process

Unit -1	**Hours**
Introduction to microwaves: History, Microwave Spectrum and Bands, Applications of Microwaves. **Rectangular Waveguides**: Introduction, TE/TM mode analysis, Dominant and Degenerate Modes, Sketches of TE and TM mode fields in the cross-section, Mode Characteristics – Phase and Group Velocities, Wavelengths and Impedance Relations, Power Transmission and Power Losses in Rectangular Guide, Impossibility of TEM mode. Related Problems. **Microstrip Lines**– Introduction, Zo Relations, Effective Dielectric Constant, Losses, Q factor.	12
Unit -2	
Microwave Passive Components: Coupling Mechanisms – Probe, Loop, Aperture types. Waveguide Attenuators – Resistive Card, Rotary Vane types; Waveguide Phase Shifters – Dielectric, Rotary Vane types, Scattering Matrix– Significance, Formulation and Properties, S-Matrix Calculations for – 2 port Junction, E-plane and H-plane Tees, Magic Tee, Hybrid Ring; Directional Couplers – 2Hole, Bethe Hole types, Ferrite Components– Faraday Rotation, S-Matrix Calculations for Gyrator, Isolator, Circulator, Related Problems.	10
Unit -3	
MICROWAVE TUBES: Review on conventional tubes, Microwave tubes – O type and M type classifications, O-type tubes :2 Cavity Klystrons – Structure, Velocity Modulation Process and Applegate Diagram, Bunching Process and Small Signal Theory –, Applications. **Reflex Klystrons** – Structure, Applegate Diagram and Principle of working Electronic Admittance; Oscillating Modes and output Characteristics, Electronic and Mechanical Tuning, Applications,	10
Unit – 4	
HELIX TWTS: Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT and Suppression of Oscillations, **M-type Tubes**	8

Introduction, Cross-field effects, Magnetrons – Different Types, 8-Cavity Cylindrical Travelling Wave Magnetron – Hull Cut-off Condition, Modes of Resonance and PI-Mode Operation, Separation of PI-Mode, o/p characteristics	
Unit – 5	
MICROWAVE SOLID STATE DEVICES: Introduction, Classification, Applications. TEDs – Introduction, Gunn Diode – Principle, RWH Theory, Characteristics, Basic Modes of Operation, Oscillation Modes. **MICROWAVE MEASUREMENTS:** Description of Microwave Bench – Different Blocks and their Features, Precautions; Microwave Power Measurement – Bolometer Method. Measurement of Attenuation, Frequency, Q- factor, Phase shift, VSWR, Impedance Measurement	10
Total	**50**

Course outcomes:

On completion of the course, student will be able to

1. understand microwave transmission lines
2. Explain the working of various microwave passive components
3. Analyze various microwave O-type tubes
4. Analyze various M Type microwave vacuum tubes
5. measure various microwave parameters by using the microwave bench setup

Text Books:

1. Samuel Y. Liao, Microwave Devices and Circuits, Pearson, 1990
2. M. Kulkarni, Microwave and Radar Engineering, Umesh Publications, 2009

Reference Books:

1. Annapurna Das and Sisir K. Das, "Microwave Engineering", 3rd Edition, Tata McGraw-Hill Education, 2000
2. G S N Raju, Microwave Engineering, I K International Publishing House Pvt. Ltd, 2013

DIGITAL SIGNAL PROCESSING LAB SEMESTER VI			
Subject Code	21ECECL6060	**Internal Marks**	15
Number of Lecture Hours/Week	03	**External Marks**	35
Total Number of Hours	36	**Exam Hours**	03
Credits – 1.5			

Course Objectives:

This course will enable students to

1. Generate the fundamental discrete-time signals.
2. Perform Convolution and DFT operation
3. Design Infinite Impulse Response filters.
4. Design Finite Impulse Response filters.
5. Understand the concept of Noise removal in a signal.

List of Experiments: Students has to perform any 10 experiments	**Hours**
1. Generation of discrete-time signals for discrete signals 2. To verify the Linear Convolution for discrete signals a. Using MATLAB b. Using Code Composer Studio (CCS) 3. To verify the Circular Convolution for discrete signals a. Using MATLAB b. Using Code Composer Studio (CCS) 4. To verify the autocorrelation between two discrete signals 5. To verify Discrete Fourier Transform (DFT) and Inverse Discrete Fourier Transform (IDFT) a. Using MATLAB b. Using Code Composer Studio (CCS) 6. Determination of the power spectrum of a discrete signal 7. Frequency Response of IIR low pass Butterworth Filter 8. Frequency Response of IIR High pass Butterworth Filter 9. Frequency Response of IIR Low pass Chebyshev Filter 10. Frequency Response of IIR high pass Chebyshev Filter 11. Frequency Response of FIR low pass Filter using Rectangle Window 12. Frequency Response of FIR high pass Filter using Rectangle Window 13. Implementation of the Decimation Process 14. Implementation of Interpolation Process	**36**

Course outcomes: On completion of the course, students will be able to

1. Illustrate the fundamental discrete-time signals
2. Experiment with the properties of an LTI system
3. Construct a Digital IIR filter for the given specifications.
4. Construct a Digital FIR filter for the given specifications.
5. Apply basic building blocks of Multi-rate signal processing.

VLSI Design LAB SEMESTER VI			
Subject Code	21ECECL6070	IA Marks	15
Number of Lecture Hours/ Week	03	Exam Marks	35
Total Number of Lecture Hours	36	Exams Hours	03
Credits -1.5			

Course Objectives:

This lab will enable the students to

1. Design CMOS logic circuits.
2. Simulate combinational and sequential CMOS circuits.
3. Analyze layouts for combinational CMOS circuits.
4. Analyze of layouts for sequential CMOS circuits.
5. Perform DRC and LVS for CMOS design.

List of Experiments:	**Hours**
List of Experiments: **Conduct any ten experiments using Mentor Graphics/Cadence/Synopsis software.** 1. Design and Implementation of an Inverter. 2. Design and Implementation of a NAND Gate. 3. Design and Implementation of an NOR Gate. 4. Design and Implementation of Full Adder. 5. Design and Implementation of 4-bit Ripple Carry Adder. 6. Design and Implementation of Multiplexer using Transmission Gate. 7. Design and Implementation of Decoder. 8. Design and Implementation of D Flip-flop. 9. Design and Implementation 4-bit Register. 10. Design and Implementation asynchronous counter. 11. Design and Implementation of static RAM cell. 12. Design and Implementation of Sequence Detector.	**36**

Course Outcomes:

On Completion of the lab, student will be able to

1. Design CMOS logic circuits
2. Design and simulate Combinational and Sequential CMOS circuits.
3. Generate and verify layouts for combinational CMOS circuits.
4. Generate and verify layouts for sequential CMOS circuits.
5. Design and analyze DRC and LVS for CMOS.

MICROPROCESSORS & MICROCONTROLLERS LAB

SEMESTER –VI

Subject Code	21ECECL6080	Internal Marks	15
Number of Lecture Hours/Week	03	External Marks	35
Total Number of Lecture Hours	36	Exam Hours	03

Credits – 1.5

Course objectives:

The course objective is to make students understanding the fundamental operations and interfacing concepts of different microprocessors and microcontrollers with various I/O peripheral, display and communication modules along with their design aspects.

In this lab different types of microprocessor and microcontroller development boars, I/O interfacing modules and communication modules along with software simulation Tools	**Teaching Hours**
PART- A: (Minimum of 5 Experiments has to be performed) 8086 Assembly Language Programming and Interfacing. 1. Signed and unsigned Arithmetic operation -(Multi byte Addition and Subtraction, Multiplication and Division) 2. Logical Operations- (Shift and rotate- Converting packed BCD to unpacked BCD, BCD to ASCII conversion) 3. Factorial of given n-numbers 4. String Operations - (Move Block, Reverse string, Sorting, Inserting, Deleting, Length of the string, String comparison). 5. DOS/BIOS programming: Reading keyboard (Buffered with and without echo) - Display characters, Strings. 6. A/D Interface through Intel 8255 7. Stepper Motor interfacing **PART- B: (Minimum of 5 Experiments has to be performed)8051 Embedded C Programming and Interfacing** 1. Switch and LED interfacing with 8051. 2. Different timer mode operations for a series of LEDs 3. 4*4 or 3*3 matrix keypad with 2*16 LCD display 4. Stepper motor with clockwise and anticlockwise rotation. 5. External ADC/DAC with temperature sensor(DS18B20) for Temperature monitoring 6. Serial Communication Implementation (UART Operation). 7. Interfacing 2 way Traffic Lights Controller to8051.	**36 Hours**
Hardware/Software Requirements: 1. MASM/TASM software 2. 8086 Microprocessor Kits 3. 8051 Micro Controller kits 4. Interfaces/peripheral subsystems i) 8259 PIC ii) 8279-KB/Display iii) 8255 PPI iv) Stepper motor control board and motor	

5. A/D and D/AC Interface 6. DS18B20 temperature sensor 7. Traffic lights modules. 8. 4x4 or 3x3 matrix display. 9. 2x16 LCD display 10. UART communication module 11. Microcontroller compact software tools and Hardware board	

Course outcomes:

On completion of the course student will be able to:

1. Perform the Arithmetic and logic operations with 8086 processors.
2. Learn the various interfacing concepts with 8086 processors.
3. Design ADC/DAC applications with modern microcontroller boards.
4. Learn the various interfacing mechanisms with modern microcontroller boards.
5. Compile, design and test a simple microcontroller based system with their programming models.

SOFT SKILLS & APTITUDE BUILDER – 2 SEMESTER VI			
Subject Code	21CMAHS6090	IA Marks	--
Number of Practice Hours/Week	2	Exam Marks	50
Total Number of Practice Hours	64	Exam Hours	3
Credits - 2			
Section A **Soft Skills**			
Unit – 1: Communicative Competence			**Hours**
Verbal Reasoning: Selecting Words, Spotting Errors, Ordering of Words, Sentence Formation, Paragraph Formation, Ordering of Sentences, Reading Comprehension, Completing Statements, Verbal Analogies, Cause and Effect, Syllogism, Logical Sequence of Words, Verbal Reasoning, Analysing Arguments, Verification of Truth, Matching Definitions, Theme Detection E-Mail Etiquette, Reporting News Activity: Completing Textual Exercises			**16**
Unit 2: Career and Employability Skills			
What is a Career: Career vs Job, Career Values & Grid, Skills vs Strengths, Spotting Skills/Reflection of Present Skills, Meeting the Expectation of your Employer, Matching your Skills with the Required Skills, Preparing Resume, Preparing for Interviews & Structuring Answers Activity: Resume Building, Interviews, Presentations, Digital Resumes			**16**
Section B **Aptitude Builder**			
Unit – 3: Time and Work			
Pipes and Cisterns: Problems on Unitary method, Relation between Men, Days, Hours and Work, Problems on Man-Day-Hours Method, Problems on Alternate Days, Problems on Pipes and Cisterns. **Time , Distance and Speed, Problems on Trains, Boats and Streams:** Relation between Speed, Distance and Time, Converting km/h into m/s and vice versa , Problems on Average Speed, Problems on Relative Speed, Problems on Circular Tracks, Problems on Races **Problems on Trains:** Two Trains Moving in Opposite Direction, Two Trains Moving in same Direction, A Train Crossing a Stationary Object of a Given Length like a Platform or Bridge, A Train Crossing a Stationary Object like a Pole or a Man **Boats and Streams:** Time Based, which can be considered as a Point Object Speed Based, Distance Based, Average Speed Based			**11**
Unit – 4: Logical and Analytical Reasoning			
Seating Arrangement: Linear Arrangement, Circular Arrangement, Tabler, Triangular Arrangement, Complex Arrangement**.** **Clocks :** Finding the Angle When the Time is Given, Finding the Time When the Angle is Known, Relation between Angles, Minutes and Hours, Position of Hands of the Clock, Time Gained or Lost by the Clock, Mirror /Water Image-based Time. **Calendars :** Definition of a Leap Year, Finding the Number of Odd Days, Framing the Year Code for Centuries, Finding the Day of any Random Calendar Date **Syllogisms:** Finding the Conclusions using Venn Diagram Method, Finding the Conclusions using Syllogism Method **Simple Interest:** Definitions, Problems on Interest and Amount, Problems when Rate of Interest and Time Period are Numerically Equal **Compound Interest:** Definition and Formula for Amount in Compound Interest, Difference between Simple Interest and Compound Interest for 2 Years on the Same Principle and Time Period.			**11**
Unit – 5: Permutations, Probability, Areas and Volumes			

Definition of permutation , Problems on Permutations , Definition of Combinations , problems on Combinations **Probability:** Definition of Probability, Problems on Coins, Problems on Dice, Problems on Deck of Cards , Problems on Years **Mensuration - 2D:** Formulas for Areas, Formulas for Volumes of Different Solids, Problems on Areas **Mensuration - 3D:** Problems on Volumes, Problems on Surface Areas	**10**
Text (T) / Reference (R) Books:	
For Units 1 & 2	
T1	R.S. Agarwal, Verbal & Non-Verbal Reasoning, S. Chand & Co., Latest ed. 2003
T2	Soft Skills: Enhancing Employability: Connecting Campus with Corporate by MS Rao, IK International Publishing House
R2	How to Prepare for Verbal Ability and Reading Comprehension, Arun Sharma, Meenakshi Upadhay, Mc Graw Hill
For Units 3, 4, & 5	
T1	R S Agarwal, S Chand, 'Quantitative Aptitude'
T2	R S Agarwal, S.Chand , 'A modern approach to Logical reasoning'
R1	Quantitative Aptitude for CAT By Arun sharma
R2	GL Barrons, Mc Graw Hills, Thorpe's verbal reasoning, LSAT Materials
Course Outcomes: On completion of this course, students can	
Section A: Soft Skills	
CO 1	learn and practice effective communication skills
CO 2	develop broad career plans, evaluate the employment market, and become industry ready
Section B: Aptitude Builder	
CO 3	develop accuracy on time and distance and units related solutions
CO 4	solve the real-time problems for performing job functions easily
CO 5	solve problems related to permutations and combinations, probability, areas and volumes

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE SEMESTER – VI			
Subject Code	21ECECN6100	Internal Marks	30
Number of Lecture Hours/Week	02	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 00			

Course Objectives:

The objectives of this course is enable the students to

1. Understand the concept of Traditional knowledge and its importance
2. Know the need and importance of protecting traditional knowledge.
3. Know the various enactments related to the protection of traditional knowledge.
4. Understand the concepts of Intellectual property to protect the traditional knowledge.

Unit -1	**Hours**
Introduction to Traditional Knowledge Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge	**10**
Unit -2	
Protection Of Traditional Knowledge Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.	**10**
Unit – 3	
Legal framework and TK: A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indicators act 2003	**10**
Unit – 4	
Traditional Knowledge And Intellectual Property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.	**10**
Unit – 5	
Traditional Knowledge In Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK. 139.	**10**

Course Outcomes:

At the end of this course the student will be able to

1. Understand and elucidate the basic knowledge of traditional knowledge to develop

the physical and social changes on traditional knowledge system.

2. Describe the significance of traditional knowledge protection to communicate the traditional knowledge information
3. Recognize the role of government on traditional knowledge to measure its impact on global economy.
4. Explain the acts related to schedule tribes, traditional forest dwellers, plants protection and farmers to inculcate the legal protection information.
5. Illustrate the rules of biological diversity and geographical indicators for the protection of traditional knowledge bill.

TEXT BOOKS

1. Traditional Knowledge System in India, by Amit Jha, 2009
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.

REFERENCES

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino2

Course Structure for

B. Tech (Electronics & Communication Engineering)

IV B.Tech. VII-Semester

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECP701X	Professional Elective-III	3	0	0	3
2	21ECECP702X	Professional Elective-IV	3	0	0	3
3	21ECECP703X	Professional Elective-V	3	0	0	3
4	21ECECO704X	Open Elective – III	3	0	0	3
5	21ECXXO705X	Open Elective – IV	3	0	0	3
6	21ECXXO706X	Humanities and Social Science Elective	3	0	0	3
7	21ECECS707A	Microwave Circuits and Antenna Design using HFSS	1	0	2	2
	21ECECS707B	Deep Learning for Image Processing Applications				
	21ECECS707C	Internet of Things and its Applications				
8	21ECECR7080	Research Internship - 2 Months (Mandatory) after Third year (to be evaluated during V semester	0	0	6	3
						23
9	H/M	Honors/Minor courses (The hours distribution can be 3-0-2 or 3-1-0 also)	4	0	0	4

Professional Elective-III

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECP701A	Digital Image Processing	3	0	0	3
2	21ECECP701B	Low Power VLSI Design	3	0	0	3
3	21ECECP701C	Wireless Sensor Networks	3	0	0	3

Professional Elective-IV

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECP702A	Embedded and Real-Time Systems	3	0	0	3
2	21ECECP702B	Testing & Testability	3	0	0	3
3	21ECECP702C	Optical Communication	3	0	0	3

Professional Elective-V

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECP703A	Radar Systems	3	0	0	3
2	21ECECP703B	Internet of Things	3	0	0	3
3	21ECECP703C	Embedded System Design	3	0	0	3

Open Elective-III

Candidate should select the subject from list of subjects offered by other departments

Open Elective-IV

Candidate should select the subject from list of subjects offered by other departments

IV B.Tech. VIII-Semester

Si.No	Subject Code	Name of the subject	L	T	P	Cr
1	21ECECR8010	Project - Project work, seminar and internship in industry	0	0	24	12
Total						**12**

DIGITAL IMAGE PROCESSING (Professional Elective-III) SEMESTER VII			
Subject Code	21ECECP701A	**Internal Marks**	30
Number of Lecture Hours/Week	03	**External Marks**	70
Total Number of Hours	50	**Exam Hours**	03
Prerequisite	SS & DSP	**Credits – 3**	

Course Objectives:

This course will enable students to

1. Familiarize with basic concepts of digital image processing and image transforms.
2. Make use of filtering in spatial and frequency domains.
3. Inference the images using wavelets and to discuss various compression models.
4. Outline the color models and explain the Morphological image processing concepts on grayscale images.
5. Choose various segmentation algorithms on digital images

Unit-1	**Hours**
Introduction: The origins of Digital Image Processing, Fundamental steps in Digital Image Processing, Components of an image processing system, Image sensing and acquisition, Image sampling and quantization, Some basic relationships between pixels. **Image Transforms:** Need for image transforms, 2-D Discrete Fourier transform (DFT) and its properties, Walsh transform, Hadamard transform, Haar transform, Discrete cosine transform, PCA and SVD.	**12**
Unit-2	
Intensity Transformations and Spatial Filtering: Background, some basic intensity transformation functions, Histogram processing, Fundamentals of spatial filtering, smoothing spatial filters, Sharpening spatial filters. **Filtering in the Frequency Domain:** The basics of filtering in the frequency domain, Image smoothing using frequency domain filters, Image Sharpening using frequency domain filters, Selective filtering.	**10**
Unit-3	
Wavelets and Multiresolution Processing: Image pyramids, Sub-band coding, Multiresolution expansions, Wavelet transforms in one dimensions & two dimensions, Wavelet coding. **Image Compression:** Fundamentals, Basic compression methods: Huffman coding, Arithmetic coding, LZW coding, Run-length coding, Block transform coding, Predictive coding.	**10**
Unit-4	
Color Image Processing: Color fundamentals, Color models, Pseudo color Image Processing. **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, Basic morphological algorithms.	**8**
Unit-5	
Image segmentation: Fundamentals, Point, Line and Edge detection, Thresholding, Region-based Segmentation. **Case studies on digital image processing:** Feature Detection, Face Recognition, Image Cryptography.	**10**
Total	**50**

Course outcomes:

On completion of the course, students will be able to

1. Interpret the fundamentals of digital image processing and apply various transforms on digital images.
2. Apply filtering concepts in spatial and frequency domains
3. Analyze digital images using compression algorithms
4. Classify the color models and interpret the Morphological image processing concepts to grayscale images.
5. Apply various segmentation algorithms on digital images

Text Books:

1. R. C. Gonzalez and R. E. Woods, **"**Digital Image Processing", 3rd edition, Prentice Hall, 2008
2. Jayaraman, S. Esakkirajan, and T. Veerakumar," Digital Image Processing", Tata McGraw-Hill Education, 2011.

Reference Books:

1. Anil K.Jain, **"**Fundamentals of Digital Image Processing", Prentice Hall of India, 7th Edition, Indian Reprint, 1989
2. B.Chanda, D.Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2009

LOW POWER VLSI DESIGN

(Professional Elective-III)

SEMESTER VII

Subject Code	21ECECP701B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Digital System Design, VLSI Design	**Credits – 03**	

Course Objectives:

This course will enable students to

1. Understand the fundamentals of Low PowerVLSI Design.
2. Study low-Power Design approaches.
3. Motivate to study and analyze the Low-Voltage Low-Power Adders, Multipliers.
4. Learn the concepts of Low-Voltage Low-Power Memories.

Unit -1	**Hours**
Fundamentals of Low Power VLSI Design: Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, ShortCircuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation.	**10**
Unit -2	
Low-Power Design Approaches: Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level approach –Pipelining and Parallel Processing approaches.	**10**
Unit – 3	
Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders. **Low-Voltage Low-Power Design Techniques**: Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.	**12**
Unit – 4	
Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh- Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.	**10**
Unit – 5	
Low-Voltage Low-Power Memories: Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, FutureTrend and Development of DRAM.	**8**

Course outcomes:

Upon completion of the course, students will be able to

1. Understand Low Power Design fundamentals.
2. Apply the Low-Power design approaches for designing Low-Power Circuits.
3. Analyze the Low-Voltage Low-Power Circuits.
4. Design different adders and multipliers to satisfy low power requirements
5. Understand the functioning Low-Voltage Low-Power Memories.

TEXT BOOKS:

1. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.
2. Practical Low Power Digital VLSI Design – Gary K. Yeap, Kluwer Academic Press, 2002.
3. Digital Integrated Circuits-Design Perspective 2nd Edition by Jan M.Rabey ,Ananta Chandra sekharan and BorivojiNikolic PH

Reference Books:

1. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.
2. Essentials of VLSI Circuits and Systems - Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited, 2005 Edition.

WIRELESS SENSOR NETWORKS
(Professional Elective-III)
SEMESTER VII

Subject Code	21ECECP701C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Computer Networks	Credits – 03	

Course Objectives:
This course will enable students to
1. Understand Cellular and Ad-Hoc networks in detail
2. Acquire the knowledge of design and principles of WSNs
3. Understand various MAC protocols for sensor networks
4. Able to understand and analyse various routing techniques of WSN and Ad-Hoc networks
5. Analyze the low duty cycle and wake up concepts of sensor networks

Unit -1	**Hours**
Cellular and Ad Hoc Wireless Networks: Concepts, Applications of Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks: Medium Access Scheme-Routing-Multicasting Transport Layer Protocols-Pricing Scheme-Quality of Service Provisioning-Self Organization-Security-Addressing and Service Discovery-Energy management Scalability-Deployment Considerations,	10
Unit -2	
Ad Hoc Wireless Internet: Comparison with Adhoc wireless networks-Challenges for WSNs – Difference between sensor networks and Traditional sensor networks, Types of Applications, Enabling Technologies for Wireless Sensor Networks –Single Node Architectures, Hardware Components	10
Unit -3	
Energy Consumption of Sensor Nodes: Issues in Designing a Multicast Routing Protocol. Data Dissemination-Flooding and Gossiping-Data gathering. **Sensor Network Scenarios** –Optimization Goals and Figures of Merit – Design Principles for WSNs Gateway Concepts – Need for gateway	10
Unit – 4	
WSN to Internet Communication: Internet to WSN Communication –WSN Tunneling MAC Protocols for Sensor Networks-Location Discovery-Quality of Sensor Networks Evolving Standards-Other Issues	10
Unit – 5	
Low duty cycle and wake-up concepts: The IEEE802.15.4 MAC Protocols- Energy Efficiency – Geographic Routing Mobile Nodes Gossiping and Agent based Unicast Forwarding-Energy Efficient Unicast	10
Total	**50**

Course outcomes:
On completion of the course student will be able to
1. Understand Cellular and Adhoc networks in detail
2. Explain wireless sensor networks design and principles
3. understand various MAC protocols for sensor networks
4. Analyze various routing techniques of WSN and ad hoc networks
5. Explain Low duty cycle and wake-up concepts

Text Books:
1. Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, Wiley-Interscience, 2007

2. Taieb Znati, Kazem Sohraby, Daniel Minoli,Wireless Sensor Networks: Technology, Protocols and Applications, Wiley, 2010
Reference Books: 1. Sabrie Solomon, Sensors Handbook, McGraw Hill, 2010 2. C.Siva Ram Murthy and B.S. Manoj Ad Hoc Wireless Networks, Pearson Education India 2006

EMBEDDED AND REAL-TIME SYSTEMS

(Professional Elective-IV)

SEMESTER VII

Subject Code	21ECECP702A	Internal Marks	30
Number of Lecture Hours/Week	3	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable students to:

1. Understand the fundamentals of the Real-Time Embedded Systems.
2. Know the various state machine models of the embedded systems.
3. Learn the components of Real-Time Operating Systems.
4. Learn about the operation of various embedded operating systems
5. Understand the mechanism for loading RTOS into Embedded Hardware.

Unit -1	**Hours**
Introduction: Introduction to Embedded Systems, Classification of Embedded Systems, An Embedded Real-Time System- Definition, Examples, Applications, Embedded System Design Flow, Processors in Embedded Systems and other hardware units, Software Development Flow & Tools. **Embedded Communication Units:** Need for communication interfaces, RS232 / UART, RS422 / RS485, USB, Infrared, IEEE 1394 Firewire, Ethernet, IEEE 802.11, Blue tooth.	**10**
Unit -2	
State Machine and Concurrent Process Models Introduction, models Vs Languages, finite state machines with data path model(FSMD),using state machines, program state machine model(PSM, concurrent process model, concurrent processes, communication among processes, synchronization among processes, Implementation, data flow model.	**10**
Unit – 3	
Embedded/RTOS Concepts-I: Introduction to Embedded/RTOS, Types of Embedded/RTOS, Architecture of the Kernel, Tasks and task scheduler, interrupt service routines, Semaphores, Mutex, Mailboxes, **Embedded/RTOS Concepts-II:** Message Queues, Event Registers, Pipes-Signals. Timers-Memory Management-Priority inversion problem, real time operating system, Basic design using an RTOS, OS security issues.	**10**
Unit – 4	
Embedded/RTOS Concepts-III: Why Embedded Linux?, Embedded Linux Versus Desktop, Embedded Linux Distributions, Architecture of Embedded Linux, Linux Kernel Architecture, User Space, Linux Start-Up Sequence, GNU Cross-Platform Tool chain, -Embedded Linux Vs Real-time operating systems	**10**
Unit – 5	
Embedded/RTOS Concepts-III: Off-the shelf OS, RTOS, Handheld OS, OS software, Target image creation for windows XP embedded, Porting RTOS on a micro-controller based development board, Overview of Linux, Shell programming, System programming, Overview of RT Linux, Core RT Linux, API. RT Linux Vs Windows CE	**10**

Course outcomes:

On completion of the course student will be able to

1. Review basic operation of the Real Time Embedded Systems and various communication models.
2. Understand various Embedded System design computing models
3. Describe the concepts of Real Time Operating Systems.
4. Demonstrate the fundamentals of Embedded Linux concepts
5. Apply RTOS in Embedded & Real Time System Hardware.

Text Books:

1. Embedded/Real Time Systems- KVKK prasad, Dreamtech press-2005.
2. Embedded System Design-A Unified Hardware/Software Introduction- Frank Vahid, Tony D.Givargis, John Wiley & Sons, Inc.2002.

Reference Books:

1. Embedded Microcomputer Systems-Jonathan W.Valvano, Books/Cole, Thomson Leaarning.
2. An Embedded Software Primer- David E.Simon, pearson Ed.2005
3. Embedded Systems-By Shibu.K.V-Tata McGraw Hill Education Private Limited, 2013.

Web References:

1. https://nptel.ac.in/courses/106105086/

2. http://studentsfocus.com/ec6703-erts-notes-embedded-real-time-systems-lecture-handwritten-notes-ece-7th-sem-anna-university/

TESTING & TESTABILITY

(Professional Elective-IV)

SEMESTER VII

Subject Code	21ECECP702B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	DSD,VLSI Design	**Credits – 03**	

Course Objectives:

1. This course will enable students toTo impart knowledge on the basic faults that occur in digital systems
2. To describe fault detection techniques in combinational circuits.
3. To outline procedures to generate test patterns for detecting single stuck faults in combinational and sequential circuits.
4. To explain design for testability techniques with improved fault coverage.
5. To give exposure to approaches for introducing BIST into logic circuits

Unit -1	**Hours**
Fundamentals of Testing: Need for testing, the problems in digital Design testing, the problems in Analog Design testing, the problems in mixed analog/digital design testing, design for test. Fault in Digital Circuits: General Introduction, Controllability and Observability, Fault Models, stuck at faults, bridging faults, CMOS technology considerations, intermittent faults.	**12**
Unit -2	
Fault Modelling – General Introduction, to test pattern genration, Test Pattern generation for combinational logic circuits, Manual test pattern generation, automatic test pattern generation, boolen difference method, Roth's Dalgoritham, Developments following Roth's D-algoritham	**10**
Unit – 3	
Test Pattern Generators: Pseudorandom, Pseudo-exhaustive test pattern generators,output response Analysis. **Linear Feedback Shift registers:** LFSR,Classification of LFSR ,Design of test pattern generator using Linear feedback shift registers (LFSRs) and cellular automata(CAs).	**10**
Unit – 4	
Design for Testability for combinational circuits: Basic Concepts of testability, controllability and observability, the Reed Muller's expansion techniques, use of control logic and syndrome testable designs.	**8**
Unit – 5	
Design For Testability: Making sequential circuits testable, testability insertion, full scan DFT technique-Full scan insertion, flipflop structures, Full scan design and test, scan architectures-full scan design, shadow register DFT, partial scan methods, multiple scan design, other scan designs.	**10**

Course outcomes:

Upon completion of the course, students will be able to

1. To acquire the knowledge of fundamental concepts in fault and fault diagnosis
2. To acquire the knowledge of fault modeling
3. Lean how to generate Test pattern using LFSR and CA.
4. Design for testability rules and techniques for combinational circuits
5. Understand variousDFT scan architecture

TEXT BOOKS:

1. Fault Tolerant and Fault Testable Hardware Design-Parag K. Lala, 1984, PHI.
2. VLSI Testing digital and Mixed analogue/digital techniques-Stanley L. Hurst, IEE Circuits, Devices and Systems series 9, 1998

REFERENCE BOOKS .

1.Digital Systems Testing and Testable Design-Miron Abramovici, Melvin A. Breuer and Arthur D. Friedman, Jaico Books
2. Esstentials of Electronic Testing-Bushnell and Vishwani D.Agarwal, Springers
. 3. Design for test for Digital IC's and Embedded Core Systems-Alfred L. Crouch, 2008,

OPTICAL COMMUNICATIONS

(Professional Elective-IV**)**

SEMESTER-VII

Subject Code	21ECECP702C	Internal Marks	30
Number of Lecture Hours/Week	3	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable students to:

1. Familiarize with basic concepts and theory of optical communication.
2. Understand the signal loss with their computation and dispersion mechanism occurring in optical fiber cable.
3. Analyze the operation of LEDs, laser diodes, and PIN photo detectors (spectral properties, bandwidth, and circuits) and apply in optical systems.
4. Understand the different types of fiber connectors.
5. Understand the performance analysis of receiver to get idea about power budget and ultimately be an engineer with adequate knowledge in optical domain.

Unit -1	**Hours**
Overview of optical fiber communication - Historical development, Thegeneral system, advantages of optical fiber communications. Optical fiber waveguides- Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, cylindrical fibers- Modes,V-number, Mode coupling, Step Index fibers, Graded Index fibers, Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index, Related problems.	**11**
Unit -2	
Signal distortion in optical fibers: - Signal distortion in optical fibers- Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses, Information capacity determination, Group delay. Types of Dispersion: - Material dispersion, Wave-guide dispersion, Polarization-Mode dispersion, Intermodal dispersion, Pulse broadening inGraded index fiber, Related problems.	**10**
Unit – 3	
Optical Sources - LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Injection Laser Diodes- Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, Resonant frequencies, Reliability of LED&ILD. **Optical detectors**- Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors, Related problems.	**12**
Unit – 4	
Optical fiber Connectors-Connector types, Single mode fiber connectors, Connector return loss, Fiber Splicing- Splicing techniques, Splicing single mode fibers, Fiber alignment and joint loss- Multimode fiber joints, single mode fiber joints.	**8**

Unit – 5	
Optical system design - Point-to- point links- Component choice and considerations, Link power budget, Rise time budget with examples, Line coding in Optical links, WDM, Necessity, Principles, Measurement of Attenuation and Dispersion, Eye pattern.	**9**
Total	**50**

Course outcomes:

On completion of the course student will be able to

1 Understand basic concepts of optical fibers
2 Analyze different losses occurs in optical fibers and
3 Understand the operation of LEDs, laser diodes, and PIN photo detectors
4 Illustrate different types of optical connectors
5 Analyze optical system design.

Text Books:

1. Optical Fiber Communications – Gerd Keiser, Mc Graw-Hill International edition,3rd Edition, 2000.
2. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.

Reference Books:

1. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education,2005.
2. Text Book on Optical Fiber Communication and its Applications – S.C.Gupta, PHI, 2005.
3. Fiber Optic Communication Systems – Govind P. Agarwal, John Wiley, 3rd Edition, 2004.
4. Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education, 2004.

RADAR SYSTEMS
(Professional Elective-V**)**
SEMESTER -VII

Subject Code	21ECECP703A	Internal Marks	30
Number of Lecture Hours/Week	3	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable students to:
ain knowledge about RADAR theory and equations.
derstand the CW and FM radar and its applications.
ain knowledge on MTI pulse Doppler radar.
analyze the Tracking RADAR.
quire information about RADAR transmitters and receivers

Unit -1	**Hours**
Basics of Radar: Introduction, Maximum Unambiguous Range, simple Radar range Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications. Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Illustrative Problems.	**8**
Unit -2	
Radar Equation: Modified Radar Range Equation, SNR, probability of detection, probability of False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Creeping Wave, Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems. **CW and Frequency Modulated Radar:** Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Applications of CW radar.	**12**
Unit – 3	
FM-CW Radar: Range and Doppler Measurement, Block Diagram and Characteristics, FM-CW altimeter. **MTI Radar:** Introduction, Principle, MTI Radar with- Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Nth Cancellation Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance.	**10**
Unit – 4	
Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar – Amplitude Comparison Mono pulse (one- and two- coordinates), Phase Comparison Mono pulse, Tracking in Range, Acquisition and Scanning Patterns.	**10**
Unit – 5	
Radar Receivers: Noise figure, Noise figure of networks in cascade, Noise temperature, Noise figure due to RF losses, Mixers-Balanced mixer, Image recovery mixer, Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers, Receiver protectors.	**10**

Course outcomes:

On completion of the course student will be able to

1. Explain RADAR theory & related equations.
2. Demonstrate the working principles of CW, FMCW RADAR's.
3. Demonstrate the working principles of MTI RADAR.
4. Describe mechanism of Tracking RADAR's.
5. Acquire information about RADAR receivers and associated components.

Text Books:

1. Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2nd Ed., 2007.

Reference Books:

1. Radar: Principles, Technology, Applications – Byron Edde, Pearson Education, 2004.
2. Radar Principles – Peebles, Jr., P.Z., Wiley, New York, 1998.
3. Principles of Modern Radar: Basic Principles – Mark A. Richards, James A. Scheer, William A. Holm.
4. Radar Engineering – GSN Raju, IK International.

INTERNET OF THINGS
(Professional Elective-V)
SEMESTER VII

Subject Code	21ECECP703B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objective This course will enable students to:

1. To study fundamental concepts of IoT
2. To understand roles of sensors in IoT
3. To Learn different protocols used for IoT design
4. To be familiar with data handling and analytics tools in IoT
5. Understand the role of IoT in various domains of Industry.

Unit -1:	
Fundamentals of IoT: Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M.	**Hours –10**
Unit-2:	
Sensors Networks : Definition, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.	**Hours –10**
Unit-3:	
Wireless Technologies for IoT: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus. **Internet protocols for IoT:** IP Based Protocols for IoT IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT. Edge connectivity and protocols.	**Hours – 10**
Unit – 4:	
Data Handling& Analytics: Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications	**Hours – 10**
Unit – 5	
Applications of IoT: Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.	**Hours – 10**

Course outcomes:
On completion of the course student will be able to

1. Understand the various concepts, terminologies and architecture of IoT systems.
2. Use sensors and actuators for design of IoT.
3. Understand and apply various protocols for design of IoT systems
4. Use various techniques of data storage and analytics in IoT
5. Understand various applications of IoT.

Text Books:

1. Hakima Chaouchi, ― "The Internet of Things Connecting Objects to the Web" ISBN :978-1- 84821-140-7, Wiley Publications
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, ― "The Internet of Things:Key Applications and Protocols", WileyPublications
3. Vijay Madisetti and ArshdeepBahga, ― "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.

Reference Books:

1. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media,2016.
2. Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.
3. Daniel Minoli, ― "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
4. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

Web References:

4. https://onlinecourses.nptel.ac.in/noc17_cs22/course
5. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

EMBEDDED SYSTEM DESIGN
(Professional Elective –V)
SEMESTER-VII

Subject Code	21ECECP703C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable the students to:
1. Understand the fundamentals of the embedded systems.
2. Know the hardware details of the embedded systems.
3. Learn concept of firmware design approaches, Interrupt concept.
4. Learn about the various embedded software development tools.
5. Understand the embedded system design life cycle and co-design issues

Unit -1	**Hours**
Introduction: Embedded System-Definition, History, Classification, application areas and purpose of embedded systems, Embedded Systems Vs General Computing Systems, Characteristics, Quality attributes of an Embedded systems, Application-specific and Domain-Specific examples of an embedded system.	**10**
Unit -2	
Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces, Wireless communication devices, Watchdog timer, Real time clock.	**10**
Unit – 3	
Embedded Firmware Design-1: Embedded Firmware design approaches, Embedded Firmware development languages, Programming in Embedded C, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, **Embedded Firmware Design-2:** Embedded DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.	**10**
Unit – 4	
Embedded System Development: The integrated development environment, Types of files generated on cross-compilation, Dissembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools. Embedded System Implementation and Testing tools.	**10**
Unit – 5	
Hardware Software Co-Design: Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware-software Trade-offs, Integration of Hardware and Firmware. **Case studies**: digital camera, Automatic Coffee Vending Machine.	**10**
Total	**50**

Course outcomes:
At the end of the course, students will be able to:
1. Understand the fundamentals of the embedded systems.
2. Know the hardware details of the embedded systems.
3. mLearn concept of firmware design approaches, Interrupt concept.
4. Learn about the various embedded software development tools.
5. Understand the embedded system design life cycle and co-design issues

Text Books:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill

2. Embedded Systems, Raj Kamal-Tata McGraw Hill Education Private Limited, Second Edition, 2008

Reference Books:

1. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2005
2. David Simon, " An Embedded Software Primer" Addison Wesley, 2000
3. Embedded Systems – Lyla, Pearson, 2013

MICROWAVE CIRCUITS AND ANTENNA DESIGN USING HFSS
(Skill Oriented Course)
SEMESTER VII

Subject Code	21ECECS707A	Internal Marks	---
Number of Lecture Hours/Week	03	External Marks	50
Total Number of Hours	36	Exam Hours	03

Credits – 2

Course Objectives:
This course will enable students to

1. Design and simulate microstrip transmission lines and Rectangular Waveguide
2. Design and simulate power dividers and Magic Tee junction
3. Design and simulate wire antennas to understand the various antenna parameters
4. Design and simulate microstrip patch antennas using different feeding techniques
5. Design and simulate dual-band patch antenna and wideband/multiband monopole planar antennas

List of Modules	**Hours**
Module-1: Design and analyze different types of transmission lines such as coaxial cable, waveguides, and microstrip transmission lines. **Module-2:** Design and analyze different types of passive microwave components **Module-3:** Design and analyze return loss and radiation characteristics of wire antennas such as 1. Dipole antenna 2. Monopole antenna **Module-4:** Design and analyze return loss and radiation characteristics of aperture antenna such as pyramidal horn. **Module-5:** Design and analyze return loss and radiation characteristics of microstrip antennas for the given specifications (operating frequency, dielectric constant, and substrate thickness) a) Rectangular microstrip antenna using line feeding and coaxial feeding b) Circular microstrip antenna using line feeding **Module-6:** Design and analyze return loss and radiation characteristics of multifunctional planar antennas	36

a) Dual band antenna using CPW feeding b) Frequency reconfigurable antenna using microstrip line feeding	

Course outcomes:

On completion of the course student will be able to

1. Analyze various microstrip transmission lines and microwave components
2. Design and analyse characteristics of half-wave and quarter-wave wire antennas.
3. Design and analyze characteristics of microstrip patch antennas using different feeding techniques
4. Design and analyze characteristics of dual-band microstrip antennas
5. Design and analyze characteristics of frequency reconfigurable antennas

Text Books

1. Samuel Y. Liao, Microwave Devices and Circuits, Pearson, 1990
2. C.A. Balanis, Antenna Theory and Design, , Wiley,4nd Edition, 2016.
3. K.D. Prasad, Antennas and Wave Propagation, Satya Prakashan,2009

REFERENCE BOOKS

1. E.C. Jordan and K.G. Balmain, Electromagnetic Waves and Radiating Systems, Pearson Education, 2015
2. John D. Kraus and Ronald J. Marhefka, Antennas for all Applications, Tata McGraw Hill Publishing, 2006

Weblinks:

1. https://courses.ansys.com/index.php/courses/intro-to-ansys-hfss/
2. **https://ece.iiita.ac.in/video/AWP-HFSS%20Introduction%20Manual-2.pdf**

Deep Learning for Image Processing Applications

(Skill Oriented Course)
SEMESTER VII

Subject Code	21ECECS707B	Internal Marks	---
Number of Lecture Hours/Week	03	External Marks	50
Total Number of Hours	36	Exam Hours	03

Credits – 02

Course Objectives

This course will enable students to

1. Understand the role of Deep Learning for Image Processing.
2. Learn the programming prerequisites related to Deep Learning.
3. Construct the Deep Learning architectures.
4. Survey the Deep Learning architectures.
5. Implement DL for various Image processing applications.

List of Modules	Hours
Module-1: Introduction to Deep Learning ➢ Role of Deep Learning (DL) ➢ AI vs ML vs DL ➢ Concept of Deep Learning	**36**
Module-2: Python Libraries for Deep Learning ➢ Google Colab Notebook for Coding ➢ Practice basic python commands ➢ Popular Python libraries for Deep Learning	
Module-3: Deep Learning Architectures ➢ Neural Networks for Image Processing ➢ Artificial Neural Networks (ANN) ➢ Convolutional Neural Networks (CNN)	
Module-4: Architectural Principles of CNNs ➢ Activation Functions ➢ Loss Functions ➢ Hyper Parameters ➢ Data Augmentation	
Module-5: Deep Learning Projects using CNN ➢ Transfer learning ➢ Cats Vs Dogs Image Classification ➢ Recognizing CIFAR-10 Images ➢ Classify Fashion MNIST Dataset Images	

Course outcomes:

On completion of the course, student will be able to

1. Illustrate the concept of Deep Learning for Image Processing.
2. Demonstrate the programming prerequisites related to Deep Learning.
3. Construct the Deep Learning architectures.
4. Analyze the Deep Learning architectures.
5. Build Image processing applications using DL architectures.

Text Books:

1. Antonio Gulli, Amita Kapoor, Sujit Pal, "Deep Learning with TensorFlow-2 and Keras", Second Edition, Packt Publishing, 2019.
2. Josh Patterson and Adam Gibson, "Deep Learning: A Practitioner's Approach", First Edition, O'Reilly Publishers, 2017.

INTERNET OF THINGS AND ITS APPLICATIONS
(Skill Oriented Course)
SEMESTER VII

Subject Code	21ECECS707C	Internal Marks	---
Number of Lecture Hours/Week	03	External Marks	50
Total Number of Hours	36	Exam Hours	03

Credits – 2

Course Objectives:

This course will enable students to

1. Understand the concepts of Arduino Uno, Raspberry Pi Board and different types of I/O Devices.
2. To develop Embedded C language program skills.
3. To develop Python language program skills.
4. Providing the basic knowledge of interfacing various peripherals to Raspberry Pi
5. To Develop Real Time Small Scale Embedded Applications using advanced IoT technologies.

List of Experiments:	**Hours**
Part-A (Perform all Experiments)	
1. Introduction and history of Arduino, types of Arduino boards, Install the Arduino Desktop IDE, Installing Libraries, functions and components of Arduino programming. 2. Introduction to Raspberry Pi Board, identification of components and software required, download and installation procedures of necessary software images in the memory card and booting of Raspberry Pi board.	**36**
Part-B (Perform any 6 Experiments)	
3. Write an Embedded C Program to control speed and direction of a stepper motor with Arduino Uno 4. Write an Embedded C Program to control speed and direction of a DC motor with Arduino Uno. 5. Write an Embedded C Program to implement real time clock using OLED and RTC modules with Arduino Uno. 6. Write a Python program to interface LED, Switch and buzzer with Raspbery Pi Board. 7. Write a Phyton code to interface camera with Raspberry Pi board 8. Write a Python code to read Light Sensor(TEMT6000) sensor data and display the data in screen 9. Write a Python code to read DHT11/22 sensor data and display the data in screen 10. Write a Phyton code to read soil moisture and temperature(DS18b20) sensors data with raspberry Pi board and display in TFT screen.	
Part- C (Perform any two experiments)	

11. Design a data logger using DHT11/22 sensors with Arduino and ESP8266 boards and thingspeak cloud. 12. Design a read and write operations from thing speak cloud of a temperature dependent auto-cooling system using DS18B20 sensor with Arduino, esp8266 WiFi module. 13. Design a Weather Monitoring System based on Raspberry Pi and Think Speak cloud. 14. Design remote patient monitoring system based on Raspberry Pi and think speak cloud.	

Course outcomes:

On completion of the course student will be able to

1. Understand the concepts of Arduino Uno and different types of I/O Devices.
2. Develop Embedded C programs for different applications using Arduino Uno
3. Construct interfacing circuits for different Applications using Raspberry Pi
4. Develop Python codes for different applications using Raspberry Pi
5. Develop Real time Embedded System applications using IoT

REFERENCE BOOKS

1. Mike Cook, For Dummies, Raspberry Pi Projects for Dummies", 1st edition (2 October 2015), ISBN-10: 1118766695, ISBN-13: 978-1118766699
2. "Arduino Book for Beginners" Mike Cheich, Open Hardware Design Group LLC (1 July 2021), ISBN-10: 0988780615, ISBN-13: 978-0988780613
3. Simon Monk, "PROGRAMMING ARDUINO Getting started with sketches", McGraw Hill TAB; 2nd edition (16 July 2016), ISBN-10: 1259641635, ISBN-13: 978-1259641633
4. Neerparaj Rai, "Arduino Projects for Engineers", BPB Publications; First edition (15 July 2016), ISBN-10: 8183335977, ISBN-13: 978-8183335973

Open Elective Courses offered by ECE to other departments

Open Elective-I (Semester-V)

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21XXECOX0XA	Fundamentals of Integrated Circuits	3	0	0	3
2	21XXECOX0XB	Fundamentals of Microprocessors and Microcontrollers	3	0	0	3
3	21XXECOX0XC	Fundamentals of Digital Signal Processing	3	0	0	3

Open Elective-II (Semester-VI)

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21XXECO605A	Fundamentals of Digital Image Processing	3	0	0	3
2	21XXECO605B	Transducers and Sensors	3	0	0	3
3	21XXECO605C	Embedded Systems	3	0	0	3

Open Elective-III (Semester-VII)

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21XXECO704A	Fundamentals of Internet of Things	3	0	0	3
2	21XXECO704B	Introduction to Cellular and Mobile Communications	3	0	0	3
3	21XXECO704C	Consumer Electronics	3	0	0	3

Open Elective-IV (Semester-VII)

S.No	Subject Code	Name of the subject	L	T	P	Cr
1	21XXECO705A	Embedded and Real-Time Concepts	3	0	0	3
2	21XXECO705B	Low Power VLSI	3	0	0	3
3	21XXECO705C	Wireless Sensor Networks	3	0	0	3

FUNDAMENTALS OF INTEGRATED CIRCUITS (Open Elective-I)			
Subject Code	21XXECO50XA	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable students to

1. To learn about various fabrication steps of IC and electrical properties of MOSFET.
2. To learn about Op-amp and Timer ICs.
3. To study the behavior of various digital logic families.
4. To learn concept of programmable logic devise and memories.
5. To understand digital-to-analog and analog-to-digital converters.

Unit -1	**Hours**
Introduction to ICs: IC technology, MOS transistor fabrication process, I_{ds} versus V_{ds} relationship, Aspects of MOS transistor Threshold Voltage, MOS transistor Trans, Output Conductance and Figure of Merit, CMOS Inverter, nMOS Inverter, Alternative forms of pull-up.	10
Unit -2	
Op-amp and Timer ICs: Integrated Circuits Types, Classification, Package Types and Temperature Ranges, Power Supplies, Op-amp Block Diagram, Ideal and Practical Op-amp Specifications, DC and AC Characteristics, 741 Op-amp & its Features, Op-Amp Parameters and Measurement, IC 555 Timer Functional Diagram, Monostable and Astable Operations and Applications, Schmitt Trigger.	10
Unit -3	
Digital Logic Families: Introduction to logic families, CMOS logic, CMOS steady state and dynamic electrical behavior, CMOS logic families. Bipolar logic, transistor-transistor logic, TTL families, CMOS/TTL interfacing, Emitter coupled logic.	10
Unit – 4	
Programmable Logic Devices & Memories: Programmable Read Only Memory, Programmable Logic Array, Programmable Array Logic Devices, ROM: Internal structure, 2D-Decoding, Commercial ROM types, timing and applications,. Static RAM: Internal structure, SRAM timing, standard, synchronous SRAMS, Dynamic RAM: Internal structure, timing, synchronous DRAMs.	10
Unit – 5	
Digital-to-Analog and Analog-to-Digital Converters: Basic DAC Techniques, Weighted Resistor DAC, R-2R Ladder DAC, Inverted R-2R DAC, IC1408 DAC, Parallel Comparator type ADC, Counter type ADC, Successive Approximation and Dual Slope ADC, DAC and ADC Specifications.	10
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Explain the fabrication steps of IC and electrical properties of MOSFET.
2. Understand the specifications of Op-amp and Timer ICs.
3. Analyze the behavior of various digital logic families.
4. Understand the concepts of programmable logic devices and memories.
5. Construct digital-to-analog and analog-to-digital converters.

Text Books:

5. Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Essentials of VLSI Circuits and Systems, Prentice-Hall of India Private Limited,2005 Edition.
6. Linear Integrated Circuits by D. Roy Choudhury, New Age International (p) Ltd, 4th Edition, 2015.
7. Digital Design Principles & Practices – John F.Wakerly, PHI/ Pearson Education Asia, 3rd Edition, 2005.

Reference Books:

1. Designing with TTL Integrated Circuits: Robert L. / John R. Morris & Miller.
2. Op-Amps and Linear ICs by Ramakanth A. Gayakwad, PHI, 1987.
3. Operational Amplifiers and Linear ICs by David A Bell, Oxford Uni. Press, 3rd Edition.

FUNDAMENTALS OF MICROPROCESSORS AND MICROCONTROLLERS (Open Elective-I)			
Subject Code	21XXECO50XB	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Credits – 03			

Course Objectives:

This course will enable students to

1. To Learn the architecture of microprocessor and microcontroller.
2. To know the programming of 8086
3. To understand the interfacing of the processors
4. To know Memory System and I/O Organization and its applications.
5. To develop Microcontroller programming for various applications

Unit -1	**Hours**
8085 Processor: Hardware Architecture, pinouts — Functional Building Blocks of Processor — Memory organization — I/O ports and data transfer concepts, Interrupts. **8086 Processor**: Main features, pin diagram/description, 8086 microprocessor family, internal architecture, interrupts and interrupt response, 8086 system timing, minimum mode and maximum mode configuration.	10
Unit -2	
8086 Programming: Program development steps, instructions, addressing modes, assembler directives, writing simple programs with an assembler, assembly language program development tools.	10
Unit -3	
8086 Interfacing: Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, interfacing switches and LEDS, interfacing seven segment displays. Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, stepper motor, A/D and D/A converters.	10
Unit – 4	
8051 Microcontroller: Hardware Architecture, pinouts — Functional Building Blocks of Processor — Memory organization — I/O ports and data transfer concepts– Timing Diagram — Interrupts- Data Transfer, Manipulation, Control Algorithms & I/O instructions.	10
Unit – 5	
Microcontroller Programming & Applications: Simple programming exercises- key board and display interface – Control of servo motor and stepper motor.	10
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Understand the architecture of microprocessor and their operation.
2. Demonstrate programming skills in assembly language for processors and controllers.
3. Analyze various interfacing techniques and apply them for the design of processor/Controller based systems.
4. Understand 8051 architecture.
5. Analyze Microcontroller programming & applications

Text Books:

1. R.S. Gaonkar, Microprocessor Architecture Programming and Application, with 8085, Wiley Eastern Ltd., New Delhi, 2013.
2. A.K Ray, K.M. Bhurchandhi," Advanced Microprocessor and Peripherals", Tata McGraw Hill Publications, 2000.
3. The 8051 Microcontrollers and Embedded systems Using Assembly and C, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D.McKinlay; Pearson 2-Edition, 2011

Reference Books:

1. Douglas V Hall, SSSP Rao, Microprocessors and Interfacing – Programming and Hardware, Tata Mc Graw Hill Education Private Limited,3rdEdition,1994

FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING

(Open Elective-I)

Subject Code	21XXECO50XC	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable students to

1. Analyze the Discrete Time Signals and compute different FFT algorithms.
2. Learn the FIR and IIR filter design procedures.
3. Understand the basics of DSP Processors and architectures.

Unit -1	**Hours**
Introduction: Introduction to Digital Signal Processing: Discrete time signals & sequences, Classification of Discrete time systems, stability of LTI systems, Invertability, Response of LTI systems to arbitrary inputs. Solution of Linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems. Review of Z-transforms, solution of difference equations using Z-transforms, System function.	10
Unit -2	
Discrete Fourier Series & Fourier Transforms: DFS representation of periodic sequences, Discrete Fourier transforms: Properties of DFT, linear filtering methods based on DFT, Fast Fourier transforms (FFT) - Radix-2 decimation in time and decimation in frequency FFT Algorithms, Inverse FFT.	10
Unit -3	
Design of IIR Digital Filters& Realizations: Analog filter approximations – Butter worth and Chebyshev filter. Design of IIR Digital filters from analog filters, Design Examples, Analog and Digital frequency transformations. Basic structures of IIR systems.	10
Unit – 4	
Design of FIR Digital Filters & Realizations: Characteristics of FIR Digital Filters, frequency response. Design of FIR Digital Filters using Window Techniques and Frequency Sampling technique, Comparison of IIR & FIR filters, Basic structures of FIR systems.	10
Unit – 5	
DSP Processors: Introduction to programmable DSPs: Multiplier and Multiplier Accumulator, Modified bus structures and memory access schemes in P-DSPs, Multiple Access Memory, Multipored memory, VLIW architecture, Pipelining, Special addressing modes, On-Chip Peripherals.	10
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Apply the difference equations concept for analyzing the Discrete Time Systems
2. Explain the FFT algorithm for solving the DFT of a given signal
3. Design and analyze a Digital IIR filter for the given specifications
4. Design and analyze a Digital FIR filter for the given specifications
5. Understand the programmable DSPs and their architectures.

Text Books:

1. John G. Proakis, Dimitris G.Manolakis, “Digital Signal Processing, Principles, Algorithms, and Applications”,Pearson Education / PHI, 2007.
2. A.V.Oppenheim and R.W. Schaffer, “Discrete Time Signal Processing”, PHI
3. B.Venkataramani, M.Bhaskar, “ Digital Signal Processors, Architecture, Programming and Applications”, TATA McGraw Hill, 2002

FUNDAMENTALS OF DIGITAL IMAGE PROCESSING

(Open Elective-II)

SEMESTER VI

Subject Code	21XXECO605A	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Engineering Mathematics, and Signals & Systems	Credits – 03	

Course Objectives:

This course will enable students to

6. Learn the fundamental concepts of digital image processing
7. Expertise about image enhancement methods in time and frequency domains
8. Understand various 2D-image transformation, restoration and segmentation techniques
9. Interpret various image compression techniques and morphological operations

Unit -1	**Hours**
Introduction: Fundamental steps in digital image processing, Elements of visual perception, Image sensing and acquisition, Simple image formation, Image sampling and Quantization, Representing digital pixels, Image quality, Introduction to color image – RGB and HSI Models	10
Unit -2	
Image Enhancement in Spatial Domain: Introduction to image enhancement, Basic grey level transforms, Histogram, Histogram-processing equalization, Matching & color histogram, Enhancement using arithmetic/logic operations, Spatial filtering, Smoothing spatial filtering, and Sharpening spatial filtering.	10
Unit -3	
Image Transforms: 2-D FFT, Properties, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform, Slant Transform and Hotelling Transform. **Image Enhancement in Frequency Domain:** Low Pass (Smoothing) frequency domain filtering, and High pass (Sharpening) filters in frequency domain.	10
Unit – 4	
Image Restoration & Segmentation: Image degradation model, Algebraic approach to restoration, Inverse filtering, Least mean square filters, and Constrained least squares restoration. Segmentation and thresholding algorithms, Edge linking and boundary detection, and Region oriented segmentation.	10
Unit – 5	
Image Compression & Morphological Operations: Need for image compression, Huffman, Run-length encoding, shift codes, Transform coding, JPEG standard. Morphological-dilation and erosion, Opening and closing, the Hit-or-miss transformation and Grey –scale morphology.	10
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Demonstrate the fundamentals of digital image processing
2. Analyze various image enhancement methods in time domains.
3. Apply different transformation techniques to 2D-image and also able to enhance image frequency domain.
4. Perform image restoration and segmentation operations/techniques on images
5. Develop simple algorithms/techniques for image compression and its morphology

Text Books:

1. Digital Image Processing – Rafael C. Gonzalez, Richard E. Woods, 3rd Edition, Pearson, 2008.
2. Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar- TMH, 2010.

Reference Books:

1. Digital Image Processing and Analysis-Human and Computer Vision Application with using CVIP Tools – Scotte Umbaugh, 2nd Ed, CRC Press, 2011

2. Digital Image Processing using MATLAB – Rafael C. Gonzalez, Richard E Woods and Steven L. Eddings, 2nd Edition, TMH, 2010.

3. Digital Image Processing and Computer Vision – Somka, Hlavac, Boyle- Cengage Learning (Indian edition) 2008.

4. Introductory Computer Vision Imaging Techniques and Solutions- Adrian low, 2nd Edition, BS

5. Fundamentals of Digital Image Processing- Anil K.Jain, Prentice Hall of India, 9th Edition, Indian Reprint, 2002.

TRANSDUCERS AND SENSORS
(Open Elective-II)

SEMESTER-VI

Subject Code	21XXECO605B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable students to

1. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
2. Predict correctly the expected performance of various sensors
3. Locate different type of sensors used in real life applications and paraphrase their importance
4. Understand and analyze the characteristics of temperature sensors
5. Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers

Unit -1	**Hours**
Introduction: Functional elements of an instrument, generalized performance characteristics of instruments – static characteristics, dynamic characteristics. Zero order, first order, second order instruments – step response, ramp response and impulse response. Response of general form of instruments to periodic input and to transient input.	10
Unit -2	
Transducers for motion and dimensional measurements: Relative displacement, translation and rotational resistive potentiometers, resistance strain gauges, LVDT, synchros, capacitance pickups, Piezo-electric transducers, electro-optical devices, nozzle – flapper transducers, digital displacement transducers, ultrasonic transducers.	10
Unit -3	
TRANSDUCERS FOR FORCE MEASUREMENT: Bonded strain guage transducers, Photo-electric transducers, variable reluctance pickup, torque measurement dynamometers. **TRANSDUCERS FOR PRESSURE MEASUREMENT:** Manometers, elastic transducers, liquid systems, gas systems, very high pressure transducers. Thermal conductivity gauges, ionization gauges, microphone	12
Unit – 4	
TRANSDUCERS FOR TEMPERATURE MEASUREMENT: Thermal expansion methods, Thermometers (liquid in glass), pressure thermometers, Thermocouples, Materials configuration and techniques. Resistance thermometers, Thermistors, junction semiconductors, Sensors, Radiation methods, Optical pyrometers, Dynamic response of temperature sensors heat flux Sensors.	10
Unit – 5	
SMART SENSORS: Introduction, primary sensors, converters, compensation. Recent trends in sensor technology – film sensors, semiconductor IC technology, MEMS, Nano-sensors	8
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Use concepts in common methods for converting a physical parameter into an electrical quantity

2. Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light

3. Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
4. Predict correctly the expected performance of various sensors knowledge outside the classroom through design of a real-life instrumentation system
5. Locate different type of sensors used in real life applications and paraphrase their importance

Text Books:

1. Sensors and Transducers Hardcover – Import, 5 December 2000by Ian Sinclai , newness publication.
2. Sensors and Transducers , Author, Department of Cybernetics, University of Reading, UK , M. J. Usher, 1985, Springer

Reference Books:

1. Doebelin, E.O., "Measurement systems – Application and Design", McGraw Hill.
2. D. Patranabis, "Sensors and Transducers", PHI, 2nd Edition.

EMBEDDED SYSTEMS
(Open Elective-II)

SEMESTER-VI

Subject Code	21XXECO605C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable the students to:
1. Understand the fundamentals of the embedded systems.
2. Know the hardware details of the embedded systems.
3. Learn concept of firmware design approaches, Interrupt concept.
4. Learn about the various embedded software development tools.
5. Understand the embedded system design life cycle and co-design issues

Unit -1	**Hours**
Introduction: Embedded System-Definition, History, Classification, application areas and purpose of embedded systems, Embedded Systems Vs General Computing Systems, Characteristics, Quality attributes of an Embedded systems, Application-specific and Domain-Specific examples of an embedded system.	**10**
Unit -2	
Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces, Wireless communication devices, Watchdog timer, Real time clock.	**10**
Unit – 3	
Embedded Firmware Design-I: Embedded Firmware design approaches, Embedded Firmware development languages, Programming in Embedded C, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, **Embedded Firmware Design-II:** DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.	**10**
Unit – 4	
Embedded System Development: The integrated development environment, Types of files generated on cross-compilation, Dissembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools. Embedded System Implementation And Testing tools.	**10**
Unit – 5	
Hardware Software Co-Design: Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware. **Case studies**: digital camera, Automatic Coffee Vending Machine.	**10**
Total	**50**

Course outcomes:
At the end of the course, students will be able to:
1. Understand the fundamentals of the embedded systems.
2. Know the hardware details of the embedded systems.
3. Learn concept of firmware design approaches, Interrupt concept.
4. Learn about the various embedded software development tools.
5. Understand the embedded system design life cycle and co-design issues

Text Books:

1. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill
2. Embedded Systems, Raj Kamal-Tata McGraw Hill Education Private Limited, Second Edition, 2008

Reference Books:

1. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2005
2. David Simon, " An Embedded Software Primer" Addison Wesley, 2000
3. Embedded Systems – Lyla, Pearson, 2013

FUNDAMENTALS OF INTERNET OF THINGS

(Open Elective-III)

SEMESTER-VII

Subject Code	21XXECO704A	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objective This course will enable students to:

1. To understand the fundamentals of Embedded Systems.
2. To study fundamental concepts of IoT
3. To understand roles of sensors in IoT
4. To Learn role of sensors and protocols used for IoT design
5. To be familiar with data handling techniques and applications of IoT

Unit -1:	**Hours**
Introduction: Introduction to Embedded Systems, Classification of Embedded Systems, An Embedded Real Time System- Definition, Examples, Applications, Embedded System Design Flow, Processors in Embedded Systems and other hardware units, Software Development Flow & Tools.	**10**
Unit-2:	
Fundamentals of IoT: Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M.	**10**
Unit-3:	
Sensors Networks : Definition, Types of Sensors, Types of Actuators, Examples and Working, IoT Development Boards: Arduino IDE and Board Types, RaspberriPi Development Kit. **Wireless Technologies for IoT**: WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, etc. IP Based Protocols for IoT IPv6, 6LowPAN, MQTT.	**10**
Unit – 4:	
Data Handling& Analytics: Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Local Analytics, Cloud analytics and applications	**10**
Unit – 5	
Applications of IoT: Home Automation, Smart Cities, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, Legal challenges, IoT design Ethics, IoT in Environmental Protection.	**10**

Course outcomes:

On completion of the course student will be able to

1. Review basic operation of the Embedded Systems

2. Understand the concepts, terminologies and architecture of IoT systems.
3. Use sensors and actuators for design of IoT.
4. Understand and apply various protocols for design of IoT systems
5. Use various techniques of data handling and applications of IoT

Text Books:

1. Embedded/Real Time Systems- KVKK prasad, Dreamtech press-2005.
2. Hakima Chaouchi, ― "The Internet of Things Connecting Objects to the Web" ISBN :978-1- 84821-140-7, Wiley Publications
3. Olivier Hersent, David Boswarthick, and Omar Elloumi, ― "The Internet of Things:Key Applications and Protocols", WileyPublications

Reference Books:

1. Vijay Madisetti and ArshdeepBahga, ― "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.
2. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media,2016.
3. Keysight Technologies, "The Internet of Things: Enabling Technologies and Solutions for Design and Test", Application Note, 2016.
4. Daniel Minoli, ― "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
5. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

Web References:

1. https://onlinecourses.nptel.ac.in/noc17_cs22/course
2. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

INTRODUCTION TO CELLULAR AND MOBILE COMMUNICATIONS

(Open Elective-III)

SEMESTER-VII

Subject Code	21XXECO704B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable students to

1. Design and analyze Basic Cellular System
2. Know of frequency reuse and Co-channel Interference, Non co-channel Interference
3. Know the concepts Cell coverage for signal and Antennas
4. Apply the different methods of Channel Assignment and Handoff mechanisms
5. Explore the implementing of these wireless technologies in cellular and mobile communications

Unit -1	**Hours**
Cellular Mobile Radio Systems: Introduction to Cellular Mobile System, uniqueness of mobile radio environment, operation of cellular systems, consideration of the components of Cellular system, Hexagonal shaped cells, Analog and Digital Cellular systems.	10
Unit -2	
Cellular Concepts: Evolution of Cellular systems, Concept of frequency reuse, frequency reuse ratio, Number of channels in a cellular system, Cellular traffic: trunking and blocking, Grade of Service; Cellular structures: macro, micro, pico and fetor cells; Cell splitting, Cell sectoring.	10
Unit -3	
Cell Coverage for Signal and Traffic: signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long-distance propagation, antenna height gain, form of a point-to-point model. **Cell Site and Mobile Antennas**: Sum and difference patterns and their synthesis, Omni directional antennas, directional antennas for interference reduction, space diversity antennas, umbrella pattern antennas, minimum separation of cell site antennas, high gain antennas.	12
Unit – 4	
Handoff Strategies: Concept of Handoff, types of hand-off, handoff initiation, delaying handoff, forced handoff, mobile assigned handoff, intersystem handoff, vehicle locating methods, dropped call rates and their evaluation.	10
Unit – 5	
Digital Cellular Networks: GSM- Architecture, Channels, Multiple-access scheme, Radio resource management, Mobility management, Communication management, Network management, Architecture, CDMA.	8
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Understand the operation of cellular systems
2. Knowledge the concepts of cellular communication
3. Recognize the cell coverage for signal and traffic
4. Apply the different methods of Handoff mechanisms
5. Implement wireless technologies in cellular and mobile communications

Text Books:

1. William C. Y. Lee (2006), Mobile Cellular Telecommunications, 2nd edition, Tata McGraw Hill, India.
2. Theodore S. Rappaport (2002), Wireless Communications, 2nd edition, Pearson education, India.

Reference Books:

1. Gordon L. Stuber (2007), Principles of Mobile Communication, 2nd edition, Springer International, India.
2. William C. Y. Lee (2006), Wireless and Cellular Telecommunications, 3rdedition, McGraw Hill, New Delhi.

CONSUMER ELECTRONICS
(Open Elective-III)

SEMESTER VII

Subject Code	21XXECO704C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:

This course will enable students to:

6. Learn the basic concepts of microphones and loud speakers.
7. Know various digital and analog audio signal processes.
8. Understand the basis of television and composite video signal and various kinds of colour TV standards and system.
9. Understand the difference between different types of digital TV system.
10. Know various types of consumer goods.

Unit -1	**Hours**
Audio Systems: Microphones and Loudspeakers: Carbon, moving coil, cordless microphone, Direct radiating and horn loudspeaker, Multi-speaker system, Hi-Fi stereo and dolby system. Concept to fidelity, Noise and different types of distortion in audio system.	10
Unit -2	
Digital Audio Fundamentals: Audio as Data and Signal, Digital Audio Processes Outlined, Time Compression and Expansion.	08
Unit -3	
Television: Basics of Television: Elements of TV communication system, Scanning and its need Need of synchronizing and blanking pulses, VSB, Composite Video Signal. **Colour Television:** Primary, secondary colours, Concept of Mixing, Colour Triangle, Camera tube, PAL TV Receiver, NTSC, PAL, SECAM.	12
Unit – 4	
Digital Transmission and Reception: Digital satellite television, Direct-To-Home (DTH) satellite television, Introduction to: CCTV, High Definition (HD)-TV. Introduction to Liquid Crystal and LED Screen Televisions Basic block diagram of LCD and LED Television and their comparison.	12
Unit – 5	
Consumer Goods: Introduction to different type of domestic/commercial appliances: Operation of Micro-wave oven, Food Processors, Digital Electronic Lock, Vacuum cleaner, Xerox Machine, Scanner.	08
Total	**50**

Course outcomes:

On completion of the course student will be able to:

6. Understand the various types of microphones and loud speakers.
7. Identify the various digital and analog audio signal processes.
8. Describe the basis of television and composite video signal and various kinds of colour TV standards and system.
9. Compare the various types of digital TV system.

10. Understand the various types of consumer goods.
Text Books: 1. Modern Television Practice by R. R. Gulai, New Age International Publishers. 2. Audio Video Systems by R. G. Gupta; McGraw Hill Education System.
Reference Books: 1. Audio Video Systems Principles Practices and Troubleshooting by Bali & Bali, Khanna Publishing Company. 2. Consumer Electronics by S. P. Bali; Pearson Education, New Delhi

EMBEDDED & REAL TIME CONCEPTS
(Open Elective-IV)
SEMESTER-VII

Subject Code	21XXECO705A	Internal Marks	30
Number of Lecture Hours/Week	3	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03

Credits – 03

Course Objectives:
This course will enable students to:

1. Understand the fundamentals of the Real Time Embedded Systems.
2. Know the various communication units used in embedded systems.
3. Learn the components of Real Time Operating Systems.
4. Understand the mechanism for loading RTOS into Embedded Hardware.
5. Understand the working of Embedded systems with case studies.

Unit -1	
Introduction: Introduction to Embedded Systems, Classification of Embedded Systems, An Embedded Real Time System- Definition, Examples, Applications, Embedded System Design Flow, Processors in Embedded Systems and other hardware units, Software Development Flow & Tools.	**Hours –10**
Unit -2	
Embedded Communication Units: Need for communication interfaces, RS232 / UART, RS422 / RS485, USB, Infrared, IEEE 1394 Fire wire, Ethernet, IEEE 802.11, Blue tooth.	**Hours – 10**
Unit – 3	
Embedded/RTOS Concepts-I: Introduction to Embedded/RTOS, Types of Embedded/RTOS, Architecture of the Kernel, Tasks and task scheduler, interrupt service routines, Semaphores, Mutex, Mailboxes, **Embedded/RTOS Concepts-II:** Message Queues, Event Registers, Pipes-Signals. Timers-Memory Management-Priority inversion problem, real time operating system, Basic design using an RTOS, OS security issues.	**Hours – 12**
Unit – 4	
Embedded/RTOS Concepts-III: Off-the shelf OS, RTOS, Handheld OS, OS software, Target image creation for windows XP embedded, Porting RTOS on a micro-controller based development board, Overview of Linux, Shell programming, System programming, Overview of RT Linux, Core RT Linux, API. RT Linux Vs Windows CE.	**Hours – 12**
Unit – 5	
Embedded case studies: Digital clock, Battery operated smart card Reader, automated meter reading system, Digital Camera.	**Hours – 6**

Course outcomes:
On completion of the course student will be able to

1. Review basic operation of the Real Time Embedded Systems.
2. Describe the various communication models used in Embedded application
3. Describe the concepts of Real Time Operating Systems.
4. Demonstrate the fundamentals of Embedded Linux concepts
5. Describe working of Embedded systems with case studies.

Text Books:

1. Embedded/Real Time Systems- KVKK prasad, Dreamtech press-2005.

2. Embedded System Design-A Unified Hardware/Software Introduction- Frank Vahid, Tony D.Givargis, John Wiley & Sons, Inc.2002.

Reference Books:

1. Embedded Microcomputer Systems-Jonathan W.Valvano, Books/Cole, Thomson Leaarning.
2. An Embedded Software Primer- David E.Simon, pearson Ed.2005
3. Embedded Systems-By Shibu.K.V-Tata McGraw Hill Education Private Limited, 2013.

Web References:

1. https://nptel.ac.in/courses/106105086/

2. http://studentsfocus.com/ec6703-erts-notes-embedded-real-time-systems-lecture-handwritten-notes-ece-7th-sem-anna-university/

LOW POWER VLSI (Open Elective-IV) SEMESTER VII			
Subject Code	21XXECO705 B	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Digital System Design	**Credits – 03**	

Course Objectives:

This course will enable students to

1. Understand the fundamentals of Low PowerVLSI Design.
2. Study low-Power Design approaches.
3. Motivate to study and analyze the Low-Voltage Low-Power Adders, Multipliers.
4. Learn the concepts of Low-Voltage Low-Power Memories.

Unit -1	**Hours**
Fundamentals of Low Power VLSI Design: Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, ShortCircuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation.	**10**
Unit -2	
Low-Power Design Approaches: Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level approach –Pipelining and Parallel Processing approaches.	**10**
Unit – 3	
Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Select Adders, Carry Save Adders. **Low-Voltage Low-Power Design Techniques**: Trends of Technology and Power Supply Voltage, Low-Voltage Low-Power Logic Styles.	**12**
Unit – 4	
Low-Voltage Low-Power Multipliers: Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, Baugh- Wooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier.	**10**
Unit – 5	
Low-Voltage Low-Power Memories: Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM.	**8**

Course outcomes:

Upon completion of the course, students will be able to

1. Understand Low Power Design fundamentals.
2. Apply the Low-Power design approaches for designing Low-Power Circuits.
3. Analyze the Low-Voltage Low-Power Circuits.
4. Design different adders and multipliers to satisfy low power requirements
5. Understand the functioning Low-Voltage Low-Power Memories.

TEXT BOOKS:

1. Low-Voltage, Low-Power VLSI Subsystems – Kiat-Seng Yeo, Kaushik Roy, TMH Professional Engineering.
2. Practical Low Power Digital VLSI Design – Gary K. Yeap, Kluwer Academic Press, 2002.
3. Digital Integrated Circuits-Design Perspective 2nd Edition by Jan M.Rabey ,Ananta Chandra sekharan and Borivoji Nikolic PH

Reference Books:

1. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.
2. Essentials of VLSI Circuits and Systems - Kamran Eshraghian, Douglas and A. Pucknell and Sholeh Eshraghian, Prentice-Hall of India Private Limited, 2005 Edition.

WIRELESS SENSOR NETWORKS

(Open Elective-IV)

SEMESTER VII

Subject Code	21XXECO705C	Internal Marks	30
Number of Lecture Hours/Week	03	External Marks	70
Total Number of Lecture Hours	50	Exam Hours	03
Pre-requisite	Computer Networks	Credits – 03	

Course Objectives:

This course will enable students to

1. Understand Cellular and Ad-Hoc networks in detail
2. Acquire the knowledge of design and principles of WSNs
3. Understand various MAC protocols for sensor networks
4. Able to understand and analyse various routing techniques of WSN and Ad-Hoc networks
5. Analyze the low duty cycle and wake up concepts of sensor networks

Unit -1	**Hours**
Cellular and Ad Hoc Wireless Networks: Concepts, Applications of Ad Hoc Wireless Networks, Issues in Ad Hoc Wireless Networks: Medium Access Scheme-Routing-Multicasting Transport Layer Protocols-Pricing Scheme-Quality of Service Provisioning-Self Organization-Security-Addressing and Service Discovery-Energy management Scalability-Deployment Considerations,	10
Unit -2	
Ad Hoc Wireless Internet: Comparison with Adhoc wireless networks-Challenges for WSNs – Difference between sensor networks and Traditional sensor networks, Types of Applications, Enabling Technologies for Wireless Sensor Networks –Single Node Architectures, Hardware Components	10
Unit -3	
Energy Consumption of Sensor Nodes: Issues in Designing a Multicast Routing Protocol. Data Dissemination-Flooding and Gossiping-Data gathering. **Sensor Network Scenarios** –Optimization Goals and Figures of Merit – Design Principles for WSNs Gateway Concepts – Need for gateway	10
Unit – 4	
WSN to Internet Communication: Internet to WSN Communication –WSN Tunneling MAC Protocols for Sensor Networks-Location Discovery-Quality of Sensor Networks Evolving Standards-Other Issues	10
Unit – 5	
Low duty cycle and wake-up concepts: The IEEE802.15.4 MAC Protocols- Energy Efficiency – Geographic Routing Mobile Nodes Gossiping and Agent based Unicast Forwarding-Energy Efficient Unicast	10
Total	**50**

Course outcomes:

On completion of the course student will be able to

1. Able to understand Cellular and Adhoc networks in detail
2. Able to understand wireless sensor networks design and principles
3. Able to understand various MAC protocols for sensor networks
4. Able to understand and analyze various routing techniques of WSN and ad hoc networks
5. Understand Low duty cycle and wake up concepts

Text Books:

1. Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks,

Wiley-Interscience, 2007

2. Taieb Znati, Kazem Sohraby, Daniel Minoli,Wireless Sensor Networks: Technology, Protocols and Applications, Wiley, 2010

Reference Books:

1. Sabrie Solomon, Sensors Handbook, McGraw Hill, 2010
2. C.Siva Ram Murthy and B.S. Manoj Ad Hoc Wireless Networks, Pearson Education India 2006

COURSES OFFERED FOR HONORS

EMBEDDED SYSTEM DESIGN
POOL-1 (HONOR)

Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03

Credits – 04

Course Objectives:
This course will enable the students to:
6. Understand the fundamentals of the embedded systems.
7. Know the hardware details of the embedded systems.
8. Learn concept of firmware design approaches, Interrupt concept.
9. Learn about the various embedded software development tools.
10. Understand the embedded system design life cycle and co-design issues

Unit -1	**Hours**
Introduction: Embedded System-Definition, History, Classification, application areas and purpose of embedded systems, Embedded Systems Vs General Computing Systems, Characteristics, Quality attributes of an Embedded systems, Application-specific and Domain-Specific examples of an embedded system.	**13**
Unit -2	
Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces, Wireless communication devices, Watchdog timer, Real time clock.	**13**
Unit – 3	
Embedded Firmware Design: Embedded Firmware design approaches, Embedded Firmware development languages, Programming in Embedded C, ISR concept, Interrupt sources, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C and Compiler versus Cross-compiler.	**13**
Unit – 4	
Embedded System Development: The integrated development environment, Types of files generated on cross-compilation, Dissembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools. Embedded System Implementation And Testing tools.	**13**
Unit – 5	
Hardware Software Co-Design: Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware. **Case studies**: digital camera, Automatic Coffee Vending Machine.	**12**
Total	**64**

Course outcomes:
At the end of the course, students will be able to:
6. Understand the fundamentals of the embedded systems.
7. Know the hardware details of the embedded systems.
8. Learn concept of firmware design approaches, Interrupt concept.
9. Learn about the various embedded software development tools.
10. Understand the embedded system design life cycle and co-design issues

Text Books:

3. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill

4. Embedded Systems, Raj Kamal-Tata McGraw Hill Education Private Limited, Second Edition, 2008

Reference Books:

4. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2005
5. David Simon, " An Embedded Software Primer" Addison Wesley, 2000
6. Embedded Systems – Lyla, Pearson, 2013

ADVANCED EMBEDDED CONTROLLERS POOL-1 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Understand architecture and advanced features of embedded processors and microcontrollers.
2. Understand PIC/ARM processor registers, instruction pipeline, interrupts and architecture.
3. Learn about instructions, addressing modes, conditional instructions and programming of advanced embedded processors and microcontrollers.
4. To Learn the concepts of ARM Instruction set.
5. To Apply the concepts of Raspberry Pi board and its components.

Unit -1	**Hours**
Embedded and Microcontroller Concepts: Introduction to embedded processors, Application Areas, Categories of embedded processors, Hardware architecture, Software architecture, Application software, Communication software, Introduction to Harvard & Von Neuman architectures, CISC & RISC Architectures.	**13**
Unit -2	
PIC Microcontrollers: Introduction to PIC microcontrollers, architecture and memory organization, registers, I/O ports, interrupts, timer, instruction sets, PIC programming in assembly and C, Sensor interfacing, motor control, SPI bus protocols.	**13**
Unit – 3	
ARM: ARM design philosophy, data flow model and core architecture, registers, program status register, instruction pipeline, interrupts and vector table, operating modes and ARM processor families.	**13**
Unit – 4	
ARM Instruction Sets: Data processing instructions, addressing modes, branch, load, store instructions, PSR instructions, and conditional instructions	**12**
Unit – 5	
Raspberry Pi: Raspberry Pi board and its processor, Programming the Raspberry Pi using Python, Communication facilities on Raspberry Pi (I2C,SPI, UART), Interfacing of sensors and actuators.	**13**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Acquire the basic knowledge in fundamentals of microcontroller architecture.
2. Understand the concepts of PIC microcontroller and its internal Architecture.
3. Understand the basic structure of ARM Design and its operating modes
4. Learn the concepts of ARM Instruction set.
5. Apply the concepts of Raspberry Pi board and its components.

Text Books:

1. Muhammod Ali Mazidi, Rolin D. Mckinlay& Danny Sansey, “PIC Microcontroller and Embeded System SPI, UART using Assembly & C for PICI8,” Pearson International Edition, 2008.

2. A. N. Sloss, D. Symes, and C. Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", Elsevier, 2008
3. S. Monk, “Programming the Raspberry Pi” McGraw-Hill Education, 2013

Reference Books:

1. John .B.Peatman , “Design with PIC Microcontroller”, Prentice Hall, 1997.
2. Steave Furber, “ARM system-on-chip architecture”, Addison Wesley, 2000.

PARALLEL PROCESSING POOL-1 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Identify limitations of different architectures of computer
2. Analysis quantitatively the performance parameters for different architectures
3. Investigate issues related to compilers and instruction set based on type of architectures.
4. Gain the knowledge of parallel programming techniques.
5. Understand the operating systems concepts.

Unit -1	**Hours**
Overview of Parallel Processing and Pipelining, Performance analysis, Scalability, Principles and implementation of Pipelining, Classification of pipelining processors, Advanced pipelining techniques, Software pipelining.	**13**
Unit -2	
VLIW processors: Case study: Superscalar Architecture- Pentium, Intel Itanium Processor, Ultra SPARC, MIPS on FPGA, Vector and Array Processor, FFT Multiprocessor Architecture	**13**
Unit – 3	
Multithreaded Architecture, Multithreaded processors, Latency hiding techniques, Principles of multithreading, Issues and solutions.	**12**
Unit – 4	
Parallel Programming Techniques: Message passing program development, Synchronous and asynchronous message passing, Shared Memory Programming, Data Parallel Programming, Parallel Software Issues	**13**
Unit – 5	
Operating systems for multiprocessors systems Customizing applications on parallel processing platforms.	**13**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Identify limitations of different architectures of computer
2. Analysis quantitatively the performance parameters for different architectures
3. Investigate issues related to compilers and instruction set based on type of architectures.
4. Gain the knowledge of parallel programming techniques.
5. Apply the operating systems concepts.

Text Books:

1. Kai Hwang, Faye A. Briggs, “Computer Architecture and Parallel Processing”, MGH International Edition
2. Kai Hwang, “Advanced Computer Architecture”, TMH

Reference Books

1. Introduction To Parallel Programming - By Steven Brawer.
2. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, By Pearson Publication.

EMBEDDED SYSTEMS FOR BIOMEDICAL APPLICATIONS POOL-1 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. To introduce fundamental concepts of biomedical devices.
2. To know about the biomedical signals.
3. To give the understanding of non-invasive measurement.
4. To understand the concepts of wireless sensor networks and health care.
5. To know Ethical Practices in Health Care

Unit -1	**Hours**
OVERVIEW OF BIOMEDICAL DEVICES: bio potentials –bio potential electrodes – bio potential amplifiers, System Theory for Physiological Signals: Filters	**12**
Unit -2	
EMBEDDED SYSTEMS IN PATIENT MONITORING: ECG, EEG, EMG, Blood pressure, respiration, pulse oxymeters, diagnostic devices.	**12**
Unit – 3	
EMBEDDED SYSTEMS FOR NON INVASIVE MEASUREMENT: Non-invasive Diagnosis Using Sounds from Within the Body, Non-invasive Measurement of Blood Pressure, Measurement of Electrical Potentials and Magnetic Fields from the Body Surface and Plethysmography.	**14**
Unit – 4	
HEALTHCARE AND THE WIRELESS SENSOR NETWORK: Smart m-Health Sensing, m-Health and Mobile Communication Systems, Data Collection and Decision Making. m-Health Computing m-Health2.0,Social Networks, Health Apps, Cloud and Big Health Data	**14**
Unit – 5	
Ethical Practices in Health Care: Morality and Ethics-A Definition of terms, Human Experimentation-Ethical issues in feasibility studies, Ethical issues in emergency use, Ethical issues in treatment use-Codes of ethics for bio engineers.	**12**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Understand overview of biomedical devices
2. Understand embedded systems in patient monitoring
3. Apply the design principals of Embedded Systems for Non Invasive Measurement
4. Illustrate the various Healthcare and The Wireless Sensor Network
5. Learn Ethical Practices in Health Care

Text Books:

1. John G. webster, "Medical Instrumentation -Application and Design", Fourth Edition, JohnWiley and Sons, 2010
2. Subhas Chandra Mukhopadhyay and Aime Lay-Ekuakille, "Advances in BiomedicalSensing, Measurements, Instrumentation and Systems", Springer, 201

Reference Books:

1. Roberts. H. Istepanian and Bryan Woodward, "m-Health Fundamentals and Applications", Wiley, 2017

INTERNET OF THINGS FUNDAMENTALS POOL-1 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. To introduce IoT Fundamentals
2. To know about the IoT Characteristics.
3. To give the understanding of IoT Architecture overview
4. To understand the concepts of IoT Reference Architecture.
5. To know different case studies of IoT.

Unit -1	**Hours**
Introduction to IoT: Sensing, Actuation, Networking basics, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, IoT Definition, Characteristics. IoT Functional Blocks, Physical design of IoT, Logical design of IoT, Communication models &APis.	**14**
Unit -2	
M2M to IoT-The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics. Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT.	**12**
Unit – 3	
M2M vs loT An Architectural Overview-Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. Reference Architecture and Reference Model of IoT.	**12**
Unit – 4	
IoT Reference Architecture-Getting Familiar with IoT Architecture, Various architectural views of IoT such as Functional, Information, Operational and Deployment. Constraints affecting design in IoT world-Introduction, Technical design Constraints.	**12**
Unit – 5	
Developing IoT solutions: Introduction to Python, Introduction to different IoT tools, Introduction to Arduino and Raspberry Pi, Introduction to Cloud Computing, Fog Computing, Connected Vehicles, Data Aggregation for the IoT in Smart Cities, Privacy and Security Issues in IoT. Case Studies: Home Automation, Smart Health care.	**14**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Understand general concepts of Internet of Things (IoT)
2. Understand general concepts of M2M
3. Know the design principals of IoT
4. Recognize the various architectural view IoT
5. Apply the different applications of IoT

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1stEdition,VPT,2014

2. JanHoller, Vlasios Tsiatsis, CatherineMulligan,StefanAvesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of intelligence",1stEdition,AcademicPress,2014.

Reference Books:

1. Francisda Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything",1st Edition, A press Publications,2013
2. CunoPfister, Getting Started with the Internet of Things, O"ReillyMedia, 2011,ISBN:978-1-4493-9357-1

COMMUNICATION PROTOCOLS FOR INTERNET OF THINGS POOL-1 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. To Acquire the basic knowledge in fundamentals of IoT architecture.
2. To Learn the constraints of IoT design process and Reference architecture.
3. To Understand the data link layer and network protocols.
4. To Understand the transport and session layer protocols.
5. To Understand the protocols

Unit -1	**Hours**
INTRODUCTION: IoT architecture outline, standards - IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics.	**14**
Unit -2	
IOT REFERENCE ARCHITECTURE: Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints.	**14**
Unit – 3	
IoT DATA LINK LAYER & NETWORK LAYER PROTOCOLS: PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, ZWave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4,IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP.	**13**
Unit – 4	
IoT TRANSPORT & SESSION LAYER PROTOCOLS: Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT.	**12**
Unit – 5	
Service Layer : oneM2M, ETSI M2M, OMA, BBF Security in IoT Protocols – MAC802.15.4 , 6LoWPAN, RPL, Application Layer.	**11**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Acquire the basic knowledge in fundamentals of IoT architecture.
2. Understand the constraints of IoT design process and Reference architecture.
3. Understand the data link layer and network protocols.
4. Understand the transport and session layer protocols.
5. Know the service and security layer protocols

Text Books:

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The EvolvingWorld of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications ,2016
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand,StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet ofThings: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2015

Reference Books:

1. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things",ISBN 978-3-642- 19156-5 e-ISBN 978-3-642-19157-2, Springer, 2016
2. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.

INDUSTRIAL INTERNET OF THINGS
POOL-1 (HONOR)

Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03

Credits – 04

Course Objectives:
This course will enable the students to:
1. Able to understand the industry 4.0 Technologies
2. To know about the industrial IoT.
3. To give the understanding of IoT Analytics.
4. To understand the concepts of IoT Security.
5. To know different case studies of IoT.

Unit -1	**Hours**
INDUSTRY 4.0 : Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis	**13**
Unit -2	
INDUSTRIAL IoT: IIoT-Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Networking	**13**
Unit – 3	
IIoT ANALYTICS: Big Data Analytics and Software Defined Networks, Machine Learning and Data Science, Julia Programming, Data Management with Hadoop.	**13**
Unit – 4	
IoT SECURITY: Industrial IoT: Security and Fog Computing - Cloud Computing in IIoT, Fog Computing in IIoT, Security in IIoT	**12**
Unit – 5	
CASE STUDY: Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Milk Processing and Packaging Industries, Manufacturing Industries	**13**
Total	**64**

Course outcomes:
At the end of the course, students will be able to:
1. Acquire the basic knowledge in fundamentals of Industry 4.0
2. Understand the Basics of Industrial IoT
3. Understand the various types of IIoT Analytics.
4. Acquire the knowledge about IIoT Security.
5. Apply the case studies of IIoT

Text Books:

1. Industry 4.0: The Industrial Internet of Things", by Alasdair Gilchrist (Apress), 2017
2. "Industrial Internet of Things: Cyber manufacturing Systems" by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer), 2017

Reference Books:

1. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT by Giacomo Veneri, Antonio Capasso, Packt, 2018

SENSOR NETWORKS AND INTERNET OF THINGS POOL-1 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. To study fundamental concepts of sensor networks
2. To understand roles of sensors network systems in IoT
3. To Learn different physical used for IoT design
4. To Learn different protocols used for IoT design
5. TO Learn role of IoT in building and smart grid.

Unit -1	**Hours**
INTRODUCTION: Introduction to Sensor networks in smart transportation, smart cities, smart living, smart energy, smart health, and smart learning	**12**
Unit -2	
SENSOR NETWORK SYSTEMS: Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security of IoT.	**13**
Unit – 3	
IOT PHYSICAL DEVICES & ENDPOINTS: Exemplary Device Board, Linux on Raspberry, Interface and Programming & IOT Device. Hardware Platforms and Energy Consumption.	**13**
Unit – 4	
Synchronization & Protocols: Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network Security, Middleware, Databases	**13**
Unit – 5	
INDUSTRIAL AUTOMATION & IoT: Industrial Automation-Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation	**13**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Understand the various concepts, terminologies and sensor netwoks of IoT systems.
2. Apply network systems for design of IoT.
3. Understand and apply various physical devices for IoT systems
4. Understand and apply various protocols for design of IoT systems
5. Understand various industrial applications of IoT

Text Books:

1. Mandler, B., Barja, J., MitreCampista, M.E., Cagáová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publication
2. Internet of Things: A Hands-On Approach Paperback – 2015, by ArsheepBahga (Author), Vijay Madisetti (Author)

VLSI TECHNOLOGY AND DESIGN POOL-2 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Learn about the MOS fabrication process and short channel effects.
2. Learn about the basic rules in layout designing.
3. Analyze various combinational logic networks and sequential systems.

Unit -1	**Hours**
MOS Transistors Introduction, The Structure of MOS Transistors, The Fluid Model, The MOS Capacitor, The MOS Transistor, Modes of Operation of MOS Transistors, Electrical Characteristics of MOS Transistors, Threshold Voltage, Transistor Trans conductance gm, Figure of Merit, Body Effect, Channel-Length Modulation, MOS Transistors as a Switch, Transmission Gate	**14**
Unit -2	
MOS Fabrication Technology Introduction, Basic Fabrication Processes, Wafer Fabrication, Oxidation, Mask Generation, Photolithography, Diffusion, Deposition. N-MOS Fabrication Steps, CMOS Fabrication Steps, n-Well Process, p-Well Process, Twin-Tub Process, Latch-Up Problem and Its Prevention, Use of Guard Rings, Use of Trenches, Short-Channel Effects-Channel Length Modulation Effect. Drain-Induced Barrier Lowering, Channel Punch Through, Hot carrier effect, Velocity Saturation Effect	**14**
Unit – 3	
Layout Design Rules Scaling Theory, Scalable CMOS Design Rules, CMOS Process Enhancements, Transistors, Interconnects, Circuit Elements, Efficient layout Design techniques	**12**
Unit – 4	
Combinational Logic Networks Layouts for logic networks. Delay through networks. Power optimization. Switch logic networks. Combinational logic testing	**12**
Unit – 5	
Sequential Systems Memory cells and Arrays, clocking disciplines, sequential circuit Design, Performance Analysis, Power optimization, Design validation and testing.	**12**
Total	**64**

Course outcomes:

At the end of the course the student able to

1. Understand the basics of MOS transistors and also the characteristics of MOS transistors.
2. Learn about the MOS fabrication process and short channel effects.
3. Learn about the basic rules in layout designing.
4. Analyse various combinational logic networks and sequential systems.

Text Books:

1. Principals of CMOS VLSI Design-N.H.EWeste, K. Eshraghian, 2nd Edition, Addison Wesley.
2. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.
3. Low-Power VLSI Circuits and Systems, Ajit Pal, SPRINGER PUBLISHERS

4. Modern VLSI Design – Wayne Wolf, 3rd Ed., 1997, Pearson Education.

Reference Books:

1. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.
2. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, BorivojeNikolic, 2nd Ed., PHI.

CMOS ANALOG IC DESIGN POOL-2 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Analyze analog circuits at least to the first order.
2. Appreciate the trade-offs involved in analog integrated circuit design.
3. Understand and appreciate the importance of noise and distortion in analog circuits.

Unit -1	**Hours**
Basic MOS Device Physics – General Considerations, MOS I/V Characteristics, Second Order effects, MOS Device models. Short Channel Effects and Device Models. Single Stage Amplifiers –Basic Concepts, Common Source Stage, Source Follower, Common Gate Stage, Cascade Stage	**14**
Unit -2	
Differential Amplifiers – Single Ended and Differential Operation, Basic Differential Pair, Common Mode Response, Differential Pair with MOS loads, Gilbert Cell. Passive and Active Current Mirrors– Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors.	**14**
Unit – 3	
Frequency Response of Amplifiers – General Considerations, Common Source Stage, Source Followers, Common Gate Stage, Cascode Stage, Differential Pair. Noise – Types of Noise, Representation of Noise in circuits, Noise in single stage amplifiers, Noise in Differential Pairs.	**13**
Unit – 4	
Feedback Amplifiers – General Considerations, Feedback Topologies, Effect of Loading. Operational Amplifiers – General Considerations, One Stage Op Amps, Two Stage Op Amps, Gain Boosting, Common – Mode Feedback, Input Range limitations, Slew Rate, Power Supply Rejection, Noise in Op Amps. Stability and Frequency Compensation.	**13**
Unit – 5	
Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.	**12**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Design MOSFET based analog integrated circuits.
2. Analyze analog circuits at least to the first order.
3. Appreciate the trade-offs involved in analog integrated circuit design.
4. Understand and appreciate the importance of noise and distortion in analog circuits.

Text Books:

1. B.Razavi, “Design of Analog CMOS Integrated Circuits”, 2nd Edition, McGraw Hill Edition2016.
2. Paul. R.Gray&Robert G. Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley, 5th Edition, 2009.

Reference Books:

1. T. C. Carusone, D. A. Johns & K. Martin, “Analog Integrated Circuit Design”, 2nd Edition, Wiley, 2012.
2. P.E.Allen &D.R. Holberg, “CMOS Analog Circuit Design”, 3rd Edition, Oxford University Press, 2011.
3. R. Jacob Baker, “CMOS Circuit Design, Layout, and Simulation”, 3rd Edition, Wiley, 2010.
4. Recent literature in Analog IC Design.

CMOS DIGITAL IC DESIGN POOL-2 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Demonstrate advanced knowledge in Static and dynamic characteristics of CMOS, Alternative CMOS Logics, Estimation of Delay and Power, Adders Design.
2. Classify different semiconductor memories. 3. Analyze, design and implement combinational and sequential MOS logic circuits.
3. Analyze complex engineering problems critically in the domain of digital IC design for conducting research.

Unit -1	**Hours**
MOS Design Pseudo NMOS Logic – Inverter, Inverter threshold voltage, output high voltage, Output Low voltage, gain at gate threshold voltage, Transient response, Rise time, Fall time, Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.	**14**
Unit -2	
Combinational MOS Logic Circuits MOS logic circuits with NMOS loads, Primitive CMOS logic gates – NOR & NAND gate, Complex Logic circuits design – Realizing Boolean expressions using NMOS gates and CMOS gates, AOI and OAI gates, CMOS full adder, CMOS transmission gates, Designing with Transmission gates.	**14**
Unit – 3	
Sequential MOS Logic Circuits Behaviour of bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop.	**12**
Unit – 4	
Dynamic Logic Circuits Basic principle, Voltage Bootstrapping, Synchronous dynamic pass transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.	**13**
Unit – 5	
Semiconductor Memories Types, RAM array organization, DRAM – Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage currents in SRAM cells, Flash Memory- NOR flash and NAND flash.	**13**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Demonstrate advanced knowledge in Static and dynamic characteristics of CMOS, Alternative CMOS Logics, Estimation of Delay and Power, Adders Design.
2. Classify different semiconductor memories.
3. Analyze, design and implement combinational and sequential MOS logic circuits.
4. Analyze complex engineering problems critically in the domain of digital IC design for conducting research.
5. Solve engineering problems for feasible and optimal solutions in the core area of digital ICs.

Text Books:

1. Digital Integrated Circuit Design – Ken Martin, Oxford University Press, 2011.

2. CMOS Digital Integrated Circuits Analysis and Design – Sung-Mo Kang, Yusuf Leblebici, TMH, 3rd Ed., 2011.

Reference Books:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011

2. Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan Borivoje Nikolic, 2nd Ed., PHI.

DESIGN FOR TESTABILITY

POOL-2 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03

Credits – 04

Course Objectives:

This course will enable the students to:

1. Analyze the various test generation methods for static & dynamic CMOS circuits.
2. Identify the design for testability methods for combinational & sequential CMOS circuits.
3. Recognize the BIST techniques for improving testability.

Unit -1	**Hours**
Introduction to Testing Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, Fault Modeling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.	**14**
Unit -2	
Logic and Fault Simulation Simulation for Design Verification and Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation	**12**
Unit – 3	
Testability Measures SCOAP Controllability and Observability, High Level Testability Measures, Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan.	**13**
Unit – 4	
Built-In Self-Test The Economic Case for BIST, Random Logic BIST: Definitions, BIST Process, Pattern Generation, Response Compaction, Built-In Logic Block Observers, Test-Per-Clock, Test-Per- Scan BIST Systems, Circular Self-Test Path System, Memory BIST, Delay Fault BIST.	**13**
Unit – 5	
Boundary Scan Standard Motivation, System Configuration with Boundary Scan: TAP Controller and Port, Boundary Scan Test Instructions, Pin Constraints of the Standard, Boundary Scan Description Language: BDSL Description Components, Pin Descriptions.	**14**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. apply the concepts in testing which can help them design a better yield in IC design.
2. tackle the problems associated with testing of semiconductor circuits at earlier design levels so as to significantly reduce the testing costs.
3. analyse the various test generation methods for static & dynamic CMOS circuits.
4. identify the design for testability methods for combinational & sequential CMOS circuits.
5. recognize the BIST techniques for improving testability.

Text Books:

1. Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits - M.L. Bushnell, V. D. Agrawal, Kluwer Academic Publishers.

Reference Books:

1. Digital Systems and Testable Design - M. Abramovici, M.A.Breuer and A.D Friedman, Jaico Publishing House.
2. Digital Circuits Testing and Testability - P.K. Lala, Academic Press.

SYSTEM ON CHIP

POOL-2 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03

Credits – 04

Course Objectives:

This course will enable the students to:

1. Identify and formulate a given problem in the framework of SoC based design approaches
2. Design SoC based system for engineering applications
3. Realize impact of SoC on electronic design philosophy and Macro-electronics thereby incline towards entrepreneurship & skill development

Unit -1	**Hours**
ASIC: Overview of ASIC types, design strategies, CISC, RISC and NISC approaches for SOC architectural issues and its impact on SoC design methodologies, Application Specific Instruction Processor (ASIP) concepts.	**11**
Unit -2	
NISC: NISC Control Words methodology, NISC Applications and Advantages, Architecture Description Languages (ADL) for design and verification of Application Specific Instruction set Processors (ASIP), No-Instruction-Set-computer (NISC)- design flow, modeling NISC architectures and systems, use of Generic Netlist Representation - A formal language for specification, compilation and synthesis of embedded processors.	**14**
Unit – 3	
Simulation: Different simulation modes, behavioural, functional, static timing, gate level, switch level, transistor/circuit simulation, design of verification vectors, Low power FPGA, Reconfigurable systems, SoC related modeling of data path design and control logic, Minimization of interconnects impact, clock tree design issues.	**14**
Unit – 4	
Low power SoC design / Digital system: Design synergy, Low power system perspective-power gating, clock gating, adaptive voltage scaling (AVS), Static voltage scaling, Dynamic clock frequency and voltage scaling (DCFS), building block optimization, building block memory, power down techniques, power consumption verification.	**14**
Unit – 5	
Synthesis: Role and Concept of graph theory and its relevance to synthesizable constructs, Walks, trails paths, connectivity, components, mapping/visualization, nodal and admittance graph. Technology independent and technology dependent approaches for synthesis, optimization constraints, Synthesis report analysis Single core and Multi core systems, dark silicon issues, HDL coding techniques for minimization of power consumption, Fault tolerant designs	**11**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Identify and formulate a given problem in the framework of SoC based design approaches Design SoC based system for engineering applications
2. Realize impact of SoC on electronic design philosophy and Macro-electronics thereby incline towards entrepreneurship & skill development.

Text Books:

1. Hubert Kaeslin, “Digital Integrated Circuit Design: From VLSI Architectures to CMOS
2. Fabrication”, Cambridge University Press, 2008.
3. B. Al Hashimi, “System on chip-Next generation electronics”, The IET, 2006

Reference Books:

1. Rochit Rajsuman, “System-on- a-chip: Design and test”, Advantest America R & D Center,2000
2. P Mishra and N Dutt, “Processor Description Languages”, Morgan Kaufmann, 2008
3. Michael J. Flynn and Wayne Luk, “Computer System Design: System-on-Chip”.

PROGRAMMABLE LOGIC DEVICES AND ASIC POOL-2 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Describe architecture of programmable devices.
2. Explain programmable methodologies.
3. Recall IC fabrication techniques vis-à-vis CMOS switch
4. Relate design and implementation flow for PLDs
5. Low power design techniques and methodologies

Unit -1	**Hours**
INTRODUCTION TO ASICS, CMOS LOGIC, ASIC LIBRARY DESIGN: Types of ASICs - Design flow – CMOS transistors- CMOS Design rules –Combinational logic Cell Sequential logic cell - Transistor as Resistors - Transistor parasitic capacitance – Logical effort - Library cell design – Library architecture.	**14**
Unit -2	
PROGRAMMABLE ASICS, PROGRAMMABLE ASIC LOGIC CELLS AND PROGRAMMABLE ASIC I/O CELLS: Anti fuse - Static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA – Altera FLEX - Altera MAX DC & AC inputs and outputs - Xilinx I/O blocks.	**14**
Unit – 3	
PROGRAMMABLE ASIC INTERCONNECT, PROGRAMMABLE ASIC 09 DESIGN SOFTWARE AND LOW LEVEL DESIGN: Entry: Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX – Design systems - Logic Synthesis - Half gate ASIC -Low level design language - PLA tools EDIF-CFI design representation.	**14**
Unit – 4	
SILICON ON CHIP DESIGN: Voice over IP SOC - Intellectual Property – SOC Design challenges- Methodology and design-FPGA to ASIC conversion – Design for integration-SOC verification-Set top box SOC.	**11**
Unit – 5	
PHYSICAL AND LOW POWER DESIGN: Over view of physical design flow- tips and guideline for physical design- modern physical design techniques- power dissipation-low power design techniques and methodologies-low power design tools- tips and guideline for low power design.	**11**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Recognize need for programmable devices
2. Describe architecture of programmable devices.
3. Explain programmable methodologies.
4. Recall IC fabrication techniques vis-à-vis CMOS switch
5. Relate design and implementation flow for PLDs
6. low power design techniques and methodologies

Text Books:

1. M.J.S. Smith, ―Application Specific Integrated Circuits‖, Pearson Education, 2008
2. Wayne Wolf, ―FPGA-Based System Design‖, Prentice Hall PTR, 2009.
3. Farzad Nekoogar and Faranak Nekoogar, ―From ASICs to SOCs: A Practical Approach‖, Prentice Hall PTR, 2003.

SCRIPTING LANGUAGE POOL-2 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Gain fluency in programming with scripting languages
2. Create and run scripts using PERL/TCL/PYTHON in CAD Tools
3. Demonstrate the use of PERL/PYTHON/ TCL in developing system and web applications

Unit -1	**Hours**
Introduction to Scripts and Scripting: Basics of Linux, Origin of Scripting languages, scripting today, Characteristics and uses of scripting languages. **PERL:** Introduction to PERL, Names and values, Variables and assignment, Scalar expressions, Control structures, Built-in functions, Collections of Data, working with arrays, Lists and hashes, Simple input and output, Strings, Patterns and regular expressions, Subroutines, Scripts with arguments	**14**
Unit -2	
Advanced PERL: Finer points of Looping, Subroutines, Using Pack and Unpack, working with files, Type globs, Eval, References, Data structures, Packages, Libraries and modules, Objects, Objects and modules in action, tied variables, interfacing to the operating systems, Security issues	**13**
Unit – 3	
TCL: The TCL phenomena, Philosophy, Structure, Syntax, Parser, Variables and data in TCL, Control flow, Data structures, Simple input/output, Procedures, Working with Strings, Patterns, Files and Pipes, Example code.	**13**
Unit – 4	
Advanced TCL: The eval, source, exec and up-level commands, Libraries and packages, Namespaces, trapping errors, Event-driven programs, Making applications 'Internet-aware',' Nuts-and-bolts' internet programming, Security issues, TCL and TK integration.	**12**
Unit – 5	
PYTHON: Introduction to PYTHON language, PYTHON-syntax, statements, functions, Built-in functions and Methods, Modules in PYTHON, Exception Handling.	**12**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Gain fluency in programming with scripting languages
2. Create and run scripts using PERL/TCL/PYTHON in CAD Tools
3. Demonstrate the use of PERL/PYTHON/ TCL in developing system and web applications

Text Books:

1. The World of Scripting Languages- David Barron, Wiley Student Edition, 2010.
2. PYTHON Web Programming, Steve Holden and David Beazley, New Riders Publications

Reference Books:

1. TCL/TK: A Developer's Guide- ClifFlynt, 2003, Morgan Kaufmann Series.
2. Core PYTHON Programming, Chun, Pearson Education, 2006.
3. Learning Perl, Randal L. Schwartz, O' Reilly publications 6th edition 2011.
4. Linux: The Complete Reference", Richard Peterson McGraw Hill Publications, 6th Edition, 2008.

LOW POWER VLSI DESIGN POOL-2 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Identify the sources of power dissipation in digital IC systems
2. Understand the impact of power on system performance and reliability.
3. Characterize and model power consumption
4. Understand the basic analysis methods
5. Understand leakage sources and reduction techniques.

Unit -1	**Hours**
Sources of Power Dissipation Introduction, Short-Circuit Power Dissipation, Switching Power Dissipation, Dynamic Power for a Complex Gate, Reduced Voltage Swing, Switching Activity, Leakage Power Dissipation, p–n Junction Reverse-Biased Current, Band-to-Band Tunneling Current, Subthreshold Leakage Current, Short-Channel Effects	**13**
Unit -2	
Supply Voltage Scaling for Low Power Device Feature Size Scaling, Constant-Field Scaling, Constant-Voltage Scaling, Architectural-Level Approaches: Parallelism for Low Power, Pipelining for Low Power, Combining Parallelism with Pipelining, Voltage Scaling Using High-Level Transformations: Multilevel Voltage Scaling Challenges in MVS Voltage Scaling Interfaces, Static Timing Analysis Dynamic Voltage and Frequency Scaling	**13**
Unit – 3	
Switched Capacitance Minimization Probabilistic Power Analysis: Random logic signals, probability and frequency, probabilistic power analysis techniques, signal entropy, Bus Encoding: Gray Coding, One-Hot Coding, Bus-Inversion, T0 Coding, Clock Gating, Gated-Clock FSMs FSM State Encoding, FSM Partitioning, Precomputation, Glitching Power Minimization	**13**
Unit – 4	
Leakage Power Minimization Fabrication of Multiple Threshold Voltages, Multiple Channel Doping, Multiple Oxide CMOS, Multiple Channel Length, Multiple Body Bias, VTCMOS Approach, MTCMOS Approach, Power Gating, Clock Gating Versus Power Gating, Power-Gating Issues, Isolation Strategy, State Retention Strategy, Power-Gating Controller, Power Management, Combining DVFS and Power Management	**13**
Unit – 5	
Low power clock distribution & Simulation Power Analysis Low power clock distribution: Power dissipation in clock distribution, single driver versus distributed buffers, Zero skew versus tolerable skew, chip and package co design for clock network. Simulation Power Analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, architecture level analysis, data correlation analysis of DSP systems, Monte Carlo Simulation	**12**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Identify the sources of power dissipation in digital IC systems & understand the impact of power on system performance and reliability.

2. Characterize and model power consumption & understand the basic analysis methods.

3. Understand leakage sources and reduction techniques.

Text Books:

1. Low-Power VLSI Circuits and Systems, Ajit Pal, SPRINGER PUBLISHERS

2. Practical Low Power Digital Vlsi Design , Gary Yeap Motorola, Springer Science Business Media, LLC.

Reference Books:

1. Low Power CMOS Design – Anantha Chandrakasan, IEEE Press/Wiley International, 1998. 2

2. Massoud Pedram, Jan M. Rabaey , "Low power design methodologies ", Kluwer Academic Publishers.

3. Low Power CMOS VLSI Circuit Design – A. Bellamour, M. I. Elamasri, Kluwer Academic Press, 1995.

WIRELESS SENSOR NETWORKS POOL-3 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Understand the hardware details of different types of sensors and select right type of sensor for various applications.
2. Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.
3. Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.

Unit -1	**Hours**
Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.	**12**
Unit -2	
Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tiny OS, MANTIS, Contiki, and RetOS.	**12**
Unit – 3	
Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)	**13**
Unit – 4	
Overview of sensor network protocols (details of at least 2 important protocol per layer): Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy), UWB.	**13**
Unit – 5	
Data dissemination and processing; differences compared with other database management systems, data storage; query processing. Specialized features: Energy preservation and efficiency; security challenges; fault- tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.	**14**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Design wireless sensor network system for different applications under consideration.
2. Understand the hardware details of different types of sensors and select right type of sensor for various applications.
3. Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.
4. Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
5. Handle special issues related to sensors like energy conservation and security challenges

Text Books:

1. H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, India,2012.

2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor Networks”, Springer Verlag, 1stIndian reprint,2010.

Reference Books:

1. F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint,2013.

2. YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology,2008.

SOFTWARE DEFINED RADIO

POOL-3 (HONOR)

Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03

Credits – 04

Course Objectives:

This course will enable the students to:

1. Analyze complex problems critically in the domains of Radio frequency implementation issues, Multirate signal processing in SDR, as well as a Smart antenna technique for better spectrum exploitation for conducting research.
2. Apply appropriate techniques for the development of scientific and technology
3. knowledge in designing software defined radios and their usage for cognitive radio.

Unit -1	**Hours**
Introduction: The Need for Software Radios, What is Software Radio, Characteristics and benefits of software radio- Design Principles of Software Radio, RF Implementation issues- The Purpose of RF Front – End, Dynamic Range- The Principal Challenge of Receiver Design – RF Receiver Front- End Topologies- Enhanced Flexibility of the RF Chain with Software Radios- Importance of the Components to Overall Performance- Transmitter Architectures and Their Issues- Noise and Distortion in the RF Chain, ADC and DAC Distortion.	**15**
Unit -2	
Multi Rate Signal Processing: Introduction- Sample Rate Conversion Principles- Polyphase Filters Digital Filter Banks- Timing Recovery in Digital Receivers Using Multirate Digital Filters. Digital Generation of Signals: Introduction- Comparison of Direct Digital Synthesis with Analog Signal Synthesis- Approaches to Direct Digital Synthesis- Analysis of Spurious Signals- Spurious Components due to Periodic jitter- Band Pass Signal Generation- Performance of Direct Digital Synthesis Systems- Hybrid DDS-PLL Systems- Applications of direct Digital Synthesis- Generation of Random Sequences- ROM Compression Techniques.	**15**
Unit – 3	
Analog to Digital and Digital to Analog Conversion: Parameters of ideal data converters- Parameters of Practical data converters- Analog to Digital and Digital to Analog Conversion- Techniques to improve data converter performance- Common ADC and DAC architectures.	**11**
Unit – 4	
Digital Hardware Choices: Introduction- Key Hardware Elements- DSP Processors- Field Programmable Gate Arrays- Trade-Offs in Using DSPs, FPGAs, and ASICs- Power Management Issues Using a Combination of DSPs, FPGAs, and ASICs.	**11**
Unit – 5	
Object – Oriented Representation of Radios and Network Resources: Networks- Object Oriented Programming- Object Brokers- Mobile Application Environments- Joint Tactical Radio System. Case Studies in Software Radio Design: Introduction and Historical Perspective, SPEAK easy- JTRS, Wireless Information Transfer System, SDR-3000 Digital Transceiver Subsystem, Spectrum Ware, CHARIOT	**12**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Demonstrate advanced knowledge in the evolving paradigm of Software defined radio and technologies for its implementation.
2. Analyze complex problems critically in the domains of Radio frequency implementation issues, Multirate signal processing in SDR, as well as a Smart antenna technique for better spectrum exploitation for conducting research.

3. Apply appropriate techniques for the development of scientific and technological knowledge in designing software defined radios and their usage for cognitive radio.

Text Books:

1. Software Radio: A Modern Approach to Radio Engineering - Jeffrey H. Reed, 2002, PEA Publication.
2. Software Defined Radio: Enabling Technologies- Walter Tuttle Bee, 2002, Wiley Publications.

Reference Books:

1. Software Defined Radio for 3G - Paul Burns, 2002, Artech House.
2. Software Defined Radio: Architectures, Systems and Functions - Markus Dillinger, KambizMadani, Nancy Alonistioti, 2003, Wiley.
3. Software Radio Architecture: Object Oriented Approaches to wireless System Engineering – Joseph Mitola, III, 2000, John Wiley & Sons.
4. R.F Microelectronics – B. Razavi, 1998, PHI. 5. DSP – A Computer Based Approach – S. K. Mithra, 1998, McGraw-Hill

DATA COMMUNICATION & COMPUTER NETWORKS

POOL-3 (HONOR)

Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03

Credits – 04

Course Objectives:

This course will enable the students to:

1. Know the Categories and functions of various Data Communication Networks
2. Design and analyze various error detection techniques.
3. Demonstrate the mechanism of routing the data in network layer
4. Know the significance of various Flow control and Congestion Control Mechanisms

Unit -1	**Hours**
Introduction to Data Communications: Components, Data Representation, Data Flow, Networks- Distributed Processing, Network Criteria, Physical Structures, Network Models, Categories of Networks Interconnection of Networks, The Internet - A Brief History, The Internet Today, Protocol and Standards - Protocols, Standards, Standards Organizations, Internet Standards. Network Models, Layered Tasks, OSI model, Layers in OSI model, TCP/IP Protocol Suite, Addressing Introduction, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs -The 802.11 Architecture	**14**
Unit -2	
Data Link Layer: Links, Access Networks, and LANs- Introduction to the Link Layer, The Services Provided by the Link Layer, Types of errors, Redundancy, Detection vs Correction, Forward error correction Versus Retransmission Error-Detection and Correction Techniques, Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC) , Framing, Flow Control, and Error Control protocols , Noisy less Channels and Noisy Channels, HDLC, Multiple Access Protocols, Random Access ,ALOHA, Controlled access, Channelization Protocols. 802.11 MAC Protocol, IEEE 802.11 Frame	**14**
Unit – 3	
The Network Layer: Introduction, Forwarding and Routing, Network Service Models, Virtual Circuit and Datagram Networks-Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks, Inside a Router-Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane, The Internet Protocol(IP):Forwarding and Addressing in the Internet- Datagram format, Ipv4 Addressing, Internet Control Message Protocol(ICMP), IPv6	**12**
Unit – 4	
Transport Layer: Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and De-multiplexing, Connectionless Transport: UDP -UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer-Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go- Back-N(GBN), Selective Repeat(SR), Connection Oriented Transport: TCP - The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, Principles of Congestion Control - The Cause and the Costs of Congestion, Approaches to Congestion Control-The Cause and the Costs of Congestion, Approaches to Congestion Control	**13**
Unit – 5	
Application Layer: Principles of Networking Applications – Network Application Architectures, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the File Transfer: FTP,- FTP Commands and Replies, Electronic Mail in the Internet- STMP, Comparison with HTTP, DNS-The Internet's Directory Service – Service Provided by DNS, Overview of How DNS Works, DNS Records and messages.	**11**
Total	**64**

Course outcomes:
At the end of the course, students will be able to:

1. Know the Categories and functions of various Data Communication Networks
2. Design and analyze various error detection techniques.
3. Demonstrate the mechanism of routing the data in network layer
4. Know the significance of various Flow control and Congestion Control Mechanisms
5. Know the Functioning of various Application Layer Protocols.

Text Books:

1. Computer Networking A Top-Down Approach – Kurose James F, Keith W, 6th Edition, Pearson.
2. Data Communications and Networking Behrouz A. Forouzan 4th Edition McGraw-Hill Education

Reference Books:

1. Data communication and Networks - Bhusan Trivedi, Oxford university press, 2016
2. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education
3. Understanding Communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.

COGNITIVE RADIO
POOL-3 (HONOR)

Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03

Credits – 04

Course Objectives:

This course will enable the students to:

1. Develop the cognitive radio, as well as techniques for spectrum holes' detection that cognitive radio takes advantages in order to exploit it.
2. Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
3. Understand fundamental issues regarding dynamic spectrum access, the radio resource management and trading, as well as a number of optimization techniques for better Spectrum exploitation

Unit -1	**Hours**
Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.	**14**
Unit -2	
Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).	**14**
Unit – 3	
Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.	**12**
Unit – 4	
Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.	**12**
Unit – 5	
Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross- layer design for cognitive radio networks	**12**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Understand the fundamental concepts of cognitive radio networks.
2. Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
3. Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
4. Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimization techniques for better Spectrum exploitation

Text Books:

1. Ekram Hossain, DusitNiyato, Zhu Han, “Dynamic Spectrum Access and Management in Cognitive Radio Networks”, Cambridge University Press,2009.
2. Kwang-Cheng Chen, Ramjee Prasad, “Cognitive radio networks”, John Wiley & Sons Ltd.,2009.

Reference Books:

1. Bruce Fette, “Cognitive radio technology”, Elsevier, 2nd edition,2009.
2. HuseyinArslan, “Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems”, Springer,2007.
3. Francisco Rodrigo Porto Cavalcanti, Soren Andersson, “Optimizing Wireless Communication Systems” Springer,2009.
4. Linda Doyle, “Essentials of Cognitive Radio”, Cambridge University Press,2009

5G COMMUNICATIONS
POOL-3 (HONOR)

Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03

Credits – 04

Course Objectives:

This course will enable the students to:

1. Learn 5G Technology advances and their benefits
2. Learn the key RF, PHY, MAC and air interface changes required to support 5G
3. Learn Device to device communication and millimeter wave communication
4. Implementation options for 5G

Unit -1	**Hours**
Overview of 5G Broadband Wireless Communications: Evaluation of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro) , An Overview of 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G.	**12**
Unit -2	
The 5G wireless Propagation Channels: Channel modeling requirements, propagation scenarios and challenges in the 5G modeling, Channel Models for mm Wave MIMO Systems.	**12**
Unit – 3	
Transmission and Design Techniques for 5G: Basic requirements of transmission over 5G, Modulation Techniques – Orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC), Multiple Accesses Techniques – orthogonal frequency division multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), non-orthogonal multiple accesses (NOMA).	**14**
Unit – 4	
Device-to-device (D2D) and machine-to-machine (M2M) type communications – Extension of 4G D2D standardization to 5G, radio resource management for mobile broadband D2D, multi-hop and multi-operator D2D communications	**12**
Unit – 5	
Millimeter-wave Communications – spectrum regulations, deployment scenarios, beam forming, physical layer techniques, interference and mobility management, Massive MIMO propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with Imperfect CSI, Multi-Cell Massive MIMO, Pilot Contamination, Spatial Modulation (SM)	**14**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Learn 5G Technology advances and their benefits
2. Learn the key RF, PHY, MAC and air interface changes required to support 5G
3. Learn Device to device communication and millimeter wave communication
4. Implementation options for 5G

Text Books:

1. Martin Sauter “From GSM from GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband”, Wiley-Blackwell.

2. Afif Osseiran, Jose.F.Monserrat, Patrick Marsch, “Fundamentals of 5G Mobile Networks” , Cambridge University Press.

3. Athanasios G.Kanatos, Konstantina S.Nikita, Panagiotis Mathiopoulos, “New Directions in Wireless Communication Systems from Mobile to 5G”, CRC Press.

4. Theodore S.Rappaport, Robert W.Heath, Robert C.Danials, James N.Murdock “Millimeter Wave Wireless Communications”, Prentice Hall Communications.

Reference Books:

1. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, John Wiley & Sons.

2. Amitabha Ghosh and Rapeepat Ratasuk “Essentials of LTE and LTE-A”, Cambridge University Press

SATELLITE COMMUNICATION

POOL-3 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03

Credits – 04

Course Objectives:

This course will enable the students to:

1. Understand the concepts, applications and subsystems of Satellite communications.
2. Derive the expression for G/T ratio and to solve some analytical problems on satellite link design.
3. Understand the various types of multiple access techniques and architecture of earth station design.
4. Understand the concepts of GPS and its architecture.

Unit -1	**Hours**
INTRODUCTION Origin of Satellite Communications, Historical Back-ground, Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications. **ORBITAL MECHANICS AND LAUNCHERS:** Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance.	**14**
Unit -2	
SATELLITE SUB SYSTEMS: Attitude and orbit control system, telemetry, tracking, Command and monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space qualification.	**12**
Unit – 3	
SATELLITE LINK DESIGN: Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N, System design example.	**10**
Unit – 4	
MULTIPLE ACCESS: Frequency division multiple access (FDMA) Intermodulation, Calculation of C/N. Time division Multiple Access (TDMA) Frame structure, link design using TDMA, Examples. Satellite Switched TDMA Onboard processing, DAMA, Code Division Multiple access (CDMA), Spread spectrum transmission and reception. **EARTH STATION TECHNOLOGY:** Introduction, Transmitters, Receivers, Antennas, Tracking systems, Terrestrial interface, Primary power test methods	**14**
Unit – 5	
LOW EARTH ORBIT AND GEO-STATIONARY SATELLITE SYSTEMS: Orbit consideration, coverage and frequency considerations, Delay & Throughput considerations, System considerations, Operational NGSO constellation Designs **SATELLITE NAVIGATION & THE GLOBAL POSITIONING SYSTEM:** Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers and codes, Satellite signal acquisition, GPS Navigation Message, GPS signal levels, GPS receiver operation, GPS C/A code accuracy, Differential GPS	**14**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Understand the concepts, applications and subsystems of Satellite communications.
2. Derive the expression for G/T ratio and to solve some analytical problems on satellite link design.
3. Understand the various types of multiple access techniques and architecture of earth station design.
4. Understand the concepts of GPS and its architecture.

Text Books:

1. Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.
2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud, 2nd Edition, Pearson Publications, 2003.
3. Digital satellite communication by TRI T HA …..TMH

Reference Books:

1. Satellite Communications: Design Principles – M. Richharia, BS Publications, 2nd Edition, 2003.
2. Satellite Communication - D.C Agarwal, Khanna Publications, 5th Ed.
3. Fundamentals of Satellite Communications – K.N. Raja Rao, PHI, 2004
4. Satellite Communications – Dennis Roddy, McGraw Hill, 2nd Edition, 1996.

OPTICAL COMMUNICATION

POOL-3 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03

Credits – 04

Course Objectives:

This course will enable the students to:

1. Design and build optical fiber experiments in the laboratory
2. Calculate electromagnetic modes in waveguides, the amount of light lost going through an optical system, dispersion of optical fibers.
3. Use different types of photo detectors and optical test equipment to analyze optical fiber and light wave systems.
4. Choose the optical cables for better communication with minimum losses

Unit -1	**Hours**
Overview of optical fiber communication - Historical development, The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, Cylindrical fibers- Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers, Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index, Related problems.	**13**
Unit -2	
Fiber materials: - Glass, Halide, Active glass, Chalgenide glass, Plastic optical fibers. Signal distortion in optical fibers-Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses, Information capacity determination, Group delay, Types of Dispersion: - Material dispersion, Wave-guide dispersion, Polarization-Mode dispersion, Intermodal dispersion, Pulse broadening in Graded index fiber, Related problems.	**13**
Unit – 3	
Optical fiber Connectors-Connector types, Single mode fiber connectors, Connector return loss, Fiber Splicing- Splicing techniques, Splicing single mode fibers, Fiber alignment and joint loss- Multimode fiber joints, single mode fiber joints.	**12**
Unit – 4	
Optical sources- LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Injection Laser Diodes- Modes, Threshold conditions, External quantum efficiency, Laser diode rate equations, Resonant frequencies, Reliability of LED&ILD, Optical detectors- Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors, Related problems.	**13**
Unit – 5	
Source to fiber power launching - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling, Optical receiver operation-Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of Error, Quantum limit, Analog receivers. **Optical system design** - Point-to- point links- Component choice and considerations, Link power budget, Rise time budget with examples, Line coding in Optical links, WDM, Necessity, Principles, Measurement of Attenuation and Dispersion, Eye pattern.	**13**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Choose necessary components required in modern optical communications systems.

2. Design and build optical fiber experiments in the laboratory, and learn how to calculate electromagnetic modes in waveguides, the amount of light lost going through an optical system, dispersion of optical fibers.
3. Use different types of photo detectors and optical test equipment to analyze optical fiber and light wave systems.
4. Choose the optical cables for better communication with minimum losses
5. Design, build, and demonstrate optical fiber experiments in the laboratory

Text Books:

1. Optical Fiber Communications – Gerd Keiser, Mc Graw-Hill International edition, 3rd Edition, 2000.
2. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.

Reference Books:

1. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education,2005.
2. Text Book on Optical Fiber Communication and its Applications – S.C.Gupta, PHI, 2005.
3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Edition, 2004.
4. Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education, 2004.

GLOBAL NAVIGATIONAL SATELLITE SYSTEMS

POOL-3 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03

Credits – 04

Course Objectives:

This course will enable the students to:

1. Understand global navigational satellite systems
2. Understand Indian Regional Navigational Satellite System
3. Develop GNSS Receiver

Unit -1	**Hours**
Introduction, GNSS overview, Global Positioning System, Russian GLONASS system, Galileo satellite system, Chinese BeiDou system, Regional system: Quasi-Zenith Satellite System (QZSS), Navigation with Indian Constellation (NavIC), Augmentations, Markets and Applications. **Fundamentals of satellite Navigation**: Concept of Ranging using Time of arrival Measurements: Two-Dimensional Position Determination, Principle of Position Determination via Satellite-Generated Ranging Codes, Fundamentals of satellite orbits: Orbital Mechanics, Constellation Design, Positioning determination using Ranging codes: Determining Satellite-to-User Range,	**14**
Unit -2	
Global positioning system: overview: Space Segment Overview, Control Segment Overview, User Segment Overview, Space segment description: GPS Satellite Constellation Description, Space Segment Phased Development, Control segment description: OCS Current Configuration, OCS Transition, OCS Planned Upgrades, User segment: GNSS Receiver Characteristics	**13**
Unit – 3	
Navigation with Indian Constellation (NavIC): overview, space segment, NavIC control segment, Geodesy and time system, Navigation services, signals, applications and NavIC user equipment	**12**
Unit – 4	
GNSS Receiver: Acquisition: Single Trial Detector, Tong Search Detector, M of N Search Detector, Combined Tong and M of N Search Detectors, FFT-Based Techniques, Direct Acquisition of GPS Military Signals, Vernier Doppler and Peak Code Search, carrier tracking, code tracking: Carrier Loop Discriminator, sequence of initial receiver operation.	**12**
Unit – 5	
GNSS errors: Introduction, Measurement errors: satellite clock error, ephemeris error, relative effects, atmospheric effects, receiver noise and resolution, multipath and shadowing effects, hardware bias errors, Psedorange error budgets.	**13**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Understand global navigational satellite systems
2. Understand Indian Regional Navigational Satellite System
3. Develop GNSS Receiver

Text Books:

1. Elliott D. Kaplan, Christopher J. Hegarty, **Understanding GPS/GNSS** principles and applications, third edition, artech house publishers, Boston, 2017

Reference Books:

1. G S Rao, Global Navigational satellite system, Tata McGraw-Hill education private Ltd, New Delhi, 2010
2. ISRO-IRNSS-ICD-SPS-1.1, Bangalore, 2017
3. Bhatta, B., 2010. Global Navigation Satellite Systems: Insights Into GPS, Glonass, Galileo, Compass, and Others, BS Publications, New Delhi.
4. Grewal, M. S., Weill, L. R., Andrews, A. P., 2006. Global Positioning Systems, Inertial Navigation, and Integration, John Wiley & Sons, New York.
5. Hofmann-Wellenhof, B., Lichtenegger, H., Wasle, E., 2008. GNSS – Global Navigation Satellite Systems, Springer, Verlag Wien.

SPEECH SIGNAL PROCESSING POOL-4 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Identify the time domain speech signal parameters
2. Differentiate time and frequency domain methods of speech processing
3. Attribute linear predictive analysis for speech signals
4. Explain the solutions for LPC equations

Unit -1	**Hours**
Mechanics of speech: Speech production: Mechanism of speech production, Acoustic phonetics, The Acoustic Theory of Speech Production: Uniform lossless tube, Effects of losses in the vocal tract, Digital models for speech signals: Vocal tract, Radiation, Excitation, Auditory perception: psycho acoustics. Representations of speech waveform: Sampling of speech signals, Quantization.	**12**
Unit -2	
Time and frequency domain methods for speech processing: Time domain parameters of Speech signal: Short-Time Energy, Average Magnitude, Average Zero Crossing Rate, Silence Discrimination using ZCR and energy, Short Time Auto Correlation Function, Pitch period estimation using Auto Correlation Function. Short Time Fourier analysis: Fourier transform and linear filtering interpretations, Sampling rates in time and frequency, Pitch detection, Analysis by Synthesis, Analysis synthesis systems: Phase vocoder, Channel Vocoder, Median Smoothing, Spectrographic displays.	**15**
Unit – 3	
Linear predictive analysis of speech: Basic Principles of linear predictive analysis: Auto correlation method, Covariance method, Solution of LPC equations: Cholesky method, Durbin's Recursive algorithm, Application of LPC parameters: Pitch detection using LPC parameters, Formant analysis using LPC parameters, VELP. Relations Between the Various Speech Parameters, CELP.	**14**
Unit – 4	
Application of speech processing: Voice response systems: General considerations in the design of voice response systems, A multiple output digital voice response system, Speaker recognition systems: Speaker verification system, Speaker identification system.	**12**
Unit – 5	
Speech recognition systems: Isolated digit recognition system, Continuous digit recognition system. Typical applications of computer voice response systems: Wiring communication equipment, Information retrieval systems.	**11**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Summarize the mechanism of human speech production and articulation
2. Identify the time domain speech signal parameters
3. Differentiate time and frequency domain methods of speech processing
4. Attribute linear predictive analysis for speech signals
5. Explain the solutions for LPC equations
6. Implementthedifferentalgorithmsandmodelsinvolvedforspeakerandspeechrecognition systems

Text Books:

1. L.R.Rabinerand, R.W.Schaffer, Digital Processing of Speech signals, Prentice Hall, 2004
2. Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons Inc., Singapore, 2004

Reference Books:

1. Quatieri, Discrete-time Speech Signal Processing, PrenticeHall,2001
2. L.R. Rabiner and B. H. Juang, Fundamentals of speech recognition, Prentice Hall, 1999.

VIDEO SIGNAL PROCESSING POOL-4 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Understand the formation of video, its perception and representation and characterization of video in frequency domain
2. Understand the concept of Lattice theory and sampling of video signals
3. Modeling of the video signal in different methods and understand the different motion estimation algorithms
4. Coding of video in different approaches / algorithms

Unit -1	**Hours**
Video formation, perception and representation – color perception and specification – video capture and display – Analog video raster – Analog color television systems, Digital video and Frequency Domain characterization of Video Signals.	**13**
Unit -2	
Video sampling – Basics of the Lattice theory, Sampling of Video Signals, Conversion of Signals Sampled on Different Lattices, Sampling Rate Conversion of Video Signals	**13**
Unit – 3	
Video modeling-Camera model, Illumination model, Object model and Scene model, Two dimensional models, Two Dimensional motion estimation-Types, Optical Flow, Pixel Based Motion, Block matching Algorithm.	**13**
Unit – 4	
Waveform Based Video Coding-Predictive coding, Video coding using Temporal prediction and transform coding, Content Dependent Video Coding – Two dimensional shape coding, Texture coding for Arbitrarily shaped Regions	**13**
Unit – 5	
Video Compression standards-Standardization- Video Telephony with H.261 and H.263-Multimedia content description with MPEG7	**12**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Understand the formation of video, its perception and representation and characterization of video in frequency domain
2. Understand the concept of Lattice theory and sampling of video signals
3. Modeling of the video signal in different methods and understand the different motion estimation algorithms
4. Coding of video in different approaches / algorithms
5. Knowledge in Video compression standards

Text Books:

1. Video Processing and Communication – 1st edition - Yao Wang, J.Ostermann, Ya Zhang, Prentice Hall, 2001.

Reference Books:

1. Image processing, analysis, and machine vision, 2nd Edition,-Sonka M, Hlavac V, Boyle R. Brooks Cole publishing, 1999.
2. Multidimensional, signal, image and video processing and coding, -Woods, Elsevier, Academic press, 2006.

ADAPTIVE SIGNAL PROCESSING POOL-4 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Study of different algorithms to develop the adaptive filter theory
2. Application of adaptive filter theory for different problems
3. Study of RLS & Kalman Filtering

Unit -1	**Hours**
Introduction to Adaptive Systems: Adaptive Systems: Definitions, Characteristics, Applications, Example of an Adaptive System. The Adaptive Linear Combiner - Description, Weight Vectors, Desired Response, Performance function - Gradient & Mean Square Error.	**13**
Unit -2	
Development of Adaptive Filter Theory & Searching the Performance surface: Introduction to Filtering - Smoothing and Prediction – Linear Optimum Filtering, Problem statement, Principle of Orthogonality - Minimum Mean Square Error, Wiener- Hopf equations, Error Performance surface Searching the performance surface – Methods & Ideas of Gradient Search methods, Gradient Searching Algorithm & its Solution, Stability& Rate of convergence, Learning Curve.	**13**
Unit – 3	
Steepest Descent Algorithms: Gradient Search by Newton's Method, Method of Steepest Descent, Comparison of Learning Curves.	**12**
Unit – 4	
LMS Algorithm & Applications: Overview - LMS Adaptation algorithms, Stability & Performance analysis of LMS Algorithms - LMS Gradient & Stochastic algorithms - Convergence of LMS algorithm. Applications: Noise cancellation – Cancellation of Echoes in long distance telephone circuits, Adaptive Beam forming	**13**
Unit – 5	
RLS & Kalman Filtering: Introduction to RLS Algorithm, Statement of Kalman filtering problem, The Innovation Process, Estimation of State using the Innovation Process-Expression of Kalman Gain, Filtering Examples using Kalman filtering.	**13**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Review the Adaptive Systems and Understand the various measures to be opted for developing adaptive system
2. Study of different algorithms to develop the adaptive filter theory
3. Application of adaptive filter theory for different problems
4. Study of RLS & Kalman Filtering

Text Books:

1. Adaptive Signal Processing - Bernard Widrow, Samuel D. Strearns, 2005, PE.
2. Adaptive Filter Theory - Simon Haykin-, 4th Ed., 2002, PE Asia.

Reference Books:

1. Optimum signal processing: An introduction – Sophocles .J. Orfamadis, 2nd Ed., 1988, McGraw-Hill, New York
2. Adaptive signal processing-Theory and Applications - S.Thomas Alexander, 1986, Springer – Verlag.
3. Signal analysis – Candy, McGraw Hill Int. Student Edition
4. James V. Candy - Signal Processing: A Modern Approach, McGraw-Hill, International Edition, 1988

BIO- MEDICAL SIGNAL PROCESSING POOL-4 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Understand different types of biomedical signal.
2. Identify and analyze different biomedical signals.
3. Find applications related to biomedical signal processing

Unit -1	**Hours**
Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, Study of diagnostically significant bio-signal parameters	**11**
Unit -2	
Electrodes for bio-physiological sensing and conditioning, Electrode-electrolyte interface, polarization, electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes (body surface, internal, array of electrodes, microelectrodes), Practical aspects of using electrodes, Acquisition of bio-signals (signal conditioning) and Signal conversion (ADC's DAC's) Processing, Digital filtering	**15**
Unit – 3	
Biomedical signal processing by Fourier analysis, Biomedical signal processing by wavelet (time-frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant)	**12**
Unit – 4	
Classification of signals and noise, Spectral analysis of deterministic, stationary random signals and non-stationary signals, Coherent treatment of various biomedical signal processing methods and applications	**12**
Unit – 5	
Principal component analysis, Correlation and regression, Analysis of chaotic signals Application areas of Bio–Signals analysis Multi resolution analysis (MRA) and wavelets, Principal component analysis(PCA), Independent component analysis(ICA). Pattern classification– supervised and unsupervised classification, Neural networks, Support vector Machines, Hidden Markov models. Examples of biomedical signal classification examples.	**14**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Understand different types of biomedical signal.
2. Identify and analyze different biomedical signals.
3. Find applications related to biomedical signal processing

Text Books:

1. W. J. Tompkins, "Biomedical Digital Signal Processing", Prentice Hall,1993.
2. Eugene N Bruce, "Biomedical Signal Processing and Signal Modeling", John Wiley & Son's publication,2001.

Reference Books:

1. Myer Kutz, "Biomedical Engineering and Design Handbook, Volume I", McGraw Hill, 2009.
2. D C Reddy, "Biomedical Signal Processing", McGraw Hill,2005.
3. Katarzyn J. Blinowska, Jaroslaw Zygierewicz, "Practical Biomedical Signal Analysis Using MATLAB", 1st Edition, CRC Press,2011

DSP PROCESSORS AND ARCHITECTURES POOL-4 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:
This course will enable the students to:

1. Able to distinguish between the architectural features of general purpose processors and DSP processors.
2. Understand the architectures of TMS320C54xx devices and ADSP 2100 DSP devices.
3. Able to write simple assembly language programs using instruction set of TMS320C54xx.
4. Can interface various devices to DSP Processors.

Unit -1	**Hours**
Introduction to Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation. Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.	**15**
Unit -2	
Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.	**12**
Unit – 3	
Programmable Digital Signal Processors: Commercial digital signal processing devices, Data Addressing modes of TMS320C54XX DSPs, data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX processors, program control, TMS320C54XX instructions and programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, pipeline Operation of TMS320C54XX Processors.	**13**
Unit – 4	
Analog Devices Family of DSP Devices: Analog Devices Family of DSP Devices ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP 2100, ADSP2181 high performance processor. Introduction to Blackfin Processor- The Blackfin Processor, Introduction to Micro signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.	**12**
Unit – 5	
Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).	**12**
Total	**64**

Course outcomes:
At the end of the course, students will be able to:

1. Understand the basics of Digital Signal Processing and transforms.
2. Able to distinguish between the architectural features of general purpose processors and DSP processors.
3. Understand the architectures of TMS320C54xx devices and ADSP 2100 DSP devices.
4. Able to write simple assembly language programs using instruction set of TMS320C54xx.

5. Can interface various devices to DSP Processors.

Text Books:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. A Practical Approach To Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007

Reference Books:

1. Digital Signal Processors, Architecture, Programming and Applications–B. Venkata ramani and M. Bhaskar, 2002, TMH.
2. DSP Processor Fundamentals, Architectures & Features – Lapsley et al., S. Chand & Co
3. Digital Signal Processing Applications Using the ADSP-2100 Family, Amy Mar, PHI
4. The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, California Technical Publishing
5. Embedded Media Processing, David J. Katz and Rick Gentile of Analog Devices, Newness

WAVELET THEORY POOL-4 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. differentiate windowed Fourier Transform and wavelet transform.
2. Characterize continuous and discrete wavelet transforms
3. Understand multiresolution analysis and identify various wavelets and evaluate their Time-frequency resolution properties
4. Analyze discrete wavelet transforms with multirate digital filters

Unit -1	**Hours**
The Age of Wavelets –Introduction-The Origins of Wavelets-Are They Fundamentally New- Wavelets and Other Reality Transforms, Managing Heisenberg's Uncertainty Ghost. History of Wavelet from Morlet to Daubechies Via Mallat , Different Communities of Wavelets, Different Families of Wavelets within Wavelet Communities, Interesting Recent Developments, Wavelets in the Future	**14**
Unit -2	
Introduction-Vector spaces – bases, orthonormality, projection, functions and function spaces, orthogonal functions, orthonormal functions, function spaces, orthogonal basis functions, orthonormality and the method of finding the coefficients, complex fourier series, orthogonality of complex exponential bases	**13**
Unit – 3	
Continuous Wavelet and Short time Fourier Transform-Wavelet Transform, mathematical preliminaries, continuous time frequency representation of signals, the windowed fourier transform (Short Time Fourier Transform), The uncertainty principle and time frequency tiling, properties of wavelets used in Continuous Wavelet Transform, Continuous Versus Discrete Wavelet Transform	**14**
Unit – 4	
Discrete Wavelet Transform-Haar scaling functions and function spaces, Nested Spaces, Haar Wavelet Function, Normalization of Haarbases at different scales, Standardizing the Notations, Refinement Relation with Respect to Normalized Bases, Support of a wavelet system, Daubechies Wavelets	**12**
Unit – 5	
Biorthogonal Wavelets-Biorthogonality in vector space, Biorthogonal Wavelet Systems, Signal Representation using Biorthogonal Wavelet System, Biorthogonal Analysis, Biorthogonal Synthesis, Construction of Biorthogonal Wavelet Systems.	**11**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Understand windowed Fourier transform and difference between windowed Fourier Transform and wavelet transform.
2. Understand wavelet basis and characterize continuous and discrete wavelet transforms
3. Understand multiresolution analysis and identify various wavelets and evaluate their Time-frequency resolution properties
4. Implement discrete wavelet transforms with multirate digital filters and can understand Wavelet packets
5. Design certain classes of wavelets to specification and justify the basis of the application of wavelet transforms to different fields

Text Books:

1. Insight into Wavelets: From theory to practice by K.P.Soman, Ramachandran, Resmi, PHI Learning PVT Ltd,2010
2. L.Prasad & S.S.Iyengar, Wavelet Analysis with Applications to Image Processing, CRC Press, 1997.

Reference Books:

1. Wavelet Transforms - Introduction to Theory and Applications, Raghuveer M.Rao, Ajit Bopardikar, Pearson Education, Asia
2. Fundaments of Wavelets - Theory, Algorithms and Applications, Jaideva C.Goswami, Andrew K. Chan, John Wiley & Sons.

MULTIRATE SYSTEMS AND FILTER BANKS POOL-4 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Describe the applications of multi-rate systems
2. Study of various filter banks
3. Analyze the efforts of quantization
4. Explain the overall multi-rate systems and filter banks

Unit -1	**Hours**
Fundamentals of Multirate Systems: Basic Multirate Operations, Interconnection of Building Blocks, The Polyphase representation, Multistage Implementations, Some Applications of Multirate Systems, Special Filters and Filter Banks	**13**
Unit -2	
Maximally Decimated Filter Banks: Errors created in the QMF Bank, A Simple Alias Free QMF System, Power Symmetric QMF Banks, M-Channel Filter Banks, Polyphase representation, Perfect Reconstruction Systems, Alias Free Filter Banks, Tree Structured Filter Banks, Trans-Multiplexers	**13**
Unit – 3	
Para unitary Perfect Reconstruction (PR) Filter Banks: Lossless Transfer Matrices, Filter Bank Properties Induced by Paraunitariness, Two channel FIR Para unitary QMF Banks, The Two channel Para unitary QMF Lattice, Transform Coding and the LOT.	**13**
Unit – 4	
Cosine Modulated Filter Banks: The Pseudo QMF Bank, Design of Pseudo QMF Bank, Efficient Polyphase Structures, Deeper Properties of Cosine Matrices, Cosine Modulated Perfect Reconstruction Systems.	**13**
Unit – 5	
Quantization effects, Types of Quantization effects, Review of standard techniques, Noise transmission in multirate systems, Noise in filter banks, Filter bank output noise, Limit Cycles, Coefficient Quantization	**12**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Understand the concepts multi-rate systems
2. Describe the applications of multi-rate systems
3. Study of various filter banks
4. Analyze the efforts of quantization
5. Explain the overall multi-rate systems and filter banks

Text Books:

1. Multirate Systems and Filter Banks, P.P.Vaidyanathan, Pearson Education, Low Priced Edition, 2006.

Reference Books:

1. Multirate Signal Processing for Communication Systems by F.J.Harris, Pearson Education, Low Priced Edition.
2. Digital Signal Processing, A computer Based Approach by Sanjit K Mitra, Tata McGraw Hill Publishing.

MATHEMATICAL METHODS FOR SIGNAL PROCESSING POOL-4 (HONOR)			
Subject Code	21ECECHXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03

Credits – 04

Course Objectives:

This course will enable the students to:

1. Solve the problem associated with linear algebra
2. Understand probability theory and conditional probability
3. Summarize the concepts associated with multiple random variables and to solve the problems associated with power spectral density of the output of the system.
4. Recognize the usage of random process in signal processing and to solve the corresponding problems.

Unit -1	**Hours**
Vectors: Representation and Dot products, Matrices: Matrix Multiplication, Transposes, Inverses, Gaussian Elimination, factorization, rank of a matrix, Vector spaces: Column and row spaces, Solving Ax=0 and Ax=b, Independence, basis, dimension, linear transformations, Orthogonality: Orthogonal vectors and subspaces, projection and least squares, Gram- Schmidt orthogonalization.	**14**
Unit -2	
Determinants: Determinant formula, cofactors, inverses and volume, Eigenvalues and Eigenvectors: characteristic polynomial, Diagonalization, Hermitian and Unitary matrices, Spectral theorem, Change of basis, Positive definite matrices and singular value decomposition, Linear transformations.	**14**
Unit – 3	
Review of Probability: Basic set theory and set algebra, basic axioms of probability, Conditional Probability, Bayes theorem/Law of total probability.	**10**
Unit – 4	
Random variables PDF/PMF/CDF Properties, random vectors marginal/joint/conditional density functions, transformation of Random Variables, characteristic/moment generating functions, Random sums of Random variables, Law of Large numbers (strong and Weak), Limit theorems convergence types, Inequalities Chebyshev/Markov/Chernoff bounds.	**13**
Unit – 5	
Random processes: classification of random processes, wide sense stationary processes, autocorrelation function and power spectral density and their properties. Examples of random process models - Gaussian/Markov Random process, Random processes through LTI systems.	**13**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Understand and solve the problems associated with Vectors
2. Solve the problem associated with linear algebra
3. Understand probability theory and conditional probability
4. Summarize the concepts associated with multiple random variables and to solve the problems associated with power spectral density of the output of the system.
5. Recognize the usage of random process in signal processing and to solve the corresponding problems.

Text Books:

1. Introduction to linear algebra - Gilbert Strang, SIAM, 2016.

2. Introduction to probability - Bertsekas and Tsitsiklis, Athena, 2008

Reference Books:

1. Probability and Random processes for Electrical Engineers, Leon Garcia Addison Wesley, 2nd edition, 1994
2. Probability and Random Processes, Geoffrey Grimmett, David Stirzaker, 3rd Edition, Oxford University Press, 2001.
3. Probability and Stochastic Process, Roy D Yates, David J Goodman, 2nd edition Wiley, 2010

COURSES

OFFERED FOR

MINORS

ELECTRONICS DEVICES AND BASIC CIRCUITS (MINOR COURSE)			
Subject Code	21ECECMXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Understand the formation of p-n junction and how it can be used as a p-n junction as diode in different modes of operation.
2. Know the construction, working principle of rectifiers with and without filters with relevant expressions and necessary comparisons.
3. Understand the construction, principle of operation of transistors, BJT and FET with their V-I characteristics in different configurations.
4. Know the need of transistor biasing, various biasing techniques for BJT and FET and stabilization concepts with necessary expressions.
5. Perform the analysis of small signal low frequency transistor amplifier circuits using BJT and FET in different configurations.

Unit -1	**Hours**
Review of Semiconductor Physics: Hall effect, continuity equation, law of junction, Fermi Dirac function, Fermi level in intrinsic and extrinsic Semiconductors **Junction Diode Characteristics :** energy band diagram of PN junction Diode, Open circuited p-n junction, Biased p-n junction, p-n junction diode, current components in PN junction Diode, diode equation, V-I Characteristics, temperature dependence on V-I characteristics, Diode resistance, Diode capacitance.	**14**
Unit -2	
Special Semiconductor Devices: Zener Diode, Breakdown mechanisms, Zener diode applications, LED, Varactor Diode, Photodiode, Tunnel Diode, UJT, PNPN Diode, SCR. Construction, operation and V-I characteristics. **Rectifiers and Filters:** Basic Rectifier setup**,** half wave rectifier, full wave rectifier, bridge rectifier, derivations of characteristics of rectifiers, rectifier circuits-operation, input and output waveforms, Filters, Inductor filter(Series inductor), Capacitor filter(Stunt inductor), π- Filter, comparison of various filter circuits in terms of ripple factors	**14**
Unit – 3	
Transistor Characteristics: **BJT:** Junction transistor, transistor current components, transistor equation, transistor configurations, transistor as an amplifier, characteristics of transistor in Common Base, Common Emitter and Common Collector configurations, Ebers-Moll model of a transistor, punch through/ reach through, Photo transistor, typical transistor junction voltage values. **FET:** FET types, construction, operation, characteristicsμ, gm, rd parameters, MOSFET-types, construction, operation, characteristics, comparison between JFET and MOSFET.	**12**
Unit – 4	
Transistor Biasing and Thermal Stabilization: Need for biasing, operating point, load line analysis, BJT biasing- methods, basic stability, fixed bias, collector to base bias, self bias, Stabilization against variations in VBE, Ic, and β, Stability factors, (S,S',S''), Bias compensation, Thermal runaway, Thermal stability. FET Biasing- methods and stabilization.	**12**
Unit – 5	
Small Signal Low Frequency Transistor Amplifier Models: **BJT:** Two port network, Transistor hybrid model, determination of h-parameters, conversion of h-parameters, generalized analysis of transistor amplifier model using h-parameters, Analysis of CB, CE and CC amplifiers using exact and approximate analysis, Comparison of transistor amplifiers.	**12**

FET: Generalized analysis of small signal model, Analysis of CG, CS and CD amplifiers, comparison of FET amplifiers.	
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Apply the basic concepts of semiconductor physics.
2. Understand the formation of p-n junction and how it can be used as a p-n junction as diode in different modes of operation.
3. Know the construction, working principle of rectifiers with and without filters with relevant expressions and necessary comparisons.
4. Understand the construction, principle of operation of transistors, BJT and FET with their V-I characteristics in different configurations.
5. Know the need of transistor biasing, various biasing techniques for BJT and FET and stabilization concepts with necessary expressions.

Text Books:

1. Electronic Devices and Circuits- J. Millman, C. Halkias, Tata Mc-Graw Hill, SecondEdition,2007
2. Electronic Devices and Circuits by David A. Bell, Oxford University Press
3. Electronics devices & circuit theory- Robert L.Boylestad and Loui Nashelsky, Pearson/Prentice hall, tenth edition,2009

Reference Books:

1. Integrated Electronics-J. Millman, C. Halkias,Tata Mc-Graw Hill, Second Edition, 2009
2. Electronic Devices and Circuits-K. Lal Kishore, BS Publications, Fourth Edition, 2016.
3. Electronic Devices and Circuits-Salivahanan, Kumar, Vallavaraj, Tata Mc-Graw Hill, 4th Edition, 2008.
4. Electronic Devices and Integrated Circuits – B.P. Singh, Rekha , Pearson publications, 2006.

DIGITAL ELECTRONICS (MINOR COURSE)			
Subject Code	21ECECMXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Use the concept of Boolean algebra in minimization of switching functions
2. Design different types of combinational logic circuits.
3. Apply knowledge of flip-flops in designing of Registers and counters
4. The operation and design methodology for synchronous sequential circuits and algorithmic state machines.

Unit -1	**Hours**
REVIEW OF NUMBER SYSTEMS & CODES: Representation of numbers of different radix, conversation from one radix to another radix, r- 1's compliments and r's compliments of signed members. Gray code ,4 bit codes; BCD, Excess-3, 2421, 84-2-1 code etc. Error detection & correction codes: parity checking, even parity, odd parity, Hamming code. **BOOLEAN THEOREMS AND LOGIC OPERATIONS:** Boolean theorems, principle of complementation & duality, De-morgan theorems. Logic operations; Basic logic operations -NOT, OR, AND, Universal Logic operations, EX-OR, EX-NOR operations. Standard SOP and POS Forms, NAND-NAND and NOR-NOR realizations, Realization of three level logic circuits. Study the pin diagram and obtain truth table for the following relevant ICs 7400,7402,7404,7408,7432,7486.	**15**
Unit -2	
MINIMIZATION TECHNIQUES: Minimization and realization of switching functions using Boolean theorems, K-Map (up to 6 variables) and tabular method (Quine-mcCluskey method) with only four variables and single function. **COMBINATIONAL LOGIC CIRCUITS DESIGN:** Design of Half adder, full adder, half subtractor, full subtractor, applications of full adders; 4- bit adder-subtractor circuit, BCD adder circuit, Excess 3 adder circuit and carry look-a-head adder circuit, Design code converts using Karnaugh method and draw the complete circuit diagrams.	**15**
Unit – 3	
COMBINATIONAL LOGIC CIRCUITS DESIGN USING MSI &LSI: Design of encoder, decoder, multiplexer and de-multiplexers, Implementation of higher order circuits using lower order circuits. Realization of Boolean functions using decoders and multiplexers. Design of Priority encoder, 4-bit digital comparator and seven segment decoder. Study the relevant ICs pin diagrams and their functions 7442,7447,7485,74154. **INTRODUCTION OF PLD's:** PLDs: PROM, PAL, PLA -Basics structures, realization of Boolean functions, Programming table.	**12**
Unit – 4	
SEQUENTIAL CIRCUITS I: Classification of sequential circuits (synchronous and asynchronous) , operation of NAND & NOR Latches and flip-flops; truth tables and excitation tables of RS flip-flop, JK flip-flop, T flip-flop, D flip-flop with reset and clear terminals. Conversion from one flip-flop to another flip-flop. Design of 5ripple counters, design of synchronous counters, Johnson counter, ring counter. Design of registers - Buffer register, control buffer register, shift register, bidirectional shift register, universal shift, register. Study the following relevant ICs and their relevant functions 7474,7475,7476,7490,7493,74121.	**12**

Unit – 5	
SEQUENTIAL CIRCUITS II: Finite state machine; state diagrams, state tables, reduction of state tables. Analysis of clocked sequential circuits Mealy to Moore conversion and vice-versa. Realization of sequence generator, Design of Clocked Sequential Circuit to detect the given sequence (with overlapping or without overlapping).	**10**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Classify different number systems and apply to generate various codes.
2. Use the concept of Boolean algebra in minimization of switching functions
3. Design different types of combinational logic circuits.
4. Apply knowledge of flip-flops in designing of Registers and counters
5. The operation and design methodology for synchronous sequential circuits and algorithmic state machines.

Text Books:

1. Switching and finite automata theory Zvi.KOHAVI, Niraj.K.Jha 3rd Edition, Cambridge University Press,2009
2. Digital Design by M.Morris Mano, Michael D Ciletti,4th edition PHI publication,2008
3. Switching theory and logic design by Hill and Peterson**,** Mc-Graw Hill TMH edition, 2012.

Reference Books:

1. Fundamentals of Logic Design by Charles H. Roth Jr, Jaico Publishers,2006
2. Digital electronics by R S Sedha.S.Chand& company limited,2010
3. Switching Theory and Logic Design by A. Anand Kumar, PHI Learning pvt ltd,2016.
4. Digital logic applications and design by John M Yarbough, Cengage learning, 2006.
5. TTL 74-Series data book.

PRINCIPLES OF COMMUNICATION SYSTEMS (MINOR COURSE)			
Subject Code	21ECECMXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:
This course will enable the students to:

1. Analyze the performance of angle modulated signals.
2. Characterize analog signals in time domain as random processes and noise
3. Characterize the influence of channel on analog modulated signals
4. Determine the performance of analog communication systems in terms of SNR

Unit -1	**Hours**
Amplitude modulation: Introduction, Amplitude Modulation: Time & Frequency – Domain description, switching modulator, Envelop detector. **Double side band-suppressed carrier modulation:** Time and Frequency –Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing. **Single side and vestigial sideband methods of modulation:** SSB Modulation, VSB Modulation, Frequency Translation, Frequency-Division Multiplexing, Theme Example: VSB Transmission of Analog and Digital Television	**14**
Unit -2	
Angle modulation: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, **Phase–Locked Loop:** Nonlinear model of PLL, Linear model of PLL, Nonlinear Effects in FM Systems. The Super-heterodyne Receiver	**14**
Unit – 3	
Random variables & process: Introduction, Probability, Conditional Probability, Random variables, Several Random Variables. Statistical Averages: Function of a random variable, Moments, Random Processes, Mean, Correlation and Covariance function: Properties of autocorrelation function, Cross–correlation functions. **Noise**: Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth, Noise Figure.	**14**
Unit – 4	
Noise in analog modulation: Introduction, Receiver Model, Noise in DSB-SC receivers, Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis and De-emphasis in FM.	**11**
Unit – 5	
Digital representation of analog signals: Introduction, Why Digitize Analog Sources? The Sampling process, Pulse Amplitude Modulation, Time Division Multiplexing, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves, The Quantization Process, Quantization Noise, **Pulse Code Modulation:** Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing	**11**
Total	**64**

Course outcomes:
At the end of the course, students will be able to:

1. Analyze the performance of analog modulation schemes in time and frequency domains.
2. Analyze the performance of angle modulated signals.
3. Characterize analog signals in time domain as random processes and noise

4. Characterize the influence of channel on analog modulated signals
5. Determine the performance of analog communication systems interms of SNR

Text Books:

1. Principles of Communication Systems – H Taub& D. Schilling, Gautam Sahe, TMH, 2007, 3rd Edition.
2. Communication Systems–B.P.Lathi,BSPublication,2006.

Reference Books:

1. Principles of Communication Systems – Simon Haykin, John Wiley, 2nd Edition.
2. Electronics & Communication System – George Kennedy and Bernard Davis, TMH 2004.
3. Communication Systems–R.P. Singh, SPSapre, Second EditionTMH,2007.

SIGNAL ANALYSIS (MINOR COURSE)			
Subject Code	21ECECMXXXX	Internal Marks	30
Number of Lecture Hours/Week	04	External Marks	70
Total Number of Lecture Hours	64	Exam Hours	03
Credits – 04			

Course Objectives:

This course will enable the students to:

1. Differentiate the various classifications of signals and systems
2. Analyze the frequency domain representation of signals using Fourier concepts
3. Know the sampling process and various types of sampling techniques.
4. Apply Laplace and z-transforms to analyze signals and Systems (continuous & discrete)

Unit -1	**Hours**
INTRODUCTION: Definition of Signals and Systems, Classification of Signals, Classification of Systems, Operations on signals: time-shifting, time-scaling, amplitude shifting, amplitude-scaling. Problems on classification and characteristics of Signals and Systems. Complex exponential and sinusoidal signals, Singularity functions and related functions: impulse function, step function signum function and ramp function. Analogy between vectors and signals, orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, closed or complete set of orthogonal functions, Orthogonality in complex functions. Related Problems.	**14**
Unit -2	
FOURIER Analysis of Periodic Signals: Fourier series representation of continuous time periodic signals, properties of Fourier series, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Relation between Trigonometric and Exponential Fourier series, Complex Fourier spectrum.	**12**
Unit – 3	
FOURIER Analysis of Aperiodic Signals: Deriving Fourier transform from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms, Fourier transforms involving impulse function and Signum function. Introduction to Hilbert Transform. Related Problems	**13**
Unit – 4	
CORRELATION: Auto-correlation and cross-correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between Convolution and correlation **SAMPLING THEOREM :** Graphical and analytical proof for Band Limited Signals, impulse sampling, Natural and Flat top Sampling, Reconstruction of signal from its samples, effect of under sampling – Aliasing, Introduction to Band Pass sampling, Related problems.	**14**
Unit – 5	
LAPLACE TRANSFORMS: Introduction**,** Concept of region of convergence (ROC) for Laplace transforms, constraints on ROC for various classes of signals, Properties of L. T's, Inverse Laplace transform, Relation between L. T's, and F.T. of a signal. **Z–TRANSFORMS:** Concept of Z- Transform of a discrete sequence. Region of convergence in Z-Transform, constraints on ROC for various classes of signals, Inverse Z-transform, properties of Z-transforms. Distinction between Laplace, Fourier and Z transforms.	**11**
Total	**64**

Course outcomes:

At the end of the course, students will be able to:

1. Differentiate the various classifications of signals and systems

2. Analyze the frequency domain representation of signals using Fourier concepts
3. Know the sampling process and various types of sampling techniques.
4. Apply Laplace and z-transforms to analyze signals and Systems (continuous & discrete).

Text Books:

1. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2ndEdn,1997

Reference Books:

1. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2ndEdition,2007