Dr. M.G.R.
EDUCATIONAL AND RESEARCH INSTITUTE
DEEMED TO BE UNIVERSITY
University with Graded Autonomy Status
(An ISO 21001 : 2018 Certified Institution)
Periyar E.V.R. High Road, Maduravoyal, Chennai-95. Tamilnadu, India.

FACULTY OF ENGINEERING AND TECHNOLOGY

OUTCOME BASED CURRICULUM

Curriculum and Syllabus

BACHELOR OF TECHNOLOGY
ELECTRONICS AND COMMUNICATION ENGINEERING
(PART TIME)
2022

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

VISION AND MISSION OF THE DEPARTMENT

VISION

- To create centers of excellence in evolving competent core areas of Electronics and Communication Engineering and effectively respond to the demands of industry, R & D organizations.
- To emerge as a premier centre of technology for research using open source tools

MISSION

- **M1**: To accomplish academic excellence through valuable teaching-learning processes to meet requirements of the industry and society.
- **M2**: To prepare students to face the challenges in the field of electronics and communication engineering and prepare them as responsible engineers with ethical values.
- **M3**: To promote the zeal for innovation and creativity among students towards research and development.
- **M4**: To augment students with skills needed for employability, entrepreneurship and for pursuing higher studies.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- **PEO 1**: To emphasize on the fundamental concepts of Electronics and Communication Engineering.
- **PEO 2**: To provide a conducive academic learning environment by creating awareness on lifelong learning and promoting research to excel in their career through higher education.
- **PEO 3**: To impart analytical skills to explore socially acceptable and economically feasible solutions for the real life problems using modern design tools.
- **PEO 4**: To inculcate effective communication skills and ethical team work so as to be capable of functioning in diverse environments.
- **PEO 5**: To instill leadership traits among the students and hone their innovative skills to become successful entrepreneurs.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Upon the completion of program, graduates will be able to

- **PSO1**: Recognize, adapt the knowledge of science, engineering and mathematics for providing solutions to techno-economical problems in real world.
- **PSO2**: Formulate logical approach to solve engineering problems in core area of Electronics and Communication Engineering.
- **PSO3**: Demonstrate inter-disciplinary subject knowledge in diverse fields of Engineering and Technology.
- **PSO4**: Apply the emerging technology and open source tool for life-long learning to face the challenges in society.

PROGRAM OUTCOMES (POs)

Engineering graduates will be able to:

- **PO-1** Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO-2** Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **PO-3** Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **PO-4** Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **PO-5** Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO-6** The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **PO-7** Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **PO-8** Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO-9** Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO-10** Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **PO-11** Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **PO-12** Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

MISSION/ PEO	PEO1	PEO2	PEO3	PEO4	PEO5
M1	3	2	2	1	1
M2	3	2	3	3	1
M3	2	3	2	1	2
M4	2	3	1	1	3

Mapping of MISSION with PEO

PEO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	3	3	3	1		1					2
PEO2	2	2	3	3	1			2	1			3
PEO3	2	3	3	3	3					1	1	
PEO4						2	3	2	3	3	3	1
PEO5						2	1	2	3	3		3

Mapping of PEO with PO

PEO/PSO	PSO1	PSO2	PSO3	PSO4
PEO1	1	3		2
PEO2	2	3	1	2
PEO3	2	2		3
PEO4		1	3	3
PEO5	2		2	

Mapping of PEO with PSO

Strength of Correlation : 3-High, 2-Medium, 1-Low

B.Tech. Electronics and Communication Engineering
(Part Time)
Curriculum – 2022 Regulation

Semester: 1

S.No.	SUBJECT CODE	SUBJECT NAME	Ty/ Lb/ ETL/IE	L	T/ SLr	P/ R	C	CATEGORY
1	EBEC22018	Circuit And Networks	Ty	3	1/0	0/0	4	PC
2	EBCS22ID2	C++ and Java Programming	Ty	3	0/0	0/0	3	ID
3	EBEC22003	Digital Electronics	Ty	3	1/0	0/0	4	PC
4	EBEC22019	Solid State Devices	Ty	3	0/0	0/0	3	PC
5	EBEC22L01	Digital Electronics Lab	Lb	0	0/0	3/0	1	PC

Credits Sub Total: 15

Semester: 2

S.No.	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/ R	C	CATEGORY
1	EBMA22010	Probability and Random Process	Ty	3	1/0	0/0	4	BS
2	EBEC22004	Electronic Circuits	Ty	3	0/0	0/0	3	PC
3	EBEC22007	Analog Communication	Ty	3	0/0	0/0	3	PC
4	EBEE22ID2	Electrical and Instrumentation Engineering	Ty	3	0/0	0/0	3	ID
5	EBEC22L03	Electronic Circuits Lab	Lb	0	0/0	3//0	1	PC

Credits Sub Total: 14

Semester: 3

S.No.	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/ R	C	CATEGORY
1	EBEC22006	Linear Integrated Circuits	Ty	3	0/0	0/0	3	PC
2	EBEC22005	Control Systems Engineering	Ty	3	1/0	0/0	4	PC
3	EBEC22009	Microprocessor and Microcontroller	Ty	3	0/0	0/0	3	PC
4	EBEC22ET2	Field and Wave Electromagnetics	ETL	2	0/0	2/0	3	PC
5	EBEC22L07	Microprocessor and Microcontroller Lab	Lb	0	0/0	3/0	1	PC

Credits Sub Total: 14

Semester: 4

S.No.	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/ R	C	CATEGORY
1	EBEC22010	Digital Signal Processing	Ty	3	1/0	0/0	4	PC
2	EBEC22012	Digital Communication	Ty	3	1/0	0/0	4	PC
3	EBCC22ID2	Principles Of Management and Behavioral Science	Ty	3	0/0	0/0	3	ID
4	EBEC22EXX	Program Elective I	Ty	3	0/0	0/0	3	PE
5	EBEC22L14	Analog and Digital Communication Lab	Lb	0	0/0	3/0	1	PC

Credits Sub Total: 15

Semester: 5

S.No.	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/ R	C	CATEGORY
1	EBEC22011	Sensors and Robotics	Ty	3	0/0	0/0	3	PC
2	EBEC22008	Communication Networks	Ty	3	0/0	0/0	3	PC
3	EBEC22020	VLSI and Embedded System Design	Ty	3	0/0	0/0	3	PC
4	EBEC22EXX	Program Elective II	Ty	3	0/0	0/0	3	PE
5	EBEC22L11	VLSI and Embedded System Design Lab	Lb	0	0/0	3/0	1	PC

Credits Sub Total: 13

Semester: 6

S.no.	Subject code	subject name	Ty/Lb/ ETL/IE	L	T/ SLr	P/ R	C	Category
1	EBEC22017	Wireless Networks	Ty	3	1/0	0/0	4	PC
2	EBEC22021	Optical Communication	Ty	3	0/0	0/0	3	PC
3	EBEC22022	RF and Microwave Engineering	Ty	3	0/0	0/0	3	PC
4	EBEC22EXX	Program Elective III	Ty	3	0/0	0/0	3	PE
5	EBEC22I05	Project Phase - I	Lb	0	0/0	3/3	2	P

Credits Sub Total: 15

Semester: 7

S.No.	SUBJECT CODE	SUBJECT NAME	Ty/Lb/ ETL/IE	L	T/ SLr	P/R	C	CATEGORY
1	EBEC22EXX	Program Elective IV	TY	3	0/0	0/0	3	PE
2	EBEC22EXX	Program Elective V	TY	3	0/0	0/0	3	PE
3	EBEC22L13	Project Phase - II	LB	0	0/0	12/ 12	8	P

Credits SubTotal: 14

Semester 1:15
Semester 2:14
Semester 3: 14
Semester 4: 15
Semester 5: 13
Semester 6: 15
Semester 7: 14

Total Credits: 100

C : Credits L : Lecture T : Tutorial S.Lr : Supervised Learning P : Problem / Practical R : Research
T/L/ETL: Theory/Lab/Embedded Theory and Lab

LIST OF PROGRAM ELECTIVES							
S.No	**SUBJECT CODE**	**SUBJECT NAME**	**Ty/Lb/ ETL/IE**	**L**	**T/SLr**	**P/R**	**C**
ELECTIVE 1 – Electronics stream							
1.	EBEC22E01	Semiconductor Devices and its Applications	Ty	3	0/0	0/0	3
2.	EBEC22E02	Real time Operating Systems	Ty	3	0/0	0/0	3
3.	EBEC22E03	Introduction to PLC	Ty	3	0/0	0/0	3
ELECTIVE 1 –Communication stream							
4.	EBEC22E04	Antenna and Wave Propagation	Ty	3	0/0	0/0	3
5.	EBEC22E05	Telecommunication Switching Systems	Ty	3	0/0	0/0	3
6.	EBEC22E06	Audio Signal Processing	Ty	3	0/0	0/0	3
ELECTIVE 2 – Electronics stream							
7.	EBEC22E07	Intelligent Instrumentation	Ty	3	0/0	0/0	3
8.	EBEC22E08	Advanced Microprocessors	Ty	3	0/0	0/0	3
9.	EBEC22E09	Nano Electronics	Ty	3	0/0	0/0	3
ELECTIVE 2 –Communication stream							
10.	EBEC22E11	Internet of Things and its Application	Ty	3	0/0	0/0	3
11.	EBEC22E13	Neural networks and its Applications	Ty	3	0/0	0/0	3
12.	EBEC22E14	Radar and Navigational Aids	Ty	3	0/0	0/0	3
ELECTIVE 3 - Electronics stream							
13.	EBEC22E16	Embedded Software Design	Ty	3	0/0	0/0	3
14.	EBEC22E17	Quantum Computing	Ty	3	0/0	0/0	3
15.	EBEC22E18	Power Electronics	Ty	3	0/0	0/0	3
ELECTIVE 3 –Communication stream							
16.	EBEC22E19	High Speed Switching Architecture	Ty	3	0/0	0/0	3
17.	EBEC22E20	Information Coding Techniques	Ty	3	0/0	0/0	3
18.	EBEC22E21	Optical Network and Switching Techniques	Ty	3	0/0	0/0	3
ELECTIVE 4 - Electronics stream							
19.	EBEC22E23	Device Modeling	Ty	3	0/0	0/0	3
20.	EBEC22E24	VLSI Technology	Ty	3	0/0	0/0	3
21.	EBEC22E25	Biomedical Instrumentation	Ty	3	0/0	0/0	3
ELECTIVE 4 –Communication stream							
22.	EBEC22E28	Satellite Communication	Ty	3	0/0	0/0	3
23.	EBEC22E29	Next Generation Communication	Ty	3	0/0	0/0	3
24.	EBEC22E30	Cognitive Radio	Ty	3	0/0	0/0	3
ELECTIVE 5 - Electronics stream							
25.	EBEC22E31	Introduction to MEMS System Design	Ty	3	0/0	0/0	3
26.	EBEC22E32	Analysis and Design of Analog IC’s	Ty	3	0/0	0/0	3
27.	EBEC22E33	Cyber Physical System	Ty	3	0/0	0/0	3
ELECTIVE 5 –Communication stream							
28.	EBEC22E35	Electromagnetic Interference and Compatibility	Ty	3	0/0	0/0	3
29.	EBEC22E36	Advanced Concepts in Signal Processing	Ty	3	0/0	0/0	3
30.	EBEC22E37	Ultra Wide Band Communication	Ty	3	0/0	0/0	3

COMPONENTS OF CURRICULUM AND CREDIT DISTRIBUTION

Course Component	Description	No. Of Courses	Credits	Total	Credit Weightage	Contact Hours
BASIC SCIENCCE	Theory	1	4	4	4	60
	Lab					
	ETL					
	Lab					
	ETL					
PROGRAM CORE	Theory	16	54	62	62	1095
	Lab	5	5			
	ETL	1	3			
PROGRAM ELECTIVES	Theory	5	15	15	15	225
	Lab					
	ETL					
INTER-DISCIPLINARY	Theory	3	9	9	9	135
	Lab					
	ETL					
PROJECT		2	10	10	10	90
OTHERS IF ANY						
	Total	33	100	100	100	1605

REVISION/MODIFICATIONS DONE IN THE SYLLABUS

S.No	Course (Subject) Code	Course (Subject) Name	Concept/ topic if any, removed in current curriculum	Concept/topic added in the new curriculum	% of Revision/ Modification done
1	EBEC22005	Control Systems Engineering	State Space Analysis in Unit 5 merged into Unit 1. Nichols Chart, and Constant M and N circles, Compensators, have been included as Qualitative	Design of Controllers as a case study included in Unit 5	20%
2	EBEC22006	Linear Integrated Circuits			ETL Converted into theory
3	EBEC22008	Computer Networks			Nomenclature changed as Communicatio n Networks
4	EBEC22E12	Next Gen IP Networks	Unit 2 (IP Encapsulation Security Payload-IP Authentication using Keyed MD5-The ESP DES-CBC Transform) Unit 4 (User Packet Routing and Transport, Configuring PDP Addresses on Mobile Stations, GPRS Attach Procedure, Access to MWIF Networks, Session Management)		20%
5	EBEC22010	Digital Signal Processing	UNIT4(Multirate Signal Processing)	Finite word length effects	20%
6	EBEC22L07	Microprocessor and Microcontroller Lab		8085 Experiments Added	No Changes
7	EBEC22ET2	Field and Wave Electromagnetic s	Electromagnetics topic in Units 1 & 2 have been compressed into a single Unit with qualitative treatment	Plane Wave Propagation has been added	20%

S.No	Course (Subject) Code	Course (Subject) Name	Concept/ topic if any, removed in current curriculum	Concept/topic added in the new curriculum	% of Revision/ Modification done
8	EBEC22009	Microprocessors and Microcontrollers	Advanced 80386 Architecture, Addressing modes – Data types of 80386 – Real address mode of 80386 – Segmentation , paging , Salient Features of PENTIUM. ARM Architecture –ARM programmer's model- ARM development tools- memory hierarchy- ARM assembly language programming-Simple Examples- Architectural support for operating system- ARM instruction Set- Embedded ARM Applications	Register organization, memory segmentation, Signal descriptions of 8086-common function signals, minimum mode and maximum mode system design, timing diagrams, Interrupts of 8086 Instruction formats, Addressing modes, instruction set, assembler Directives. Macros, Simple programs involving Arithmetic, logical, branch and call instructions. Sorting, evaluating arithmetic expressions, string manipulations DC Motor speed Control using PWM, RTC and EEPROM interface using I2C protocol, Traffic Light Interface, Interfacing matrix Keyboard, and (16x2) LCD interfacing	Elective converted into a core paper
9	EBEC22E08	Advanced Microprocessors	ARM Architecture –ARM programmer's model- ARM development tools- memory hierarchy - ARM assembly language programming-Simple Examples- Architectural support for operating system- ARM instruction Set-Embedded ARM Applications	Implementation of Strings, Procedures, Macros, BIOS and DOS Services using X86 Assembly Language Programming, Memory and I/O Interfacing, Analog Interfacing and Industrial Control.	20%

S.No	Course (Subject) Code	Course (Subject) Name	Concept/ topic if any, removed in current curriculum	Concept/topic added in the new curriculum	% of Revision/ Modification done
10	EBEC22E09	Nano Electronics	UNIT 1: Nano-scale electronics; Foundation of Nano-electronics; Size & Scale Units Scaling Atoms, Molecules, Clusters and Supramolecules; Materials for Nano electronics- Semiconductors- Electron energy bands UNIT-2: SYNTHESIS AND MEASUREMENT TECHNIQUES Synthesis- Sol-gel methods, Mechanical methods: ball milling, mechanical attrition, Thin films methods: chemical vapor deposition, physical vapor deposition UNIT III NANO MATERIALS & ITS PROPERTIES UNIT-IV NANO STRUCTURE DEVICES No Changes UNIT-5 APPLICATIONS OF NANOTECHNOLOGY Nano sensors- Nano electronics in Diagnostics applications, Environmental, Agricultural and Food, Nano electronics for energy systems- batteries, solar cells.	Microelectronics towards biomolecule electronics Growth, fabrication, and measurement techniques for nanostructures- Bulk crystal and heterostructure growth- Nanolithography, etching, and other means for fabrication of nanostructures Chemical and biological methods for Nano scale fabrication- Fabrication of Nano-electromechanical systems. Electron transport in semiconductors and nanostructures- Time and length scales of the electrons in solids- Statistics of the electrons in solids and nanostructures. Logic Devices-Silicon MOSFETs-Ferroelectric Field Effect Transistors- Superconductor Digital Electronics-Quantum Computing Using Superconductors- Carbon Nanotubes for Data Processing- Molecular Electronics	50

S.No	Course (Subject) Code	Course (Subject) Name	Concept/ topic if any, removed in current curriculum	Concept/topic added in the new curriculum	% of Revision/ Modification done
11	EBEC22012	Digital Communication		Geometric Representation of signals – Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK – QAM – Carrier Synchronization – Structure of Non-coherent Receivers – Principle of DPSK.	20% To Study about the digital modulation scheme the contents have been included
				Hamming codes	In Error control coding hamming codes plays a vital role hence it is added
12	EBEC22L14	Communication Engineering lab			Nomenclature changed to Analog and Digital communication Lab

DETAILS OF NEW COURSES, ELECTIVES, INTER DISCIPLINARY, LIFE SKILL, COURSES FOCUSED ON EMPLOYABILITY, ENTREPRENEURSHIP, SKILL ETC.

S.No	New Courses (Subjects)	Value Added Courses	Life Skill	Electives	Interdisciplinary	Focus On Employability/Entrepreneurship/Skill Development.
1					Electrical and Instrumentation Engineering	
2					C++ and Java Programming	
3	Sensors and Robotics					
4	Electronic Circuits Lab					
5	VLSI Design and Embedded System Lab					
6						Principles Of Management and Behavioral Science

SEMESTER-1

Subject Code:	**Subject Name : CIRCUITS AND NETWORKS**	**Ty /Lb/ ETL/IE**	**L**	**T / S.Lr**	**P/ R**	**C**
EBEC22018	**Prerequisite: Mathematical Knowledge, Basic Electrical Concepts**	**Ty**	**3**	**1/0**	**0/0**	**4**

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To understand the concept of circuit elements lumped circuits, waveforms, circuit laws and network reduction
- To solve the electrical network using mesh and nodal analysis by applying network theorems
- To learn methods of circuits analysis in time domain and frequency domain
- To understand the concept of resonance in Series and parallel circuits and to know the concepts of coupled circuits.
- Obtaining equations to solve circuits in steady state and transient state

COURSE OUTCOMES (COs) : (3- 5)
The student will be able to

CO1	Understand the concept of circuits, network theorems and various circuit laws
CO2	Analyze and solve a given electrical networks using mesh and nodal analysis
CO3	Done their inferences to analyze circuits analysis in time domain and frequency domain
CO4	Demonstrate their skills in understanding the concept of various resonance and coupled circuits
CO5	Apply their understanding to derive the analyze the equations with respect to solving circuit transients.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**				
CO1	**3**	**3**	**3**	**3**				
CO2	**3**	**3**	**3**	**3**				
CO3	**3**	**3**	**3**	**3**				
CO4	**3**	**3**	**3**	**3**				
CO5	**3**	**3**	**3**	**3**				

3/2/1 indicates Strength of Correlation 3- High,2- Medium,1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : CIRCUITS AND NETWORKS	Ty /Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22018	Prerequisite: Mathematical Knowledge, Basic Electrical Concepts	Ty	3	1/0	0/0	4

UNIT-I: BASIC CIRCUIT CONCEPTS **12 Hrs**

V-I Relationships Of R, L And C – Independent Sources – Dependent Sources – Kirchhoff's Laws - Simple Resistive Circuits – Network Reduction – Voltage Division – Current Division – Source Transformation. Formation of Matrix Equations and Analysis Using Mesh-Current and Node-Voltage Methods.

UNIT-II: AC FUNDAMENTALS **12 Hrs**

AC Quantity, Phasor Representation – Analysis Of Simple Series And Parallel Circuits – Power And Power Factor – Analysis Mesh Current And Node Voltage Methods – Series Resonance And Parallel Resonance

UNIT-III: NETWORK THEOREM AND DUALITY **12Hrs**

Useful Circuit Analysis techniques - Linearity and superposition, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Super position theorem - Delta-Wye Conversion. Duals, Dual circuits.

UNIT- IV: TRANSIENT ANALYSIS **12 Hrs**

Transient Concepts-Behavior Of Circuit Elements Under Switching Conditions and Their Representation-Forced and Free Response of RL, RC And RLC Circuits with D.C. And Sinusoidal Excitations Using Laplace Transform Method – Natural Frequency and Damping Facto

UNIT-V: COUPLED CIRCUITS **12 Hrs**

Mutual Inductance – Coefficient Of Coupling – Ideal Transformer – Analysis Of Multi Winding Couple Circuits – Single & Double Tuned Circuits – Critical Coupling.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 60

TEXTBOOKS :

1. A.Sudhakar & Shyanmugam S.Palli *" Circuits & Network Analysis & Synthesis*", 4th Edition, Tata McGraw Hill, 2010
2. Bruce Carlson, "*Circuits: Engineering Concepts and Analysis of Linear Electric Circuits*", Thomson Learning, 1st Edition, 2002
3. M.L Soni & J.C. Gupta, " *Electric Circuit Analysis"*, Dhanpat Rai & Sons , New Delhi, 1999.

REFERENCE BOOKS:

1. Hyatt, W.H. Jr and Kimmerly, J.E., "*Engineering Circuits Analysis*", McGraw Hill International Editions,1993.
2. Edminister, J.A., "*Theory and Problems of Electric Circuits*", Schaum's Outline Series McGraw Hill Book Company, 2nd Edition, 1983.
3. Paranjothi S.R., "*Electric Circuit Analysis*", New Age International Ltd., Delhi, 2nd Edition, 2000.
4. Artice.M. Davis, "*Linear Circuits Analysis*", Thomson Learning 2002
5. Roy Choudhury, "*Networks and Systems*", New Age International Ltd, 1992

Subject Code:	Subject Name : C++ AND JAVA PROGRAMMING	Ty / Lb/ ETL/IE	L	T/SL r	P/R	C
EBCS22ID2	Prerequisite: Programming and Multimedia	Ty	3	0/0	0/0	3

	lab					

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To introduce the Object Oriented Programming concepts using C++ and JAVA
- To understand object oriented programming concepts, and apply them in solving problems.
- To introduce the concepts of exception handling and multithreading
- To analyze basic data structures as well as programming techniques and algorithms that operates on them.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Understand fundamentals of C++ programming such as variables, conditional and iterative execution, methods, etc.
CO2	Analyze the use of function to create programs and evaluate the concepts of inheritance and polymorphism
CO3	Identify the basic concepts of Java programming
CO4	Design and development of programs for File and exceptions handling using JAVA
CO5	Evaluate the concepts data structures and corresponding algorithms

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**1**	**1**	**3**	**3**	**2**	**3**	**2**		**2**		**3**	**2**
CO2	**2**	**3**	**3**	**3**	**3**	**3**	**3**		**3**	**1**	**3**	**2**
CO3	**2**	**3**	**3**	**3**	**3**	**3**	**3**		**3**	**1**	**3**	**2**
CO4	**2**	**3**	**3**	**3**	**3**	**3**	**3**		**3**	**1**	**3**	**2**
CO5	**2**	**3**	**3**	**3**	**3**	**3**	**3**		**3**		**3**	**2**

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**2**	**2**	**3**	**3**
CO2	**3**	**1**	**3**	**3**
CO3	**3**	**1**	**3**	**3**
CO4	**3**	**1**	**3**	**3**
CO5	**2**	**1**	**3**	**3**

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill	Practical / Project			
							✓					

Subject Code:	**Subject Name : C++ AND JAVA PROGRAMMING**	**Ty / Lb/ ETL/IE**	**L**	**T/SLr**	**P/R**	**C**
EBCS22ID2	**Prerequisite: Programming and Multimedia lab**	**Ty**	**3**	**0/0**	**0/0**	**3**

UNIT I INTRODUCTION TO C++ 9 Hrs

Programming Paradigms - Key Concepts of OOP - Advantages of OOP - Usage of OOP -Evolution of C++ -Input and Output in C++-Streams-Stream classes-Keywords, Identifiers, Variables, Operators, Expressions and Control Structures: If, If. Else, Switch - Repetitive Statements- for, while, do…while - arrays

UNIT II CLASSES, INHERITANCE & TEMPLATES 9 Hrs

Main Function – Parts of function - Parameters Passing in Functions - Function Overloading - Constructors and Destructors- types -Operator Overloading - Inheritance - Pointers - Virtual Functions and Polymorphism

UNIT III INTRODUCTION TO JAVA 9 Hrs

Introduction to Java : Basics of Java programming- Data types- Variables –Operators -Control structures Decision making- Looping control- Math class-string class-Arrays in java

UNIT IV FILE AND EXCEPTION HANDLING 9 Hrs

File handling in java- Character stream – Java File class methods – File operations –Exception handling-Exceptions Methods-Catch-throw-Finally

UNIT V DATASTRUCTURES USING JAVA 9 Hrs

Array-One Dimensional -Two Dimensional-Linked list-Single-Doubly-circular- Stack- Queue- Trees – Graphs

Practical component P : Include case studies / application scenarios
Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

Textbooks:

1. The Complete Reference C++, 4th Edition, Herbert Schildt, Tata McGraw Hill..
2. Java Fundamentals – A comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.
3. The C++ Programming Language, 3rd Edition, B. Stroutstrup, Pearson Education.
4. Weiss, Mark Allen (2012). Data Structures and Algorithm Analysis in Java. 3rd ed. Prentice Hall.

Reference Books:

1. OOP in C++, 3rd Edition, T. Gaddis, J. Walters and G. Muganda, Wiley Dream Tech Press.
2. Object Oriented Programming in C++, 3rd Edition, R. Lafore, Galigotia Publications Pvt Ltd.
3. Java for Programmers, P. J. Deitel and H. M. Deitel, Pearson education (OR) Java: How to Program P. J. Deitel and H. M. Deitel, PHI.
4. Object Oriented Programming through Java, P. Radha Krishna, Universities Press.
5. Data Structures and Algorithms in Java,Robert Lafore ,Sams Publishing

Subject Code:	Subject Name : DIGITAL ELECTRONICS	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22003	Prerequisite: Basic electronics and computer concepts	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To give a conceptual understanding about the Digital fundamentals, Boolean algebra and its applications in digital systems.
- To familiarize with the design of various combinational digital circuits using logic gates.
- To introduce the analysis and design procedure for synchronous and asynchronous sequential circuits.
- To explain various semiconductors memoriesnand relate technology.
- To introduce the electronic circuits involved in making of logic gates.

COURSE OUTCOMES (COs) : (3- 5)

The Student will be able to

CO1	Apply Boolean Algebra, Karnaugh map and Quine McCluskey methodology to minimize the given Boolean functions.
CO2	Design and implement combinational logic circuits.
CO3	Design and analyze the synchronous sequential circuits.
CO4	Design and analyze the asynchronous sequential circuits
CO5	Compare different types of logic families based on their characteristics and summarize types of semiconductor memories.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	3	2					
CO2	3	3	3	2	3	3	2				2	2
CO3	3	3	3	2	3	3	2				2	2
CO4	3	3	3	2	3	3	2				2	2
CO5	3	1	1	1	1	3	2					2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2
CO2	3	3	2	2
CO3	3	3	2	2
CO4	3	3	2	2
CO5	2	2	2	2

3/2/1 indicates Strength of Correlation 3- High,2- Medium,1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : DIGITAL ELECTRONICS	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22003	Prerequisite: Basic electronics and computer concepts	Ty	3	1/0	0/0	4

UNIT I DIGITAL FUNDAMENTALS 12 Hrs

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1 s and 2 s complements, Codes –Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Minimization using Karnaugh map, and Quine-McCluskey method.

UNIT II COMBINATIONAL LOGIC 12 Hrs

Design of Combinational Logic Circuits – Half adder – Full adder, Half Subtractor,Full Subtractor – Binary parallel adder-Carry lookahead adder-BCD adder– Code Converters – Multiplexer – Demultiplexer-Encoder – Decoder –Magnitude comparator

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 12 Hrs

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, – Design - Moore/Mealy models, state minimization, state assignment,State Reduction techniques- Design of Counters- Ring Counters, Shift registers,analysis of clocked sequential circuits.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 12 Hrs

Design of asynchronous sequential circutis-Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Design of Hazard free circuits.

UNIT V LOGIC FAMILIES 12 Hrs

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) -Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) – Implementation of combinational logic circuits using PLA, PAL.Digital logoc families, propagation delay, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics- TTL, ECL, CMOS-Operation and its Characteristics.

Practical component P : Include case studies / application scenarios
Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 60

TEXTBOOKS:

1. Charles H. Roth, "*Fundamentals of Logic Design*", cengageLearning, 5th Edition
2. FLOYD:"*Digital Fundamentals*", 10th Edition Universal Book Stall, New Delhi.1993
3. Morris Mano, "*Digital Electronics and Design*", Prentice Hall of India, 2000 .
4. A.Anand Kumar ―Fundamentals of Digital Circuits‖, 4th Edition, PHI Learning Private Limited, 2016.
5. Soumitra Kumar Mandal ― Digital Electronics‖, McGraw Hill Education Private Limited,2016.

REFERENCE BOOKS:

1. *John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008*
2. *Jayadeep Chakravarthy "Digital electronics and logic design", Universities press.(2012)*
3. *John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.*
4. *Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.*
5. *Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.*
6. *Donald D.Givone, "Digital Principles and Design", TMH, 2003*

Subject Code:	Subject Name : SOLID STATE DEVICES	Ty / Lb/ ETL/IE	L	T/S Lr	P/ R	C
EBEC22019	Prerequisite: Basics of Electrical and Electronics.	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To learn the theory of semiconductor devices such as diodes and zener diode
- To study the working and biasing of bipolar junction transistors both PNP and NPN.
- To understand the construction and operation of FET and MOSFET and their biasing.
- To study behavior of power electronic devices like SCR, UJT, etc. and photo devices.
- To study the small signal model and analysis of transistors and FET

COURSE OUTCOMES (COs) : (3- 5)

The students will be able to

CO1	Learn semiconductor devices like diodes and zener diode
CO2	Know working and biasing of bipolar junction transistors.
CO3	Understand the construction and operation of FET and MOSFET
CO4	Study the behavior of power electronic and photo electronic devices.
CO5	Analyze transistors and FET using small signal model

Mapping of Course Outcomes with Program Outcomes (POs)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2
CO1	3	1	2	1	2	2	1	3	3	2	2	2
CO2	3	1	1	2	1	3	2	2	2	2	1	1
CO3	3	3	1	1	1	2	2	3	2	1	3	2
CO4	3	2	1	1	1	3	3	3	2	2	2	1
CO5	3	3	2	2	2	2	1	1	2	2	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	1
CO2	3	2	2	2
CO3	3	2	1	3
CO4	3	2	2	3
CO5	3	3	2	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project
				✓					

Subject Code:	Subject Name : SOLID STATE DEVICES	Ty / Lb/ ETL/IE	L	T/S Lr	P/ R	C
EBEC22019	Prerequisite: Basics of Electrical and Electronics.	Ty	3	0/0	0/0	3

UNIT I SEMICONDUCTOR DIODES 9 Hrs

Theory of PN Junction Diode – VI characteristics – Static and Dynamic Resistance – Effect of Temperature on Diodes – Space Charge and Diffusion Capacitance - Zener Diode – Avalanche and Zener Break Down Mechanisms – Zener Diode as a Voltage Regulator.

UNIT II BJT & BIASING 9 Hrs

Principles of Transistor Action – Current Components – Cut Off, Active & Saturation Region – I/P & O/P characteristics CE, CB and CC. Small Signal Large Signal 'β', Break Down & Switching Characteristics – Transistor Biasing – Bias Stabilization – Bias Compensation – Thermal Runaway – Design with Heat Sink.

UNIT III FET & MOSFET 9 Hrs

Construction Feature & Working Principles of JFET, MOSFET Depletion and Enhancement Mode, Biasing of FET, and MOSFETS, Transmission Gate using CMOS.

UNIT IV POWER DEVICES 9 Hrs

Charge Transfer Device, UJT, SCR, Diac, Triac, GTO, MCT and Introduction to Gallium Arsenide Devices, FinFET, LDR, Photo Voltaic cell, Varactor diode.

UNIT V SMALL SIGNAL MODEL 9 Hrs

Small Signal Model of Transistor- Analysis of Amplifiers using Small Signal Model. Common Emitter, Common Base, Common Collector, Common Source, Common Drain, Common Gate, Multistage Amplifiers.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXTBOOKS:

1. Nandita Das Gupta, Amitava Das Gupta, "Semiconductor Devices", Prentice Hall of India, 2005
2. Sedra and Smith, "Microelectronic Circuits" Oxford University Press, 2004
3. Mohammed Gausi and Spencer, "Introduction to Electronics Circuit Design", Pearson Education, 2004

REFERENCE BOOKS:

1. *Boylestad, Robert. L and Nashelsky Louis ," Electronic Devices and Circuit theory" Prentice Hall of India,6th Edition, 2001*
2. *William & Harris, "Electronic Devices and Circuits", Tata McGraw Hill International Editions, 2000*
3. *Millman Halkias, "Electron Devices", Tata McGraw Hill, 2000.*
4. *Donald neamam, " Micro electronics" , Tata McGraw Hill, 2007.*
5. *Sedra smith, " Micro Electronic Circuits" Fifth edition,2013.*

Subject Code	Subject Name : DIGITAL ELECTRONICS LAB	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22L01	Prerequisite: nil	Lb	0	0/0	3/0	0

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To design and develop a programmable digital circuit for practical applications

COURSE OUTCOMES (COs) : (3- 5)
The Students will be able to

CO1	Develop a simple digital circuits
CO2	Test the working of logic gates and flip flops.
CO3	Implement a digital sequential circuits for real time applications

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	2	2	1	1		1			1
CO2	3	2	3	2	2					1		
CO3	3	2	3	2	2	1	1		2			1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3
CO2	3	3		3
CO3	3	3		3

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code	Subject Name : DIGITAL ELECTRONICS LAB	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22L01	Prerequisite: nil	Lb	0	0/0	3/0	0

LIST OF EXPERIMENTS:

1. Verification of Truth tables of Logic Gates
2. Implementation of Boolean function
3. Implementation of Half and full Adders
4. Implementation of Half and full Subtractors
5. Implementation of Multiplexers
6. Implementation of Demultiplexers
7. Implementation of Encoder
8. Implementation of Decoders
9. Verification of Flip – Flops
10. Implementation of Shift Registers
11. Implementation of Counters
12. Study of A to D Converters

Total Number of Hours: 45

SEMESTER II

Subject Code	Subject Name : PROBABILITY AND RANDOM PROCESS	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
EBMA22010	Prerequisite: Higher secondary Mathematics	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

The student should be made to:

To understand the basic concepts in the Probability like Independent events, mutually exclusive events and so on.
To understand the various Standard Discrete and Continuous probability distributions.
To understand the Basic concepts in Random process like Poisson process, Markov process and so on.
To understand the concepts like Auto correlation and Cross correlation
To understand the concepts like Cross spectral density

COURSE OUTCOMES (COs) :

CO1	To understand the Basic concepts in Probability
CO2	To understand the Basic concepts in Probability distributions
CO3	To understand the Basic concepts in Random process
CO4	To understand the Basic concepts in Correlation
CO5	To understand the Basic concepts in Spectral density

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2	1	2	1	1	2	2	3
CO2	3	2	1	3	1	2	2	1	1	1	2	3
CO3	3	3	2	2	1	1	1	2	1	2	1	3
CO4	3	3	2	3	2	1	2	1	2	2	1	2
CO5	2	3	1	3	2	1	2	2	1	1	2	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	3	1	2
CO2	2	2	1	3
CO3	1	2	2	3
CO4	2	3	2	3
CO5	2	3	1	2

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
	✓											

Subject Code	Subject Name : PROBABILITY AND RANDOM PROCESS	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
EBMA22010	Prerequisite: Higher secondary Mathematics	Ty	3	1/0	0/0	4

UNIT I RANDOM VARIABLES 12 Hrs

Baye's Theorem – Applications – Random Variables – Distribution functions – Moments – Moment Generating functions – Chebychev's Inequality (Statement and Applications only) – Function of Random Variables.

UNIT II STANDARD DISTRIBUTIONS 12 Hrs

Marginal and Conditional Distributions – Applications of Discrete Distributions: Binomial – Poisson – Geometric – Applications of Continuous distributions: Uniform – Exponential– Normal distributions – Central Limit theorem (Statement and Applications only).

UNIT III RANDOM PROCESS 12 Hrs

Stationary Process – Ergodic Process – Poisson Process – Applications: Birth and Death Process – Markov Process – Markov Chains.

UNIT IV CORRELATION 12 Hrs

Auto Correlation – Auto Covariance – Cross Correlation – Cross Covariance.

UNIT V LINEAR SYSTEMS - APPLICATIONS 12Hrs

Spectral Density – Cross Spectral Density – Applications to Linear Systems with Random Inputs and Outputs.

Total Number. of hrs: 60

REFERENCE BOOKS:

1) Veerarajan T., *Probability, Statistics and, Random Processes*, Tata McGraw Hill Publishing Co., (2008).
2) Singaravelu, *Probability and Random Processes*, Meenakshi Agency, (2017).
3) Gupta S.C., Kapoor V.K., *Fundamentals of Mathematical Statistics*, S.Chand & Co., (2007).
4) Richard Johnson A., *Miller & Freund's Probability and statistics for Engineers (9th ed)*, Prentice Hall of India, (2016).

Subject Code:	Subject Name: ELECTRONIC CIRCUITS	Ty / Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22004	Prerequisite: Solid State Devices	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- On completion of this course the student will understand
- The construction and operation of rectifiers
- Design of amplifier circuits
- Working of oscillators
- Construction of multivibrators
- Design of power amplifiers

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Discuss various types of rectifiers.
CO2	Design different amplifiers with required gain independently
CO3	Construct the feedback amplifiers and oscillators for desired frequency.
CO4	Calculate the delay and design multivibrator circuits
CO5	Design and construct power amplifiers for different applications.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	1	2	3	2	3	3
CO2	3	3	3	3	3	2	2	3	2	2	3	3
CO3	3	3	3	3	3	1	1	2	3	3	3	2
CO4	3	3	3	3	3	1	1	1	3	3	2	2
CO5	3	3	2	3	3	1	2	1	3	2	1	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3
CO2	3	2	3	3
CO3	3	2	3	2
CO4	3	3	2	1
CO5	3	3	3	3

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project		
				✓							

Subject Code:	Subject Name: ELECTRONIC CIRCUITS	Ty / Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22004	Prerequisite: Solid State Devices	Ty	3	0/0	0/0	3

UNIT I REGULATED POWER SUPPLIES **9 Hrs**

Linear mode power supply - Rectifiers: Half-wave rectifier - Full-wave rectifier - Bridge rectifier - Filters: L, C, LC and CLC filter - Voltage regulators - series and shunt - Over load protection - Switched mode power supply (SMPS) –IC voltage regulators.

UNIT II FEEDBACK AMPLIFIERS **9 Hrs**

Basic concept of feedback - Gain with feedback - Feedback factor - General characteristics of negative feedback amplifiers - Effect of negative feedback on input and output resistance; topologies of feedback amplifiers - Analysis of series-shunt, series-series, shunt-series and shunt-shunt feedback amplifiers - Nyquist criterion for stability of feedback amplifiers - Gain and phase margin.

UNIT III OSCILLATORS **9 Hrs**

Classification of Oscillators - Barkhausen criterion for oscillation - RC phase shift, Wien bridge and Twin-T oscillator - General form of LC oscillator - Hartley, Colpitts and Clapp oscillator - Ring oscillators - Crystal oscillators – Equivalent circuit of crystal - Miller and Pierce crystal oscillator - Frequency stability of oscillator.

UNIT IV WAVE SHAPING AND MULTIVIBRATOR CIRCUITS **9 Hrs**

RC differentiator and integrator - Diode clippers and clampers – Multivibrators - Collector-coupled astable multivibrator, monostable multivibrator and bistable multivibrator - Triggering methods for bistable multivibrators - Schmitt trigger - UJT relaxation oscillator.

UNIT V POWER AMPLIFIERS AND TUNED AMPLIFIERS **9 Hrs**

BJT Power amplifiers - Class A - Class B - Class AB - Class C - MOSFET Power amplifiers –Tuned amplifiers- Q of tank circuits- Single tuned amplifier-Frequency response - Double tuned amplifier - Effect of cascading single tuned and double tuned amplifiers on bandwidth - Stagger tuned amplifiers - Comparison of tuned amplifiers .

Practical component P: Include case studies / application scenarios
Research component R: Future trends / research areas / Comparative Analysis

Total number of hrs: 45

TEXT BOOKS

1. Adel S. Sedra, Kenneth C. Smith, Microelectronic Circuits, Oxford University Press, Seventh Edition, 2016.
2. Salivahanan S and Suresh Kumar N, Electronic Devices and Circuits, McGraw Hill Education, Fourth Edition, 2017

REFERENCE BOOKS

1. Millman J, Halkias C and Chetan D. Parikh, Integrated Electronics, McGraw Hill Education (India) Private Ltd., Second Edition, 2015.
2. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, Eleventh Edition, 2016.
3. Millman J, Taub H and Suryaprakash Rao Mothiki, Pulse Digital and Switching Waveforms, McGraw Hill Education (India) Private Ltd., Third Edition, 2011.
4. David A. Bell, Solid State Pulse Circuits, Prentice Hall of India, Fourth Edition, 1992.
5. David A. Bell, Electronic Devices and Circuits, Oxford University Press, Fifth Edition, 2017.

Subject Code:	Subject Name : ANALOG COMMUNICATION	Ty/ Lb/ ETL/IE	L	T/S Lr	P/ R	C
EBEC22007	Prerequisite: Probability and random process	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To study various Amplitude modulation and demodulation systems.
- To provide some depth analysis in noise performance of various receiver.
- To study some basic information theory with some channel coding theorem.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Identify the types of Noise and express the need for modulation.
CO2	Illustrate the concepts of amplitude modulation and its transmission technique.
CO3	Articulate the generation & demodulation of FM systems.
CO4	Analyze the analog to digital conversion methods.
CO5	Implement the coding techniques and calculate the channel capacity.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	3	2	3	1	2	3	1	2
CO2	3	3	3	3	3	2	2	2	2	2	3	3
CO3	3	3	3	3	3	2	2	1	2	2	3	3
CO4	3	3	3	3	3	1	2	1	2	2	3	3
CO5	3	3	3	3	3	1	2	3	1	2	2	3

COs/ PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3
CO2	3	3	3	3
CO3	3	3	3	3
CO4	3	2	2	3
CO5	3	2	3	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : ANALOG COMMUNICATION	Ty/ Lb/ ETL/IE	L	T/S Lr	P/ R	C
EBEC22007	Prerequisite: Probability and random process	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO COMMUNICATION SYSTEMS AND NOISE 9 Hrs

Basic Communication Systems – Need for Modulation in Communication Systems - Noise - Sources of Noise – Types of Noise - External Noise – Thermal Agitation – Shot Noise – Noise Figure – Signal to Noise Ratio – Equivalent Noise Resistance, Amplitude Modulation and demodulation- Frequency Spectrum – power relations in Amplitude Modulation.

UNIT II CONTINUOUS MODULATION SYSTEMS 9 Hrs

Balanced Modulator, DSB – SC, SSB and VSB – Modulation and Demodulation - AM Transmitter, Receiver- Types, AM receivers.

UNIT III ANGLE MODULATION 9 Hrs

Frequency modulation – Mathematical representation of FM – Frequency Spectrum – Phase Modulation – Noise triangle – Pre-emphasis, de- emphasis- Comparison of Wide band and Narrow band FM, AFC - Stereophonic FM multiplex system – Generation of FM - FM receivers - Communication receivers.

UNIT IV ANALOG TO DIGITAL CONVERSION 9 Hrs

Sampling Theorem - PAM- Quantization of signal - Quantization Error – PWM , PPM – Introduction to digital modulation systems – ASK, FSK, PSK – Transmitter and receiver.

UNIT V INFORMATION THEORY AND CODING 9 Hrs

Introduction –Information - Entropy - Information rate, Classification of codes, Kraft McMillan inequality –-Source coding theorem - Shannon , Fano coding - Huffman coding, Joint and conditional entropies– Channel capacity -- Mutual information.

Practical component P : Include case studies / application scenarios
Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXTBOOKS :

1. Roy Blake, "*Electronic Communication Systems*", Thomson Learning 2nd Edition, 2002.
2. George Kennedy: "*Electronic Communication Systems*", Tata McGraw Hill publications, 1992.
3. R Bose, "*Information theory, Coding and Cryptography*", TMH 2007.

REFERENCE BOOKS:

1. *1.K.C.Raveendranath,"Communication system modeling and simulation using matlab& Simulink" universities press, 2011.*
2. *Taub & Schilling," Principles of Communication", Tata McGraw Hill,1986 3.Simon Haykins, "Principles of Communications", Prentice Hall of India. 2001*

Subject Code:	Subject Name : ELECTRICAL AND INSTRUMENTATION ENGINEERING	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
EBEE22ID2	Prerequisite: Basic Electrical concepts	Ty	3	0	0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

The student should be made to:

- Constructional details, principle of operation, performance, starters and testing of D.C. machines.
- To illustrate the operating principle and performance of transformers.
- Constructional details, principle of operation and performance of AC rotating machines.
- To summarize the operating principle of alternators and special machines.
- Constructional details and principle of operation electrical measuring instruments
- Constructional details and principle of operation electronic measuring instruments

COURSE OUTCOMES (COs) :

CO1	Illustrate the working principle of DC machines.
CO2	Analyze the losses, efficiency and voltage regulation of transformers.
CO3	Identify the appropriate rotating machines for various applications
CO4	Explain the types and operating principles of electrical measuring instruments
CO5	Interpret the features of various electronic instruments

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	2	1	2	2	2	1
CO2	3	3	3	3	2	2	2	1	2	1	2	1
CO3	3	3	2	3	3	3	2	2	2	2	3	2
CO4	3	2	3	3	3	3	2	2	3	2	3	3
CO5	3	3	3	3	3	3	2	2	3	2	3	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2
CO2	3	3	3	2
CO3	3	3	2	2
CO4	3	3	2	2
CO5	2	3	2	3

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
							✓					

Subject Code:	Subject Name : ELECTRICAL AND INSTRUMENTATION ENGINEERING	Ty/Lb/ ETL/IE	L	T/ S.Lr	P/R	C
EBEE22ID2	Prerequisite: Basic Electrical concepts	Ty	3	0	0	3

UNIT-I: D.C MACHINES **9 Hrs**

Introduction – Constructional Features– Motor and Generator mode - EMF and Torque equation –Starting and Speed Control-Testing And Efficiency – Losses in DC Machines -Brushless DC Motors- Universal Motor –Stepper Motor –Servo Motor - Tachogenerator - Linear Induction Motor

UNIT-II: TRANSFORMERS **9 Hrs**

Introduction - Ideal and Practical Transformer - EMF Equation – Phasor diagram– Per Unit System – Equivalent circuit- Testing- - Losses and Efficiency – Voltage Regulation – Three Phase Transformers – Auto Transformers, Advantages- Harmonics.

UNIT-III: AC ROTATING MACHINES **9 Hrs**

Principle of operation of three-phase induction motors – Construction –Types –Single phase Induction motors -Construction– Types–starting methods. Alternator: Working principle–Equation of induced EMF Synchronous motors- working principle-starting methods – Torque equation.

UNIT-IV: MEASUREMENTS USING ELECTRICAL INSTRUMENTS **9 Hrs**

Functional elements of an instrument-Standards and calibration- Operating Principle -types - Moving Coil and Moving Iron meters-Measurement of three phase power -Energy Meter- Instrument Transformers-CT and PT-DSO- Block diagram- Data acquisition

UNIT-V: MEASUREMENTS USING ELECTRONIC INSTRUMENTS **9Hrs**

Electronic Instruments: CRO: -Measurements of Voltage & Frequency, Function generator:- Frequency Measurements in Various Range and Wave Form : Power Supply: -Fixed and Variable :Multi-meter:- Measurement of Voltage ,Current, Frequency, R,L,C : IC tester:-Linear ICs and Non Linear ICs

Practical component P: Include case studies / application scenarios

Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hrs: 45

TEXT BOOKS:

1. Mulukutla.S.Sarma, “Electric Machines, Stead state theory and dynamic Performance", 2nd Edition Thomson Learning 1997
2. S.K Bhattacharya, “Electrical Machines”, 3rd Edition Tata McGraw Hill Publications 2008.
3. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, New Delhi, 2015.

REFERENCES:

1. I.J. Nagrath & D.P. Kothari, “Electrical Machines”, Tata McGraw Hill Publications, Second Edition 1997.
2. Nasar S.A, “Electrical Machines & Power Systems”, TMH Publications
3. I McKenzie Smith ,“Hughes Electrical Technology”, Revised Low price Edition, Pearson Education, Seventhedition.
4. Irving I.Kosow, “Electric Machinery and Transformers”, PHI, Second Edition, 2001

Subject Code:	Subject Name : ELECTRONICS CIRCUITS LAB	Ty /Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22L03	Prerequisite: Nil	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To gain hands on experience in designing electronic circuits.
- To familiarize students with the implementation of basic analog circuits using discrete components.
- To observe characteristics of electronic circuits.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Construct and Verify rectifier circuits.
CO2	Design amplifiers and oscillators using transistors
CO3	Design multivibrators and power amplifiers
CO4	Verify network theorems,KCLand KVL

Mapping of Course Outcomes with Program Outcomes (POs)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	1	3	2	2	3	2
CO2	3	2	3	2	2	1	2	2	1	2	2	1
CO3	2	3	3	3	1	1	1	1	2	2	2	2
CO4	2	3	2	3	3	2	1	1	2	1	2	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3
CO2	3	3	3	2
CO3	3	2	3	2
CO4	2	2	2	2

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
									✓			

Subject Code:	Subject Name : ELECTRONICS CIRCUITS LAB	Ty /Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22L03	Prerequisite: Nil	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Verification of Half–Wave Rectifier
2. Verification of Full-Wave Rectifier
3. Shunt Voltage Regulator
4. Frequency Response of RC Coupled Amplifier.
5. Hartley and Colpitts Oscillators
6. Wien Bridge Oscillator
7. Waveshapping Circuits Clipper and Clamper
8. Monostable Multivibrator Circuit
9. Astable Multivibrator Circuit
10. Class A Power Amplifier
11. Verification of Network Theorems
12. Mesh and Node Analaysis

Total Number of Hours: 45

SEMESTER- III

Subject Code:	Subject Name : LINEAR INTEGRATED CIRCUITS	Ty / Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22006	Prerequisite: Electronic Circuits/Digital electronics	Ty	3	0	0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To introduce the basics of linear integrated circuits.
- To understand the applications of operational amplifiers.
- To design comparators, signal generators and timers.
- To express analog multiplier and PLL.
- To examine the concepts of IC regulators and Data converters.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Recognize the basics of linear IC's and characteristics of operational amplifier
CO2	Express various applications of op-amp.
CO3	Design comparators and signal generators using op-amp.
CO4	Analyze the characteristics of Analog multipliers and PLL.
CO5	Examine IC regulators and implement data convertors for real time application.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	3	1	2	1	2	2
CO2	3	3	3	3	3	3	3	1	2	1	2	2
CO3	3	3	3	3	3	2	2	1	3	1	1	2
CO4	3	3	3	3	3	3	3	1	2	1	2	1
CO5	3	3	3	3	3	3	3	1	2	1	2	2

COs/ PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	3	3	3	3
CO3	3	3	3	3
CO4	3	2	2	2
CO5	3	3	2	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : LINEAR INTEGRATED CIRCUITS	Ty / Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22006	Prerequisite: Electronic Circuits/Digital electronics	Ty	3	0	0	3

UNIT I INTRODUCTION TO INTEGRATED CIRCUITS 9 Hrs

Integrated circuit and its classification, Introduction to Operational amplifier-General operational amplifier stages-Internal circuit diagram of IC 741, Ideal Op-Amp , DC & AC Characteristics, Slew rate and methods of improving slew rate, CMRR, PSRR, Frequency Response and Compensation techniques

UNIT II APPLICATIONS OF OPAMP IC741 9 Hrs

Scale changer, Voltage follower, Inverting and Non-Inverting amplifiers ,V-to-I and I-to-V converters, Summer and Subtractor – Multiplier and Divider – Differentiator and Integrator – Instrumentation Amplifier, Op- Amp Circuits using Diodes, Precision Rectifier – Clipper and Clamper – Sample and Hold Circuit – Log and Antilog Amplifiers.RC Active filters-low pass and High pass-Band pass and Band reject-Switched capacitor and Butterworth filters

UNIT III COMPARATORS AND SIGNAL GENERATORS 9 Hrs

applications of Comparators – Regenerative Comparators (Schmitt Trigger) – Sine wave generator, Square Wave Generator (Astable Multivibrator) – Monostable Multivibrator –Triangular Wave Generator – Saw Tooth Wave Generator – IC 555 Timer

UNIT IV ANALOG MULTIPLIER AND PLL 9 Hrs

Analog Multiplier using Emitter Coupled Transistor Pair – Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, PLL Basic Principles, Monolithic PLL IC 565,Functional blocks of PLL-Phase Detector -Comparator-Analog and Digital Voltage Controlled Oscillator, Applications of PLL-AM detection-FM detection-FSK modulation and demodulation-Frequency synthesizing

UNIT V IC REGULATORS AND DATA CONVERTERS 9 Hrs

IC voltage regulators: Introduction, Fixed voltage regulators, SMPS, current limiting and current feedback techniques using IC723.DA converters- DAC Specifications -Weighted resistor type,R-2R Ladder type, A/D converters-ADC Specifications --Counter ramp type, Successive Approximation, Dual slope, Flash type, High Speed A/D Converters

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. James. M. Fiore, "*Operational Amplifiers and Linear Integrated Circuits*", First Edition, Thomson Learning.
2. Roy Choudhury and Shail Jain, "*Linear Integrated Circuits*", Wiley Eastern Ltd., 1991.
3. Coughlin and Dirscol, "*Operational Amplifiers and Linear Integrated Circuits*", Prentice Hall of India Pvt., Ltd., 1992

REFERENCE BOOKS:

1. *Millman and Halkias, "Integrated Electronics", McGraw Hill, 1992.*
2. *Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Third Edition, TMH, 2002.*
3. *Ramakant A. Gayakwad, "Op – amp and Linear Integrated Circuits", Fourth edition, PH*

Subject Code:	Subject Name : CONTROL SYSTEMS ENGINEERING	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22005	Prerequisite: : Signals and Systems, Basic mathematics	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To learn the basic elements of control system with mathematical model.
- To understand the time response of first and second order system feedback.
- To learn the frequency response of systems using bode plot and polar plot.
- To check the stability of Control system using various techniques.
- To study different compensators and the need of contollers.

COURSE OUTCOMES (COs) : (3- 5)

The student will be able to

CO1	Model physical systems using block diagram and signal flow graph.
CO2	Analyze the system in time domain for standard input functions
CO3	Perform analysis of open and closed loop systems in frequency domain.
CO4	Explain the nature of stability for the given system.
CO5	Design compensators to obtain the required dynamic response of the system and identify the need of different types of controllers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	1			2	1
CO2	3	3	3	3	3	1					1	1
CO3	3	3	3	3	3	2	1				1	1
CO4	3	3	3	3	3	2					2	1
CO5	3	3	3	3	3	1		1			2	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2
CO2	3	3	2	2
CO3	3	3	2	2
CO4	3	3	2	2
CO5	3	3	2	2

3/2/1 indicates Strength of Correlation 3- High,2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : CONTROL SYSTEMS ENGINEERING	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22005	Prerequisite: : Signals and Systems, Basic mathematics	Ty	3	1/0	0/0	4

UNIT I SYSTEM REPRESENTATION & STATE SPACE ANALYSIS 12 Hrs

Control Systems – Basic elements in control systems – Open and Closed loop systems – Mathematical models of physical systems – Transfer function – Block diagram reduction techniques – Signal flow graph- Concepts of state variables -Solution of state equations- Conversion of transfer function to state space model.

UNIT II TIME RESPONSE 12 Hrs

Standard Test Signals-Time Domain study of first order and second order feedback control systems -Time domain Specifications - I and II order System Response - Error Coefficients - Generalized Error Series - Steady State Error

UNIT III FREQUENCY RESPONSE 12 Hrs

Frequency Domain Specifications -Correlation between Frequency Domain and Time Domain Specifications- Bode plot - Polar plot – Introduction to Closed Loop Frequency Response- Constant M and N circles – Nichols chart (Qualitative approach)

UNIT IV STABILITY OF CONTROL SYSTEM 12 Hrs

Characteristics Equation - Location of Roots in S plane for stability - Routh Hurwitz Criterion - Root Locus Construction - Effect of Pole, Zero Addition - Gain Margin and Phase Margin - Nyquist Stability Criterion- Concept of Controllability & Observability.

UNIT V COMPENSATORS AND CONTROLLERS 12 Hrs

Compensator-Types -Lag, Lead and Lag-Lead Compensators (Qualitative approach)- Controllers -Need - Types-P, I, D – Effect of PI, PD and PID controller- Intelligent controllers (Case Study)

Practical component P: Include case studies / application scenarios
Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 60

TEXTBOOKS:

1. K. Ogata, “Modern Control Engineering”, 4th edition, Pearson Education, New Delhi, 2003 / PHI.
2. I.J. Nagrath& M. Gopal, “Control Systems Engineering”, New Age International Publishers, 2003.
3. B.C. Kuo, “Automatic Control Systems”, Prentice Hall of India Ltd., New Delhi,7thEdition, 1995.

REFERENCES:

1. *M. Gopal, “Control Systems, Principles & Design”, Tata McGraw Hill, New Delhi, 2002.*
2. *M.N. Bandyopadhyay, “Control Engineering Theory and Practice”, Prentice Hall of India, 2003.*
3. *A.Nagoorkani , “Control System Engineering” RBA Publications.*
4. *Stefani, Shanian, Savant, Hostetter, “Design of Feedback Control Systems”, 4thEdition, Oxford university press 2002.*

Subject Code:	Subject Name : MICROPROCESSOR AND MICROCONTROLLER	Ty / Lb/ ETL/ IE	L	T/ SLr	P/R	C
EBEC22009	Prerequisite: Digital Electronics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To develop an in-depth understanding of the operation of microprocessors.
- To master the assembly language programming using concepts like assembler directives, procedures, macros, software interrupts etc.
- To create an exposure to basic peripherals, its programming and interfacing techniques
- To study the architecture and assembly language programming of 8051 microcontroller
- 5. To design and implement interfacing units with 8051 microcontroller based systems.

COURSE OUTCOMES (COs) :

The students will be able to

CO1	Develop programs in 8086 microprocessor by understanding its architecture and instruction set
CO2	Understand the programming model of micro processors and microcontrollers
CO3	Show their ability to interface peripherals with microprocessors
CO4	Develop programs in 8051 microcontroller by understanding its architecture and instruction set
CO5	Design various interfacing units with 8051 microcontroller based systems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/ POs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO 11	PO12
CO1	3	2	3	2	2	1			2	2	2	1
CO2	3	2	2	2	2				2	3	1	2
CO3	3	3	3	2		1			2	3	2	2
CO4	2	2	2	2	3	3			3	3	3	2
CO5	3	3	2	2	2	1			2	2	1	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	3	3	2				
CO2	3	2	2	2				
CO3	2	2	3					
CO4	3	3	3	3				
CO5	3	2	3	3				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : MICROPROCESSOR AND MICROCONTROLLER	Ty / Lb/ ETL/ IE	L	T/ SLr	P/R	C
EBEC22009	Prerequisite: Digital Electronics	Ty	3	0/0	0/0	3

UNIT I- THE 8086 MICROPROCESSOR **9 Hrs**

Introduction To 8085 Micro Processor

8086 architecture- functional diagram, Register organization, memory segmentation, Signal descriptions of 8086-common function signals, minimum mode and maximum mode system design, timing diagrams, Interrupts of 8086

UNIT II - INSTRUCTION SET AND ASSEMBLY LANGUAGE PROGRAMMING OF 8086 **9 Hrs**

Instruction formats, Addressing modes, instruction set, assembler directives. Macros, Simple programs involving Arithmetic, logical, branch and call instructions. Sorting, evaluating arithmetic expressions, string manipulations

UNIT III - PERIPHERALS AND INTERFACING **9 Hrs**

Programmable Peripheral Interface (8255), Serial Communication Interface (8251), Keyboard display controller (8279), Programmable Interval Timer/counter (8254), Programmable interrupt controller (8259),DMA controller(8257), ADC and DAC Interface.

UNIT IV- 8051 MICROCONTROLLER **9 Hrs**

Comparison between Microprocessor and Microcontroller , 8051 – Architecture, Instruction set, Addressing modes, Assembly language programming, I/O Ports, Timers / counters, serial communication, Interrupt, Special Function Registers (SFRs).

UNIT V- MICROCONTROLLER BASED SYSTEM DESIGN **9 Hrs**

Interfacing High power devices-Stepper Motor, DC Motor speed Control using PWM, RTC and EEPROM interface using I2C protocol, Traffic Light Interface, Interfacing matrix Keyboard and (16x2) LCD interfacing

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

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 Bhurchandi, Advanced Microprocessors and Peripherals, TMH, 2007.
3. Krishna Kant, "Microprocessors and Microcontrollers, Architecture,programming and system design using 8085, 8086, 8051 and 8096",PHI 2007.
4. Muhammad Ali Mazidi, Janice GillispieMazidi, RolinD.MCKinlay "The 8051Microcontroller and Embedded Systems", Second Edition, Pearson Education 2008.

REFERENCES:

1. *Douglas V Hall, "Microprocessor and Interfacing, Programming and hardware",TMH, 2006.*
2. *Kenneth J. Ayala, "The 8086 Microprocessor: Programming & Interfacing the PC",Delmar Publishers, 2007.*
3. *Steve furber "ARM Systems on chip Architecture", Second Edition Addison Wesley trade computer publication,2000.*
4. *John .B.Peatman"Design with PIC Microcontrollers" ,Pearson Education, 3rd Edition, 2004*

Subject Code:	Subject Name : FIELD AND WAVE ELECTROMAGNETICS	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22ET2	Prerequisite: Basic Mathematics, Physics Electrical and Electronics	ETL	2	0/0	2/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the Basics of electromagnetics
- To analyse the different types of transmission lines
- To study 5G wireless channel models

COURSE OUTCOMES (COs) : (3- 5)

Upon the completion of the course the students will be able to

CO1	Understand the fundamental postulates of electrostatics and magneto statics
CO2	Demonstrate the significance of Telegrapher's equations
CO3	Analyse the impedance matching using different methods
CO4	Illustrate the different polarisation methods adopted
CO5	Apply rhe waveguide principle in real time applications

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	2	2	1					1
CO2	3	2	3	2	3	3			2			1
CO3	3	3	3	3	3	1				3	2	
CO4	3	2	3	2	3	1	1	1		2		
CO5	3	3	3	2	3	3	3	3	2		2	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2		3
CO2	3	2		3
CO3	3	3		3
CO4	3	3		3
CO5	3	3		3

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Elective	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : FIELD AND WAVE ELECTROMAGNETICS	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22ET2	Prerequisite: Basic Mathematics, Physics Electrical and Electronics	ETL	2	0/0	2/0	3

UNIT I ELECTROMAGNETICS **12 Hrs**

Introduction to Electrostatics and Magnetostatics-Fundamental Laws- Boundary Conditions- Analogy between the parameters-Divergence and Curl Equations-Maxwell's Equations - Poynting Vector and Theorem

UNIT II TRANSMISSION LINES **12 Hrs**

Introduction-Wave Equations of Lossless Lines- Finite Difference Method-Laplace's equations and Telegrapher's Equations-Octave Simulation

UNIT III LOSSY TRANSMISSION LINES **12 Hrs**

Transmission Lines with Losses-Reflections and Reflection Coefficient -Voltage Reflection Coefficient and Standing Wave Ratio - Graphical Representation of Reflection Coefficient - Impedance Matching using Smith Chart - Impedance Matching Demonstration using VNA - Octave Simulation

UNIT IV POLARISATION **12 Hrs**

Polarisation of Electromagnetic Waves - Electromagnetic Waves in Conducting Media - Plane Waves-Plane Waves at normal incidence - Plane Waves at oblique incidence -Perpendicular Polarisation-Dielectric Conductor Interface-Octave Simulation

UNIT V WAVEGUIDES **12 Hrs**

Parallel Plate Waveguide- Rectangular Waveguide-Phase Velocity and Group Velocity-Modes and Field Pattern in Waveguides - Cavity Resonators- Octave Simulation-Real Time Applications.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 60

TEXT BOOKS:

1. David K.Cheng,'*Field and Wave Electromagnetics"*, Pearson Education, 2 ed.

2. William Hayt," Engineering Electromagnetics", Tata McGraw Hill

REFERENCES:

1. "Transmission Lines and Networks";Umesh Sinha,Sathya Prakasam

2. R.K. Shevgaonkar, "Electromagnetic waves"

Subject Code:	Subject Name :MICROPROCESSOR AND MICROCONTROLLER LAB	T y/ Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22L07	Prerequisite: Microprocessor and Microcontroller	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To write Assembly Language Program for arithmetic and logical operations in 8085 / 8086.
- To write Assembly Language Program for arithmetic and logical operations in 8051.
- To understand string manipulation instruction using 8086.
- To understand various peripheral interfacing techniques using 8086/8051

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Write assembly language programming in 8085 / 8086 microprocessor
CO2	Interface peripherals with 8086 microprocessor/8051 Microcontroller
CO3	Develop programs using 8051 Microcontroller.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO10	PO11	PO12
CO1	3	3	3	3	3	1			2	3	3	3
CO2	3	3	3	3	3	2			2	3	3	3
CO3	3	3	3	3	3	2			2	3	3	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	3	3	2	
CO3	3	3	3	3

3/2/1 indicates Strength of Correlation 3- High,2- Medium,1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name :MICROPROCESSOR AND MICROCONTROLLER LAB	T y/ Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22L07	Prerequisite: Microprocessor and Microcontroller	Lb	0	0/0	3/0	1

LIST OF EXERCISES USING 8085/8086 Kits:

1. Basic Arithmetic, Logical operations and move a data block without overlap.

LIST OF EXERCISES USING 8086 kits / MASM

2. Decimal Arithmetic, Code conversion, and Matrix operations.
3. String manipulations.
4. Sorting and Searching

PERIPHERALS AND INTERFACING EXPERIMENTS

5. Traffic light control
6. Stepper motor control
7. Key board and Display
8. Serial interface
9. Parallel interface
10. A/D and D/A interface and Waveform Generation

LIST OF EXERCISES USING 8051 kits

11. Basic Arithmetic, Logical operations, Square and Cube program
12. Find 2s complement of a number
13. Conversion of packed BCD to unpacked BCD

Total Number of Hours: 45

SEMESTER IV

Subject Code:	Subject Name : DIGITAL SIGNAL PROCESSING	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22010	Prerequisite: Signals System	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To learn the concepts of Fourier transform and it's Applications.
- To understand the design techniques of digital IIR filters
- To learn the concepts and design techniques of digital FIR filters.
- To understand the concepts and applications of Multi – rate sampling.
- To introduce the architecture of Digital Signal Processors.

COURSE OUTCOMES (COs) : (3- 5)

The students will be able to

CO1	Illustrate Fourier transform concepts.
CO2	Interpret the knowledge of designing IIR filters.
CO3	Learn to design FIR filters.
CO4	Summarize finite word length effects and quantization errors
CO5	Describe the modules in the architecture of digital signal processor.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	1		1	1	2	2
CO2	3	3	3	3	3	2	2		2	2	1	2
CO3	3	3	3	3	3	2	1		1	1	2	1
CO4	3	3	3	3	3	1	2		2	1	2	2
CO5	3	3	3	2	2	2	1		2	2	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3
CO2	3	3	2	2
CO3	3	3	1	3
CO4	3	3	1	2
CO5	2	2	3	1

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : DIGITAL SIGNAL PROCESSING	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22010	Prerequisite: Signals System	Ty	3	1/0	0/0	4

UNIT I DFT AND FFT 12 Hrs

Discrete Fourier Transform (DFT) - Properties-Convolution of Sequences - Linear Convolution - Circular Convolution - Introduction to Radix-2 FFT- Properties - DIT (FFT)-DIF (FFT) - Algorithms of Radix-2FFT-Computing Inverse DFT by doing a direct DFT.

UNIT II DESIGN OF IIR FILTER 12 Hrs

IIR Filters- Properties of IIR Filters -Analog Low pass Filter Design - Butterworth Filter - Chebyshev Filter - Design of IIR Filters from Analog filters - Approximation of Derivatives – Impulse Invariance - Bilinear Transformation – The Matched z- Transformation - Frequency Transformation.

UNIT III DESIGN OF FIR FILTER 12 Hrs

FIR Filters - Characteristics of FIR Filters with Linear Phase-Properties of FIR Filters-Design of FIR Filters using Windows-Fourier Series Method-Frequency sampling Method

UNIT IV FINITE WORD LENGTH EFFECTS 12 Hrs

Fixed point and floating-point number representations - Comparison - Truncation and Rounding errors - Quantization noise - derivation for quantization noise power - coefficient quantization error - Product quantization error - Overflow error Limit cycle oscillations- Zero- Input Limit cycle oscillations- Overflow Limit cycle oscillations- Signal Scaling.

UNIT V OVERVIEW OF DIGITAL SIGNAL PROCESSOR 12Hrs

Overview of Digital Signal Processors – Application of Digital Signal Processor – Memory Architecture of DSP Processor – Von Neumann Architecture – Harvard Architecture - Architecture of TMS32C5X Processor – Addressing modes – Pipelining .

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 60

TEXTBOOKS :

1. John . G. Proakis and Dimitris C.Manolakis, "*Digital Signal Processing Principles, Algorithms and Applications",*Pearson Education, Third edition 2006.
2. Sanjit k.Mitra "*Digital signal processing*",A Computer Based Approach,Tata McGraw Hill,New delhi,2001.
3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, "*Discrete – Time Signal Processing*", 8th Indian reprint, Pearson 2004.

REFERENCE BOOKS:

1. *Ashok Ambardar,"Analog and Digital Signal Processing",2nd Edition,Thomson Learning 2000.*
2. *Ashok Ambardar,"Analog and Digital Signal Processing A Modern Introduction",1stedition Thomson Learning 2006*

Subject Code:	Subject Name : DIGITAL COMMUNICATION	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22012	Prerequisite: Communication System, Probability and Random Process, Mathematics-I	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To study detection, estimation and discuss the process of sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
- To understand the concepts of different digital modulation techniques and their applications in our day to day life
- To learn error control coding which encompasses techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy channels.

COURSE OUTCOMES (COs) : (3- 5) The students will be able to

CO1	Interpret the sampling process in real-time systems and reconstruct the signal with the estimation of noise
CO2	Design a system without distortion and interference
CO3	Hone their inferences to develop various modulation technologies for the state of the art communication.
CO4	Demonstrate their skills in generating a unique code for detecting the error in digital communication
CO5	Apply their understanding to improve the digital communication efficiency in a multipath environment.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	1	1	3	3	2	1
CO2	3	3	3	3	3	3	1	1	3	3	2	1
CO3	3	3	3	3	3	3	2	1	3	3		3
CO4	3	3	3	3	3	2	2		2	3	1	3
CO5	3	3	3	3	3	2	1	1	3	3		3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	1
CO2	3	1	1	2
CO3	3	3	1	2
CO4	3	3	1	1
CO5	3	3	1	2

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : DIGITAL COMMUNICATION	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22012	Prerequisite: Communication System, Probability and Random Process, Mathematics-I	Ty	3	1/0	0/0	4

UNIT I DETECTION, ESTIMATION AND SAMPLING PROCESS 12 hrs

Model of Digital Communication System, Gram Schmidt Orthogonalization Procedure, Matched Filters, Correlation Receivers, Error Probability, Maximum Likelihood Estimation, Linear Prediction and Prediction Filters, Sampling Theorem, Quadrature Sampling of Band-Pass Signals, Reconstruction of a message from its samples

UNIT II WAVEFORM CODING TECHNIQUES AND BASEBAND SHAPING 12 hrs

PCM and TDMA Principles, Channel Noise and Error Probability, Quantization Noise and SNR, Differential Pulse Code Modulation and Delta Modulation, Speech Coding at Low Bit Rates, Power Spectra of PAM Signals, Inter Symbol Interference, Nyquist Criterion for distortionless baseband transmission, Correlative Coding and Precoding, Eye Patterns and Equalization Techniques.

UNIT III DIGITAL MODULATION SCHEME 12 hrs

Geometric Representation of signals – Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK – QAM – Carrier Synchronization – Structure of Non-coherent Receivers – Principle of DPSK.

UNIT IV ERROR CONTROL CODING 12 hrs

Need for Coding, Types of Codes, Hamming codes, Linear Block Codes, Cyclic Codes, Convolution Codes, Maximum, Likelihood Decoding of convolutional Codes, Distance Properties and Sequential Decoding of convolutional Codes, Trellis coding, Viterbi coding.

UNIT V SPREAD SPECTRUM SYSTEMS 12 hrs

Generation of Pseudo Noise Sequences, Correlation Properties, Direct Sequence Spread Spectrum Systems, Frequency Hop System, Signal Space Dimension and Processing Gain , Probability of Error, Antijam and Multipath Performance.

Practical component P: Include case studies / application scenarios
Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 60

TEXTBOOKS:

1. Simon Haykin, "Digital *communications*", John Wiley & Sons, 1988.
2. John. G. Proakis, "*Digital Communication*", McGraw Hill Inc., Third Edition, Malaysia, 1995.
3. B.P. Lathi, "*Modern Digital and Analog communication system*", Oxford publications, Third edition.

REFERENCE BOOKS:

1. *Roy Blake, "Electronic Communication systems",Thomson Learning, 2nd edition 2002.*
2. *M.K. Simen, "Digital Communication Techniques Signal Design & Detection", Prentice Hall of India, 1999.*
3. *Bernard Sklar, "Digital Communication: Fundamentals and Applications",Prentice Hall, 2011 Edition.*
4. *UpamanyuMadhow, "Fundamentals of Digital Communication",Cambridge University Press, 2008*
5. *Robert G. Gallager, "Principles of Digital Communication",Cambridge University Press 2008*

Subject Code:	Subject Name : PRINCIPLES OF MANAGEMENT AND BEHAVIORAL SCIENCE	Ty/Lb/ ETL/IE	L	T/ SLr	P/ R	C
EBCC22ID2	Prerequisite: Nil	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab./Embedded Theory and Lab.

OBJECTIVE: The student will learn:

- About the evolution, functions and principles of Management Studies
- The applications of the principles in an organization
- The system and process of effective controlling in the organization.

COURSE OUTCOMES (COs): The student will be able to

CO1	Clear understanding in planning, and have knowledge in aspect of Management Studies (Level 2)
CO2	Understanding the planning process in the organization. (Level 2)
CO3	Understanding the concept of organization. (Level 2)
CO4	Demonstrate the ability to directing and coordinating. (Level 3)
CO5	Analyze and formulate the best control methods. (Level 4)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3		2	-	3	3	2	3	2
CO2	3	2	2	3		2	-	3	2	3	-	2
CO3	3	-	-	2		-	3	2	-	2	2	2
CO4	3	3	3	3		2	-	2	2	2	2	2
CO5	2	3	3	-	3	3	3	2	3	2	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	-	2	3	3
CO2	-	2	3	3
CO3	-	2	3	3
CO4	-	2	3	3
CO5	-	2	3	3

Category	Basic Science	Engineering Science	Humanities and social Science	Program Core	Program elective	Open Elective	Inter Disciplinary	Skill Component	Practical /Project			
							✓					

Subject Code:	Subject Name : PRINCIPLES OF MANAGEMENT AND BEHAVIORAL SCIENCE	Ty/Lb/ ETL/IE	L	T/ SLr	P/ R	C
EBCC22ID2	Prerequisite: Nil	Ty	3	0/0	0/0	3

UNIT- I INTRODUCTION **9 Hrs**

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and responsibilities – Evolution of Management –need and Importance of Organizational Behavior, Leadership styles – Theories – Leaders Vs Managers.

UNIT –II PLANNING & ORGANISING **9 Hrs**

Nature and purpose of planning – planning process – types of planning – Planning premises objectives – hierarchy of objectives, Management By Objectives (MBO)— Decision making process. Nature and purpose of Formal and informal organization structure– types – Line and staff authority– delegation of authority – centralization and decentralization.

UNIT-III STAFFING AND COORDINATING **9 Hrs**

Human Resource Planning, Job Analysis, Recruitment, Selection, Training and Development, Performance Management, Career planning. Coordination –Nature and purpose - Coordination at various levels: Top management, Middle management, Supervisory management and workers. Techniques for effective coordination

UNIT- IV DIRECTING AND CONTROLING **9 Hrs**

Direction: Principles of direction – Need and Importance for directing, process of controlling – budgetary and non-budgetary control techniques – use of technology. Recent Trends in Management controlling.

UNIT-V GROUP BEHAVIOUR AND MOTIVATION **9 Hrs**

Group Dynamics - How Groups Work, Stages of Group Development, Team building, Motivation – Theories of motivation Organizational Conflict – Causes – Types of Conflicts, Managing conflicts.

Total No. of Periods: 45

Reference Books:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” 7th Edition, Pearson Education,2011.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra,2008.
3. Harold Koontz & Heinz Weihrich “Essentials of management” Tata Mc Graw Hill,1998.
4. S.S. Khanka - Organizational Behaviour - S. Chand Ltd. – 2006.
5. L.M.Prasad - Organizational Behaviour. S. Chand Company – 3rd edition – 2004.

Subject Code:	Subject Name :ANALOG AND DIGITAL COMMUNICATION LAB	T y/ Lb/ ETL/IE	L	T/ SLr	P/ R	C
EBEC22L14	Prerequisite: Analog communication, Digital communication	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To test and design AM, FM Systems.
- To understand the Sampling theory.
- To implement Digital modulation techniques.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Develop a AM/FM trainer kits.
CO2	Design and test the Pre-emphasis and De-emphasis circuits.
CO3	Apply the coding techniques for data encryption.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3		2	-	3	3	2	3	2
CO2	3	2	2	3		2	-	3	2	3	-	2
CO3	3	-	-	2		-	3	2	-	2	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	-	2	3	3
CO2	-	2	3	3
CO3	-	2	3	3

3/2/1 indicates Strength of Correlation 3- High,2- Medium,1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name :ANALOG AND DIGITAL COMMUNICATION LAB	T y/ Lb/ ETL/IE	L	T/ SLr	P/ R	C
EBEC22L14	Prerequisite: Analog communication, Digital communication	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

1. Design and testing of Amplitude modulation and demodulation.
2. Design and testing of Frequency modulation and demodulation.
3. Design and testing of Pulse Amplitude modulation & demodulation.
4. Design and testing of Pulse Width modulation & Pulse Position modulation.
5. Design and testing of Pre-emphasis and De-emphasis.
6. Design and testing of Narrow Frequency modulation.
7. Design and testing of ASK, FSK and PSK
8. Study of Line Coding and Decoding techniques
9. Study of Sampling
10. Study of Pulse Code modulation

Total Number of Hours: 45

SEMESTER V

Subject Code:	Subject Name : SENSORS AND ROBOTICS	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22011	Prerequisite: Microprocessor and Microcontroller	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot.
- To develop a deep knowledge sensors and their applications in robot.

COURSE OUTCOMES (COs) : (3- 5)
The students will be able to

CO1	Predict the importance of robotics in today and future goods production.
CO2	Analyze the robot configuration and subsystems.
CO3	Illustrate the role of manipulators and end effectors
CO4	Understand the fundamental concepts of sensor and its characteristics
CO5	Identify the working of sensors in different applications.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	2	3				1	3
CO2	3	3	3	3	2	2	3		1		1	3
CO3	3	2	3	3	2	2	3		1			3
CO4	3	3	3	2	2	2	3					3
CO5	3	3	3	3	2	2	3					3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3
CO2	3	2	3	3
CO3	3	2	3	3
CO4	3	3	3	3
CO5	3	3	3	3

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill	Practical / Project			
				✓								

Subject Code:	Subject Name : SENSORS AND ROBOTICS	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22011	Prerequisite: Microprocessor and Microcontroller	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO ROBOTICS 9 Hrs

Robot - Definition – Law of Robotics - Robot Anatomy - Coordinate Systems- Robot Classification- Wrist configuration-Technical Specifications of Robot - Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT II ROBOT DRIVES AND POWER TRANSMISSION SYSTEMS 9 Hrs

Robot drive mechanisms- hydraulic – electric –pneumatic drives- servomotor- stepper motor- Mechanical transmission method - Gear transmission - Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion.

UNIT III MANIPULATORS AND END EFFECTORS 9 Hrs

Construction of Manipulators- Electronic and Pneumatic manipulators-Classification of End effectors – Tools as end effectors -Mechanical grippers- -Magnetic grippers-Vacuum grippers-hydraulic grippers - Gripper force analysis

UNIT IV BASICS OF SENSOR 9 Hrs

Sensor definition- Sensor Systems - Sensor Characteristics- - Sensor Classification-Types of sensors – Transducer and actuators

UNIT V APPLICATION OF SENSORS 9 Hrs

Mechanical sensors- Temperature sensor- pressure sensor- optical sensors- proximity sensors-biosensors-Role of sensors in robotics and automation.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Deb S. R. and Deb S., “Robotics Technology and Flexible Automation”, Tata McGraw Hill Education Pvt. Ltd, 2010.
2. John J.Craig , “Introduction to Robotics”, Pearson, 2009. 3. Mikell P. Groover et. al., "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2008.
3. Jacob Fraden, “Handbook Of Modern Sensors Physics, Designs, And Applications” 2. Jon S. Wilson,” Sensor Technology Handbook 3. S J Prosser,E.Lewis ,”Sensor and their Applications XII” CRC Press

References:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
2. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics : Control, Sensing, Vision and Intelligence", McGraw Hill, 1987
3. Ian Sinclair , “ Sensors and Transducers” eBook ISBN: 9780080516998
4. H.Rosemary Taylor, “Data acquisition for sensor systems”, Chapman & Hall, 1997. 5. Ramon Pallas-Areny, John G. Webster, “Sensors and signal conditioning” John Wiley & Sons, 2001.

Subject Code:	Subject Name : COMMUNICATION NETWORKS	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22008	Prerequisite: Communication System	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To understand different storage media and OSI layers
- To introduce the features of different I/O peripheral devices and protocols.
- To introduce the students the functions and standards of LAN.
- To introduce IEEE standard employed in computer networking.
- To make students to get familiarized with different protocols and network components.

COURSE OUTCOMES (COs) : (3- 5)

The Students will able to

CO1	Describe the basic concepts of data communication and OSI layers.
CO2	Analyze data link control protocol.
CO3	Explain different standards and protocols used in LAN
CO4	Express the duties of network support layer and WAN protocols
CO5	Demonstrate the functions of upper OSI layer

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1	1	1	3	3	2		
CO2	3	3	1	1	2	1	1	1			2	
CO3	2	2	2	1	3	2	2	2				3
CO4	3	1	2	2	2	2	2	2	2			3
CO5	3	2	1	2	1	3	2	1	2	2	2	

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	3
CO2	3	2	3	1
CO3	1	3	2	2
CO4	1	1	1	1
CO5	2	2	3	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : COMMUNICATION NETWORKS	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22008	Prerequisite: Communication System	Ty	3	0/0	0/0	3

UNIT I DATA COMMUNICATION 9 Hrs

Introduction, Basic concepts, OSI Reference Model, Transmission of Digital Data –Electrical Interface, Modems-Transmission rate-modem standards-Guided Media-Twisted –pair Cable-Coaxial cable-Performance- Error Detection and Correction (CRC) - Time and Frequency domains Signals

UNIT II DATA LINK CONTROL AND PROTOCOLS 9 Hrs

Flow Control and Error Control, Stop And Wait - Sliding Windows- Automatic Repeat (ARQ), Asynchronous Protocols - X Modem, Y Modem, Synchronous Protocols – Character Oriented and Bit Oriented Protocols (HDLC).

UNIT III LOCAL AREA NETWORKS 9 Hrs

IEEE 802 Standards, LLC, MAC Layer Protocols –CSMA/CD Ethernet, Token Bus, Token Ring, FDDI, Distributed Queue Dual Bus, Switched Multimegabit Data Service

UNIT IV WIDE AREA NETWORKS 9 Hrs

Switching, Duties of the Transport Layer, ATM Protocol –Architecture Header Structure, Function of AAL Layer,Internetworking Devices, Repeater,Bridge, Routers and Gateways, Routing Algorithms- Link Stateand Distance Vector routing.

UNIT V UPPER OSI LAYERS 9 Hrs

Session Layer - Presentation Layer –Translation, Brief Introduction to Encryption / Decryption, Authentication -Data Compression, Application Layer Protocols, MHS, File Transfer , Virtual Terminal, Common Management Information Protocol.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS :

1. Behrouz A. Forouzan , "*Data Communication and Networking*", Tata McGraw Hill, 5th Edition, 2013.
2. William A, Shay, "*Understanding Data Communications and Networks*", Thomson Learning, 3rd Edition 2003.
3. Gallo, "*Computer Communications and Networking Technologies*", Thomson Learning, 1st edition 2001.

REFERENCE BOOKS:

1. William Stallings, "Data and Computer Communication", Prentice Hall of India, Fifth Edition 1997.
2. Andrew S. Tanenbaum, "Computer Networks", prentice hall of India, Third Edition 1996.
3. Fred Hallsall, "Data Communication Computer Networks and Open System", Addison – Wesley, 1992

Subject Code:	Subject Name : VLSI AND EMBEDDED SYSTEMS DESIGN	T y/ Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22020	Prerequisite: Solid State Devices, Digital Electronics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To enable the students to understand various design flow in VLSI and their applications in fuzzy systems

COURSE OUTCOMES (COs) : (3- 5)
The Students will be able to

CO1	Study the fabrication of CMOS transistor & its layout.
CO2	Interpret the interconnection resistance & capacitance & their extraction.
CO3	Learn the distribution of clock signals in a chip.
CO4	Illustrate VLSI implementation of FLC and study about testing techniques.
CO5	Design different types of adders and multipliers.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2	1	3	2	3	3	3	3
CO2	3	3	2	3	3	2	3	2	3	3	3	3
CO3	3	3	3	2	3	3	3	2	3	2	3	3
CO4	3	3	3	3	3	3	3	1	3	2	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3
CO2	3	3	2	3
CO3	3	3	3	3
CO4	3	3	2	3
CO5	3	3	3	3

3/2/1 indicates Strength of Correlation 3- High,2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : VLSI AND EMBEDDED SYSTEMS DESIGN	T y/ Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22020	Prerequisite: Solid State Devices, Digital Electronics	Ty	3	0/0	0/0	3

UNIT I MOS TRANSISTOR THEORY **9Hrs**

Introduction – NMOS and PMOS transistor, Threshold voltage, Body effect, MOS device – Basic DC equations ,Second order effects, MOS models, Small signal AC characteristics, Complementary CMOS Inverter, Power dissipation and scaling of MOS transistors.

UNIT II DESIGNING COMBINATIONAL LOGIC CIRCUITS **9Hrs**

Static CMOS design – Complementary CMOS, Propagation Delay and Power Consumption in static CMOS, Pseudo NMOS Logic, Pass Transistor Logic, Transmission gates, Dynamic CMOS Design – Basic principle, Speed and Power dissipation of Dynamic logic, Signal integrity issues in dynamic design,CMOS Domino logic, np CMOS logic.

UNIT III DESIGNING SEQUENTIAL LOGIC CIRCUITS **9Hrs**

Introduction – Timing metrics for sequential circuits, Classification of memory elements, Static latches and registers – The bi-stability principle, Multiplexer based latch, Master slave edge triggered register, Static SR flip flop, Dynamic latches and registers – Dynamic transmission gate edge triggered registers, clocked CMOS register.

UNIT IV VHDL & VERILOG PROGRAMMING **9Hrs**

VHDL background – VHDL requirement, Elements of VHDL, operators, Basic concepts in VHDL, Structural modeling, Behavioral modeling and Dataflow modeling in VHDL and Simple programs, Verilog HDL – Basic concepts – Gate Level modeling, Dataflow modeling and Behavioral modeling – Simple programs.

UNIT V PIC MICROCONTROLLER **9Hrs**

Introduction - PIC16F877 Micro controller overview, Special Function Registers, I/O Ports, Timers, Oscillators, Capture/ Compare and PWM module, Serial communication module, Analog module and Instruction set.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXTBOOKS:

1. Neil H.E. Weste, Kamran Eshraghian, "*Principles of CMOS VLSI Design – A system perspective*", second edition,Addison Wesley,1997.

2. Jan M.Rabaey, Ananth Chandrakasan, Borivoje Nikolic, " *Digital Integrated Circuits : A Design perspective*", second edition, Prentice Hall of India, 2003.

3. ZainalabedinNavabi, " *VHDL – Analysis and modeling of Digital Systems*" , Second edition, Mcgraw – Hill International Editions, 1998.

REFERENCE BOOKS:

1. A. Pucknell, Kamran Eshraghian, " Basic VLSI Design", Third Edition, Prentice Hall of India,2007.

2. R.Jacob Baker, Harry W.Li, David E. Boyce, "CMOS circuit design, Layout and Simulation", Prentice Hall of india, 2005.

3. J.Baskar, "A VHDL Primer", Third edition, Pearson Education,2004.

4. Samir Palnitkar, "Verilog HDL, A Guide to Digital Design and Synthesis", second edition, Pearson Education,2003.

5. pic-microcontroller.com / free- ebook- pic-microcontrollers.

Subject Code:	Subject Name : VLSI AND EMBEDDED SYSTEM DESIGN LAB	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22L11	Prerequisite: Introduction of VLSI & embedded system design	Lb	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To have a detailed practical study of microwave diodes
- To study the optical devices and to use in the appropriate application.
- To establish the fiber optical communication link

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Demonstrate the ability to design and conduct microwave experiments, analyze and interpret data.
CO2	Demonstrate the skills to use modern engineering tools, software and equipments to analyze design problems.
CO3	Design a system and to learn about measurement of fiber optic parameters.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	3		2		2	2
CO2	3	3	3	3	3	3	3		2		2	2
CO3	3	3	3	3	3	3	3		2		2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	3	3	2				
CO2	3	3	3	2				
CO3	3	2	2	2				

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : VLSI AND EMBEDDED SYSTEM DESIGN LAB	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22L11	Prerequisite: Introduction of VLSI & embedded system design	Lb	0	0/0	3/0	1

LIST OF EXPERIMENTS

SIMULATION OF DIGITAL CIRCUITS USING Verilog

1. Design and Verification of Adder and Subtractor
2. Design and Verification of Multiplexer, Demultiplexer, Encoder, Decoder.
3. Design and Verification of Magnitude Comparator with 4 Bits.
4. Design and Verification of Jk, D, T and Sr Flip Flops
5. Design and Verification of Synchronous & Asynchronous Counters.
6. Design and Verification of Shift Registers (Right / Left).

INTERFACING WITH PIC MICROCONTROLLER

7. ADC Interface with LM 35.
8. Stepper Motor Interface
9. Traffic Light Controller Interface
10. DC Motor Interface
11. LCD Display Interface.
12. LED Interface

References:

1. Lab manual, Department of ECE, DR.MGR UNIVERSITY.

Total number of hours: 45

SEMESTER VI

Subject Code:	Subject Name : WIRELESS NETWORKS	Ty / Lb/ ETL/IE	L	T /SLr	P/R	C
EBEC22017	Prerequisite: Computer networks	Ty	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To give a deep insight for the wireless network architectures, protocols, and applications.
- To study about Adhoc wireless networks and its MAC & Routing protocols.
- To understand the wireless sensor networks and its MAC & Routing protocols.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Understand the concepts of WLAN and PAN
CO2	Identify and Analyze the issues in Adhoc wireless networks
CO3	Design MAC protocols and study its implementation in Adhoc networks.
CO4	Classify the different network routing protocols and potray their significance in the field of wireless networks.
CO5	Learn the architecture of wireless sensor networks and the method of data transmission IN SENSOR NETWORKS

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	2	2	2	2	2	2
CO2	3	3	3	3	3	2	2	2	2	2	2	2
CO3	3	3	3	3	3	2	2	2	2	2	2	2
CO4	3	3	3	3	3	2	2	2	2	2	2	2
CO5	3	3	3	3	3	2	2	2	2	2	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	3
CO2	3	3	2	3
CO3	3	3	3	2
CO4	3	3	3	2
CO5	2	1	1	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : WIRELESS NETWORKS	Ty / Lb/ ETL/IE	L	T /SLr	P/R	C
EBEC22017	Prerequisite: Computer networks	Ty	3	1/0	0/0	4

UNIT I WIRELESS LANS AND PANS 12Hrs

Introduction - FUNDAMENTALS OF WLANS- Technical Issues - Differences Between Wireless and Wired Transmission, Use of WLANs, Design Goals- Network Architecture - Infrastructure Based Versus Ad Hoc LANs, Components in a TypicalIEEE802.11 Network, Services Offered by a TypicalIEEE802.11 Network- IEEE802.11 STANDARD- Physical Layer, Basic MAC Layer Mechanisms- HIPERLAN standard-Bluetooth

UNIT II AD HOC WIRELESS NETWORKS 12Hrs

INTRODUCTION - Cellular and Ad Hoc Wireless Networks - definition, characteristics features, Applications of Ad Hoc Wireless Networks- Issues in ad hoc wireless networks - Ad Hoc wireless internet.

UNIT III MEDIUM ACCESS PROTOCOLS 12Hrs

MAC Protocols: design issues, Design goals of a MAC protocol For Ad Hoc wireless networksand classification of MAC protocols -Contention based protocols- with reservation, with scheduling mechanisms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15, 802.16.

UNIT IV NETWORK PROTOCOLS 12Hrs

Routing Protocols: Design issues, goals and classification of Routing Protocols - Proactive Vs reactive routing, Table-driven routing protocols: Destination sequence Distance – Vector routing Protocol, wireless Routing Protocol - On-demand routing protocols: Dynamic source Routing protocol, Ad Hoc on Demand Distance – vector Routing protocol - Hybrid Routing protocol : Core extraction distributed Ad Hoc routing protocol , Zone routing protocol - Power-aware routing protocols: Power – aware routing metrics.

UNIT V WIRELESS SENSOR NETWORKS 12 Hrs

Introduction - Sensor Network Architecture - Data Dissemination - Data Gathering - MACPROTOCOLS for Sensor Networks - Location Discovery - Quality of a Sensor Network

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 60

TEXT BOOKS:

1. C.Siva Ram Murthy and B.S.Manoj, Ad hoc Wireless Networks Architectures andprotocols, 2nd edition, Pearson Education. 2007
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000

REFERENCES:

1. *Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobilead hocnetworking, Wiley-IEEE press, 2004.Mohammad Ilyas, The handbook of adhoc wireless networks, CRC press, 2002.*
2. *T. Camp, J. Boleng, and V. Davies "A Survey of Mobility Models for Ad Hoc Network*
3. *Research," Wireless Commun. and Mobile Comp., Special Issue on Mobile Ad HocNetworking Research, Trends and Applications, vol. 2, no. 5, 2002, pp. 483–502.*
4. *A survey of integrating IP mobility protocols and Mobile Ad hoc networks, FekriM.Abduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, v no.12007*
5. *V.T. Raisinhani and S.Iyer "Cross layer design optimization in wireless protocolstacks"Comp. communication, vol 27 no. 8, 2004.*
6. *V.T.Raisinhani and S.Iyer,"ÉCLAIR; An Efficient Cross-Layer Architecture forwireless protocol stacks",World Wireless cong., San francisco,CA,May 2004.*

Subject Code:	Subject Name OPTICAL COMMUNICATION	Ty/ Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22021	Prerequisite: Basic Physics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To learn the basic elements of optical fiber transmission link, types of fibers, Slicing and connectors.
- To study the different kinds of fiber materials, optical sources and its modulation methods.
- To learn the various optical losses and fiber optical receivers such as PIN, APD diodes, noise performance in photo detectors and optical network concepts.

COURSE OUTCOMES (COs) :
The Students will be able to

CO1	Analyze the various optical laws and its properties.
CO2	Deduce the classification of fiber and their material characteristics.
CO3	Describe the fiber optic system design by their losses.
CO4	Learn techniques for designing optical systems using sources.
CO5	Design efficient optical detectors and systems using budget calculations.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	3	2	3	1	2	3	1	2
CO2	3	3	3	3	3	2	2	2	2	2	3	3
CO3	3	3	3	3	3	2	2	1	2	2	3	3
CO4	3	3	3	3	3	1	2	1	2	2	3	3
CO5	3	3	3	3	3	1	2	3	1	2	2	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3
CO2	3	3	3	3
CO3	3	3	3	3
CO4	3	2	2	3
CO5	3	2	3	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name OPTICAL COMMUNICATION	Ty/ Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22021	Prerequisite: Basic Physics	Ty	3	0/0	0/0	3

UNIT I: OVERVIEW OF OPTICAL FIBER COMMUNICATION **9Hrs**

The general 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

UNIT II: OPTICAL FIBERS **9 Hrs**

Evolution of Fiber Optical System - Elements of an Optical Fiber Transmission Link - Cylindrical Fiber - Single Mode Fibers and Multimode Fibers - Fiber Splicing and Connectors - Fiber materials - glass fiber - plastic fiber

UNIT III: OPTICAL LOSSES **9 Hrs**

Absorption Losses - Scattering Losses - Bending Losses - Core and Cladding Losses - Signal Distortion in SM Fibers

UNIT IV: OPTICAL SOURCES **9 Hrs**

Direct and Indirect Band Gap Material - LED Structures - LED Power and Efficiency - Modulation - Laser Diodes Structures - laser diode rate equations - Modulation of Laser Diodes

UNIT V: OPTICAL DETECTORS AND NETWORKS **9 Hrs**

PIN and APD Diodes - Photo Detector Noise, SNR, Detector Response Time, Avalanche Multiplication Noise - Comparison of Photodetectors - Point to Point Links – System Design Consideration - Line Power Budget - Rise Time Budget - SONET - WDM

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXTBOOKS:

1. Gerd Keiser, “Optical Fiber Communication System”, McGraw Hill, International, Singapore 3rd ed., 2000.
2. John M. Senior, “Optical Fiber Communication principles and practice”, Prentice Hall of India private limited, 1996.

REFERENCE BOOKS:

1. J. Gower, “Optical communication system”, Prentice Hall of India, 2001.
2. Govind P. Agrawal “Fiber-Optic Communication Systems”, Wiley India 3rd Edition.
3. P.E. Green, Jr., “Fiber Optic Networks”, Prentice Hall, NJ, 1993.
4. Biswanath Mukherjee, “Optical WDM Networks”, Springer Series, 2006.

Subject Code:	Subject Name : RF AND MICROWAVE ENGINEERING	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22022	Prerequisite: Transmission Lines and Waveguides, Antenna and Wave Propagation	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To learn the working of microwave passive devices and generators.
- To Study the operation of microwave active devices and its applications in circuits.
- To Learn the importance of microwave measurements.

COURSE OUTCOMES (COs) : (3- 5)

The students will be able to

CO1	Analyze the characteristics of microwave passive devices using Scattering matrix
CO2	Apply the principle of generators in developing microwave signals
CO3	Demonstrate the characteristics of microwave solid state devices.
CO4	Develop the concepts of microwave transistors in the fabrication of RF circuits.
CO5	Anallyze the parameters of transmission lines in microwave circuits.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	1	2	1	1	1	1	1
CO2	2	3	3	3	3	1	1	1	2	2	1	1
CO3	3	2	2	2	3	1	2	1	1	1	1	1
CO4	3	2	2	2	2	3	1	1	3	1	1	2
CO5	3	3	3	3	3	3	1	1	1	2	1	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	1	2	1	2				
CO2	1	3	1	2				
CO3	1	2	1	1				
CO4	1	3	2	2				
CO5	1	3	1	3				

3/2/1 indicates Strength of Correlation 3- High,2- Medium,-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : RF AND MICROWAVE ENGINEERING	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22022	Prerequisite: Transmission Lines and Waveguides, Antenna and Wave Propagation	Ty	3	0/0	0/0	3

UNIT I MICROWAVE PASSIVE DEVICES 9 Hrs

Transmission Lines for use at Microwave Frequencies – Attenuators, Directional Couplers, Terminators, Phase Shifters, Faraday Rotation Isolators and Circulators, Field Displacement Isolators, Microwave Filters, Frequency Meters, Hybrid Junctions – Scattering Analysis.

UNIT II MICROWAVE GENERATORS 9 Hrs

Limitations of Conventional Tubes at Very High Frequencies – Velocity – Modulated Tubes, Two – Cavity Klystron Amplifiers, Reflex Klystron Oscillators – Periodic Slow Wave Structures and their Use in Travelling Wave Tube Amplifiers, Focusing Techniques, TWTA Performance Characteristics – Electron Motion in Crossed Electric and Magnetic Fields - Magnetron Oscillators, Hartree Equation Rieke Diagram and Performance Charts .

UNIT III MICROWAVE SOLID-STATE DEVICES 9 Hrs

Varactor Diodes, Manley – Rowe Relations, Low Noise Parametric Amplifiers – Transferred – Electron Devices and Their Operation, Cavity – Controlled Modes, LSA Mode-Avalanche – Transit Time Devices and Their Operation, TRAPATT Mode, BARITT mode, PIN Diodes and Their use as Attenuators and Switches.

UNIT IV MICROWAVE CIRCUITS 9 Hrs

Small – Signal Equivalent Circuits, High-Frequency Applications, Performance Criteria and Limitations of BJTs and FETs – HEMTs – Fabrication Techniques.

UNIT V MICROWAVE MEASUREMENTS 9 Hrs

Slotted - Line Techniques – Measurements of Wavelength – Measurement of Low and High VSWR – Measurement of Frequency and Frequency Meters – Measurement of Insertion Loss and Attenuation by Substitution Methods – Measurement of Low and High Powers at Microwave Frequencies – Modern Measurement Techniques using Automatic Network Analyzer and Spectrum Analyzer.

Practical component P: Include case studies / application scenarios

Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXTBOOKS:

1. Annapurna Das, Sisir. K. Das, “Microwave Engineering”, Tata McGraw Hill Co., Ltd., 1999. Reprint 2001.
2. Samuel Y. Liao: “Microwave Devices and Circuits” , Prentice Hall of India – 3rd Edition (2003)
3. SubalKar , “Microwave Engineering” , Universities press(India) private limited – 1st Edition (2016)

REFERENCE BOOKS:

1. D.M. Pozer, "Microwave Engineering", Addison – Wesley, 1998.
2. R.E. Collins: “Foundations for Microwave Engineering”, IEEE Press Second Edition (2002) David K. Cheng,” Field and Waves in Electromagnetism”, Pearson Education, 1989.

Subject Code:	Subject Name : PROJECT PHASE - I	T y/ Lb/ ETL/IE	L	T/SL r	P/R	C
EBEC22I05	Prerequisite: NIL	Lb	0	0/0	3/3	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES : The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue , address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	Formulate students to think critically and creatively about societal issues and develop user friendly and reachable solutions
CO3	Analyze research skills and demonstrate their proficiency in communication skills.
CO4	Make the students to face challenges of team work, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	3	1	2	2	3	3
CO2	3	3	3	3	3	3	3	2	2	2	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	2
CO4	3	2	3	3	3	3	2	3	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	3	3	3				
CO2	3	3	3	3				
CO3	3	2	3	3				
CO4	3	2	2	3				

3/2/1 indicates Strength of Correlation 3- High,2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
									✓			

Subject Code:	Subject Name : PROJECT PHASE - I	T y/ Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22I05	Prerequisite: NIL	Lb	0	0/0	3/3	2

Students are expected to do the Project in a group of 3 to 4 students. They should identify the area/topic of the Project and should collect the literatures related to the project. Students intending to do Industrial projects will approach the industries with the support of the university, identify the industrial problem and finalize the project. In case of Industrial projects apart from Industry guide, a guide has to be appointed by the department. At the end of the Semester the students should submit their Project Phase - I report to the Department and Viva -Voce examination will be conducted by the examiners duly appointed by the Head of the department.

SEMESTER VII

Subject Code:	Subject Name : PROJECT PHASE - II	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22L13	Prerequisite: NIL	Lb	0	0/0	12/12	8

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES: The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue, address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	Formulate students to think critically and creatively about societal issues and develop user friendly and reachable solutions
CO3	Analyse research skills and demonstrate their proficiency in communication skills.
CO4	Make the students to face challenges of teamwork, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	2	3	3	3
CO4	3	3	3	3	3	3	3	2	2	3	3	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	3	3	3				
CO2	3	3	3	3				
CO3	3	3	3	3				
CO4	3	3	3	3				

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
									✓			

Subject Code:	Subject Name : PROJECT PHASE - II	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22L13	Prerequisite: NIL	Lb	0	0/0	12/12	8

To make the students to make use of the knowledge and skill developed during their four years of study and to apply them for making an innovative product/process for the development of society and industries.

Students are expected to do a Project work either in an Industry or at the University in the field of relevant Engineering /inter-disciplinary /multi-disciplinary area in a group of 3 or 4 students. The work to be carried out in Phase II should be continuation of Phase I. Each group will be allotted a guide based on the area of Project work. In case of industrial Project external guide has to be allotted from Industry. Inter disciplinary/multi-disciplinary project can be done with students of different disciplines as a group. Monthly reviews will be conducted during the semester to monitor the progress of the project by the project review committee. Students have to submit the Project thesis at the end of the semester and appear for the Project Viva-Voce examination conducted by the examiners duly appointed by the Controller of Examination. In case of industrial project certificate in proof has to be included in the report along with the bonofide certificate.

PROGRAM ELECTIVES

Elective-1 Electronics stream

Subject Code:	**Subject Name : SEMICONDUCTOR DEVICES AND ITS APPLICATIONS**	**Ty / Lb/ ETL/IE**	L	T/SLr	P/R	C
EBEC22E01	Prerequisite: Solid state Devices	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To learn the functions of special diodes and their applications.
- To gain the knowledge about operation of power diodes.
- To apply the power diodes for inverters, converters and regulated power supply.

COURSE OUTCOMES (COs) : (3- 5)
The Students will be able to

CO1	Understand the characteristics of special diodes
CO2	Apply the diodes for basic electronic design
CO3	Remember the operations of inverters.
CO4	Illustrate the different types of converters.
CO5	Demonstrate the design of protection and switch gear

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	**PO 1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**2**	**1**	**2**	**2**	**2**	**1**	**1**	**1**		**2**		
CO2	**2**	**1**	**2**	**3**	**2**	**1**	**1**	**1**		**2**		
CO3	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**1**	**2**		**2**
CO4	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	
CO5	**2**	**2**	**3**	**3**	**2**	**1**	**2**	**3**	**2**	**2**	**1**	**2**

COs / PSOs	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	**2**	**3**	**1**	**1**
CO2	**2**	**3**	**1**	**1**
CO3	**1**	**1**	**2**	**2**
CO4	**1**	**1**		**2**
CO5	**1**	**1**	**2**	**2**

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : SEMICONDUCTOR DEVICES AND ITS APPLICATIONS	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E01	Prerequisite: Solid state Devices	Ty	3	0/0	0/0	3

UNIT I SPECIAL DIODES 9 Hrs

Breakdown Diodes-Avalanche Multiplication, Zener breakdown and its characteristics, Tunnel Diodes – Principle and Characteristics, Photodiode and its characteristics, Photo Voltaic Effect, and Light Emitting Diodes, Four Layer diode and its characteristics

UNIT II APPLICATIONS OF DIODES 9 Hrs

Diode as clipper, clamper, comparator, sampling gate, voltage multipliers and peak detectors - Regulated Power Supply

UNIT III INVERTERS 9 Hrs

Single Phase and three phase inverters-Voltage source inverters-current source inverters-Multilevel inverters-Resonant inverters

UNIT IV CONVERTERS 9 Hrs

Single phase and three phase converters –Buck-Boost Converters-Dc to Dc converters-Ac to Ac Converters- Resonant Converters-Cycloconverters

UNIT V FIRING AND PROTECTING CIRCUITS 9 Hrs

Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT - Over voltage, over current and gate protections

Total Number of Hours: 45

TEXT BOOKS :

1. Jacob Milman, Christos Halkias and Chetan D.Parikh, ‘Integrated Electronics, Analog and Digital Circuits and Systems”

2. Rashid M.H., " Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Third Edition, New Delhi, 2004

3. B.W Williams ‘Power Electronics Circuit Devices and Applications’.

REFERENCES :

1. P.S.Bimbra, ‘Power Electronics” , Khanna Publishers,Eleventh Edition 2003

2. Ned Mohan,T.MUndeland and W.P Robbin, “Power Electronics: converters, Application and design” John Wiley and sons.Wiley India edition, 2006

3. P.C. Sen, “Modern Power Electronics”, Wheeler Publishing Co, First Edition, New Delhi, 1998

Subject Code:	Subject Name : REAL TIME OPERATING SYSTEMS	T y/ Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E02	Prerequisite: Operating Systems Concepts	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- Review of elements and fundamentals of Systems.
- To know the operation of embedded software tools
- To understand the importance of queues and scheduling

COURSE OUTCOMES (COs) :
The Student will be able to

CO1	Understand the fundamentals of embedded system
CO2	Apply scheduling techniques for completing an operation
CO3	Remember the functions of key elements of RTOS
CO4	Implement the design of simple RTOS
CO5	Demonstrate the applications of software development tools in real time system.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	3	1	1	1			
CO2	2	3	3	3	3	2		1	2	3	2	1
CO3	1	3	3	2	3	1		1	3	3	1	1
CO4	1	3	3	3	3	2	1		2	2		
CO5	2	2	3	3	3	1	1		2	2		

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	1	2	2
CO2	1	2	3	
CO3	1	2	2	
CO4	1	2	3	2
CO5	1	2	2	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : REAL TIME OPERATING SYSTEMS	T y/ Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E02	Prerequisite: Operating Systems Concepts	Ty	3	0/0	0/0	3

UNIT I EMBEDDED SYSTEM FUNDAMENTALS 9 Hrs

Complex systems and microprocessors– Embedded system design process –Designexample: Model train controller- Design methodologies- Design flows - RequirementAnalysis – Specifications-System analysis and architecture design – Quality Assurancetechniques - Designing with computing platforms – consumer electronics architecture –platform-level performance analysis.

UNIT II SURVEY OF SOFTWARE ARCHITECTURES 9 Hrs

Round –robin, Round-robin with interrupts, queues. Function- scheduling architecture, Real time operating system architecture, Scheduling architecture.

UNIT III ELEMENTS OF REAL TIME OPERATING SYSTEMS 9 Hrs

Structure of a Real Time System — Estimating program run times – Task Assignment and Scheduling – Fault Tolerance Techniques – Reliability, Evaluation – Clock Synchronisation Tasks & Task states, Tasks & data, Semaphores & shares data, Message Queues, Mailboxes and Pipes, Timer functions, Events, Memory management and Interrupt Routines in an RTOS environment.

UNIT IV BASIC DESIGN USING REAL-TIME OPERATING SYSTEMS 9 Hrs

Principles, encapsulating semaphores & queues, hard real-time scheduling considerations, saving memory space, saving power.

UNIT V EMBEDDED TOOLS 9 Hrs

Embedded software development tools- host and target machines, linker/locators for embedded software, getting embedded software into the target system. Debugging techniques- testing on host system, instruction set simulators, the assert, macro using laboratory tools.

Practical component P: Include case studies / application scenarios

Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Wayne Wolf, “Computers as Components- Principles of Embedded Computing Systems Design”, Academic press, 2001.
2. David E. Simon, “An Embedded Software Primer”, Pearson education, 1999.

REFERENCES:

1. 1.Arnold S. Berger, “Embedded Systems Design- an Introduction to Processes, Tools & Techniques”, CMP books, 2002.
2. 2.Jean J. Labrosse, “Embedded Systems Building Blocks”, CMP books, 2002.
3. 3.Michael Barr, “Programming Embedded Systems in C andC++”, O’Reilly, 1999.
4. 4.Lyla B.Das, ―Embedded Systems : An Integrated Approach‖ Pearson Education, 2013.
5. Jonathan W.Valvano, ―Embedded Microcomputer Systems Real Time Interfacing‖, Third Edition Cengage Learning, 2012.
6. David. E. Simon, ―An Embedded Software Primer‖, 1st Edition, Fifth Impression, Addison Wesley Professional, 2007.
7. Raymond J.A. Buhr, Donald L.Bailey, ―An Introduction to Real-Time Systems- From Design to Networking with C/C++‖, Prentice Hall, 1999.

Subject Code:	Subject Name : INTRODUCTION TO PLC	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E03	Prerequisite: Logic gates operations, Boolean algebra	ETL	1	0/1	3/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

To study the working principles of Programmable Logic Controller:
Provide students with opportunities to develop basic skills in the design of electronic equipment using PLC
To understand the generic architecture and constituent components of a Programmable Logic Controller.

- To develop architecture of PLC explaining each unit in detail.
- To develop a software program using modern engineering tools and technique for PLC
- To apply knowledge gained about PLC systems and to identify few real-life industrial applications

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Enable the students to develop knowledge on role of automation and importance of PLC
CO2	Interpret the Programming equipment, Various techniques of programming in PLC
CO3	Familiarize the students about the components of PLC
CO4	Understanding the architecture of SCADA and explain the importance of SCADA
CO5	Develop the various industrial applications of PLC

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	2		2	2	2	1
CO2	3	3	3	3	2	2	2		2	2	2	1
CO3	3	3	2	3	3	2	2		2	2	3	2
CO4	3	2	3	3	3	2	2		3	2	3	3
CO5	3	3	3	3	3	2	2		3	2	3	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2
CO2	3	3	3	2
CO3	3	3	2	2
CO4	3	3	2	2
CO5	2	3	2	3

3/2/1 indicates Strength of Correlation 3- High,2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : INTRODUCTION TO PLC	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E03	Prerequisite: Logic gates operations, Boolean algebra	ETL	1	0/1	3/0	3

UNIT I INTRODUCTION TO PLC **9 Hrs**

Role of automation in Industries – benefits of automation – Necessity of PLC – History and Evolution of PLC – Definition, types, selection criterion – Overall PLC system – PLC Input and Output modules – CPU, programmers and monitors, power supplies – Solid state memory

UNIT II PROGRAMMING OF PLC **9 Hrs**

Programming equipment, Various techniques of programming, Ladder diagram fundamentals ,proper construction of ladder diagram, basic components and their symbols in ladder diagram, Basics of PLC Programming: Processor Memory Organization, Program Scan, PLC Programming Languages, Relay-Type Instructions, Instruction Addressing, Branch Instructions, Internal Relay Instructions, Programming Examine If Closed and Examine If Open Instructions, Entering the Ladder Diagram, Modes of operation

UNIT III COMPUTER CONTROLLED TEST SYSTEM **9 Hrs**

Programmable Logic Controllers: Introduction, Parts of a PLC, Principles of Operation, architecture, PLCs versus Computers, PLC Size and Application.PLC Hardware Components: The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, The Central Processing Unit (CPU), Memory Design, Memory Types, Programming Terminal Devices, Recording and Retrieving Data, Human Machine Interfaces (HMIs). Definition of discrete state process control, PLC Vs PC, PLC Vs DCS, relay diagram, ladder diagram, ladder diagram examples, relay sequencers, timers/counters, high speed counter, PLC design, study of at least one industrial PLC.

UNIT IV SCADA FUNDAMENTALS **9 Hrs**

Introduction, Open system: Need and advantages, Building blocks of SCADA systems, Remote terminal unit (RTU): Evolution of RTUs, Components of RTU, Communication subsystem, Logic subsystem, Termination subsystem, Testing and human-machine interface (HMI) subsystem, Power supplies, Advanced RTU functionalities, Intelligent electronic devices (IEDs).

UNIT V APPLICATIONS OF PLC **9 Hrs**

Developing Fundamental PLC Wiring Diagrams and Ladder Logic Programs: Electromagnetic Control Relays, Contactors, Motor Starters, Manually Operated Switches, Mechanically Operated Switches, Sensors, Output Control Devices, Seal-in Circuits, Latching Relays, Converting Relay Schematics into PLC Ladder Programs, Measurement of temperature, flow, pressure, force, displacement, speed, level Developing a ladder logic for Sequencing of motors, Tank level control, ON OFF temperature control, elevator, bottle filling plant, car parking Motors Controls

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXTBOOKS:

1. Gary Dunning, “Introduction to Programmable Logic Controllers”, Thomson, 2nd Edition
2. John R. Hackworth, Frederick D., Hackworth Jr., “Programmable Logic Controllers Programming Methods and Applications”, PHI Publishers
3.John W. Webb, Ronald A. Reis, “Programmable Logic Controllers: Principles and Application”, PHI Learning, New Delhi, 5th Edition
4.L.A. Bryan, E. A. Bryan, “Programmable Controllers Theory and Implementation” Industrial Text Company Publication, Second Edition

REFERENCE BOOKS:

1. Batten G. L., “Programmable Controllers”, McGraw Hill Inc., Second Edition
2. Krishna Kant, “Computer Based Industrial Control”, PHI
3. M. Chidambaram, “Computer Control of Process”, Narosha Publishing
4. P. K. Srivstava, “Programmable Logic Controllers with Applications”, BPB Publications
5. Webb J. W, “Programmable Controllers”, Merrill Publishing Company, 1988

Elective-1 Communication stream

Subject Code:	Subject Name : ANTENNA AND WAVE PROPAGATION	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E04	Prerequisite: EMF, TLWG	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To study Antenna Parameters.
- To study Radiation Resistance, Antenna Efficiency Measurement.
- To study Antenna Arrays.
- To study different types Antennas
- To study Radio wave propagation.

COURSE OUTCOMES (COs) : (3- 5)

The students will be able to

CO1	Understand the knowledge about antenna basics.
CO2	Write about the radiation from a current element.
CO3	Analyze the antenna arrays.
CO4	Explain various types of antenna.
CO5	Describe various types of radio wave propagation.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2					
CO2	3	3	3	3	3	3	2					
CO3	3	3	3	3	3	2	2					
CO4	3	3	3	3	3	2	2					
CO5	3	3	3	3	3	2	2					

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	
CO2	3	3	2	
CO3	3	3	2	
CO4	3	3	2	
CO5	3	3	2	

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : ANTENNA AND WAVE PROPAGATION	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E04	Prerequisite: EMF, TLWG	Ty	3	0/0	0/0	3

UNIT I ANTENNA BASICS 9Hrs

Antenna Parameters – Gain, Directivity, Effective Aperture Polarization, Beam width, Balun, Ground System, Top loading, monopole and Half wave dipole antenna, Short linear antenna, Beam solid angle, Antenna Temperature.

UNIT II RADIATION PRINCIPLE AND ANTENNA TERMINOLOGIES 9Hrs

Principle of Radiation, pattern, Antenna Terminologies – Reciprocity Theorem, Friss Formula, Slot Antennas, SWR(Standing Wave Radiators)

UNIT III ANTENNA ARRAYS 9Hrs

Arrays – Two Element Arrays – Uniform Linear Array – Broadside Array – End fire array – Principle of Pattern Multiplication – Binomial Arrays.

UNIT IV SPECIAL ANTENNA 9Hrs

Dish Antenna – Helical Antenna, Biconical Antenna, Microstip Patch Antenna, Turnstile Antenna, Yagi – uda antenna, Loop Antenna, Antenna Low and Medium Frequencies.

UNIT V WAVE PROPAGATION 9Hrs

Wave Propagation - Surface Wave Propagation , Structure of the Ionosphere, Space Wave Propagation- Determination of Critical Frequencies - Maximum Usable Frequency - Effect of Earth's Magnetic Field - Fading - Super Refraction - Scatter Propagation.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Constantine A.Balanis, "*Antenna theory analysis and design*" JohnWiley , 2nd Edition 2007.
2. G.S.V. Raju, "*Antenna wave propagation*", pearson education, 2004.
3. R.E. Collins, "*Antenna and Radio wave propagation*".

REFERENCE BOOKS:

1. John D. Kraus, Ronald J Marhefka. "Antenna for all Appplications" Tata McGraw Hill 3nd Edition,2007.
2. A.R.Harish, M. Sachidanada, "Antenna and wave propagation", Oxford university press,2007.
3. W.L.Stutzman and G.A. Thiele, "Antenna analysis and design", John willey,2000.

Subject Code:	Subject Name : TELECOMMUNICATION SWITCHING SYSTEM	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E05	Prerequisite: Computer Networks	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the working of simple telephone networks.
- To establish the significance of network parameters in traffic engineering.
- To demonstrate the transmission of data in networks

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Describe and apply the fundamentals of telecommunication systems and associated technologies.
CO2	Understand and explain the reasons for switching and the relative merits of the various modes of switching.
CO3	Analyze and design systems related to traffic engineering.
CO4	Analyze the internal design and operation of telephone networks with regard to key signaling systems used in telecommunication networks.
CO5	Understand and analyze the switching techniques used in data networks.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	3	3	1	1	1		1	1	
CO2	1	3	1	3	3	1		1		1	1	
CO3	3	3	3	3	1	1						
CO4	1	3	3	3	1	1	1		1			
CO5	1	3	3	3	3	1	1		1			2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3		2
CO2	3	3		1
CO3	3	2	2	2
CO4	3	3	1	3
CO5	3	3	1	2

H/M/L indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : TELECOMMUNICATION SWITCHING SYSTEM	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E05	Prerequisite: Computer Networks	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION **9 Hrs**

Evolution of Telecommunications, Simple Telephone Communication, Manual switching system, major telecommunication Networks, Strowger Switching System, Crossbar Switching

UNIT II SWITCHING CONCEPTS **9 Hrs**

SPC-its categorization, Enhanced Services, Two stage networks, Three stage networks, n-stage networks

Time multiplexed Space Switching, Time Multiplexed time switching, combination Switching, Three stage combination switching, n-stage combination switching.

UNIT III TRAFFIC ENGINEERING **9 Hrs**

Network Traffic load and parameters, Grade of service and blocking probability, Modeling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking Models and Loss Estimates, Delay systems.

UNIT IV TELEPHONE NETWORKS **9 Hrs**

Subscriber Loop Systems, Switching Hierarchy and Routing, Transmission Plan, Transmission Systems, Numbering Plan, Charging Plan, Signaling Techniques, In channel signaling, common channel signaling, Cellular mobile telephony.

UNIT V DATA NETWORKS **9 Hrs**

EPABX system – block diagram, working – Data transmission in PSTN, data rates in PSTNs – ISO – OSI reference model – Motivation for ISDN – Networks and protocol architecture, ISDN standards, broadband ISDN, voice data integration.

Practical component P: Include case studies / application scenarios

Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Thiagarajan Vishwanathan, “Telecommunication Switching Systems and Networks”; PHI Publications.
2. J. E. Flood, “Telecommunications Switching, Traffic and Networks”, PearsonEducation.
3. B.Forouzan “Data Communications and Networking”, Pearson Education.

REFERENCE BOOKS:

1. *John C. Bellamy, “Digital Telephony”, Third Edition; Wiley Publications.*
2. *Andy Valder,”Understanding Telecommunication Networks”,IET press*

Subject Code:	Subject Name : AUDIO SIGNAL PROCESSING	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E06	Prerequisite: Signals and Systems	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To study the basic concepts of speech and audio.
- To study the analysis of various M-band filter banks for audio coding
  To learn various transform coders for audio coding.
  To study the speech processing methods in time and frequency domain.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Determine the natures of speech generation and modeling..
CO2	Analyze various transforms and m – band filter bank for audio coding.
CO3	Understand different audio coding and transform coders.
CO4	Estimate various speech parameters with suitable techniques.
CO5	Apply linear prediction coding tool to analyze speech.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1	3	3	3	2	3		3
CO2	3	3	3	3	1	2	3	3	2	1		3
CO3	3	3	3	3	1	2	3	3	2	1		3
CO4	3	3	3	3	1	3	3	3	2	1		3
CO5	3	3	3	3	1	3	3	3	2	3		3

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	3	3	3				
CO2	3	3	3	3				
CO3	2	1	3	3				
CO4	3	3	2	3				
CO5	3	2	3	3				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : AUDIO SIGNAL PROCESSING	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E06	Prerequisite: Signals and Systems	Ty	3	0/0	0/0	3

UNIT I MECHANICS OF SPEECH AND AUDIO 9 Hrs

Introduction - Review Of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modeling of Speech production – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Non simultaneous Masking - Perceptual Entropy - Basic measuringphilosophy -Subjective versus objective perceptual testing - The perceptual audio quality measure (PAQM) - Cognitive effects in judging audio quality.

UNIT II TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS 9 Hrs

Introduction -Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters- Tree- Structured QMF and CQF M-band Banks - Cosine Modulated "Pseudo QMF" M-band Banks - Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT) - Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion- Preecho Control Strategies.

UNIT III AUDIO CODING AND TRANSFORM CODERS 9 Hrs

Lossless Audio Coding-Lossy Audio Coding- ISO-MPEG-1A,2A,2A Advanced, 4Audio Coding - Optimum Coding in theFrequency Domain - Perceptual Transform Coder -Brandenburg-Johnston Hybrid Coder - CNET Coders - Adaptive Spectral Entropy Coding -Differential Perceptual Audio Coder - DFT Noise Substitution -DCT with Vector Quantization -MDCT with Vector Quantization.

UNIT IV TIME AND FREQUENCY METHODS FOR SPEECH PROCESSING 9 Hrs

Time domain parameters of Speech signal – Methods for extracting the parameters: Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods HOMOMORPHIC SPEECH ANALYSIS:Cepstral analysis of Speech – Formant and Pitch Estimation – HomomorphicVocoders.

UNIT V LINEAR PREDICTIVE ANALYSIS OF SPEECH 9 Hrs

Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXTBOOKS:

1. Digital Audio Signal Processing, Second Edition, UdoZölzer, A John Wiley& sons Ltd Publicatioons
2. Applications of Digital Signal Processing to Audio And Acoustics Mark Kahrs, Karlheinz Brandenburg, Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow.

REFERENCE:

1. *Digital Processing of Speech signals – L. R. Rabiner and R.W. Schaffer - Prentice Hall – 1978*

Elective -2 Electronics stream

Subject Code:	Subject Name : INTELLIGENT INSTRUMENTATION	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E07	Prerequisite: Electronic Circuit	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- Introduce students to the use of various electrical/electronic instruments, their construction, applications, principles of operation, standards and units of measurements .Basic measurement and transducers concepts
- Provide students with opportunities to develop basic skills in the design of electronic equipments using PLC.

COURSE OUTCOMES (COs) : (3- 5)

The student will be able to

CO1	Learn the concepts of transducers.
CO2	Understand the basic design techniques of signal generators and analyzers.
CO3	Gain knowledge about Instrumentation standard protocols.
CO4	Use various laboratory instruments like cathode ray oscilloscope, function generators and analyze various patterns.
CO5	Develop basic skills in designing of computer controlled instrumentation.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	2	1	1	2	3		2	
CO2	3	3	3	3	3	3	3	2	2		2	
CO3	3	1	1	2	3	3	2	1	3		2	
CO4	3	3	3	2	2	2	3	1	2		2	
CO5	3	3	3	2	2	2	3	1	2		2	

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	
CO2	3	3	3	
CO3	3	2	3	
CO4	3	3	2	
CO5	3	3	3	

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : INTELLIGENT INSTRUMENTATION	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E07	Prerequisite: Electronic Circuit	Ty	3	0/0	0/0	3

UNIT I TRANSDUCERS 9 Hrs

Transducer definition, classification, and performance characteristics. Potentiometer and its types, loading effect, sensitivity, piezo-resistive, equivalent circuits, charge and voltage sensitivity. Measurements, Instrumentation, Errors in Measurements, Calibration and Standard.

UNIT II SIGNAL GENERATOR AND SIGNAL ANALYZERS 9Hrs

A.F. Generator, Pulse Generator, AM / FM Signal Generator, Function Generator, Sweep Frequency Generator, Wave Analyzers, Spectrum Analyzers, Logic Analyzer, Distortion Analyzers, Network Analyzer.

UNIT III INSTRUMENTATION STANDARD PROTOCOLS 9 Hrs

Definition of protocol, HART Protocol: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation. Foundation Field bus H1: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation. Comparison of HART, Foundation Fieldbus, Devicenet, Profibus, Controlnet, Industrial Ethernet.

UNIT IV DATA DISPLAY AND RECORDING SYSTEM 9 Hrs

CRO, Single Beam, Dual Trace, Double Beam CRO, Digital Storage and Analog Storage Oscilloscope, Sampling Oscilloscope, Power Scope, Curve Tracer, Analog, Digital Recorders and Printers – Case Study on Lissajous Pattern.

UNIT V COMPUTER CONTROLLED TEST SYSTEM 9 Hrs

Programmable logic controllers (PLC) Introduction, architecture, definition of discrete state process control, PLC Vs PC, PLC Vs DCS, relay diagram, ladder diagram, ladder diagram examples, relay sequencers, timers/counters, high speed counter, PLC design, study of at least one industrial PLC.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Rangan C.S. "*Instrumentation Devices and Systems*", Tata McGraw Hill, 1998.
2. SandeepRedkar, "Foundation Fieldbus control system", Rockwell Automation,2010,
3. K. Shawney "*Electronics and Electrical Instrumentation"*, Tata McGraw Hill, 1975.

REFERENCES BOOKS:

1. Bouwels A.J., "Digital Instrumentation", McGraw Hill, 1986.
2. Barney .C, "Intelligent Instrumentation ", Prentice Hall of India, 1985.
3. Oliver and Cage, "Electronic Measurements and Instruments and Instrumentation", McGraw Hill, 1975.
4. Deobelin, "Measurements Systems", McGraw Hill, 1990.
5. Cooper, "Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 1988.

Subject code:	Subject Name : ADVANCED MICROPROCESSORS	Ty/Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22E08	Prerequisite: Microprocessor and Microcontrollers	Lb	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To introduce the concepts in internal programming model of Intel family of microprocessors.
- To learn the functions of ARM processor and their applications To introduce the architecture programming and interfacing of 16 bit microcontrollers.
- To introduce the concepts and architecture of RISC processor

COURSE OUTCOMES (COs) :

The Students will be able to

CO1	Explain the generalized architecture of advanced microprocessor
CO2	Apply their understanding to do a project to develop an application using ARM processor.
CO3	Appreciate the microprocessor based system design
CO4	Analyze the MOTOROLA MC 68000 family
CO5	Describe about the various RISC processors

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2		1			3	3	1	3
CO2	3	2	3	2	3	3			3	2	3	3
CO3	3	3	2	2		1			1	3	2	3
CO4	3	3	3	3		1			2	2	3	2
CO5	3	3	3	3		1			3	3	1	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2		1
CO2	3	2	2	3
CO3	3	2	2	1
CO4	3	1		2
CO5	3	1		2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium,1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project	Inter Disciplinary		
					✓							

Subject code:	Subject Name : ADVANCED MICROPROCESSORS	Ty/Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E08	Prerequisite: Microprocessor and Microcontrollers	Lb	3	0/0	0/0	3

UNIT I THE INTEL X86 FAMILY 9 Hrs

The Intel X86 Family Architecture, 32 bit Processor Evolution Systems Connections and Timing, Instruction and Data Formats, Instruction set of X86 Processors, Addressing Modes.

UNIT II INTRODUCTION TO ARM PROCESSOR 9 Hrs

ARM Architecture –ARM programmer's model- ARM development tools-memory hierarchy-ARM assembly language programming-Simple Examples-Architectural support for operating system- ARM instruction Set-Embedded ARM Applications

UNIT III SYSTEM DEVELOPMENT 9 Hrs

Microprocessors Based System Design, TMS 320 Series DSP Based Signal Processing, Microcontroller 8096, architecture, addressing mode and system design.

UNIT IV THE MOTOROLA MC 68000 FAMILY 9 Hrs

The MC 68000 Architecture, CPU Registrars, Data Formats, Addressing Modes, Instruction Set and Assembler Directors, Memory Management Instruction and Data, Caches, Exception Processing.

UNIT V RISC PROCESSORS 9 Hrs

RISC vs CISC, RISC Properties and Evaluation, Advanced RISC Microprocessors, DEC ALPHA, The Power PC family.The SUN SPARC Family, the MIPS RX 100 Family, the Intel 960 Family. The Motorola M88110 Family, HP Precision Architecture.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. B.B. Bery, "The Intel Microprocessors 8086 / 8088, 80186 / 80188, 80286, 80386, 80486, PENTIUM, and PENTIUM Processors", Prentice Hall, 1997.
2. K Udayakumar, B.S. Uma Shankar, "Advanced Microprocessors and IBM PC Assembly Language Programming", Tata McGraw Hill, 1996
3. Andrew N.Sloss, Dominic Symes and Chris Wright " ARM System Developer"s Guide : Designing and Optimizing System Software" , First edition, Morgan Kaufmann Publishers, 2004

REFERENCES:

1. Daniel Tabak, "Advanced Microprocessors", McGraw Hill, 1995.
2. Douglas V. Hall, "Microprocessors and Interfacing – Programming Hardware", McGraw Hill, 1992.
3. Steve furber "ARM Systems on chip Architecture", Second Edition Addison Wesley trade computer publication,2000.
4. W.A. Tribel& A. Singh, "The 68000 and 68020 Microprocessors – Architecture, Software and Interfacing Techniques", Prentice hall of India, 1991
5. Rifiquzzaman, "Microprocessors – Theory and Applications: Intel and MotorolaPrentice Hall, 1992.
6. Kenneth J. Ayala, "The 8051 Microcontroller, Architecture, Programming and Application", Penram International Publishing (India), 1996.6. John Peatman, "Design with Microcontrollers", McGraw Hill International, 1988

Subject Code:	Subject Name :NANO ELECTRONICS	TY / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E09	Prerequisite: Engineering Physics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To learn and understand basic concepts of Nano electronics.
- To know the techniques of fabrication and measurement.
- To gain knowledge about Nanostructure devices and logic devices.

COURSE OUTCOMES (COs) : (3- 5)
The Students will be able to

CO1	Introduce the concepts in nanoparticles
CO2	Demonstrate fabrication and characterization techniques
CO3	Describe the properties of Nano materials
CO4	Categorize the Nano structure devices
CO5	Understand and explain the principle and application of Nano devices.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	3	3	3	3	1	3	1	3
CO2	3	3	3	3	3	3	2	2	3	3	3	3
CO3	3	3	3	3	3	3	3	2	1	3	2	3
CO4	3	3	3	3	3	3	3	3	2	3	2	3
CO5	3	3	3	2	3	3	3	3	3	3	2	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	3	3	3	3
CO3	3	3	3	3
CO4	3	3	3	3
CO5	3	3	3	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium,1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name :NANO ELECTRONICS	TY / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E09	Prerequisite: Engineering Physics	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO NANOELECTRONICS 9 Hrs

Nano-scale electronics; Foundation of nano-electronics- Size & Scale Units Scaling Atoms, Molecules, Clusters and Supramolecules; Wave mechanics- Schrödinger wave equation; Chemical Bonds (types and strength).

UNIT II SYNTHESIS AND MEASUREMENT TECHNIQUES 9 Hrs

Nanomaterial Synthesis- Sol-gel methods, Mechanical methods: ball milling, mechanical attrition, Thin films methods: chemical vapor deposition, physical vapor deposition; Characterization techniques for nanomaterials and nano structures – FTIR, XRD, AFM, SEM, TEM, Analysis by Diffraction and Fluorescence Methods-Scanning Probe Techniques

UNIT III NANO MATERIALS & ITS PROPERTIES 9 Hrs

Classifications of nanomaterials - Zero dimensional, one-dimensional and two dimensional nanostructures; Carbon nanomaterials: nanotubes and fullerenes; Properties- Dielectrics-Ferroelectrics-Electronic Properties and Quantum Effects- Magneto transport in Layered Structures-Organic Molecules – Electronic Structures, Properties, and Reactions.

UNIT IV NANO STRUCTURE DEVICES 9 Hrs

Density of states of electrons in nanostructures- Electron transport in nanostructures- Electrons in quantum wells, Electrons in quantum wires, Electrons in quantum dots; Nanostructure devices- Resonant- tunneling diodes- Field-effect transistors- Single-electron-transfer devices- Potential-effect transistors- Light-emitting diodes and lasers- Nano-electromechanical system devices- Quantum-dot cellular automata

UNIT V APPLICATIONS OF NANOELECTRONICS 9 Hrs

Nanosensors- Nanoelectronics in Diagnostics applications, Environmental, Agriculturaland Food, Nanoelectronics for energy systems- batteries, solar cells.

Practical component P : Include case studies / application scenarios
Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, “Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications”, Cambridge University Press 2011
2. Supriyo Datta,“Lessons from Nanoelectronics: A New Perspective on Transport”, World Scientific2012
3. George W. Hanson,“Fundamentals of Nanoelectronics”, Pearson 2009

REFERENCES:

1. Korkin, Anatoli; Rosei, Federico (Eds.), “Nanoelectronics and Photonics”,Springer 2008
2. Mircea Dragoman, Daniela Dragoman, “Nanoelectronics: principles and devices”, CRC Press 2006
3. Karl Goser, Peter Glösekötter, Jan Dienstuhl,“Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices“,
4. Springer 2004
5. W. R. Fahrner, Nanotechnology and Nan electronics: Materials, Devices, Measurement Techniques(SpringerVerlag Berlin Heidelberg 2005)
6. Mark A. Reed, Takhee Lee,“Molecular nanoelectronics”, American Scientific Publishers 2003
7. Jaap Hoekstra, “Introduction to Nanoelectronic Single-Electron Circuit Design”, Pan Stanford Publishing 2010

Elective -2 Communication stream

Subject Code:	Subject Name : INTERNET OF THINGS AND ITS APPLICATIONS	Ty / Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22E11	Prerequisite:: Internet of Things	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To study basics of IoT.
- To study IoT with Cloud environment.
- To study IoT applications.

COURSE OUTCOMES (COs) : (3- 5)

The students will be able to

CO1	Explore basics concepts of technology of IoT
CO2	Understand different IoT domains.
CO3	Manage system data in cloud environment
CO4	Interface embedded system with IoT
CO5	Learn new applications based on IoT.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	3	2	2	2	3	3
CO2	3	2	2	3	3	2	2	2	2	2	3	3
CO3	3	2	3	3	3	2	2	2	2	2	3	3
CO4	3	3	2	3	3	2	2	2	2	2	3	3
CO5	3	2	3	3	3	2	2	2	3	2	3	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	3	3	2	3
CO3	3	3	2	3
CO4	3	3	2	3
CO5	2	3	3	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : INTERNET OF THINGS AND ITS APPLICATIONS	Ty / Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22E11	Prerequisite:: Internet of Things	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO INTERNET OF THINGS 9 Hrs

Definition and Characteristics of IoT – Things in IoT – IoT Protocols – Logical Design of IoT – IoT enabling technologies – IoT Levels.

UNIT II DOMAIN SPECIFIC IoT 9 Hrs

Home Automation – Cities – Environment – Energy – Retail – Logistics – Agriculture – Industry – Health and Life style–SDN and NFV for IoT.

UNIT III IoT SYSTEM MANAGEMENT AND CLOUD 9 Hrs

Need for IoT System Management - SNMP – NETOPEER – IoT design methodology - Xively – Django-Amazon Web for IoT – SkyNetIoT.

UNIT IV IoT PHYSICAL DEVICES 9 Hrs

Raspberry Pi - Raspberry Pi Interfaces – Arduino boards – Other IoT devices –Intel Galileo Arduino board Specification.

UNIT V IoT APPLICATIONS 9 Hrs

Applications based on IoT - Smart Cities -Smart Home and Buildings -Smart Energy and the Smart Grid - Smart Health- Smart Transportation and Mobility

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXTBOOKS:

1. ArshdeepBahga.Vijaymadisetti ,*" Internet of things – A hands- on approach* " , Universities press, First Editon, 2015.
2. Adrian McEwen and Hakim Cassimally, "*Designing the Internet of Things*",Wiley,First edition 2014.
3. C HillarGastn, "*Internet of Things with Python*",Packt publishing, first edition ,2016.

REFERENCE BOOKS:

1. *Dominique D. Guinard and Vlad M. Trifa "Building the Web of Things With examples in Node.js and Raspberry Pi",June 2016 ISBN 9781617292682*
2. *CharalamposDoukas, "Building Internet of Things with the Arduino" ISBN/EAN13:1470023431 / 9781470023430*
3. *Gastón C. Hillar, "Internet of Things with Python", May 2016 , PACKT Publishing limited.*
4. *Marco Schwartz "Internet of Things with the Raspberry Pi: Build Internet of Things Projects Using the Raspberry Pi Platform", Kindle Edition.*

Subject Code	Subject Name : NEURAL NETWORKS AND ITS APPLICATIONS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
EBEC22E13	Prerequisite: nil	Ty	3	0	0	3

L : Lecture T : Tutorial S.Lr : Supervised Learning P : Project R : Research C: Credits
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

The student should be made to: To study the various neural network algorithms and its application in pattern recognition.

COURSE OUTCOMES (COs) :

CO1	Describe the basic concepts of artificial neural networks.
CO2	Explain about BPN and BAM
CO3	Implement the concept of simulated annealing and CPN
CO4	Interpret the concepts of SOM and ART.
CO5	**Describe** Deep learning.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	1	1	1	1	2	2	3
CO2	3	3	2	2	1	1	1	1	2	2	1	2
CO3	3	3	3	3	3	2	2	2	3	2	3	2
CO4	3	2	3	3	2	1	1	1	1	2	2	2
CO5	3	3	3	3	2	1	2	1	1	1	1	1
	3	2	2	2	1	1	1	1	1	1	2	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	3
CO2	1	2	3	1
CO3	3	2	3	1
CO4	1	1	3	2
CO5	1	2	1	3

3/2/1 Indicates Strength Of Correlation, 3 – High, 2- Medium, 1- Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code	Subject Name : NEURAL NETWORKS AND ITS APPLICATIONS	Ty/Lb/ ETL	L	T/ S.Lr	P/R	C
EBEC22E13	Prerequisite: nil	Ty	3	0	0	3

UNIT I INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS 9 Hrs

Neuro – Physiology – General Processing Element – ADALINE – LMS Learning Rule – MADALINE – Perception Networks

UNIT II BPN AND BAM 9 Hrs

Back Propagation Network – Updating of Output and Hidden Layer Weights – Application of BPN – Associative Memory – Bi-Directional Associative Memory - Hopfield Memory – Traveling Sales Man Problem

UNIT III SIMULATED ANNEALING AND CPN 9 Hrs

Annealing, Boltzmann Machine – Learning – Application – Counter Propagation Network – Architecture – Training – Application.

UNIT IV SOM AND ART 9 Hrs

Self-Organizing Map – Learning Algorithm – Feature Map Classifier – Applications – Architecture of Adaptive Resonance Theory – Pattern Matching in ART Network. Neocognitron: Architecture of Neocognitron – Data Processing and Performance of Architecture of Spacio – Temporal Networks for Speech Recognition

UNIT V DEEP LEARNING 9 Hrs

Deep Feed Forward network, regularizations, training deep models, dropouts, Training Deep Neural Networks using Back Propagation-Setup and initialization issues, vanishing and exploding Gradient problems, Gradient- Descent Strategies

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Laurence Fausett, “Fundamentals of Neural Networks: Architecture, Algorithms and Applications”, Prentice Hall, 1994.
2. J.A. Freeman and B.M.Skapura, “Neural Networks, Algorithms Applications and Programming Techniques”, Addison-Wesley, 1990.
3. CharuC.Aggarwal “Neural Networks and Deep learning” Springer International Publishing, 2018

REFERENCE BOOKS:

1. Martin T. Hagan, Howard B. Demuth “Neural Networks Design”,2 ndEdition, Martin Hagan, 2014
2. Simon Haykin, “Neural Networks and Learning Machines” -3/E - Pearson/ Prentice Hall 2009

Subject Code:	Subject Name :RADAR AND NAVIGATIONAL AIDS	TY /Lb/ ETL/IE	L	T/ SLr	P/R	C
EBEC22E14	Prerequisite: Engineering Physics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To become familiar with fundamentals of RADAR
- To gain in-depth knowledge about the different types of RADAR and their operations
- Need for signal detection in RADAR and various detection techniques
- To become familiar with RADAR navigation techniques

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Distinguish the various types of radar
CO2	Understand the operation of high frequency signal generators.
CO3	Identify the targeted radar signals in noise
CO4	Analyze the propagation of radar waves and formation of clutter
CO5	Exhibit the different navigational aids

Mapping of Course Outcomes with Program Outcomes (POs)

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	1	1		1	1		2
CO2	2	3	2	1	1	1	1		1			
CO3	1	2	2	2	2	2	2	2	2	2	1	
CO4	1	2	2	2	2	2	2	2	2	2	1	1
CO5	1	1	1	1	1	2		1	1	2		2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	2	3	2
CO2	2	3	2	3
CO3	1	3	2	1
CO4	1	2	2	2
CO5	1	2	3	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name :RADAR AND NAVIGATIONAL AIDS	TY /Lb/ ETL/IE	L	T/ SLr	P/R	C
EBEC22E14	Prerequisite: Engineering Physics	Ty	3	0/0	0/0	3

UNIT I RANGE AND TYPES OF RADAR 9 Hrs

Range Parameters, Pulsed Radars, Signal to Noise Ratio, Integration of Pluses Beam Parameters, System Losses and Propagation Effects MTI; CW and Pulse-Doppler Radar, Delay Lines Tracking Radar, Mono pulse, Sequential, Simultaneous, Conical Scan and Monopulse Trackers, Beacons.

UNIT II TRANSMITTERS, RECEIVERS AND ANTENNA 9 Hrs

Klystron, Magnetron, TWT Amplifiers and Oscillators, Crossed Fields Devices, Parabolic Cassegrainian, Coefficient, Squares Antennas, Radomes, Feeds, Receivers, Performance Figures, Displays Scope and PPI Duplexers.

UNIT III DETECTION OF RADAR SIGNALS IN NOISE 9 Hrs

MF, Correlation Detection, Detector Characteristics, Automatic Detection, CFAR Receiver, Pulse Compression and Classification of Targets with Radar.

UNIT IV PROPAGATION OF RADAR WAVES AND CLUTTER 9 Hrs

Plane Earth and Spherical Earth Problem, Refraction and Diffraction, GTD Analyzers, Surface and Sea Clutter, Detection of Targets, Effects of Weather on Radar.

UNIT V RADAR TOPICS AND NAVIGATIONAL AIDS 9 Hrs

Synthetic Aperture, Over the Horizon Radar, ARSR, ASR, Bistatic and Monostatic Radars, LORAN, ILS, GCA, Direction Finder, VOR Concepts, Airborne Doppler Navigation.

Practical component P: Include case studies / application scenarios
Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. M.I. Skoinik “Introduction to Radar Systems:, McGraw Hill 1981.
2. N.S. Nagaraja, Elements of Electronic Navigation Systems, 2nd Edition, TMH, 2000.

REFERENCES:

1. *F.E. Terman, “Electronics and Radio Engineering” McGraw Hill*
2. *Peyton Z. Peebles:, "Radar Principles", John Wiley, 2004*
3. *J.C Toomay, " Principles of Radar", 2nd Edition –PHI, 2004*

Subject Code:	Subject Name : EMBEDDED SOFTWARE DESIGN	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E16	Prerequisite: Basic C Programming	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE:

- Toimplement software design for an embedded system using C and assembly level programs

COURSE OUTCOMES (COs) : (3- 5)
The Students will be able to

CO1	Understand the concept of basic embedded system
CO2	Write a simple program using C and assembly
CO3	Differentiate the methods of IO programming using interrupts
CO4	Apply scheduling methods for multi-threaded programming
CO5	Demonstrate the principle of shared memory and memory management

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1			2	1	1				2
CO2	1	2	2	2	3	1	1	1		2	3	2
CO3	1	3	2	3	3	1	1	1	1	2		
CO4	1	3	3	3	3	1	1	2	3		2	
CO5	1	2	3	3	3	2	2	3		2	3	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	1	1	1
CO2	2	2	3	1
CO3	1	2	3	1
CO4	2	2	3	2
CO5	1	1	3	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : EMBEDDED SOFTWARE DESIGN	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E16	Prerequisite: Basic C Programming	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO EMBEDDED SYSTEM AND DATA REPRESENTATION& ARM PROCESSOR 9hrs

Embedded system-Design goals for embedded software- Real time and multi-tasking-Embedded processors and languages-Building an embedded application-Data Representation-Fixed precision binary numbers-Binary representation of Integers and real numbers-ASCII and BCD number.

ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU.

UNIT II EMBEDDED PROGRAMMING 9hrs

Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing

UNIT III INPUT OUTPUT PROGRAMMING 9hrs

I/O instructions – synchronization, transfer rate and latency – polled waiting loops – interrupt driven I/O-interrupt service routine-Buffers and queues –ISR in assembly and C – Non-maskable interrupts - Software interrupts – Exceptions - direct memory access –comparison of methods .

UNIT IV CONCURRENT SOFTWARE AND SCHEDULING 9hrs

Foreground/background systems - Multi threaded programming – shared resources and critical sections – thread states – pending threads – context switching – round-robin scheduling – priority-based scheduling – assigning priorities – deadlock –watchdog timers.

UNIT V MEMORY MANAGEMENT AND SHARED MEMORY 9hrs

Objects in C – scope – lifetime –automatic allocation – static allocation – Dynamic allocation- recognizing shared objects – reentrant functions – read only data – accessing shared memory.

Practical component P: Include case studies / application scenarios

Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Daniel W. Lewis, “Fundamentals of embedded software where C and assembly meet”, Pearson Education, 2002.
2. Steve Heath, “Embedded system design”, Elsevier, 2003.
3. Marilyn Wolf, ―Computers as Components - Principles of Embedded Computing System Design‖, Third Edition ―Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
4. Jane W.S. Liu, Real Time Systems‖, Pearson Education, Third Indian Reprint, 2003.

REFERENCES:

1. Lyla B.Das, ―Embedded Systems : An Integrated Approach‖ Pearson Education, 2013.
2. Jonathan W.Valvano, ―Embedded Microcomputer Systems Real Time Interfacing‖, Third Edition Cengage Learning, 2012.
3. David. E. Simon, ―An Embedded Software Primer‖, 1st Edition, Fifth Impression, AddisonWesley Professional, 2007.
4. Raymond J.A. Buhr, Donald L.Bailey, ―An Introduction to Real-Time Systems- From Design to Networking with C/C++‖, Prentice Hall, 1999.
5. C.M. Krishna, Kang G. Shin, ―Real-Time Systems‖, International Editions, Mc Graw Hill 1997
6. K.V.K.K.Prasad, ―Embedded Real-Time Systems: Concepts, Design & Programming‖, Dream Tech Press, 2005
7. Sriram V Iyer, Pankaj Gupta, ―Embedded Real Time Systems Programming‖, Tata Mc Graw Hill, 2004.

Subject Code:	Subject Name :QUANTUM COMPUTING	Ty/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E17	Prerequisite: Engineering Physics	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES:

- To understand the building blocks of a quantum computer.
- To understand the principles, quantum information and limitation of quantum operations formalizing.
- To understand the various quantum algorithms.

COURSE OUTCOMES (COs) : (3- 5)
The Students will be able to

CO1	Demonstrate the importance of quantum computing and superposition states.
CO2	Explain Quantum operators and its applications.
CO3	Build quantum circuits with the knowledge of various quantum gates.
CO4	Apply the concept of different quantum algorithms and have the insight of QKD.
CO5	Identify Quantum errors and correct it using Quantum error correcting codes.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	3	2	1	1	2	2	1	2	2	1	2	3
CO2	3	3	2	2	1	1	1	2	2	1	2	3
CO3	3	3	3	2	3	1	1	2	2	2	3	3
CO4	2	2	2	3	3	1	1	2	2	2	2	2
CO5	3	3	3	2	3	2	2	2	2	2	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2
CO2	3	3	3	2
CO3	3	3	2	3
CO4	3	3	2	3
CO5	3	3	2	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name :QUANTUM COMPUTING	Ty/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E17	Prerequisite: Engineering Physics	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION 9 Hrs

Introduction to Quantum Computing- Power of Quantum Computing- Quantum Information- Quantum Computers. The Wave and the Corpuscular Nature of Light Photon Behavior, State Description, Measurement in Multiple Bases, Superposition States – The Superposition probability Rule.

UNIT II QUANTUM MECHANICS 9 Hrs

Quantum Postulates – State space, Evolution, Quantum Measurement, Distinguishing Quantum states, Projective measurements, POVM measurements -Quantum Mechanics-Hilbert Space-Linear Operators Tensor and Outer Products-Quantum Operators- Application Quantum mechanism: Super dense Coding - Double Silt Experiments.

UNIT III QUBITS AND QUANTUM GATES 9 Hrs

Qubits, Bloch Sphere Representation-Rotation Operation-The Measurement of a Single Qubits-A Pair of Qubits- Bell States- Qubits as Spin Half- Integer Particles- Qubits as Polarized Photon-Entanglement, Exchange of Information / Teleportation – Quantum Coping Circuit - The Non-Cloning Theorem-Quantum Gates – Universal Quantum Gate Gates – Matrix Representation – Quantum Circuits- Single and Multiple Qubit Controlled Operations.

UNIT IV QUANTUM ALGORITHM 9 Hrs

Turing Machine - Quantum Parallelism-Deutsch's Problem, Deutsch – Jozsa Algorithm -QFT(Quantum Fourier Transform)-Short's Factoring Algorithm-Simon's Algorithm-Quantum Search Algorithm- Quantum key distribution - Mathematical Models of Quantum Computers - Introduction Different implementations of quantum computer.

UNIT V QUANTUM ERROR CORRECTION 9 Hrs

Quantum error correction and simple examples – The Three Qubit flip code, Three Qubit Phase flip code, The Shor Code - Brief Introduction to Quantum Computing Software - Quantum error-correcting codes:Error models, Criteria for a good code: reversible operations.

Practical component P : Include case studies / application scenarios
Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS :

1. Dan C. Marinescu, Gabriela M. Marinescu, "*Approaching Quantum Computing*", Pearson Education 2008-09.
2. M.A. Neilson and I.L .Chuang "*Quantum computing and Quantum information"*, Cambridge University Press,2009.
3. Vishal Sahani "*Introduction to Quantum Computing*", TATA McGraw-Hill Publishing Company Limited.

REFERENCE BOOKS:

1. *A.Yu.Kitaev, A.H.Shen, M.N.Vyalyi, "Classical and Quantum Computation", American Mathematical Society.*
2. *Mark.M.Wilde, "Quantum information theory" Cambridge university press.*
3. *J.A.Jones, "Quantum information, computation and communication" Cambridge University Press.*
4. *Scott Aaronson, "Quantum computing since Democritus", Cambridge University Press 2013.*

Subject Code:	Subject Name : POWER ELECTRONICS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E18	Prerequisite: Solid State Devices	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To study about power electronic circuits for voltage and current control and protection.
- To learn the switching characteristics of transistors and SCRs. Series and parallel functions of SCRs, Programmable triggering methods of SCR.
- To learn controlled rectification AC supplies.
- To study of converters and inverters.
- To learn about motor control, charges, SMPS and UPS.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Understand the operation of power electronic devices.
CO2	Apply the triggering of SCR for natural and forced commutation.
CO3	Design phase controlled convertors using power diodes.
CO4	Develop different types of inverters and choppers.
CO5	Apply the concepts of power electronics in industries and HVDC system.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	2	2	1	2	2	1	2
CO2	3	2	3	3	2	2	2	2	1	2	1	2
CO3	3	3	3	3	3	1	2	1	1	2	2	1
CO4	2	3	3	3	1	1	1	1	1	2	1	2
CO5	3	3	3	3	1	1	1		1	2	1	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2
CO2	2	3	2	2
CO3	3	2	2	1
CO4	3	3	2	1
CO5	3	2	2	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : POWER ELECTRONICS	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E18	Prerequisite: Solid State Devices	Ty	3	0/0	0/0	3

UNIT I POWER ELECTRONIC DEVICES 9 Hrs

Characteristics of Power Devices – Characteristics of SCR – Two Transistor Model of SCR,Characteristics of TRIAC, BJT, MOSFET, IGBT, GTO both Static and Switching Characteristics – Protection of Thyristors against Over Voltage – Over Current, dv/dt and di/dt.

UNIT II TRIGGERING & COMMUTATION TECHNIQUES 9 Hrs

Turn on Circuits for SCR – Triggering with Single Pulse & Train of Pulses – Triggering with Microprocessor – Different Techniques of Commutation – Natural and Forced Commutation – Series & Parallel Operations.

UNIT III PHASE CONTROLLED CONVERTERS 9 Hrs

Converters – Single Phase – Three Phase – Half Controlled and Fully Controlled Rectifiers with R, RL and RLE Loads – Waveforms of Load Voltage and Line Current – Harmonic Factor, Power Factor, Ripple Factor, Distortion Factor – Operation with Freewheeling Diode – Effect of Source Inductance – Dual Converter.

UNIT IV INVERTERS & CHOPPERS 9 Hrs

Voltage and Current Source Inverters, Resonant, Series Inverter – Basic Series Inverter, Modified, Improved – PWM Techniques – Single Phase AC Choppers with R and RL Load – Half Wave and Full Wave – DC Choppers – Various Classes of Operation – Buck, Boost and Buck – Boost Type Choppers – Merits and Applications.

UNIT V AC VOLTAGE CONTROLLERS & INDUSTRAIL APPLICATIONS 9 Hrs

Single-Phase and Three-Phase AC Voltage Controllers - Sequence Control of AC Voltage Regulators.Cycloconverters – Single-Phase and Three-Phase Cycloconverters, SMPS & UPS – Static Compensators – HVDC Transmission System.

Practical component P: Include case studies / application scenarios
Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Rashid, M.H., “Power Electronics - Circuits Devices and Applications”, Prentice Hall of India, 3 rd Edition, 2004.
2. Singh.M.D and Kanchandani, “Power Electronics”, Tata McGraw Hill & Hill publication Company Ltd, New Delhi, 2002.

REFERENCES:

1. *Dubey, G.K., Doradia, S.R., Joshi, A. and Sinha, R.M., “Thyristorised Power Controllers”, Wiley Eastern Limited, 1986.*
2. *Lander,W., “Power Electronics”, McGraw Hill and Company, Third Edition, 1993. 3. P.S. Bimbhra, “Power Electronics”, Khanna Publishers, 3rd Edition, 1999.*

Subject Code:	Subject Name : HIGH SPEED SWITCHING ARCHITECTURE	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E19	Prerequisite: Computer Networks	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To equip the students with the concepts of high speed switching techniques in ATM networks
- To understand the significance of quivering in ATM Modules.
- To compare the features of different high speed switching systems.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Describe the basic concepts of High speed switching newtwork
CO2	Interpret the switching concepts and LAN switching technology
CO3	Classify blocking & non – blocking architecture.
CO4	Operate quivering methods in ATM switches.
CO5	Explain addressing model & switching topologies.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	1	2	1	1		2	2	2
CO2	3	3	3	3	2	1	3	3	1		3	
CO3	2	3	2	1	1	1	2	2		1		
CO4	3	3	3	3	1	2	1	1				
CO5	3	3	3	2	1	2	2	2	1	2	3	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	1
CO2	3	3	3	2
CO3	3	2	3	1
CO4	3	3	1	1
CO5	2	1	2	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : HIGH SPEED SWITCHING ARCHITECTURE	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E19	Prerequisite: Computer Networks	Ty	3	0/0	0/0	3

UNIT I HIGH SPEED NETWORK 9 Hrs

Introduction-LAN, WAN, Network evolution through ISDN to B-isdn, Transfer mode and control of B-ISDN, SDH multiplexing structure, ATM standard, ATM Adaption layers

UNIT II LAN SWITCHING TECHNOLOGY 9 Hrs

Switching concepts, Switch forwarding techniques, Switch path control, LAB switching, cut through forwarding, Store and forward, Virtual LANS

UNIT III ATM SWITCHING ARCHITECTURE 9 Hrs

Switch models, blocking networks-Basic-and-enhanced banyan networks, sorting networks merge sorting, Re-arrange able networks-full-and-partial connection networks, Non-blocking networks-Recursive network construction, comparison of non-blocking network, Switches with deflection routing-shuffle switch, Tandem banyan

UNIT IV QUEUES IN ATM SWITCHES 9 Hrs

Internal Queuing-Input, Output and shared queuing multiple queuing networks Combined input, Output and shared queuing-performance analysis of Queued Switches

UNIT V IP SWITCHING 9 Hrs

Addressing model, IP Switching types-flow driven and topology driven solutions, IP over ATM address and next hop resolution, Multicasting, Ipv6 over ATM

Practical component P: Include case studies / application scenarios
Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Ranier Handel, Manfred N Huber, Stefan Schroder, "ATM Networks- concepts protocols applications", 3rd Edition, Addison Wesley, New York, 1999
2. AchillePattavina, "Switching Theory: Architecture and performance in broadband ATM Networks", John Wiley & Sons Ltd., New York. 1998

REFERENCE BOOKS:

1. *Ranier Handel, Manfred N Huber, Stefan Schroder, "ATM Networks- concepts protocols applications", 3rd Edition, Addison Wesley, New York, 1999*
2. *AchillePattavina, "Switching Theory: Architecture and performance in broadband ATM Networks", John Wiley & Sons Ltd., New York. 1998*
3. *Christopher Y Metz, "Switching protocols & Architectures", McGraw Hill Professionals publishing, NewYork.1998.*

Subject Code:	Subject Name :INFORMATION CODING TECHNIQUES	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E20	Prerequisite: Digital Communication	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To have a complete understanding of error–control coding.
- To understand encoding and decoding of digital data streams.
- To introduce methods for the generation of these codes and their decoding techniques.
- To have a detailed knowledge of compression and decompression techniques.
- To introduce the concepts of multimedia communication.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Recognize the various coding theorems in information theory
CO2	Interpret the digital modulation techniques in digital coding
CO3	Analyze the different coding methods and apply it for error correction
CO4	Demonstrate the different compression techniques
CO5	Develop a code for audio/video signals

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	3	2	2	2	3	3	2
CO2	3	3	3	3	3	2	2	1	2	3	3	3
CO3	3	3	3	3	3	3	1	1	2	3	3	3
CO4	3	3	3	3	2	3	1	2	2	3	3	3
CO5	3	3	3	2	2	3	1	2	2	3	3	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	3	3	3	2				
CO2	3	3	3	2				
CO3	3	3	2	1				
CO4	3	3	2	2				
CO5	3	3	2	1				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name :INFORMATION CODING TECHNIQUES	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E20	Prerequisite: Digital Communication	Ty	3	0/0	0/0	3

UNIT I INFORMATION ENTROPY FUNDAMENTALS 9Hrs

Uncertainty, Information and Entropy – Source coding Theorem – Huffman coding –Shannon Fano coding – Discrete Memory less channels – channel capacity – channel coding Theorem – Channel capacity Theorem.

UNIT II DATA AND VOICE CODING 9Hrs

Differential Pulse code Modulation – Adaptive Differential Pulse Code Modulation – Adaptive sub band coding – Delta Modulation – Adaptive Delta Modulation – Coding of speech signal at low bit rates (Vocoders, LPC).

UNIT III ERROR CONTROL CODING 9Hrs

Linear Block codes – Syndrome Decoding – Minimum distance consideration – cyclic codes – Generator Polynomial – Parity check polynomial – Encoder for cyclic codes – calculation of syndrome – Convolutional codes.

UNIT IV COMPRESSION TECHNIQUES 9 Hrs

Principles – Text compression – Static Huffman Coding – Dynamic Huffman coding – Arithmetic coding – Image Compression – Graphics Interchange format – Tagged Image File Format – Digitized documents – Introduction to JPEG standards.

UNIT V AUDIO AND VIDEO CODING 9Hrs

Linear Predictive coding – code excited LPC – Perceptual coding, MPEG audio coders – Dolby audio coders – Video compression – Principles – Introduction to H.261 & MPEG Video standards.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXTBOOKS:

1. Simon Haykin, “Communication Systems”, John Wiley and Sons, 4th Edition, 2001.
2. Fred Halsall, “Multimedia Communications, Applications Networks Protocols and Standards”, Pearson Education, Asia 2002; Chapters: 3,4,5.

REFERENCES BOOKS:

1. *Mark Nelson, “Data Compression Book”, BPB Publication 1992.*
2. *Watkinson J, “Compression in Video and Audio”, Focal Press, London, 1995.*

Subject Code:	Subject Name :OPTICAL NETWORK AND SWITCHING TECHNIQUES	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E21	Prerequisite: nil	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To learn basic elements of optical communication
- To understand networks and switching techniques

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Understand the basic elements of optical fiber.
CO2	Understand the concept of switching network in OSI layer. .
CO3	Explain all types of optical networks.
CO4	Analyze multiple access methods in WDM.
CO5	Understand the all optical switches.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	1	1	1	1	1	1	1	2
CO2	3	3	2	2	1	2	3	3	1	3	2	2
CO3	1	3	3	1	1	3	1	1	1	3	1	1
CO4	1	3	3	1	3	1	3	2	1	3	1	2
CO5	3	2	1	3		1	3	1	1	2	1	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	2	2	1	1				
CO2	3	2	1	2				
CO3	2	3	2	2				
CO4	1	3	2	2				
CO5	3	2	1	2				

3/2/1 indicates Strength of Correlation 3- High,2- Medium,-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name :OPTICAL NETWORK AND SWITCHING TECHNIQUES	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E21	Prerequisite: nil	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION 9 Hrs

Optical communication – Basics of sources, transmitters, Modulators, Optical fiber, photo detectors, and receivers – Switching in networks – circuit switched – Packet switched – cell switched – Virtual circuit switched – Burst switched (fast circuit switched) – Transmission /Asynchronous – synchronous.

UNIT II SWITCHING NETWORKS 9 Hrs

Layering in packet switched networks – motivation – commonly used abstraction: Physical layer – Data link layer – Network layer – Transport layer – Application layer – Layering in circuit switched networks – Physical layer – Multiplexing standards – Signaling – CAS, CCS, SS7 concept – Data plane – management plane – control plane – concept.

UNIT III OPTICAL TRANSMITTER AND RECEIVERS 9 Hrs

First generation networks – SDH/SONET – Computer interconnections – ESCON – Fiber channel – HIPPI – FDDI – ATM –DQDB – Components – description – Mode locked laser (for ps pulses) – Tunable filters – multiplexers – De-multiplexers – Tunable wavelength convertors – Optical amplifiers.

Fiber – EDFA – SOA – Tunable transmitters – Tunable receivers – Dispersion compensating fibers – Multiplexing techniques – SDM – TDMA – WDMA (OFDMA) – DWDM – SCM – CDMA – Protocols for single channel broadcast networks – ALOHA, CSMA/CD – Problems with CSMA/CD – Definition of high speed network.

UNIT IV MULTIPLE ACCESS METHODS 9 Hrs

Classifications of multiple access methods – Random access – Reserved access – Scheduled access – Multichannel multiple access protocols – Desirable characteristics of protocol – Scalability – Fairness – TTTR – TTFR – FTTR – FTFR – Problem of wavelength stability – Multi hop WDM network – Shuffle net – MSN – Wavelength routed networks – Mesh – Ring – Traffic grooming problem – IP over optical framework – ASON – MpeS – Burst switched network (buffer less networks).

UNIT V OPTICAL SWITCHES 9 Hrs

All –optical circuit switches – All−optical packet switches – Broadcast and select – Wavelength routed – Spaced switch based – Discussion on various switch architectures – Packet buffering techniques: Travelling type – Recirculating type: Protection and restoration – Restoration mechanism: Restoration timing issues – Path protection- Span protection – P –cycles.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Gerd Keiser, "Optical Fiber Communication" Mc Graw -Hill International, 4 th Edition., 2010.
2. Hussein T.Mouftah and Jaafar M.H.Elmirghani, " Photonic Switching Technology – Systems and Networks ",IEEE Press, New York -10016-5997,ISBN – 0-7803-4707-2.
3. C.Siva Rama Murthy and Mohan Gurusamy, " WDM Optical Networks – Concepts, Design and Algorithms", Prentice Hall of India Pvt. Ltd, New Delhi –2002.

REFERENCE BOOKS:

1. John M. Senior , "Optical Fiber Communication", Second Edition, Pearson Education, 2007.
2. Ramaswami, Sivarajan and Sasaki "Optical Networks", Morgan Kaufmann, 2009.
3. J.Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 3 rd Edition, 2008.
4. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.
5. Uyless Black, " Optical Network: Third Generation Transport System",Pearson Education, Ist edition,2002.
6. Rajiv Ramaswamy and Kumar N.Sivarajan, "Optical Networks – A Practical Persepctive", Morgan Kauffman, 2004

Subject Code:	Subject Name : DEVICE MODELING	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E23	Prerequisite: Solid State Devices	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To understand passive devices and structures
- To understand the integrated BJT and MOS devices
- To implement solid state circuits using SPICE modeling

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Discuss the types and structures of resistors & capacitors in IC.
CO2	Criticize the dynamic & static behavior of integrated diodes.
CO3	Learn different models of integrated BJT.
CO4	Study the modeling of MOSFETS &their characteristics.
CO5	Analyze the small signal & large signal modeling of devices using SPICE.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	2	3		3	2	3	
CO2	3	3	3	3	3	2	3	3		2	3	
CO3	3	3	3	3	3	1		2	3		3	
CO4	3	3	3	3	3	2	3	3		2		
CO5	3	3	3	3	3	2			3	2		

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	3
CO2	3	3		3
CO3	3	2	1	3
CO4	3	3		3
CO5	3	3	1	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : DEVICE MODELING	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E23	Prerequisite: Solid State Devices	Ty	3	0/0	0/0	3

UNITI INTEGRATED PASSIVE DEVICES 9 Hrs

Types and Structures of Resistors and Capacitors in Monolithic Technology – Dependence of Model Parameters on Structure.

UNIT III NTEGRATED DIODES 9 Hrs

Junction and Schottky Diodes in Monolithic Technologies – Static and Dynamic Behavior – Small and Large Signal Models – SPICE Models.

UNIT III INTEGRATED BIPOLAR TRANSISTOR 9 Hrs

Types and Structures in Monolithic Technologies – Basic Model (Eber Moll_-Cunmel – Poon Model – Dynamic Model, Parasitic Effects – SPICE Model –Parameter Extraction.

UNIT IV INTEGRATED MOS TRANSISTOR 9 Hrs

n-MOS and p-MOS Transistor – Threshold Voltage -Threshold Voltage Equations – MOS Device Equations – Basic DC Equations Second Order Effects – MOS Models Small Signal AC Characteristics – MOSFET SPICE Model Level 1,2,3,4

UNIT V SPICE MODELLING 9 Hrs

Advanced Concepts of Large Signal & Low Signal Modeling

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Daniel Foty, “MOSFET Modeling with Spice” prentice hall, 1997.
2. Neil Weste and Kamran Eshranghian “Principles of CMOS VLSI Design, A System Perspective”, “Addition – Wesley, 1993.

REFERENCES BOOKS:

1. *Jacob Millman& Arvin Millman, “Micro Electronics”, McGraw Hill (Second Edi) 1987.*
2. *M. Satyagi, John Wiley “ Introduction to Semi-conductor materials and devices”, New Edition.*

Subject Code:	Subject Name : VLSI TECHNOLOGY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E24	Prerequisite: Solid State Devices	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
To enable the students to understand various design flow in VLSI and their applications in fuzzy systems

COURSE OUTCOMES (COs) : (3- 5)
The Students will be able to

CO1	Study the fabrication of CMOS transistors & its layout design rles.
CO2	Interpret the interconnection resistance & capacitance & their extraction&estimation.
CO3	Learn the distribution of clock signals in a chip, henceforth the system timing.
CO4	Illustrate VLSI implementation of FLC, testing techniquesand the CAD automation for the same.
CO5	Design different types of adders and multiplier.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	2						3	3
CO2	3	3	2	3	3						1	3
CO3	3	3	3	2	3						1	3
CO4	3	3	3	3	3						1	3
CO5	3	3	3	3	3						3	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3
CO2	3	3	2	3
CO3	3	3	3	3
CO4	3	3	2	3
CO5	3	3	3	3

3/2/1 indicates Strength of Correlation 3- High,2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : VLSI TECHNOLOGY	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E24	Prerequisite: Solid State Devices	Ty	3	0/0	0/0	3

UNIT I VLSI DESIGN FLOW 9 Hrs

Design hierarchy concepts of regularity, modularity & locality VLSI Design styles - CMOS Fabrication Technology- Introduction, Fabrication Process flow- basic steps, CMOS n-well process,p-well process,twin tub process, layout design rules-Introduction–CMOS Layout design rules – CMOS inverter Layout design – Layout of CMOS NAND & NOR gates – Complex CMOS Logic gates

UNIT II PARASITIC EXTRACTION & PERFORMANCE ESTIMATION FROM PHYSICAL STRUCTURE 9 Hrs

Introduction – Reality with inter connection –MOSFET capacitances-interconnect capacitance estimation – interconnect resistance estimation

UNIT III CLOCK SIGNALS & SYSTEM TIMING 9 Hrs

On chip clock generation & distribution using ring & pierce crystal oscillator – non – overlapping clock signals and gate level implementation – H-tree clock distribution N/W – clock skew reduction – Zero – Skew clock routing N/W- Clock distribution N/W for DEC alpha µp chips

UNIT IV TESTABILITY OF INTEGRATED SYSTEMS-VLSI FOR FUZZY LOGIC SYSTEMS 9Hrs

Design constraints – Testing – The rule of ten – terminology – Failures in CMOS – Combinational Logic Testing – Practical Ad-Hoc DFT guidelines – Scan design techniques- Integrated implementations of FLC, Digital implementation of FLC's, Analog implementation of FLC's, Mixed digital / analog implementations of Fuzzy systems, CAD automation for FLC DESIGN, NN implementing fuzzy systems.

UNIT V ARITHMETIC FOR DIGITAL SYSTEMS 9Hrs

Introduction – notation systems – Principles of generation & propagation – 1 bit full adder – Enhancement Techniques for Adders – multi operand – Adders – Multiplication – Addition and Multiplication in Galois Fields GF(2n)

Practical component P: Include case studies / application scenarios

Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Cheng., SZE., "VLSI Technology"., Prentice Hall of India,
2. Douglas A. Pucknell and Kamran Eshraghian, "Basic VLSI Design Systems and Circuits", Prentice Hall of India Pvt Ltd., 1993.

REFERENCES:

1. Cheng., SZE., "VLSI Technology"., Prentice Hall of India,
2. Douglas A. Pucknell and Kamran Eshraghian, "Basic VLSI Design Systems and Circuits", Prentice Hall of India Pvt Ltd., 1993.
3. Horspool., Gorman., "The ASIC Handbook", Tata McGraw Hill Publications., 1999
4. Randall .L. Geiger and P. E. Allen, "VLSI Design Techniques for Analog and Digital Circuits", McGraw Hill International Company, 1990

Subject Code:	Subject Name : BIOMEDICAL INSTRUMENTATION	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E25	Prerequisite: Measurement and Instrumentation, control Systems	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To study the methods of recording various bio potentials
- To study how to measure biochemical and various physiological information
- To understand the working of units which will help to restore normal functioning
- To understand the use of radiation for diagnostic and therapy
- To understand the need and technique of electrical safety in Hospitals

COURSE OUTCOMES (COs) :

The students will able to

CO1	Enable the students to develop knowledge of how instruments work in the various department and laboratories of a hospital and thereby recognize their limitations.
CO2	Interpret technical aspects of medicine.
CO3	Familiarize students with various medical equipment's and their technical aspects. Understand medical diagnosis and therapy.
CO4	Introduce students to the measurements involved in some medical equipment's.
CO5	Understanding the problem and ability to identify the necessity of equipment's to a specific problem.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1	1	3	3	3	3	1	3	3
CO2	1	1	1	2	1	3	3	2	3	1	2	2
CO3	1	2	1	2	1	3	3	3	3	2	3	2
CO4	1	1	1	1	2	3	3	3	3	2	2	2
CO5	1	2	2	1	2	3	3	3	3	2	2	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	1	1	3	2
CO2	1	2	3	1
CO3	1	2	3	2
CO4	3	2	3	3
CO5	3	2	3	2

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : BIOMEDICAL INSTRUMENTATION	Ty / Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E25	Prerequisite: Measurement and Instrumentation, control Systems	Ty	3	0/0	0/0	3

UNIT I BASIC PHYSIOLOGY 9 Hrs

Cells and their Structures – Transport of Ions Through Cell Membrane – Resting and Excited State – Trans membrane Potential – Action Potential – Bio-Electric Potential – Nervous System – Physiology of Muscles – Heart and Blood Circulation – Respiratory System – Urinary System.

UNIT II BASIC TRANSDUCER PRINCIPLES AND ELECTRODES 9 Hrs

The Transducer Principles – Active Transducers – Passive Transducers – Transducer for Bio-Medical Application – Electrode Theory- Bio-Potential Electrode – Bio-Chemical Transducer.

UNIT III CARDIOVASCULAR SYSTEM 9 Hrs

The Heart and Cardiovascular System – Blood Pressure – Characteristics of Blood Flow – Heart Sounds - Electro Cardiograph – Measurements of Blood Pressure – Measurement of Blood Flow and Cardiac O/P Plethysmography – Measurements of Heart Sounds

UNIT IV X-RAY AND RADIOISOTOPE INSTRUMENTATION: 9 Hrs

X-ray Imaging Radiography – Fluoroscopy – Image Intensifiers – Angiography - Medical use of Radioisotopes – Beta Radiations – Detectors – Radiation Therapy.

UNIT V BIO-TELEMETRY 9 Hrs

Introduction to Bio-Telemetry – Physiological Parameters Adaptable to Bio-Telemetry – The Components of Bio-Telemetry Systems – Implantable Units – Applications of Telemetry in Patient Care – Application of Computer in Bio-Medical Instrumentation, Anatomy of Nervous System – Measurement from the Nervous System – EEG – EMG.

Practical component P: Include case studies / application scenarios
Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. M. Arumugam, "*Bio-medical Instrumentation*" – Anuradha Agencies Publishers, 1992.
2. Khandpur," *Handbook on Biomedical Instrumentation*" – Tata McGraw Hill Co Ltd., 1989.

REFERENCE BOOKS:

1. *Leusis Cromwell Fred, J. Werbell and Erich A.pfraffer, "Biomedical instrumentation and Measurements" – Prentice Hall of India, 1990.*
2. *Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment Technology", John Wiley and Sons, New York, 1997*

Subject Code:	Subject Name : SATELLITE COMMUNICATION	T y/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E28	Prerequisite: Communication Systems	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- Overview of satellite systems in relation to other terrestrial systems
- Study of satellite orbits and launching.
- Study of earth segment and space segment components
- Study of satellite access by various users.
- Study of DTH and compression standards**.**

COURSE OUTCOMES (COs) :
The students will be able to

CO1	Recognize various element of orbital Mechanics
CO2	Interpret various multiple access and switching techniques.
CO3	Illustrate the concepts involved in satellite link design
CO4	Analyze the principles, concepts and operation of satellite communication systems
CO5	Examine the various process of earth station design.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	2	2		2	1	2
CO2	3	3	3	2	3	2	2	3	3	3	3	3
CO3	3	3	3	3	2	2	2	1	2	3	2	2
CO4	3	3	3	3	2	2	1		2	3		2
CO5	3	3	3	2	3	2	2		3	2		3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2
CO2	3	3	2	2
CO3	3	3		2
CO4	3	3		2
CO5	3	3	2	

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : SATELLITE COMMUNICATION	T y/ Lb/ ETL/IE	L	T / S.Lr	P/ R	C
EBEC22E28	Prerequisite: Communication Systems	Ty	3	0/0	0/0	3

UNIT I ELEMENTS OF ORBITAL MECHANICS 9 Hrs

Equation, Orbital Elements, Orbital Perturbation, Tracking and Orbital Determination, Orbital Correction Control.

ELEMENTS OF COMMUNICATION SATELLITE DESIGN

Space Environment, Spacecraft Configuration, Spacecraft Subsystem, Payload, Reliability Consideration Spacecraft Integration and Testing.

UNIT II MULTIPLE ACCESS TECHNIQUES 9 Hrs

FDM – FM – FDMA, TDMA, SSMA / CDMA, RANDOM MULTIPLE Access Techniques; Packet Switching and Packet Satellite Networks Satellite on Board Processing and Switching.

UNIT III SATELLITE LINK DESIGN 9 Hrs

Types of System: BSS, Performance Requirements and Standards for Telephony, TV and DATA, Performance Impairments, Noise, Interference, Inter modulation, Design of Typical Satellite Links.

UNIT IV DOMESTIC SATELLITE SYSTEMS 9 Hrs

The INSAT System, International System, INTELSAT, IMMARSAT, Satellite Based Personal Communication LEO, ICO, GEO Systems.

UNIT V EARTH STATION DESIGN 9 Hrs

Earth Station Configuration, Site Selection, Antenna and Tracking Systems, Receiver and Transmitter Subsystems, Terminal Equipment: Telephone / Video Interface, Rearward Links, Miscellaneous Facilities Like Echo Suppressor, FM Digitizers, Ground Station Measurements, Elements of Frequency Co-ordination and Control, VSAT Networks and Terminals – Satellite Broadcasting, Satellite TV Systems.

Practical component P: Include case studies / application scenarios
Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. T. Pratt and C.W. Bostian, "*Satellite Communication*" – John Wiley & Son, 1986.
2. Abdul Namith, “Satellite *Communication*"-Lakshmi Publications.

REFERENCES:

1. *B.N. Agarwal, "Design of Geosynchronous Spacecraft" – Prentice Hall, 1986.*
2. *D. Roddy, "Satellite Communication" – Prentice Hall, 1989*
3. *M. Richharia,“Satellite Communication SystemsDesign Principles”, Macmillan Press Ltd. Second Edition 2003.*

Subject Code:	Subject Name : NEXT GENERATION COMMUNICATION	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E29	Prerequisite: nil	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To learn the Basics of 5G and Beyond Wireless communication
- To provide a basic understanding of the key technologies and enablers of 5G beyond communication systems
- To study 5G wireless channel models

COURSE OUTCOMES (COs) : (3- 5)

Upon the completion of the course the students will be able to

CO1	Distinguish the major cellular communication standards
CO2	Understand the 5G techniques
CO3	Analyze various modulation and multiplexing techniques
CO4	Demonstrate the key enablers of 6G Communication
CO5	Apply Machine Learning in 5G Wireless Communications

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	2	2	1	1		1	1	1	1
CO2	2	1	2	2	3	1	1		1	1	1	1
CO3	2	3	3	3	3	1			1			
CO4	2	3	3	3	3	1						2
CO5	2	3	3			1						1

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	3	3	1	2				
CO2	3	3	1	2				
CO3	3	3		3				
CO4	3	3		3				
CO5	3	3		3				

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Elective	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : NEXT GENERATION COMMUNICATION	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E29	Prerequisite: nil	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO FUNDAMENTALS OF WIRELESS COMMUNICATION 9 Hrs

Evolution of cellular systems-Requirements, goals, and vision of the next generation wireless communication systems- Fading-Digital modulations-Performance Metrics

UNIT II KEY CONCEPTS IN 5G 9 Hrs

Small cells: Past, present, and future trends of cellular networks coverage and capacity of small cell networks-Interference management, D2D architecture Towards IoT Spectrum sharing. Massive MIMO: Point-to-point MIMO, Virtual MIMO (relaying), multiuser MIMO Massive MIMO, propagation channel model, channel estimation, uplink and downlink data transmission-capacity bounds- achievable rate- energy and spectral efficiency trade-off

UNIT III mmWAVE TECHNOLOGY AND MULTIPLE ACCESS TECHNIQUES 9 Hrs

Applications-Radiowave propagation-Physical layer design and algorithms- mmWave MIMO challenges-channel modeling- channel estimation- Beamforming. Multiple access techniques: OFDM, filter banks, GFDM, OTFS, NOMA

UNIT IV TRANSITION TO 6G 9 Hrs

Wireless energy harvesting-Machine learning, visible light communication, Intelligent reflecting surface (IRS)- Extremely Large Aperture Massive MIMO- Energy-rate trade-off- Simultaneous wireless information and power transfer (SWIPT)- time-switching- power splitting- Wireless powered communication networks -Outage probability and throughput.

UNIT V APPLICATIONS OF MACHINE LEARNING 9 Hrs

Channel modeling and estimation Spectrum sensing and sharing Resource allocation (NOMA, mmWave massive MIMO).

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. R. Vannithamby and S. Talwar, *Towards 5G: Applications, Requirements and Candidate Technologies.*, John Willey & Sons, West Sussex, 2017.

2. Manish, M., Devendra, G., Pattanayak, P., Ha, N., *5G and Beyond Wireless Systems PHY Layer Perspective*, Springer Series in Wireless Technology

REFERENCES:

1.T. S. Rappaport, R. W. Heath Jr., R. C. Daniels, and J. M. Murdock, *Millimeter Wave Wireless Communication.*, Pearson Education, 2015.

2.M. Vaezi, Z. Ding, and H. V. Poor,, *Multiple Access techniques for 5G Wireless Networks and Beyond.*, Springer Nature, Switzerland, 2019

Subject Code:	Subject Name : COGNITIVE RADIO	Ty / Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22E30	Prerequisite: Communication Theory	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To enable the student to understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation.
- To enable the student to understand the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication.
- To expose the student to the evolving next generation wireless networks and their associated challenges

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Describe the basics of the software defined radios.
CO2	To learn the hardware and software architecture of software defined radio
CO3	Design the wireless networks based on the cognitive radios
CO4	To understand cognitive radio architecture
CO5	Explain the concepts behind the wireless networks and next generation networks

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	3	1	3	1		2		
CO2	3	1	2	3	2	3	2	3	1		2	
CO3	2	1	3	1	2	2	2	1	1	2		
CO4	2	3	2	3	2	3	3	1		3	3	
CO5	3	1	2	1	3	3	1	2	2	3		

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	2		3
CO2	3	3	2	3
CO3	3	3		3
CO4	3		3	3
CO5	3	2		3

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
				✓								

Subject Code:	Subject Name : COGNITIVE RADIO	Ty / Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22E30	Prerequisite: Communication Theory	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO SDR **9 Hrs**

Definitions and potential benefits, software radio architecture evolution – foundations, technology tradeoffs and architecture implications, Antenna for Cognitive Radio.

UNIT II SDR ARCHITECTURE **9 Hrs**

Essential functions of the software radio, architecture goals, quantifying degrees of Programmability, top level component topology, Computational properties of functional components, interface topologies among plug and play modules, architecture partitions.

UNIT III INTRODUCTION TO COGNITIVE RADIOS **9 Hrs**

Making radio self-aware, the cognition cycle, organization of cognition tasks, structuring knowledge for cognition tasks, Enabling location and environment awareness in cognitive radios – concepts, architecture, design considerations.

UNIT IV COGNITIVE RADIO ARCHITECTURE **9 Hrs**

Primary Cognitive Radio functions, Behaviors, Components, A–Priori Knowledge taxonomy, observe – phase data structures, Radio procedure knowledge encapsulation, components of orient, plan, decide, act phases; knowledge representation, design rules.

UNIT V NEXT GENERATION WIRELESS NETWORKS **9 Hrs**

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

Practical component P : Include case studies / application scenarios
Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Alexander M. Wyglinski, MaziarNekovee, and Y. Thomas Hou, “Cognitive Radio Communications And Networks - Principles And Practice”, Elsevier Inc., 2010.
2. E. Biglieri, A.J. Goldsmith., L.J. Greenstein, N.B. Mandayam, H.V. Poor, “Principles of Cognitive Radio”, Cambridge University Press, 2013.
3. Kwang-Cheng Chen and Ramjee Prasad, “Cognitive Radio Networks”, John Wiley & Sons Ltd., 2009.

REFERENCES:

1. Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, “Cognitive Radio Networks - From Theory to Practice”, Springer Series: Analog Circuits and Signal Processing, 2009.
2. J. Mitola, “Cognitive Radio: An Integrated Agent Architecture for software defined radio”, Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.
3. Simon Haykin, “Cognitive Radio: Brain –empowered wireless communications”, IEEE Journal on selected areas in communications, Feb 2005.
4. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, “NeXt generation /dynamic spectrum access / cognitive radio wireless networks: A Survey” Elsevier Computer Networks, May 2006.
5. Joseph Mitola, “Software Radio Architecture: A Mathematical Perspective” IEEE Journal on Selected Areas in Communication, Vol. 17, No. 4, April 1999.
6. HasariCelebi ,Huseyin Arslan, “Enabling location and environment awareness in cognitive radios”, Elsevier Computer Communications, January 2008.

ELECTIVE V - Electronics Stream

Subject Code:	Subject Name : INTRODUCTION TO MEMS SYSTEM DESIGN	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E31	Prerequisite: Electronic Circuits	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To enable the students to learn the basic concepts of MEMS design and their applications

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Be familiar with concepts of MEMS, sensors and fabricate techniques.
CO2	To analyze different properties of MEMS, systems.
CO3	To understand and analyze electrostatic design properties of MEMS.
CO4	To analyze and understand different issues related to design of MEMS circuit and system.
CO5	Will be exposed to the optical and RF based MEMS system.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	3	1	3	1	1	1	1	1	1	2
CO2	3	1	3	3	1	1	1	1	1	1	1	2
CO3	3	1	3	3	1	1	1	1	1	1	1	1
CO4	3	1	3	1	3	1	1	1	1	1	1	2
CO5	1	3	1	3	1	1	3	1	1	1	1	1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1
CO2	1	3	2	2
CO3	3	3	2	2
CO4	3	2	2	2
CO5	3	3	2	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : INTRODUCTION TO MEMS SYSTEM DESIGN	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E31	Prerequisite: Electronic Circuits	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO MEMS 9 Hrs

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Micro accelerometers and Micro fluidics, MEMS materials, Micro fabrication

UNIT II MECHANICS FOR MEMS DESIGN 9 Hrs

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics.

UNIT III ELECTRO STATIC DESIGN 9Hrs

Electrostatics: basic theory, electro static instability. Surface tension, gap and finger pull up, Electro static actuators, Comb generators, gap closers, rotary motors, inch worms, Electromagnetic actuators. Bi stable actuators.

UNIT IV CIRCUIT AND SYSTEM ISSUES 9 Hrs

Electronic Interfaces, Feedback systems, Noise, Circuit and system issues, Case studies – Capacitive accelerometer, Peizo electric pressure sensor, Modeling of MEMS systems, CAD for MEMS.

UNIT V INTRODUCTION TO OPTICAL AND RF MEMS 9 Hrs

Optical MEMS, - System design basics – Gaussian optics, matrix operations, resolution. Case studies, MEMS scanners and retinal scanning display, Digital Micro mirror devices. RF Memes – design basics, case study – Capacitive RF MEMS switch, performance issues.

Practical component P : Include case studies / application scenarios

Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOK:

1. Stephen Santuria, “Microsystems Design”, Kluwer publishers, 2000.
2. NadimMaluf, “An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000
3. Mohamed Gad-el-Hak, editor, “The MEMS Handbook”, CRC pressBaco Raton, 2000.

REFERENCES:

1. *Stephen Santuria, “Microsystems Design”, Kluwer publishers, 2000.*
2. NadimMaluf, “An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000
3. Mohamed Gad-el-Hak, editor, “The MEMS Handbook”, CRC pressBaco Raton, 2000.
4. Tai Ran Hsu, “MEMS & Micro Systems Design and Manufacture” Tata McGraw Hill, New Delhi, 2002.

Subject Code:	Subject Name : ANALYSIS AND DESIGN OF ANALOG IC'S	Ty /Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22E32	Prerequisite: Solid State Devices	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To know the fundamentals of Analog Design and current mirrors
- To illustreste the operstions of Op –amp and noise.
- To unerstsnd the working principle of Analog multiplier and PLL.
- To design MOS analog Ic's and the working of switched capacitor filters.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Know the general operating principle of analog ICs.
CO2	Analyze the characteristics of poles with nodes,source followers and Noise
CO3	Illustrate the concepts for design of analog multiplier and PLL
CO4	Examine MOS amplifiers
CO5	Design MOS switched capacitor filters.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	3	2	2	1	3	2
CO2	3	3	3	3	3	3	2	1	3	1	3	1
CO3	3	3	3	3	3	3	3	1	3	1	2	2
CO4	3	3	3	3	3	2	3	1	2	1	2	2
CO5	3	3	3	3	2	3	3	1	2	1	1	2

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3
CO2	3	3	2	3
CO3	3	3	2	2
CO4	3	3	2	2
CO5	3	3	2	1

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : ANALYSIS AND DESIGN OF ANALOG IC'S	Ty /Lb/ ETL/IE	L	T/S Lr	P/R	C
EBEC22E32	Prerequisite: Solid State Devices	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO ANALOG IC DESIGN AND CURRENT MIRRORS 9 Hrs

Concepts of Analog Design - General consideration of MOS devices – MOS I/V Characteristics – Second order effects – MOS device models. Basic current mirrors- Cascade current mirrors- Active current mirrors- Large and Small signal analysis- Common mode properties.

UNIT II OPERATIONAL AMPLIFIERS AND NOISE 9 Hrs

General considerations- Miller Effect and Association of Poles with Nodes, Common source stage- Source followers- Common gate stage- Cascade stage- Differential pair. Noise- Statistical characteristics of noise- Types of noise- Representation of noise in circuits- Noise in single stage amplifiers- Noise in differential pairs- Noise Bandwidth

UNIT III ANALOG MULTIPLIER AND PLL 9 Hrs

Analysis of four Quadrant and Variable Trans-conductance Multiplier, Phase Locked Loops-Simple PLL- Charge pump PLLs - Non ideal Effects in PLLs- Delay locked loops- its Applications.

UNIT IV MOS ANALOG ICS 9 Hrs

Design of MOS Operational Amplifier, MOS Power Amplifier. CMOS Operational Amplifier: Introduction and analysis of Cascade Amplifier and Telescopic Cascade Amplifier. Design of CMOS op-amps, Compensation of op-amps, Design of Two stage op-amps, Cascade op-amps.

UNIT V SWITCHED CAPACITOR CIRCUITS 9 Hrs

General Considerations- Sampling switches- Switched Capacitor Amplifiers- Switched Capacitor Integrator- Switched Capacitor Common mode feedback.

Practical component P : Include case studies / application scenarios
Research component R : Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXTBOOKS:

1. Behzad Razavi, ―Design of Analog CMOS Integrated Circuits‖, Tata McGraw Hill, 2001, 33rd re-print, 2016.
2. Grey and Meyer, "Analysis and Design of Analog Ics." Wiley International, 1996.

REFERENCES:

1. Kenneth R.Laker, Willy M.C.Sansen, William M.C.Sansen, "Design of Analog Integrated Circuits and Systems", McGraw Hill, 1994
2. Grey, Wolley, Brodersen, "Analog MOS Integrated Circuits", IEEE Press, 1989.
3. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, Wiley, 2009

Subject Code:	Subject Name : CYBER PHYSICAL SYSTEM	T y/ Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E33	Prerequisite: Basic Engineering	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To make them learn the basics of cyber physical system.
- To implement a cyber-physical system for automated control.
- To develop safety and secure methods for CPS.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Understand the basics of cyber physical system.
CO2	Design a dynamic stable control system.
CO3	Implement a CPS in control system.
CO4	Apply formal methods for safety of CPS.
CO5	Deploy a secured environment for CPS.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	3	1	1	2	1	1	1		2
CO2	1	3	3	3	3	1	1	1	2			
CO3	3	1	3	3	1	1		2	1		2	
CO4	1	3	3	3	1	2		1		1	1	2
CO5	1	1	1	1	1	1	1	1		2		1

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1
CO2	1	3	1	2
CO3	3		2	3
CO4	1	3	1	2
CO5	3	3	2	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : CYBER PHYSICAL SYSTEM	T y/ Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E33	Prerequisite: Basic Engineering	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO CPS 9 Hrs

Basic Principles of Design and validation – Industry 4.0 – IOT Implications – Processors, Sensors and Actuators – Wireless HART, CAN ,Automotive Ethernet-RTOS

UNIT II AUTOMATED CONTROL DESIGN 9 Hrs

Dynamic System and Stability – Controller Design Techniques – CLFs, MLFs under slow switching - Performance under Packet drop and noise

UNIT III CPS IMPLEMENTATION 9 Hrs

Mapping of features to software to ECUs –Effect of scheduling – Bus Latency – sense and actuation faults on control performance-network congestion-Control, Bus and Network Scheduling

UNIT IV FORMAL METHODS FOR SAFETY 9 Hrs

Advanced Automata based Modeling and Analysis – Introduction, Timed and Hybrid Automata, Trajectories and zenoness, and formal analysis, CPS software–weakest Pre-conditions and bounded model checking

UNIT V SECURE DEPLOYMENT 9 Hrs

Secure Task Mapping and Partitioning – State Estimation for attack detection – Case Study –Automated Lighting and AC control in green buildings

Practical component P: Include case studies / application scenarios

Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. Rajeev Alur, "Principles of Cyber Physical Systems " , MIT Press@2015,ISBN:0262029111 9780262029117
2. Marwedel, Peter"Embedded System Design Embedded Systems Foundations of Cyber-Physical Systems, and the Internet of Things"SpringerISBN 978-3-319-56045-8

REFERENCES:

1. Rolf Dreschler, Ulrich Kuhne, "Formal Modeling and Verification of Cyber Physical System",.
2. DhandaP.Rawat, Joel JPC Rodrigues, Ivan StojMenovic " Cyber Physical Systems : From Theory to Practice", CRC Press,2016

ELECTIVE V – Communication Stream

Subject Code:	Subject Name : ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E35	Prerequisite: Electromagnetic fields	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To understand EMI Sources, EMI problems and their solution methods in PCB level / Subsystem and system level design.
- To measure the emission Immunity level from different systems to couple with the prescribed EMC standards

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Remember the sources of EMI and its standards
CO2	Understand the coupling principles in EMI
CO3	Test the EMI measurements and its calibration
CO4	Interpret the control and isolation of various parts of EMI
CO5	Design PCBs for various applications in EMI control

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	2	1	2	2	3		2		3
CO2	3	2	1	2	2	2	2	2		3		2
CO3	2	2	3	2	2	3	2	3	2	3	3	2
CO4	1	2	3	3	3	2	2	2		3	2	2
CO5	2	2	3	2	2	2	2	2	2	2		2

COs / PSOs	PSO1	PSO2	PSO3	PSO4				
CO1	1	2	2	2				
CO2	2	3	2	2				
CO3	2	3	2	2				
CO4	2	3	2	1				
CO5	2	2	2	2				

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	Ty/ Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E35	Prerequisite: Electromagnetic fields	Ty	3	0/0	0/0	3

UNIT I EMI ENVIRONMENT 9 Hrs

Sources of EMI, Conducted and Radiated EMI, Transient EMI, EMI-EMC Definitions and Units of Parameters.Units of Specification, Civilian Standards Military Standards.

UNIT II EMI COUPLING PRINCIPLES 9 Hrs

Conducted, Radiated and Transient Coupling, Common Impedance Ground Coupling, Radiated Common Mode and Ground Loop Coupling, and Radiated Differential Mode Coupling, Near Field Cable to Cable Coupling, Power Mains and Power Supply Coupling.

UNIT III EMI MEASUREMENTS 9 Hrs

EMI Test Instruments Systems. EMI Test, EMI Shielded Chamber, Open Area Test Site, TEM Cell Antennas, Conductors Sensors / Injectors / Couplers. Military Test Method and Procedures, Calibration Procedures.

UNIT IV EMICONTROL TECHINQUES 9 Hrs

Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal Control, Component Selection and Mounting.

UNIT V EMI DESIGN OF PCBs 9 Hrs

PCB Traces Cross Talk, Impedance Control, Power Distribution Decoupling, Zoning Motherboard Design and Propagation Delay Performance Models.

Practical component P: Include case studies / application scenarios

Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 45

TEXT BOOKS:

1. V.P. Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, 1996.
2. Clayton R. Paul – Introduction to Electromagnetic compatibility – Wiley & Sons – 1992

REFERENCES:

1. *Bernhard Keiser.”Principles of Electromagnetic Compatibility”, Artech House, #rd Ed, 1986.*
2. Henry W. Ott, “Noise Reduction Techniques in Electronic Systems”, John Wiley and Sons, Newyork, 1988.

Subject Code:	Subject Name : ADVANCED CONCEPTS IN SIGNAL PROCESSING	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E36	Prerequisite: Digital Signal Processing	Ty	3	0/0	0/0	0

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- The student learns important theorems and algorithms related to random signal processing.
- The student knows estimation, prediction and filtering concepts & techniques.

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Analyze the characterstics of random signal processing.
CO2	Learn different types of spectrum estimators & their models.
CO3	Understand the concept of predictive filters.
CO4	Design different types of adaptive filters for different applications
CO5	Learn multirate signal processing & implementation of filter banks.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	3	3	2	2	3	2	3	1
CO2	3	3	3	3	3	3	3	2	3	1	1	2
CO3	3	3	3	2	3	3	3	3	2	3	2	2
CO4	3	3	3	3	3	2	2	3	2	3	3	2
CO5	3	3	3	3	3	2	3	3	3	3	3	3

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2
CO2	3	3	2	3
CO3	3	3	3	3
CO4	3	3	3	3
CO5	3	3	3	3

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : ADVANCED CONCEPTS IN SIGNAL PROCESSING	Ty / Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E36	Prerequisite: Digital Signal Processing	Ty	3	0/0	0/0	0

UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9 Hrs

Discrete Random Process, Expectation, Variance, Co-Variance, Scalar Product, Energy of Discrete SignalParseval's Theorem, Wiener Khintchine Relation-Power Spectral Density –Periodogram – Sample AutocorrelationSum Decomposition Theorem, Spectral Factorization Theorem – Discrete Random Signal Processing by Linear Systems-Simulation of White Noise – Low Pass Filtering of White Noise.

UNIT II SPECTRUM ESTIMATION 9 Hrs

Non-Parametric Methods-Correlation Method – Co-Variance Estimator – Performance Analysis of Estimators – Unbiased, Consistent Estimators – Periodogram Estimator – Barlett Spectrum Estimation – Welch Estimation – Model based Approach – AR, MA, ARMA Signal Modeling – Parameter Estimation using Yule-Walker Method.

UNIT III LINEAR ESTIMATION AND PREDICTION 9 Hrs

Maximum likelihood criterion-efficiency f estimator – Least mean squared error criterion – Wiener filter – Discrete Wiener Hoff equations – Recursive estimators-Kalman filter – Linear prediction, prediction error-whitening filter, inverse filter – Levinson recursion, Lattice realization, and Levinson recursion algorithm for solving Teoplitz system of equations.

UNIT IV ADAPTIVE FILTERS 9 Hrs

FIR adaptive filters – Newton's steepest descent method-adaptive filter based on steepest descent method – Widrow Hoff LMS adaptive algorithm – Adaptive channel equalizations – Adaptive echo chancellor – Adaptive noise cancellation – RLS adaptive filters –Exponentially weighted RLS – sliding window RLS – Simplified IIR LMs adaptive filter

UNIT V MULTIRATE DIGITAL SIGNAL PROCESSING 9 Hrs

Mathematical description of change of sampling rate – Interpolation and Decimation –continuous time model – Direct digital domain approach -Decimation by an integer factor – Interpolation by an integer factor – single and multistage realization - Poly phase realization – Application to sub band coding – Wavelet transform and filter bank implementation of wavelet expansion of signals.

Practical component P: Include case studies / application scenarios
Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 45 hrs

Text books:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc., New York, 1996
2. Sopocles J. Orfanidis, "Optimum Signal Processing", McGraw Hill, 1990.

References:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc., New York, 1996
2. Sopocles J. Orfanidis, "Optimum Signal Processing", McGraw Hill, 1990. .
3. John G. Proakis, Dimitris G. Manolais, "Digital Signal Processing", Prentice Hall of India, 1995

Subject Code:	Subject Name : ULTRA WIDE BAND COMMUNICATION	Ty /Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E37	Prerequisite: Optical Communication	Ty	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVES :

- To learn the basic operation of UWB system
- To design a UWB transmitter and receiver
- To study about the characteristics of UWB antennas

COURSE OUTCOMES (COs) : (3- 5)

The Students will be able to

CO1	Understand the operation of Ultra Wide Band Systems
CO2	Learn the properties of UWB antennas
CO3	Design a UWB transmitter
CO4	Design a UWB receiver
CO5	Develop a multi-carrier UWB receiver

Mapping of Course Outcomes with Program Outcomes (POs)

COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			3	3	2		3	2		3	2	3
CO2			3	2	2		2	3		3	3	3
CO3	3	3	3	3	2		2			3	2	2
CO4	3	3	3	3	2		2					
CO5	3	3	3	3	3		2	3	3			

COs / PSOs	PSO1	PSO2	PSO3	PSO4
CO1		3	2	2
CO2		3	3	2
CO3	2	3		
CO4	2	3		2
CO5		3	2	2

3/2/1 indicates Strength of Correlation 3- High, 2- Medium, 1-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Inter Disciplinary	Skill Component	Practical / Project			
					✓							

Subject Code:	Subject Name : ULTRA WIDE BAND COMMUNICATION	Ty /Lb/ ETL/IE	L	T/SLr	P/R	C
EBEC22E37	Prerequisite: Optical Communication	Ty	3	0/0	0/0	3

UNIT I INTRODUCTION TO UWB SYSTEMS 9 Hrs

Overview of UWB - UWB Concept - UWB Signals: Impulse (I) and Multi-Carrier (MC) Signals, Uniqueness of UWB Systems; I-UWB System Model; MC-UWB System Model. Advantages of UWB Systems - Challenges in UWB Systems - Single Band Vs. Multi Band - Applications of UWB Systems - Regulatory, Legal & Other Controversial Issues.

UNIT II INTERFERENCE, COEXISTENCE & UWB ANTENNAS 9 Hrs

Interference of UWB on NB: UWB Pulse Model - Effect of NB Receive Filter - BER Analysis - Time-Hopped Case - Aggregate of UWB Interference Modeling: Received Power - Asymptotic PDF of Aggregate Noise - Amplitudes: Aggregated PDF - Bernoulli and Poisson Models - Interference Analysis: NB on UWB, UWB on UWB - Basic Properties of UWB Antennas.

UNIT III UWB TRANSMITTER DESIGN 9 Hrs

IUWB Signal Generators: Avalanche Pulse Generators - Step Recovery Diode Pulse Generators- Tunnel Diode Pulsars - Pulse Circuits Suitable for Integrated Circuits – Modulators- I-UWB Transmitters: TH-PPM and TH(A-PAM) UWB Signals - OOC-PPM UWB Signals - DSUWB Signals - TR UWB System-MC-UWB Transmitters: CI-UWB Signals - FH-UWB Systems - OFDM-UWB Systems - Spectral Encoded UWB Communication System.

UNIT IV IUWB RECEIVER DESIGN 9 Hrs

System Model- Threshold/Leading Edge Detection - Correlation Detection (CD) Receivers - RAKE Receivers - Multi-User Detection (MUD) UWB Receivers- Hybrid RAKE IMUD Receivers - Auto Correlation TR UWB Receivers- Synchronization and Timing Issues - Digital I-UWB Implementation.

UNIT V UWB COMMUNICATION STANDARDS AND ADVANCED TOPICS 9 Hrs

standardization in wireless personal area networks – DS-UWB proposal – MB-OFDM UWB proposal – IEEE proposals for UWB channel models – UWB ad-hoc and sensor networks – MIMO and Space-time coding for UWB systems – Self interference in high data-rate UWB communications – Coexistence of DS-UWB with WIMAX.

Practical component P: Include case studies / application scenarios
Research component R: Future trends / research areas / Comparative Analysis

Total Number of Hours: 45 hrs

Text books:

1. Jeffrey H. Reed, "An Introduction to UWB Communication Systems, Prentice Hall, 2005.
2. Robert Aiello and Anuj Batra, "UWB Systems: Technologies and Applications", Newnes- Elsevier, 2006.
3. FaranakNekoogar, "UWB Communications: Fundamentals and Applications", Prentice Hall, 2005.

References:

1. Ultra Wideband Antennas: Design, Methodologies, and Performance BY (Author), Marco Antonio Peyrot- Solis (Author), HildebertoJardón Aguilar
2. Design of CMOS RFIC Ultra-Wideband Impulse Transmitters and Receivers Book by Cam Nguyen and Meng Miao 3.Ultra-Wideband Antennas and Propagation: For Communications, Radar and Imaging 1st Editionby BenAllen (Editor), Mischa Dohler (Editor), Ernest Okon (Editor), WasimMalik (Editor), Anthony Brown (Editor), David Edwards