SRI CHANDRASEKHARENDRA SARASWATHI VISWA MAHAVIDYALAYA

(University established under section 3of UGC Act 1956)
(Accredited with 'A' Grade by NAAC)

CURRICULUM FOR FULL TIME

ELECTRONICS AND COMMUNICATION ENGINEERING

(Applicable for the Students admitted from 2023-24 onwards)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT VISION AND MISSION

VISION

To emerge as a centre of excellence in the field of Electronics and Communication Engineering for producing talented engineers by imparting quality education, innovation, research and Indian values towards growth and development of the society.

MISSION

- To provide essential knowledge and skills to the students for enhancing employable potential to compete globally.
- To establish state of art laboratories for fostering innovation and research in the emerging fields.
- To establish a centre of excellence in collaboration with industries, research laboratories and other organizations to meet the changing needs of society.
- To develop ethical integrity among the students for facing the real life challenges.
- To promote curricular and co-curricular activities among the students for instilling social responsibility, creativity and entrepreneurship.

Program Outcomes (POs)
1. Engineering knowledge:
Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis:
Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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.
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.
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.
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.
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.
8. Ethics:
Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work:
Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
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.
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.

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.
Professional Educational Objectives (PEOs) for B.E (ECE):
PEO 1: Core Competence
To produce graduates with an understanding of fundamentals and applications of Electronics and Communication Engineering.
PEO 2: Professional Development
To instill students with engineering breadth to create, innovate and contribute effective solutions for multidisciplinary real-life problems.
PEO 3: Learning Attitude
To augment the ability and attitude to adapt towards the growth of technology and social challenges.
PEO 4: Professionalism
To inculcate in students, professional and ethical attitude with spiritual exposure, effective communication skills and teamwork to become a successful professional.

DEFINITION OF CREDIT:

No of hours per week	No of credits
1 Hr. Lecture (L) per week	1
1 Hr. Tutorial (T) per week	1
1 Hr. Practical (P) per week	0.5

COURSE CODE AND DEFINITION:

COURSE CODE	DEFINITIONS
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities / Social Sciences / Management Courses
PCC	Programme Core Courses
PEC	Professional Elective Courses
OEC	Open Elective Courses
LC	Laboratory Course
MC	Mandatory Courses
PIIC	Project / Industrial Practice / Internship

CREDIT DISTRIBUTION:

SL.NO	CATEGORY	CREDITS
1.	Basic Science Courses (BSC)	**29**
2.	Engineering Science Courses (ESC)	**20**
3.	Programme Core Courses (PCC)	**75**
4.	Professional Elective Courses (PEC)	**21**
5.	Humanities / Social Sciences / Management Courses (HSMC)	**06**
6.	Project / Industrial Practice / Internship (PIIC)	**12**
7.	Open Elective Courses (OEC)	**09**
8.	Mandatory Course (MC) *	**14***
Total Credits		**172**

- **Not calculated for CGPA**

CURRICULUM FOR FULL TIME BE (ECE) REGULATIONS

(For candidates admitted during the year 2023-24 onwards)

SEMESTER – I

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	CHSEN18T10	ENGLISH	HSMC	2	1	0	3	40	60	100
2.	CBSMA18T20	MATHEMATICS –I (CALCULUS AND DIFFERENTIAL EQUATIONS)	BSC	3	1	0	4	40	60	100
3.	CBSPH18T30	ENGINEERING PHYSICS	BSC	3	0	0	3	40	60	100
4.	CESCS18T40	PROGRAMMING FOR PROBLEMSOLVING	ESC	2	1	0	3	40	60	100
Laboratory										
5.	CBSPH18P50	PHYSICS LABORATORY	BSC	0	0	3	2	40	60	100
6.	CESCS18P60	PROBLEM SOLVING PROGRAMMING LABORATORY	ESC	0	0	3	2	40	60	100
7.	CESME18P70	WORKSHOP/MANUFACTURING PRACTICES	ESC	0	0	3	2	40	60	100
			Total	**10**	**3**	**9**	**19**	**-**	**-**	**700**

SEMESTER –II

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	CBSMA68T10	MATHEMATICS – II (LINEAR ALGEBRA, TRANSFORMCALCULUS AND NUMERICAL METHODS)	BSC	3	1	0	4	40	60	100
2.	CBSCH18T20	ENGINEERING CHEMISTRY	BSC	3	0	0	3	40	60	100
3.	CESME18P50	ENGINEERING GRAPHICS ANDDESIGN	BSC	1	0	2	3	40	60	100
4.	CESEE18T30	BASIC ELECTRICAL ENGINEERING	ESC	3	0	0	3	40	60	100
5.	CMCCH28T50	ENVIRONMENTAL SCIENCE AND ENGINEERING *	MC*	2	0	0	2 *	40	60	100
Laboratory										
6.	CBSCH18P60	CHEMISTRY LAB	BSC	0	0	3	2	40	60	100
7.	CESEE18P70	BASIC ELECTRICAL ENGINEERING LABORATORY	ESC	0	0	3	2	40	60	100
			Total	**12**	**1**	**8**	**17**	**-**	**-**	**700**

SEMESTER –III

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	BECF183T10	MATHEMATICS –III (PROBABILITY AND STATISTICS)	BSC	3	1	0	4	40	60	100
2.	BECF183T30	ELECTRONIC DEVICES	PCC	3	0	0	3	40	60	100
3.	BECF183T40	DIGITAL SYSTEM DESIGN	PCC	3	0	0	3	40	60	100
4.	BECF183T50	SIGNALS AND SYSTEMS	PCC	3	0	0	3	40	60	100
5.	BECF183T60	NETWORK THEORY	PCC	3	0	0	3	40	60	100
6.	BECF183T20	OBJECT ORIENTED PROGRAMMINGUSING C++	ESC	2	1	0	3	40	60	100
7.	BECF183MC2	SANSKRIT AND INDIAN CULTURE *	MC*	2	0	0	2*	40	60	100
8.	BETF183MC3	SOFT SKILLS – I *	MC*	-	0	0	1*	-	-	-
Laboratory										
9.	BECF183P80	ELECTRONIC DEVICES LABORATORY	PCC	0	0	3	2	40	60	100
10.	BECF183P90	DIGITAL SYSTEM DESIGN LABORATORY	PCC	0	0	3	2	40	60	100
11.	BECF183P70	OBJECT ORIENTED PROGRAMMING LABORATORY USING C++	ESC	0	0	3	2	40	60	100
			Total	**19**	**2**	**9**	**25**	**-**	**-**	**1100**

SEMESTER –IV

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	CBSMAJ8T10	MATHEMATICS-IV (CALCULUS, SPECIAL FUNCTIONS AND DESIGN OF EXPERIMENTS)	BSC	3	1	0	4	40	60	100
2.	BECF184T20	ANALOG ELECTRONICS	PCC	3	0	0	3	40	60	100
3.	BECF184T30	ANALOG AND DIGITAL COMMUNICATION	PCC	3	0	0	3	40	60	100
4.	BECF184T40	MICROPROCESSOR AND MICROCONTROLLERS	PCC	3	0	0	3	40	60	100
5.	BECF186T10	CONTROL SYSTEMS	PCC	3	0	0	3	40	60	100
6.	BECF184T60	ELECTROMAGNETIC FIELDS ANDWAVEGUIDES	PCC	3	0	0	3	40	60	100
7.	BETF184MC4	SOFT SKILLS – II *	MC*	0	0	0	1*	40	60	100
Laboratory										
8.	BECF184P70	ANALOG ELECTRONICS LABORATORY	PCC	0	0	3	2	40	60	100
9.	BECF184P80	ANALOG AND DIGITAL COMMUNICATION LABORATORY	PCC	0	0	3	2	40	60	100
10.	BECF184P90	MICROPROCESSOR AND MICROCONTROLLERS LABORATORY	PCC	0	0	3	2	40	60	100
			Total	**18**	**1**	**9**	**25**	**-**	**-**	**1000**

SEMESTER –V

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	BECF184P70	MICROWAVE ENGINEERING	PCC	3	0	0	3	40	60	100
2.	BECF184P80	COMPUTER ARCHITECTURE	PCC	3	0	0	3	40	60	100
3.	BECF184P90	DIGITAL SIGNAL PROCESSING	PCC	3	0	0	3	40	60	100
4.	BECF184P70	COMPUTER AIDED SYSTEM DESIGN	PCC	3	0	0	3	40	60	100
5.	PEC - I	PROFESSIONAL ELECTIVE COURSE -I	PEC	3	0	0	3	40	60	100
6.	OEC - I	OPEN ELECTIVE COURSE- I	OEC	3	0	0	3	40	60	100
7.	BETF18MC05	SOFT SKILLS – III *	MC*	-	0	-	1*	-	-	-
Laboratory										
8.	BECF185P60	ELECTROMAGNETIC FIELDS AND MICROWAVE LABORATORY	PCC	0	0	3	2	40	60	100
9.	BECF185P70	DIGITAL SIGNAL PROCESSING LABORATORY	PCC	0	0	3	2	40	60	100
10.	BECF185P80	COMPUTER AIDED SYSTEM DESIGN LABORATORY	PCC	0	0	3	2	40	60	100
			Total	**18**	**0**	**9**	**24**	**-**	**-**	**1000**

SEMESTER –VI

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	BECF184T50	MEASUREMENTS AND INSTRUMENTATION	ESC	3	0	0	3	40	60	100
2.	BECF186T20	COMPUTER NETWORKS	PCC	3	0	0	3	40	60	100
3.	PEC - II	PROFESSIONAL ELECTIVE COURSE -II	PEC	3	0	0	3	40	60	100
4.	OEC - II	OPEN ELECTIVE COURSE - II	OEC	3	0	0	3	40	60	100
5.	BECF185EA0	VLSI DESIGN	PCC	3	0	0	3	40	60	100
6.	BECF186T40	EMBEDDED SYSTEMS	PCC	3	0	0	3	40	60	100
7.	BETF18MC06	SOFT SKILLS – IV*	MC*	0	0	-	1*	-	-	-
Laboratory										
8.	BECF186P70	COMPUTER NETWORKS LABORATORY	PCC	0	0	3	2	40	60	100
9.	BECF186P80	EMBEDDED SYSTEMS DESIGN LABORATORY	PCC	0	0	3	2	40	60	100
10.	BECF186P90	VLSI DESIGN LABORATORY	PCC	0	0	3	2	40	60	100
			Total	**15**	**0**	**9**	**24**	**-**	**-**	**1000**

SEMESTER –VII

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	PEC - III	PROFESSIONAL ELECTIVE COURSE -III	PEC	3	0	0	3	40	60	100
2.	PEC - IV	PROFESSIONAL ELECTIVE COURSE- IV	PEC	3	0	0	3	40	60	100
3.	PEC - V	PROFESSIONAL ELECTIVE COURSE -V	PEC	3	0	0	3	40	60	100
4.	OEC - III	OPEN ELECTIVE COURSE III	OEC	3	0	0	3	40	60	100
5.	BECF187T50	OPTICAL COMMUNICATION	PCC	3	0	0	3	40	60	100
6.		CYBER SECURITY	MC*	3	0	0	1*	40	60	100
Laboratory										
7.	BECF197P60	OPTICAL COMMUNICATION LABORATORY	PCC	0	0	3	2	40	60	100
8.	BECF187P70	INDUSTRIAL VISIT / INTERNSHIP TRAINING**	MC*	0	0	0	2*	-	-	100
9.	BECF187Z80	PROJECT WORK - PHASE-I	PIIC	0	0	0	2	40	60	100
			Total	**15**	**0**	**3**	**19**	**-**	**-**	**800**

**** To be completed before end of VI Semester**

SEMESTER –VIII

Sl.No	Subject Code	Subject Name	Category	L	T	P	C	IA	EA	TM
1.	PEC - VI	PROFESSIONAL ELECTIVE COURSE VI	PEC	3	0	0	3	40	60	100
2.	PEC - VII	PROFESSIONAL ELECTIVE COURSE VII	PEC	3	0	0	3	40	60	100
3.	BECF186T30	PRINCIPLES OF MANAGEMENT AND PROFESSIONAL ETHICS	HSMC	3	0	0	3	40	60	100
4.		UNIVERSAL HUMAN VALUES	MC*	2	1	0	3*	40	60	100
Laboratory										
5.	BECF188Z40	PROJECT WORK - PHASE-II	PIIC	0	0	0	10	40	60	100
			Total	**9**	**0**	**0**	**19**	**-**	**-**	**400**

Total Credits: 172

SUMMARY OF CREDIT DISTRIBUTION

Sl.No.	Course	Semester								Total
		I	II	III	IV	V	VI	VII	VIII	
1.	HSMC	3	-	-	-	-	-	-	3	**06**
2.	BSC	9	12	4	4	-	-	-	-	**29**
3.	ESC	7	5	5	-	-	3	-	-	**20**
4.	PCC	-	-	16	21	18	15	5	-	**75**
5.	PEC	-	-	-	-	3	3	9	6	**21**
6.	OEC	-	-	-	-	3	3	3	-	**09**
7.	PIIC	-	-	-	-	-	-	2	10	**12**
8.	MC*	-	2*	3*	1*	1*	1*	3*	3*	**14***
9.	TOTAL	**19**	**17**	**25**	**25**	**24**	**24**	**19**	**19**	**172**

*** Not calculated for CGPA**

AICTE RECOMMENDATIONS

Sl.No.	CATEGORY	CREDITS [AICTE]	CREDITS [SCSVMV-ECE]
1.	Basic Science Courses (BSC)	**25**	**29**
2.	Engineering Science Courses (ESC)	**24**	**20**
3.	Programme Core Courses (PCC)	**48**	**75**
4.	Professional Elective Courses (PEC)	**18**	**21**
5.	Humanities/Social Science/ Management Courses (HSMC)	**12**	**06**
6.	Project/ Industrial Practice/ Internship (PIIC)	**15**	**12**
7.	Open Elective Courses (OEC)	**18**	**09**
8.	Mandatory Course (MC)	**-**	**14***
	Total Credits	**160**	**172**

- **Not calculated for CGPA**

LIST OF PROFESSIONAL ELECTIVES COURSES [PEC]

PROFESSIONAL ELECTIVE COURSE - I		
S.NO	**SUBJECT CODE**	**SUBJECT NAME**
1.	BECF185EA0	ANTENNAS AND PROPAGATION
2.	BECF185EB0	INFORMATION THEORY AND CODING
3.	BECF187EJ0	ADVANCED MICROCONTROLLERS
PROFESSIONAL ELECTIVE COURSE - II		
S.NO	**SUBJECT CODE**	**SUBJECT NAME**
1.	BECF185EB0	MULTIMEDIA COMPRESSION TECHNIQUES
2.	BECF185EC0	NANO ELECTRONICS
3.	BECF187ER0	RF DESIGN
PROFESSIONAL ELECTIVE COURSE - III		
S.NO	**SUBJECT CODE**	**SUBJECT NAME**
1.	BECF187EG0	DIGITAL IMAGE AND VIDEO PROCESSING
2.	BECF187EH0	WIRELESS SENSOR NETWORKS
3.	BECF187EI0	ASIC DESIGN
4.	BECF185EC0	INTRODUCTION TO MEMS
PROFESSIONAL ELECTIVE COURSE - IV		
S.NO	**SUBJECT CODE**	**SUBJECT NAME**
1.	BECF187EK0	MOBILE COMMUNICATION AND NETWORKS
2.	BECF187EL0	CMOS IC DESIGN
3.	BECF187EM0	SPEECH AND AUDIO PROCESSING
4.	BECF187EN0	HIGH SPEED ELECTRONICS
PROFESSIONAL ELECTIVE COURSE - V		
S.NO	**SUBJECT CODE**	**SUBJECT NAME**
1.	BECF187EO0	BIO-MEDICAL ELECTRONICS
2.	BECF187EP0	MIXED SIGNAL DESIGN
3.	BECF187EQ0	ADAPTIVE SIGNAL PROCESSING
4.	BECF187OEL	ADHOC NETWORKS
5.		EMBEDDED PRODUCT DEVELOPMENT

PROFESSIONAL ELECTIVE COURSE - VI		
S.NO	**SUBJECT CODE**	**SUBJECT NAME**
1.	BECF188ES0	NEURAL NETWORKS AND FUZZY LOGIC
2.	BECF188ET0	5G / 4G CELLULAR SYSTEMS
3.	BECF188EU0	ERROR CORRECTING CODES
4.	BECF188EV0	VLSI TESTING
5.		SMART ANTENNA FOR MOBILE COMMUNICATION AND GPS
PROFESSIONAL ELECTIVE COURSE - VII		
S.NO	**SUBJECT CODE**	**SUBJECT NAME**
1.	BECF188EW0	SATELLITE COMMUNICATION
2.	BECF188EX0	RADAR AND NAVIGATIONAL AIDS
3.	BECF188EY0	WAVELETS AND ITS APPLICATIONS
4.	BECF188EZ0	SOFTWARE DEFINED RADIO
5.	BECF188OET	IOT ARCHITECTURE & PROTOCOLS
6.		5G WIRELESS COMMUNICATION SYSTEMS

LIST OF OPEN ELECTIVES COURSES [OEC]

OPEN ELECTIVE COURSE - I		
S.NO	**SUBJECT CODE**	**SUBJECT NAME**
1.	BECF185OEA	DISASTER MANAGEMENT
2.	BECF185OEB	CRYPTOGRAPHY & NETWORK SECURITY
3.	BECF185OEC	NANO SCIENCE
4.	BECF185OED	PLC AND DISTRIBUTED CONTROL SYSTEM
5.	BECF185OEE	AUTOTRONICS
OPEN ELECTIVE COURSE - II		
S.NO	**SUBJECT CODE**	**SUBJECT NAME**
1.	BECF186OEF	REMOTE SENSING & GIS
2.	BECF186OEG	BIG DATA ANALYTICS
3.	BECF186OEJ	3D PRINTERS & APPLICATIONS
4.	BECF187OEO	GLOBAL POSITIONING SYSTEMS
5.		MACHINE LEARNING
OPEN ELECTIVE COURSE - III		
S.NO	**SUBJECT CODE**	**SUBJECT NAME**
1.	BECF187OEK	SENSORS & ACTUATORS
2.	BECF187OEM	ARTIFICIAL INTELLIGENCE
3.	BECF188OEP	ROBOTICS & AUTOMATION
4.	BECF188OES	CLOUD COMPUTING
5.		BLOCK CHAIN TECHNOLOGY
FOREIGN LANGUAGES		
S.NO	**SUBJECT CODE**	**SUBJECT NAME**
1.	BECF18OECO1	FRENCH PRIMER
2.	BECF18OECO2	GERMAN PRIMER
3.	BECF18OECO3	JAPANESE PRIMER

VALUE ADDED COURSES

The ever-changing global scenario makes the world more competitive and requires high levels of lateral thinking and the spirit of entrepreneurship to cope up with the emerging challenges. Many a times, the defined skill sets that are being imparted to students today with Programme Specific Objectives in educational institutions become redundant sooner than later due to rapid technological advancements. These courses supplement the curriculum to make students better prepared to meet the industrial demands as well as to develop their own interests and aptitudes.

The number of hours will be 30 hours per course and the certificate shall be awarded by the department.

Objectives:

- To improve employability skills of students.
- To bridge the skill gaps and make students industry ready.
- To provide students an understanding of the expectations of industry.
- To cast students as job providers rather than job seekers.
- To provide an opportunity to students to develop inter-disciplinary skills.

List of Courses Offered:

S.No	Course Name
1.	HANDS ON TRAINING ON "DIGITAL IMAGE PROCESSING AND MACHINE LEARNING APPLICATIONS"
2.	REAL TIME APPLICATIONS USING MATLAB/PYTHON/R STUDIO
3.	CONSUMER ELECTRONICS FOR SMART HOME AUTOMATION
4.	PCB DESIGN AND FABRICATION
5.	WEARABLE ELECTRONICS IN HEALTHCARE
6.	ROBOTICS USING ARDUINO FOR AUTOMATION
7.	SERVICING OF ELECTRONIC GADGETS

SEMESTER - I

Course Code	CHSEN18T10	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ENGLISH**	2	1	0	3	40	60	100
Course Category	HUMANITIES/SOCIAL SCIENCE/ MANAGEMENT COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students:

1. To enhance student proficiency in English language skills.
2. To develop students ability to think analytically, speculatively, and imaginatively.
3. To help students see themselves as professionals, as part of a discipline with skills and abilitiesvaluable in business, teaching, publishing, etc.

Course Outcomes:

On completion of the course, the student will be able to:

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the nuances of grammar and vocabulary in speaking and writing.	**K2**
CO2	Listen and comprehend different spoken excerpts critically, infer and implied meanings.	**K1**
CO3	Speak convincingly, express their opinions clearly, initiate a discussion, negotiate, and argue using appropriate communicative strategies.	**K4**
CO4	Read different genres of texts, infer implied meanings and critically analyze and evaluate them for ideas as well as for Method of presentation.	**K2**
CO5	Write effectively and persuasively and by using different techniques of writing such as narration, description, exposition and argument as well as creative, critical, analytical and Evaluative writing.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O 1**	**PS O2**	**PS O3**

CO1	-	-	-	-	M	L	L	L	M	M	L	M	-	-	-
CO2	-	-	-	-	M	L	L	L	L	L	L	M	-	-	-
CO3	-	-	-	-	L	L	L	L	L	L	L	L	-	-	-
CO4	-	-	-	-	L	L	L	L	L	L	L	L	-	-	-
CO5	-	-	-	-	M	L	L	L	M	M	L	M	-	-	-

UNIT-I	**VOCABULARY BUILDING**	**9 Hours**

The concept of Word Formation - Root words from foreign languages and their use in English - Acquaintance with prefixes and suffixes from foreign languages in English to form Derivatives - Synonyms, antonyms, and standard abbreviations.

UNIT-II	**BASIC WRITING SKILLS**	**9 Hours**

Sentence Structures - Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence - Organizing principles of paragraphs in documents - Techniques for writing precisely.

UNIT-III	**IDENTIFYING COMMON ERRORS IN WRITING**	**9 Hours**

Subject-verb agreement - Noun pronoun agreement - Misplaced modifiers - Articles - Prepositions - Redundancies – Clichés.

UNIT-IV	**NATURE AND STYLE OF SENSIBLE WRITING**	**9 Hours**

Describing – Defining – Classifying - Providing examples or evidence -Writing introduction and conclusion.

UNIT-V	**WRITING PRACTICES**	**9 Hours**

Comprehension - Précis Writing - Essay Writing.

UNIT-VI	**ORAL COMMUNICATION**	

(This involves interactive practice sessions in Language Lab)
Listening Comprehension - Pronunciation, Intonation, Stress and Rhythm - Common Everyday ituations: Conversations and Dialogues - Communication at Workplace – Interviews - Formal Presentations

Total Hours	**45 Hours**

Text Book(s)

1.	Practical English Usage. MichaelSwan.OUP. 4th edition.
2.	Remedial English Grammar. F.T.Wood.Macmillan.Jan-2014.
3.	On Writing Well William Zinsser. Harper Resource e Book.9th May 2006.

Reference Book(s)

1.	Study Writing, Liz Hamp – Lyons and Ben Heasly, Cambridge University Press, 2nd edition,

	31st Jan2007.
2.	Communication Skills, Sanjay Kumar and PushpaLata, Oxford University Press, 2nd Edition, 2015.

Course Code	CBSMA18T20	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**MATHEMATICS -I (CALCULUS AND DIFFERENTIAL EQUATIONS)**	3	1	0	4	40	60	100
Course Category	BASIC SCIENCE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students

1. The objective of this course is to familiarize the prospective engineers with techniques in calculus,differential equations and sequence and series.
2. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	The concept of convergence and divergence and their testing that is fundamental to application of analysis to Engineering probes.	**K3**
CO2	The effective mathematical tools for the solutions of differential equations that model physical processes.	**K5**
CO3	To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.	**K5**
CO4	The mathematical tools needed in evaluating multiple integrals and their usage. To deal with functions of several variables those are essential in most branches of engineering.	**K5**
CO5	To improve the ability of numerical computations to find the solutions of a given polynomial and transcendental equations along knowing the process of inter and extrapolations that improves the ability of solving helps to perform computational engineering problems.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O2	PS O3
CO1	S	S	S	S	S	-	M	-	-	M	M	M	-	-	-
CO2	S	S	S	S	S	-	-	-	M	M	L	M	-	-	-
CO3	S	S	S	S	S	-	M	-	L	M	L	M	-	-	-
CO4	S	S	S	S	S	-	M	L	M	M	M	M	-	-	-
CO5	S	S	S	S	S	-	L	-	L	M	L	M	-	-	-

UNIT-I	**SEQUENCESAND SERIES**	**12 Hours**

Convergence of sequence and series -Tests for convergence -Comparison,-Ratio- Cauchy's Root-Raabe's test-logarithmic test- Fourier series: Half range sine and cosine series-Parseval's theorem.

UNIT-II	**DIFFERENTIAL EQUATIONS**	**12 Hours**

Second order linear differential equations with constant coefficients–Cauch Euler equation, Legendre equation-Method of variation of parameters-First order partial differential equations: Formation of PDE -solutions of first order linear PDEs.

UNIT-III	**CALCULUS**	**12 Hours**

Evaluation of definite integral-Applications of definite integrals- To evaluate surface areas and volumes of revolutions; Beta and Gamma functions and their properties.

UNIT-IV	**MULTIVARIABLE CALCULUS**	**12 Hours**

Multiple Integration-double and triple integrals (Cartesian and polar)-change of order of integration in double integrals-Change of variables(Cartesian and polar) Applications - areas and volumes by double integration-Center of mass and Gravity (constant and variable densities).

UNIT-V	**NUMERICAL METHODS**	**12 Hours**

Solution of polynomial and transcendental equations–Bisection method-Newton-Raphson method-Regula-Falsi method- Finite differences-Interpolation using Newton's forward and backward difference formulae- Central difference interpolation-Gauss's forward and backward formulae.

	Total Hours	**60 Hours**

Text Book(s)

1.	B.S.Grewal, "Higher Engineering Mathematics", Khanna Publishers, 43rd Edition Jan2010.

Reference Book(s)

1.	G.B.Thomas and R.L.Finney, Calculus and Analytic geometry, Pearson, 9th Edition Jan2010.
2.	T.Veerarajan, Engineering Mathematics, Mc Graw-Hill, New Delhi, 3rd Edition 2011.
3.	B.V.Ramana, Higher Engineering Mathematics, Mc Graw Hill, New Delhi, 2010.
4.	N.P.Baliand M.Goyal, A text book of Engineering Mathematics, Laxmi Publications, 9th Edition, 2016.

Course Code	CBSPH18T30	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ENGINEERING PHYSICS**	3	0	0	3	40	60	100
Course Category	BASIC SCIENCE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. Theory of Interference-Newton strings, Michelson Interferometer and Fresnel and Fraunhoffer diffraction, Diffraction due to "n" slits - Plane Transmission grating.
2. Energy distribution in black body - Planck's law, De Broglie matter waves – dual nature and expression, Schrodinger Time Independent and Dependent, wave equation, Expression for particle in1-D box and applications.
3. Laser - Principles and Properties, Einstein's theory, Types of lasers – Nd: YAG and CO2 laser Applications of lasers – IR Thermograph, Optical fibers-Types of optical fibers, Acceptance angle and numerical aperture, Fiber losses, Applications in engineering and medicine.
4. PN Junction diode and Zener diode - V-I characteristics, BJT, SCR, FET, D-MOSFET, E-MOSFET Characteristics, Characteristics of CMOS, Logic Gates and Universal Building Blocks.
5. Fundamentals of dielectric materials, Internal field and Clausius - Mossotti relation, Super conductors–properties and types - BCS theory, Nano materials – Synthesis, Ball milling and PVD method.Principle and properties of SMA and Biomaterials.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	To develop an understanding of the principles of optics.	**K2**
CO2	Experience the diverse applications of the wave equation. Learn the mathematical tools needed to solve quantum Mechanics problems.	**K4**
CO3	To provide adequate knowledge on laser fundamentals types and applications and to expose the basics of signal propagation through fiber optics	**K2**
CO4	Understand the principles and concepts of semiconductor Physics. Understand and utilize the mathematical models of Semi conductor junctions and MOS transistors for circuits and systems.	**K2**
CO5	Acquire basic knowledge on various newly developed smart materials.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	S	S	M	M	M	L	M	L	M	M	L	L	-	-	-
CO2	S	S	S	S	S	M	M	L	M	M	L	L	-	-	-
CO3	S	S	S	S	S	M	M	M	M	S	S	S	-	-	-
CO4	S	S	S	S	S	L	L	L	M	M	M	M	-	-	-
CO5	M	M	M	M	M	S	S	M	M	M	M	M	-	-	-

UNIT-I	WAVE OPTICS	9 Hours

Huygens' principle, superposition of waves –Theory of interference of light -Young's double slit experiment. Thin films- Newton's rings, Michelson interferometer-Anti reflection coating. Fresnel and Fraunhofer diffraction– diffraction due to 'n' slits- plane transmission grating. Rayleigh criterion for limit of resolution - resolving power ofgrating.

UNIT-II	QUANTUM PHYSICS	9 Hours

Black body radiation-Planck's law – Energy distribution function, Wave – particle duality-de Broglie matter waves – Concept of wave function and its physical significance – Heisenberg's Uncertainty Principle – Schrodinger's wave equation – Time independent and Time dependent equations – Particle in a one dimensional rigid box – tunneling (Qualitative) – Scanning tunneling microscope.

UNIT-III	PHOTONICS	9 Hours

Einstein's theory of matter radiation interaction and A and B coefficients; Properties of laser-spontaneous and stimulated emission, amplification of light by population inversion, different types of lasers: solid-state laser(Neodymium), gas lasers (CO_2), applications –IR Thermography.

Optical fibre- principle [TIR]-types-material, mode, refractive index-Fibre loss-Expression for acceptance angle and numerical aperture. Application-Communication.

UNIT-IV	SEMICONDUCTOR DEVICES AND APPLICATIONS	9 Hours

Introduction to P-N junction Diode and V-I characteristics, Zener diode and its characteristics, Introduction to BJT, its input-output and transfer characteristics, SCR characteristics, FET, MOSFET and CMOS characteristics. Basic logic gates - NAND, NOR as Universal building block.

UNIT-V	NEW ENGINEERING MATERIALS	9 Hours

Dielectric materials: Definition – Dielectric Breakdown – Dielectric loss – Internal field – Claussius Mossottirelation.

Superconducting materials: Introduction – Properties- Meissner effect – Type I & Type II superconductors – BCStheory-Applications.

Nanomaterials: Introduction – Synthesis of nano materials – Top down and Bottom up approach- Ball milling- PVDmethod- Applications. **Smart materials:** Shape memory alloys-Biomaterials (properties and applications).	
Total Hours	**45 Hours**
Text Book(s)	
1.	Optics by Subramaniam N &BrijLal, S Chand & Co. Pvt. Ltd., New Delhi, [unit 1].
2.	Modern Physics by R Murugeshan, Kiruthiga, Sivaprasath S Chand [all units].
3.	Quantum Mechanics by Sathyaprakash, PragatiPrakashan, Meerut. [unit 2].
4.	Applied Engineering Physics – Rajendran&Marikani (Tata McGraw Hill) [unit 3,5] 2009.
5.	Engineering Physics – Bhattacharya, Bhaskaran – Oxford Publications [unit 2,3,5] 2012.
6.	Engineering Physics I & II – G.Senthilkumar, VRB publications [unit 2,3] 2012.
7.	Applied Physics for Engineers – K.Venkatramanan, R.Raja, M.Sundarrajan(Scitech) [3,5] 2014.
8.	Principles of Electronics by V.K.Mehta, (S.Chand) [unit 5].
Reference Book(s)	
1.	Fundamentals of Optics by Jenkins A Francis and White E Harvey, McGRaw Hill Inc., New Delhi.
2.	Quantum Mechanics by V. Devanathan, Narosa, Chennai.
3.	Engineering Physics byM.N.Avadhanulu, S.Chand& Company Ltd.
4.	Concepts of Modern Physics by Arthur Beisser, McGraw Hill, 7th edition.
5.	Optics byR.Agarwal, S.Chand publishers.
6.	Basic Electronics by B.L.Theraja, S.Chand publishers.
7.	Fundamentals of Physics, 6th Edition, D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, NewYork.

Course Code	CESCS18T40	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**PROGRAM FOR PROBLEM SOLVING**	2	1	0	3	40	60	100
Course Category	ENGINEERING SCIENCE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students

1. Be exposed to the syntax of C.
2. Be familiar with programming in C.
3. Learn to use arrays, strings, functions, pointers, structures and unions in C.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Develop algorithms for solving simple mathematical and engineering problems and examine the suitability of appropriate repetition and or selection structures for given problems.	**K3**
CO2	Solve matrix problems, merging, searching, sorting and string Manipulation problems using iteration, modularization or recursionas applicable.	**K3**
CO3	Organize files to perform text operations like editing, patternSearching using structures.	**K3**
CO4	Implement the algorithms for matrix problems, merging, searching, sorting, and string manipulation and file problems and debug and test using any procedural programming language.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	S	S	S	S	M	L	L	M	M	-	M	-	-	-
CO2	S	S	S	S	S	M	L	L	M	M	-	M	-	-	-
CO3	S	S	M	M	S	M	L	L	M	M	-	M	-	-	-
CO4	S	S	S	S	S	M	L	L	S	S	-	S	-	-	-

UNIT-I	**Module - I**	**9 Hours**

Introduction to components of computer system-Generation of programming languages-Types of

Computers-Organization of Computers-Types of memory, Number systems- Idea of Algorithm-Pseudo code- Flow Chart with examples.		
UNIT-II	**Module - II**	**9 Hours**
Introduction to C-Character set, Constants, Variables, Data Types-Operators – Arithmetic expressions and precedence-Decision Making statement - Looping statements.		
UNIT-III	**Module - III**	**9 Hours**
Arrays and its types-Functions –Parameter passing in functions-call by value- call by reference Passing array to functions-Recursive function.		
UNIT-IV	**Module - IV**	**9 Hours**
Structures and array of structures –Union, Basic searching –Linear and Binary, Basic sorting, String operations.		
UNIT-V	**Module - V**	**9 Hours**
Introduction to Pointer, Pointer arithmetic-notion of linked list (no implementation) - File handling.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
2.	Balagurusamy. E, "Programming in ANSI C", Tata McGraw Hill, Third edition, 2006.
3.	Fundamentals of Computing and Programming- V.RameshBabu, R.Samyuktha,M.Muniratham by VRB Publishers 2012 edition.
Reference Book(s)	
1.	Let Us 'C' - YashawantKanetkar, (Unit 2 to 5), BPB publications, 10th Edition, 2010.
2.	Ashok N Kamthane, "Computer Programming", Pearson education, Second Impression.
3.	Kernighan Venugopal.K and Kavichithra.C, "Computer Programming", New Age International Publishers, First Edition, 2007.
4.	B.W and Ritchie,D.M , The C programming language: second edition,Pearson education,2006.

Course Code	CBSPH18P50	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**PHYSICS LABORATORY**	0	0	3	2	40	60	100
Course Category	BASIC SCIENCE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students

1. To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Demonstrate the procedural preparation skill to conduct the experiment.	**K3**
CO2	Ability to perform the experiment and tabulate the observations made.	**K3**
CO3	Skill to obtain an expected experimental out-comes by different techniques and impart practical knowledge in real Time solution.	**K6**
CO4	Interpretation of experimental results and conclusions.	**K5**
CO5	Understand principle, concept, working and applications of new theory and articulation of the relevant theory.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	S	M	M	L	L	L	-	M	M	M	L	-	-	-
CO2	S	S	S	S	S	L	L	-	M	M	M	L	-	-	-
CO3	S	S	S	S	S	L	L	-	M	M	M	L	-	-	-
CO4	S	S	S	S	S	M	M	-	L	L	L	-	-	-	-
CO5	S	S	S	S	L	L	L	-	L	L	L	L	-	-	-

	List of Experiments	**45 Hours**

1. Determination of Rigidity Modulus & Moment of Inertia using Torsional Pendulum.
2. Determination of Young's Modulus.
3. (a) Determination of Wavelength of Laser light using transmission grating.
   (b) Measurement of numerical aperture of an optical fiber.
4. Determination of radius of curvature of the given lens using Newton's Rings.

5. Determination of Velocity of sound waves in liquid using Ultrasonic interferometer. 6. Determination of wavelength of prominent colours of mercury spectrum using grating. 7. Determination of number of lines per meter of the grating using normal incidence method. 8. Determination of refractive index of the given prism using minimum deviation method. 9. Determination of emissivity of the surface of a black body. 10. Basic logic gates- Verification of truth tables 11. NAND-Universal building block 12. NOR-Universal building block 13. Zener diode- I-V characteristics 14. Study of LCR circuit

Text Book(s)	
1.	Practical Physics - Ouseph and Rangarajan.
2.	Engineering Practical Physics-K. Srinivasan.
3.	Engineering Practical Physics - M.N. Avadhanulu.
4.	Experimental Physics – K.Venkatramanan, R.Raja, M.Sundarrajan (Scitech)

Course Code	CESCS18P60	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**PROGRAMMING FOR PROBLEM SOLVING LABORATORY**	0	0	3	2	40	60	100
Course Category	ENGINEERING SCIENCE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students

1. To get a clear understanding of C Concepts.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Develop algorithms for solving simple mathematical and engineering problems and examine the suitability of appropriate repetition and/or selection structures forgiven problems.	**K3**
CO2	Solve matrix problems, merging, searching, sorting and string Manipulation problems using iteration, modularization or recursion as applicable.	**K3**
CO3	Organize files to perform text operations like editing, pattern searching using structures	**K3**
CO4	Implement the algorithms for matrix problems, merging, searching, sorting, and string manipulation and file problems and debug and test using any procedural programming language.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	S	S	S	S	M	L	L	M	M	-	M	-	-	-
CO2	S	S	S	S	S	M	L	L	M	M	-	M	-	-	-
CO3	S	S	M	M	S	M	L	L	M	M	-	M	-	-	-
CO4	S	S	S	S	S	M	L	L	S	S	-	S	-	-	-

	LIST OF EXPERIMENTS	
	1. Basic programs in data types. 2. Evaluate Expressions using library Function. a. πr^2 b. (A+B+(2C/3A)+A2+2B) c. √S(S-A) (S-B) (S-C) d. LOG ($x^3+y^3+z^3$) 3. Problems in Decision making statements. i. Find the Biggest among 3 numbers. ii. Find Even or odd iii. Arithmetic operations using Switch - Case Statements. 4. Problems in looping statements. i. Find the Sum of digits using (i) For loop (ii) While loop ii. Generate the Fibonacci series iii. Check whether the number is prime or not. 5. Find the Linear Search. 6. General sorting. 7. Matrix Manipulation-Addition, Subtraction and Multiplication. 8. String operations-string copy, string reverse, string concatenate. 9. Swapping of numbers using call by value, call by reference. 10. Find factorial using recursive functions. 11. Numerical methods-Quadratic Equation. 12. Display the student information & marks using Structure & Unions. 13. Demonstrate array of structures. 14. Pointer Arithmetic and Array access using Pointers. 15. Basic File Operations	
		45 Hours

Course Code	CESME18P70	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**WORKSHOP/MANUFACTURING PRACTICES**	0	0	3	2	40	60	100
Course Category	ENGINEERING SCIENCE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. To make the students understand the importance of machining in engineering
2. To give hands on experience in fitting and carpentry works helpful to understand the basics of engineering.
3. To nurture the students about the use of welding operations in engineering field.
4. To give an introduction about smithy and casting processes with their applications.
5. To provide exposure to students about the components used in wiring system with simple applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Fabricate carpentry components and pipe connections including plumbing works.	**K2**
CO2	Study and practice on welding equipments to join the structures.	**K3**
CO3	Carry out the basic machining operations including turning, facing, turning, step turning and drilling operations.	**K2**
CO4	Illustrate the operations of smithy, foundry and fittings	**K3**
CO5	Applied basic engineering knowledge for house wiring practice.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	M	M	S	S	L	M	M	M	M	M	M	L	-	-	-
CO2	L	L	S	S	L	M	M	M	M	M	M	-	-	-	-
CO3	L	L	S	S	S	M	M	-	M	M	M	-	-	-	-
CO4	L	L	S	S	S	M	M	-	M	M	M	-	-	-	-
CO5	L	L	S	S	S	M	M	M	M	M	M	L	-	-	-

SL NO	MANUFACTURING/ FABRICATION LAB	EXPERIMENT NAME
1	MACHINE SHOP	TURNING (PLAIN & STEP) AND FACING PRACTICE
2		DRILLING PRACTICE
3	FITTING SHOP	V- FITTING
4		SQUARE FITTING
5	CARPENTRY SHOP	HALF LAP T- JOINT
6		HALF LAP CROSS JOINT
7	WELDING SHOP	LAP JOINT - ARC WELDING PROCESS
8		BUTT JOINT – GAS WELDING PROCESS
9	SMITHY SHOP	FABRICATION OF ROUND ROD
10	CASTING	PREPARATION OF GREEN SAND MOLD USING A GLAND PIECEPATTERN
11	ELECTRICAL AND ELECTRONICS LAB	TWO LAMPS IN SERIES CONTROLLED BY ONE WAY SWITCH
12		TWO LAMPS IN PARALLEL CONTROLLED BY ONE WAY SWITCH

Text Book(s)

1.	Hajra Choudhry.S.K., Hajra Choudhury.A.K. and Nirjhar Roy.S.K., "Elements of Workshop Technology",Vol. I 2008 and Vol. II2010, Mediapromoters and publishers private limited, Mumbai. 14th Edition 2010.
2.	Kalpakjian S. & Steven S.Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2018.
3.	GowriP., Hariharan and A.SureshBabu,"ManufacturingTechnology-I" Pearson Education, 2013.

References

1.	Roy A.Lindberg, "Processes and Materials of Manufacture", 4thedition, Prentice Hall India,1998.
2.	RaoP.N.,"ManufacturingTechnology",Vol.I and Vol.II,TataMcGrawHill,2017.

SEMESTER - II

Course Code	CBSMA68T10	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**MATHEMATICS -II (LINEAR ALGEBRA, TRANSFORM CALCULUS AND NUMERICAL METHODS)**	3	1	0	4	40	60	100
Course Category	BASIC SCIENCE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students -

1. This course aims at familiarizing the prospective engineers with techniques in Linear Algebra,Transform Calculus and Numerical Methods.
2. To understand the fundamental concepts in the above said topics.
3. To develop the ability to evaluate the problems in transform calculus and its application in various areas

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Determine consistency of liner system of equations, Rank, Eigen values and Eigen vectors of the given square matrix also compute power, inverse of the matrix using cayley Hamilton theorem.	**K6**
CO2	Work numerically on the ordinary differential equations and partial differential equations using different methods through the theory of finite differences.	**K6**
CO3	Apply Laplace transform and its inverse to solve initial value and other related problems.	**K6**
CO4	Use Fourier transforms and its inverse in practical applications of electronics engineering.	**K6**
CO5	Solving finite difference equation in z-transforms.	**K6**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	S	S	S	S	M	M	-	M	M	M	L	-	-	-
CO2	S	S	S	S	S	M	M	-	M	M	M	L	-	-	-
CO3	S	S	S	S	S	M	M	-	M	M	M	L	-	-	-

CO4	S	S	S	S	S	M	M	-	M	M	M	L	-	-	-
CO5	S	S	S	S	S	M	M	-	M	M	M	L	-	-	-

UNIT-I	**MATRICES**	**12 Hours**

Rank of a matrix, System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Eigen values and eigenvectors; Diagonaization of matrices; Cayley-Hamilton theorem, Orthogonal transformation and quadratic to canonical forms.

UNIT-II	**NUMERICAL METHODS**	**12 Hours**

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first order equations. Milne's predicator corrector methods. Partial differential equations: Finite difference solution two dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation

UNIT-III	**TRANSFORM CALCULUS- I**	**12 Hours**

Laplace Transforms : Definition, Properties of Laplace transforms: Linearity Property, First shifting property, Change of scale property – Transforms of derivatives - Transforms of integrals - Multiplication by t^n - Division by t - Evaluation of integrals by Laplace transform - Inverse transforms: Method of partial fractions – Other methods of finding inverse - Convolution theorem (Without proof) Application to differential equations.

UNIT-IV	**TRANSFORM CALCULUS- II**	**12 Hours**

Fourier integral theorem (without proof) - Fourier Sine and Cosine integrals – Complex form of Fourier integral - Fourier transform – Fourier sine and Cosine transforms – Properties of Fourier Transforms: Linear property, Change of scale property, Shifting property -Parseval's identity for Fourier transforms (without proof) – Application of transforms to boundary value problems: Heat conduction, Vibrations of a string, Transmission lines.

UNIT-V	**TRANSFORM CALCULUS- III**	**12 Hours**

Standard z-transforms of $1, a^n$ p ^{n} – Linearity property – Damping rule – Shifting rules – Multiplication by n - Initial and final value theorems (without proof) – inverse z –transforms – Convolution theorem (without proof) – Convergence of z-transforms – Two sided z- transform – Evaluation of inverse z-transforms: Power series method, Partial fraction method, inversion integral method.

	Total Hours	**60 Hours**

Text Book(s)

1.	Grewal B.S, Higher Engineering Mathematics, 41st Edition, Khanna Publishers, New Delhi, 2011.

Reference Book(s)

1.	Alan Jeffrey, Advanced Engineering Mathematics, Academic Press.
2.	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3.	Gerald C.F and Wheatley P.O, Applied Numerical Analysis, Addison-Wesley Publishing Company.

Course Code	CBSCH18T20	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ENGINEERING CHEMISTRY**	3	0	0	3	40	60	100
Course Category	BASIC SCIENCE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:
The course should enable the students
1. To learn the basics of atomic structure, bonding and analytical methods
2. To learn various types ofreactions in organic chemistry

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

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Analyze microscopic chemistry in terms of atomic and molecular orbital's andintermolecular forces.	**K2**
CO2	Rationalize bulk properties and processes using thermodynamic considerations.	**K4**
CO3	Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.	**K2**
CO4	Rationalize periodic properties.	**K4**
CO5	List major chemical reactions that are used in the synthesis of various organic molecules.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	M	M	L	M	M	-	M	M	M	M	-	-	-
CO2	S	S	M	M	L	M	M	-	M	M	M	M	-	-	-
CO3	S	S	M	M	M	M	M	-	M	M	M	M	-	-	-
CO4	S	S	M	M	M	M	M	-	M	M	M	M	-	-	-
CO5	S	S	M	M	L	M	M	-	M	M	M	M	-	-	-

UNIT-I	**ATOMIC STRUCTURE**	**9 Hours**

Comparison between Rutherford's model of atom and Bohr's model - Bohr-Sommerfeld model (Concepts only)-its limitations - de Broglie theory - Heisenberg's uncertainty principle - Schrodinger's wave equation (derivation not needed)-significance of Ψ and Ψ^2 –shapes of different orbital's –Aufbau principle-Pauli Exclusion Principle- Hund's rule. Electronic configuration of

atoms- Mosley's law – Modern periodic table - periodic properties: atomic size- ionization energies- electron affinity- electro negativity.

UNIT-II	CHEMICAL BONDING	9 Hours

Types of bonds – ionic - covalent – coordinate bond - Molecular Orbital Theory –types ofmolecular orbitals- energy level diagrams- e$^-$ns filling in MO – bond order – MO diagrams of H_2, He_2, N_2, O_2, CO and HF molecules- Metallic bond – band theory of solids (primitive treatment only) and the role of doping on band structures - Hybridization – definition - geometry of the molecules- CH_4, C_2H_4, C_2H_2- Molecular forces-Ionic, dipolar, van der waals interactions.

UNIT-III	THERMAL AND ELECTROCHEMICAL EQUILIBRIA	9 Hours

Thermodynamic functions: State functions, Path functions, Internal energy, enthalpy, entropy and free energy-Gibbs Helmholtz equation and its applications .Feasibility of reaction - Ellingham diagrams.

Types of electrodes- Standard electrodes-Standard hydrogen electrode, standard calomel electrode, Single electrode potential , electrochemical series - galvanic cell - emf - Nernst equation and its applications - Glass electrode, Potentiometric acid base titrations and Solubility equilibrium- Corrosion-types- Chemical corrosion-electrochemical corrosion-factors influencing and control measures.

UNIT-IV	SPECTROSCOPIC TECHNIQUES AND APPLICATIONS	9 Hours

Electromagnetic radiations – wavelength – frequency – energy of a radiation - electromagnetic spectrum – changes brought about by the radiations - components of a spectrometer – rotational spectra of diatomic molecules – rigid and non-rigid rotor models (energy expressions only)- selection rule– schematic instrumentation – types of vibrations in molecules (CO_2, H_2O) – vibrational spectra (primitive treatment) – selection rule- instrumentation and applications – electronic transitions – electronic spectra — Beer-Lambert's law- instrumentation and applications– NMR – principle – chemical shift - instrumentation – NMR spectra of CH_4 – CH_3OH – xylene isomers – MRI (Introduction only).

UNIT-V	STEREOCHEMISTRY & ORGANIC REACTIONS	9 Hours

Stereochemistry - Representation of 3D structures - Fisher projection, Newman and Sawhorse projection formulae – Ethane, 3-bromo-2-butanol Conformation of Ethane, Butane& Ethylene glycol, , Symmetry and Chirality - Stereo isomers, Enantiomers, Diastereomers. Configuration - R-S system. Optical activity - Lactic acid, Tartaric acid- Geometrical isomerism – cis-trans& E-Z notations.

Organic reactions - Substitution - S_N^1 & S_N^2 (Simple Example - mechanism not expected)– electrophilic substitutions – Friedel Crafts alkylations - Additions – 1,2-addition **–** types- addition of HX -Elimination – E^1& E^2 (Examples only, mechanism not expected) - Oxidations – CIS-hydroxylation with OsO_4, Reductions – Clemmensen&wolff-Kishner reductions, Cyclization – Diels Alder, Ring-Opening – Nylon-6 from caprolactum.

Synthesis of most commonly used drugs – Aspirin,Paracetamol.

	Total Hours	45 Hours

Text Book(s)	
1.	Textbook of Inorganic Chemistry, P.L.Soni, Sultan Chand & Sons, Delhi, 2013. (For units I and II).
2.	Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and Madan S. Pathania, Shoban Lal Nagin Chand & Co., Jalandhar, 2000. (For units III and IV).
3.	Advanced Organic Chemistry, B. S. Bahl and Arun Bahl, S.Chand, Delhi, 2012. (For unit V).
Reference Book(s)	
1.	Engineering Chemistry, P.C. Jain and Monika Jain, DhanpatRai Publishing Co Pvt. Ltd., New Delhi, 2008.
2.	Applied Chemistry, K. Sivakumar, Anuradha Publications, Chennai, 2009.
3.	Textbook of Engineering Chemistry, S.S.Dara &S.S. Umare, S.Chand, Delhi, 2004.
4.	Fundamentals of Molecular Spectroscopy, C.N.Banwell and Elaine.M. McCash, 4th Edition, McGraw Hill Education, 2017.
5.	Physical Chemistry, P. W. Atkins and Julio De Paula, 10th Edition, Oxford University Press, 2014.

Course Code	CESEE18T30	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**BASIC ELECTRICAL ENGINEERING**	3	0	0	3	40	60	100
Course Category	ENGINEERING SCIENCE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students -

1. This course equips students to have basic knowledge and understanding in solving algebraic, transcendental equation numerically.
2. To make the student knowledgeable in the area of matrix theory so that he/she will be familiar in Matlab applications.
3. To familiarize the student with functions of several variables. This is needed in many branches of engineering.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Explain the basic electrical quantities and laws.	**K2**
CO2	Explain the construction, types and applications of electrical machines.	**K2**
CO3	Study the working principles of power converters.	**K2**
CO4	Show the tariff or a given load and energy consumption.	**K2**
CO5	Introduce the components of low voltage electrical installations and its applications.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	L	L	M	M	M	-	S	M	-	S	-	-	-
CO2	S	S	M	M	M	S	M	L	S	M	L	M	-	-	-
CO3	S	S	M	M	S	M	M	-	M	M	-	M	-	-	-
CO4	S	S	S	S	S	M	M	M	M	M	L	M	-	-	-
CO5	S	S	M	S	M	M	L	L	S	M	L	M	-	-	-

UNIT-I	**DC CIRCUITS**	**9 Hours**

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

UNIT-II	**AC CIRCUITS**	**9 Hours**
Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three-phase balanced circuits, voltage and current relations in star and delta connections.		
UNIT-III	**TRANSFORMERS**	**9 Hours**
Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformerconnections.		
UNIT-IV	**ELECTRICAL MACHINES**	**9 Hours**
Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque- speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.		
UNIT-V	**POWER CONVERTERS AND ELECTRICAL INSTALLATIONS**	**9 Hours**
DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2.	D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
Reference Book(s)	
1.	L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
2.	E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
3.	V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

Course Code	CMCCH28T50	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ENVIRONMENT SCIENCE AND ENGINEERING**	2	0	0	2*	40	60	100
Course Category	MANDATORY COURSE (MC)*	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. To study the nature and facts about environment.
2. To finding and implementing scientific, technological, economic and political solutions to environmental problems.
3. To study the inter relationship between living organism and environment.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Nature of environment and reasons for environmental problems.	**K4**
CO2	Ecosystem – structure, functions, simplified co-system models.	**K6**
CO3	Natural resources, reasons for over exploitation of resources.	**K2**
CO4	The interrelationship between living organism and environment.	**K4**
CO5	Public awareness of environmental is at infant stage.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O 1**	**PS O2**	**PS O3**
CO1	L	L	L	L	-	M	M	S	M	M	M	L	-	-	-
CO2	M	M	M	M	L	M	M	S	M	M	M	L	-	-	-
CO3	-	-	-	-	M	M	M	S	M	M	M	L	-	-	-
CO4	L	L	L	L	M	M	M	S	M	M	M	L	-	-	-
CO5	L	L	L	L	M	M	M	S	M	M	M	L	-	-	-

UNIT-I	**INTRODUCTION TO ENVIRONMENT AND ENVIRONMENTAL STUDIES**	**9 Hours**

1.1. Introduction to environment – components – nature of environment – need of awareness– reasons for environmental problems – anthropocentric and eco centric views. 1.2. Environmental studies - multidisciplinary nature – scope and aim – sustainable development principles – RRR

concept-Indian environmental movements–environmental calendar.

UNIT-II	ECO SYSTEM AND BIO DIVERSITY	9 Hours

2.1. Ecosystem – structure – functions – simplified ecosystem models (food chain and food webs and their types, energy flow) - forest – grassland – pond –ecosystems – ecological succession – ecological pyramids–Bio-geo chemical cycles of water–oxygen-carbon-phosphorous and sulphur. 2.2.Biodiversity – definition – types – species – genetic and ecosystem diversities-values of biodiversity – threats to biodiversity – conservation of biodiversity – endemism – biodiversity hotspots – Indian biodiversity– endemic species of India–IUCN lists – red – green and blue data books.

UNIT-III	NATURAL RESOURCES	9 Hours

3.1 Natural resources – definition – types – forest resources – uses –deforestation- reasons - effects – water resources – dams – effects of dams - food resources – modern agriculture– ill effects – energy resources -types–hydel–nuclear–solar–wind and biomass energy-world scenario–Indian scenario. 3.2 Population and environment–reasons for over exploitation of resources–population–demography – population curves – population explosion – effects – consumerism – effects – urbanization – reasons and effects – role of an individual.

UNIT-IV	ENVIRONMENT POLLUTION	9 Hours

4.1 Pollution–definition–types–air pollution –causes and effects–effects of CO2–CO – NOx – SOx –particulates–control of air pollution–water pollution–causes–effects–remedies–soil pollution– solid waste management – e-waste – ill effects of e-waste – proper recycling – Noise pollution – reasons–effects – control – nuclear pollution – cases – effects and control –thermal pollution causes – effects and remedies. 4.2 Legal provisions for protecting environment – article 48 A – 51 A (g) – Environment act1986 – Air act 1981 – Water act 1974 – wild life protection act – Forest act 1980 - problems in implementation–reasons.

UNIT-V	SOCIAL ISSUES AND ENVIRONMENTAL ETHICS	9 Hours

Present environmental scenario – green house effect – climate change–The Kyoto Protocol–ozone layer depletion- The Montreal Protocol-acid rain–causes–effects-disparity among the nations– The Copenhagen UNFCCC summit – carbon currency- virtual water- genetically modified organisms, Disaster management. 5.2 Environmental ethics–introduction–people getting affected-resettlement and rehabilitation – issues involved –Sardhar Sarovar project – Tawa Matsya sang - Melting icebergs of Arctic.

	Total Hours	45 Hours

Text Book(s)

1. Anubha Kaushik and C.P. Kaushik, ”Prospects of Environmental Science”, New Age

	International publishers, 2019.
Reference Book(s)	
1.	Environmental Studies, N.Nandini, N. Sunitha and SucharitaTandon, Sapna Book House, 2019.
2.	Text book of Environmental Science, Ragavan Nambiar, Scitech Publications,2010.
3.	Text book of Environmental Chemistry and Pollution Control, S.S.Dara, S.Chandand Co., 7th Edition.
4.	Environmental Chemistry, Colin Baird, W.H.Freemanand company, NewYork, 4th Edition, 2008.
5.	Environmental Chemistry, Gary W.VanLoon and StephenJ. Duffy, Oxford University Press, 9th Edition 2017.
6.	New Trends in Green Chemistry, V.K. Ahluwalia and M. Kidwai, Anamaya Publishers, 1st Edition2012.

Course Code	CESME18P50	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ENGINEERING GRAPHICS AND DESIGN**	1	0	2	3	40	60	100
Course Category	BASIC SCIENCE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. To develop in students, graphic skills for communication of concepts, ideas and design of engineeringproducts.
2. To expose them to existing national standards related to technical drawings.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Draw orthographic projections of lines, planes and solids.	**K3**
CO2	Draw projections of solids including cylinder, prism andpyramid.	**K3**
CO3	Draw section of solids including cylinder, prisms andpyramids.	**K3**
CO4	Draw the development of surfaces including cylinder, Pyramid and prism.	**K4**
CO5	Draw projection of lines, planes, solids, orthographic, projection, Isometric projection, and section of solids including cylinder, cone, prism, pyramid and building drawing using AutoCAD.	**K6**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	S	S	M	M	-	M	M	M	L	-	-	-
CO2	S	S	S	S	S	M	M	-	M	M	M	L	-	-	-
CO3	S	S	S	S	S	M	M	-	M	L	M	L	-	-	-
CO4	S	S	S	S	S	M	M	-	M	M	M	L	-	-	-
CO5	S	S	S	S	S	L	M	-	M	L	M	L	-	-	-

Traditional Engineering Graphics:

Principles of engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing

Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing;. Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.
Computer Graphics:
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling; Introduction to Building Information Modeling (BIM). ***(Except the basic essential concepts, most of the teaching part can happen Concurrently in the laboratory)***
Module 1: Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloids, Hypocycloid and In volute; Scales – Plain, Diagonal and Vernier Scales
Module 2: Orthographic Projections covering**,** Principles of Orthographic Projections- Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes
Module 3: Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.
Module 4:Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone - Auxiliary Views; Development of surfaces of Right Regular Solids, Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)
Module 5: Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.
Module 6: Overview of Computer Graphics covering, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]
Module 7: Customization & CAD Drawing consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles
Module 8: Annotations, layering & other functions covering applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing

sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multi view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerance techniques; dimensioning and scale multi views of dwelling
Module 9: Demonstration of a simple team design project that illustrates Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying color coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modeling (BIM).

Total Hours	**45 Hours**

Text Book(s)

1.	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House.
2.	Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education.
3.	Agrawal B. & Agrawal C. M. (2012), Engineering Graphics: TMH Publication.
4.	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, SciTech Publishers.

Course Code	CBSCH18P60	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**CHEMISTRY LAB**	0	0	3	2	40	60	100
Course Category	BASIC SCIENCE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students

1. To learn the basics and perform experiments involving volumetric analysis, colligative properties, simple synthesis and other instrumental technique.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Estimate rate constants of reactions from concentration of reactants/products as afunction of time .	**K5**
CO2	Measure molecular/system properties such as surface tension, viscosity, Conductance ofsolutions, redox potentials, chloride content of water.	**K4**
CO3	Synthesize a small drug molecule.	**K4**
CO4	Analyze a salt sample.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	S	S	M	M	-	M	M	M	M	-	-	-
CO2	S	S	S	S	M	M	M	-	M	M	M	-	-	-	-
CO3	M	M	M	S	M	M	M	-	M	M	M	-	-	-	-
CO4	S	S	S	S	S	M	M	-	M	M	M	-	-	-	-

LIST OF EXPERIMENTS

1. Determination of surface tension and viscosity of a liquid or a solution
2. Thin layer chromatography / Paper chromatography for separation of a mixture.
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water by volumetry.
5. Determination of M.wt of a non-volatile solute by Rast's method.
6. Determination of the rate constant of the reaction between $K_2S_2O_8$ and KI – Clock reaction method.
7. Conductometry -Verification of Debye-Huckel-Onsager equation for a strong electrolyte.

8. Potentiometry -Determination of formal redox potential of Fe^{3+}/Fe^{2+} couple
9. Synthesis of Nylon 66 by interfacial polymerization method.
10. Determination of Saponification/acid value of oil.
11. Systematic qualitative analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces – computational experiment.
14. Chemical oscillations- Potentiometric study of the oscillations of Belousov-Zhabotinskyreaction
15. Determination of the partition coefficient of I_2 between water and CCl_4
16. Verification of Freundlich isotherm for adsorption of acetic acid / oxalic acid by charcoal.
17. Determination of iso electric point of Gelatin sols by using capillary viscosmeter.

Total Hours	**45 Hours**

Text Book(s)

1.	Advanced Practical Physical Chemistry, J.B.Yadhav, Krishna Prakasan Media, 2016.
2.	Experiments in Applied Chemistry, Sunita Rattan, S.K. Kataria & Sons, 2012.

Course Code	CESEE18P70	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**BASIC ELECTRICAL ENGINEERING LAB**	0	0	3	2	40	60	100
Course Category	ENGINEERING SCIENCE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. This course equips students to have basic knowledge and understanding in solving algebraic,transcendental equation numerically.
2. To make the student knowledge able in the area of matrix theory so that he /she will be familiar in Matlab applications.
3. To familiarize the student with functions of several variables. This is needed in many branches ofengineering.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Obtain load characteristics of Single Phase Induction Motor, Three Phase Induction Motor, Single Phase Transformer and Three Phase Alternator.	**K3**
CO2	Obtain Speed Control of DC Motor, Three Phase Induction Motor (Pole Changing Method).	**K3**
CO3	To demonstrate the working of Multi meter, CRO and LCR Meter and Measurement of Voltage, Current and Power.	**K3**
CO4	To Verify experimentally Kirchhoff's Law and Thevenin's Theorem.	**K3**
CO5	Obtain the B - H Curve of a Magnetic Material.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	M	M	M	M	M	-	-	S	M	-	L	-	-	-
CO2	S	S	M	M	S	M	L	-	S	S	-	M	-	-	-
CO3	S	S	M	M	S	M	L	-	S	M	L	M	-	-	-
CO4	S	S	S	S	M	M	L	L	M	M	-	S	-	-	-
CO5	M	M	M	S	M	M	L	-	M	M	-	M	-	-	-

	List of Experiments	
	1. Study of Electric Motors (AC & DC Motors) 2. Load Test on Single Phase Induction Motor 3. Load Test on Three Phase Induction Motor 4. Load Test on Single Phase Transformer 5. Load Test on Three Phase Alternator 6. Speed Control of DC Motor 7. Speed Control of Three Phase Induction Motor (Pole Changing Method) 8. Study of Multi meter, CRO and LCR Meter 9. Measurement of Voltage, Current and Power. 10. Verification of Kirchoff's Law 11. Verification of Thevenin's Theorem 12. B·H Curve of a Magnetic Material 13. Rectifier Circuit Analysis (AC – DC) 14. Inverter Circuit Analysis (DC – AC) 15. Chopper Circuit Analysis (DC – DC) 16. Series and Parallel RLC Circuit Analysis	
	Total Hours	**45 Hours**

Course Code	BECF183T10	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**MATHEMATICS III (PROBABILITY AND STATISTICS)**	3	1	0	4	40	60	100
Course Category	BASIC SCIENCE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	Collection of data, Counting Techniques**,** Permutation and combination							

Course Objectives:

The course should enable the students

1. To give the basic knowledge about the probability and random variables.
2. Understand about the discrete and continuous distributions
3. To find the measures of basic statistics like central tendency, dispersion, correlation and regression.
4. To fit the different types of curves for the given set of tabular values.
5. Distinguish between the parametric and non-parametric tests.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Basic probability axioms and rules and the moments of discrete and continuous random variables.	**K1**
CO2	Derive probability function of transformations of random variables and use these techniques to generate data from various distributions.	**K3**
CO3	Calculate and apply measures of location and measures of dispersion in grouped and un grouped data cases.	**K3**
CO4	Test Hypothesis and calculate confidence interval for apopulation parameter for single sample and two sample cases.	**K4**
CO5	Translate real-world problems into probability models and to collect data, analyze and deduce information from a real time survey.	**K5**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO 3**
CO1	S	S	S	S	M	M	M	-	M	M	M	M	M	-	S
CO2	S	S	S	S	M	M	M	-	M	M	M	M	M	-	S

CO3	S	S	S	S	M	M	M	-	M	M	M	L	L	-	S
CO4	S	S	S	S	M	M	M	-	M	M	M	L	L	-	S
CO5	S	S	S	S	M	M	M	-	M	M	M	L	M	M	S

UNIT-I	**BASIC PROBABILITY**	**12 Hours**
Probability spaces, conditional probability, Independent random variables, sums of independent random variables, Bayes' Theorem, Discrete and Continuous one dimensional random variables - Expectations, Moments, Variance of a sum, Moment generating function, Tchebyshev's Inequality.		

UNIT-II	**PROBABILITY DISTRIBUTIONS**	**12 Hours**
Discrete Distributions – Binomial, Poisson and Negative Binomial distributions, Continuous Distributions - Normal, Exponential and Gamma distributions.		

UNIT-III	**BASIC STATISTICS**	**12 Hours**
Measures of Central tendency: Averages, mean, median, mode, Measures of dispersion – Range, Mean deviation, Quartile deviation and Standard deviation, Moments, skewness and Kurtosis, Correlation and regression – Rank correlation.		

UNIT-IV	**APPLIED STATISTICS**	**12 Hours**
Curve fitting by the method of least squares- fitting of straight lines, second degree parabolasand more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.		

UNIT-V	**SMALL SAMPLES**	**12 Hours**
Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.		

	Total Hours	**60 Hours**

Text Book(s)

1.	T. Veerarajan, Probability, Statistics and Random Processes, Third edition, Tata McGraw-Hill, NewDelhi, 2010.
2	S.P. Gupta, Statistical Methods, 31st edition, Sultan chand and sons, New Delhi, 2002.

Reference Book(s)

1.	Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2.	S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
3	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
4	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2010.

Course Code	BECF183T30	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ELECTRONIC DEVICES**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic Electrical Engineering							

Course Objectives:

The course should enable the students:

1. To know about semiconductor materials and their types.
2. To design and construct diode circuits.
3. To learn fundamentals of transistor and its variants.
4. To study frequency response of amplifiers under small signal conditions.
5. To understand construction and characteristics of JFET and MOSFET.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Characterize the types of semiconductors.	**K1**
CO2	Design and construct circuits using various diodes.	**K2**
CO3	Design and construct circuits using BJT.	**K2**
CO4	Design and construct transistor amplifiers using h-parameters.	**K4**
CO5	Understand the characteristics of JFET and MOSFET.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	-	-	-	-	-	-	-	-	-	L	-	-	-
CO2	S	S	S	M	-	-	-	-	-	-	-	L	L	-	S
CO3	S	S	-	L	-	-	-	-	-	-	-	L	M	-	S
CO4	S	S	S	M	-	-	-	-	-	-	-	L	M	M	S
CO5	S	S	-	-	-	-	-	-	-	-	-	L	-	-	S

UNIT-I	**SEMICONDUCTOR MATERIALS**	**9 Hours**

Elemental & compound semiconductor materials , Bonding forces and Energy bands in intrinsic and extrinsic silicon, Charge carrier in semiconductors , carrier concentration, Junction properties, Equilibrium condition, biased junction, Steady state condition, breakdown mechanism (Rectifying Diodes, Zener Diodes), Metal Semiconductor Junction. Special diodes: Tunnel diodes, Varactor diodes, Schottky diode, Photo diodes, Photo detector, LED, Solar cell.

UNIT-II	**DIODE CIRCUITS**	**9 Hours**
Ideal and Practical diode, Clipper, Clamper. Power Supply: Rectifiers-Half wave, Full wave, Bridge rectifier, filter circuits, Voltage regulation using shunt & series regulator circuits, Voltage regulation using IC 723		
UNIT-III	**FUNDAMENTALS OF BJT**	**9 Hours**
Construction, basic operation, current components and equations, CB, CE and CC configuration, input and output characteristics, Early effect, Region of operations: active, cut-off and saturation region. BJT as an amplifier and switch - Photo transistor, Uni-junction Transistor (UJT) and Thyristors: UJT: Principle of operation, characteristics, UJT relaxation oscillator.		
UNIT-IV	**SMALL SIGNAL ANALYSIS**	**9 Hours**
Small signal Amplifier, Amplifier Bandwidth, Hybrid model, analysis of transistor amplifier using h-parameter, Multistage Amplifier: Cascading amplifier, Boot-strapping Technique, Darlington amplifier and Cascode amplifier, Coupling methods in multistage amplifier, Low and high frequency response, Hybrid π model, Current Mirror circuits.		
UNIT-V	**FET CONSTRUCTION**	**9 Hours**
JFET Construction, n-channel and p-channel, transfer and drain characteristics, parameters, Equivalent model and voltage gain, analysis of FET in CG, CS and CD configuration. Enhancement and Depletion MOSFET drain and transfer Characteristics. **Integrated Circuit Fabrication Process:** oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Donald .A. Neamen, Electronic Circuit Analysis and Design –2 nd Edition, Tata Mc Graw Hill, 2009.

Reference Book(s)

1.	Salivahanan, Kumar & Vallavaraj, “Electronic Devices and Circuits”, TMH, 2016.
2.	Theodore F. Bogart, Jeffrey S. Beasley, “Guillermo Rico Electronic Devices & Circuits”, PHI, 2014.
3.	Millman & Halkias, “Electronic Devices and Circuits”, TMH, 2013.

Course Code	BECF183T40	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**DIGITAL SYSTEM DESIGN**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic electronics, Boolean algebra and Number systems.							

Course Objectives:

The course should enable the students -

1. To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions.
2. To introduce the methods for simplifying Boolean expressions.
3. To outline the formal procedures for the analysis and design of combinational circuits and Sequential circuits.
4. To introduce the concept of memories and programmable logic devices.
5. To illustrate the concept of synchronous and asynchronous sequential circuits.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Explain the basic theorems and properties of Boolean algebra .	**K3**
CO2	Utilize K- Map for gate level minimization of the given Boolean function.	**K5**
CO3	Construct combinational logic circuits for the given requirement and determine their performance.	**K5**
CO4	Illustrate the Classifications of memories and programmable logic devices.	**K6**
CO5	Design synchronous and asynchronous sequential circuits using VERILOG.	**K6**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	M	-	-	-	-	-	-	-	L	S	-	S
CO2	S	S	S	S	M	-	-	-	-	-	-	M	M	-	S
CO3	S	S	S	S	S	-	-	-	-	-	-	L	S	-	S
CO4	S	S	S	S	M	-	-	-	-	-	-	-	L	M	S
CO5	S	S	S	S	S	-	-	-	-	-	-	-	M	M	S

UNIT-I	**MINIMIZATION TECHNIQUES AND LOGIC GATES**	**9 Hours**
Minimization Techniques: Boolean postulates and laws – De-Morgan's Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions — Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don't care conditions –Quine- McCluskey method of minimization. Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR Implementations of Logic Functions using gates, NAND –NOR implementations – Multilevel gate implementations- Multi output gate implementations. TTL and CMOS Logic and their characteristics – Tristate gates.		
UNIT-II	**COMBINATIONAL CIRCUITS**	**9 Hours**
Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer - decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.		
UNIT-III	**SEQUENTIAL CIRCUITS**	**9 Hours**
Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation – Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – serial adder/subtractor Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Design of Synchronous counters: state diagram- State table –State minimization –State assignment -Excitation table and maps-Circuit implementation - Modulo–n counter, Registers – shift registers - Universal shift registers – Shift register counters – Ring counter – Shift counters - Sequence generators.		
UNIT-IV	**MEMORY DEVICES**	**9 Hours**
Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM – EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle - Timing wave forms – Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell –Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL		
UNIT-V	**SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS**	**9 Hours**
Synchronous Sequential Circuits**:** General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits Asynchronous Sequential Circuits**:** Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits – Design of		

Hazard Free Switching circuits. Design of Combinational and Sequential circuits using VERILOG	
Total Hours	**45 Hours**
Text Book(s)	
1.	M. Morris Mano, "Digital Design", 4e, Prentice Hall of India Pvt. Ltd.,2008/ PearsonEducation (Singapore) Pvt. Ltd., New Delhi, 2003.
Reference Book(s)	
1.	John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008.
2.	John Yarb rough, "Digital Logic Applications and Design", Thomson Learning, 2006 .
3.	Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
4.	Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.
5.	Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
6.	Donald D.Givone, "Digital Principles and Design", TMH, 2003.
7.	A.Ananda Kumar, Fundamentals of digital circuits, second edition, PHI learning private limited, 2009.

Course Code	BECF183T50	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**SIGNALS AND SYSTEMS**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	CBSMAF8T10 - Mathematics – II							

Course Objectives:

The course should enable the students -

1. To understand the properties and representation of discrete and continuous signals.
2. To analyze continuous time signals and system in the Fourier and Laplace domain.
3. To analyze discrete time signals and system in the Fourier and Z transform domain.
4. To development of the mathematical skills to solve problems involving convolution, filtering, modulation and sampling.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand and classify systems based on the impulse response behavior of both continuous-time and discrete-time systems.	**K2**
CO2	Analyze and Evaluate the mathematical modeling of various signals and systems.	**K4**
CO3	Analyze the Continuous time signals using Fourier series and Fourier Transforms.	**K3**
CO4	Examine the Continuous time LTI systems using Fourier series and Fourier Transforms.	**K5**
CO5	Analyze sampling process and sampling of discrete time signals.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	S	-	-	S	-	-	-	-	-	-	L	M	-	S
CO2	S	S	-	S	-	-	-	-	-	-	-	L	M	-	S
CO3	S	S	-	M	-	-	-	-	-	-	-	L	L	-	S
CO4	S	S	S	-	-	-	-	-	-	-	-	L	L	-	S
CO5	S	S	-	M	-	-	-	-	-	-	-	L	M	M	S

UNIT-I	**CLASSIFICATION OF SIGNALS AND SYSTEMS**	**9 Hours**

Continuous Time Signals(CT signals) , Discrete time signals (DT signals) step, ramp, pulse, impulse, exponential, Classification of CT and DT signals - periodic, aperiodic, random signals - CT systems and DT systems, Basic properties of systems - Linear Time invariant systems and properties.		
UNIT-II	**ANALYSIS OF CONTINUOUS TIME SIGNALS**	**9 Hours**
Fourier Series Analysis- Representation of periodic signals in trigonometric and exponential form, Spectrum of CT signals-Fourier Transform and Laplace Transform in signal analysis.		
UNIT-III	**LINEAR TIME INVARIANT – CONTINUOUS TIME SYSTEMS**	**9 Hours**
Differential Equation - Block diagram Representation, Impulse response, Convolution Integral-Frequency response, Fourier and Laplace Transforms in analysis, State variable equations and Matrix representation of systems.		
UNIT-IV	**ANALYSIS OF DISCRETE TIME SYSTEMS**	**9 Hours**
Sampling of CT signals and aliasing, DTFT and properties, Z-transform and properties of Z transform.		
UNIT-V	**LINEAR TIME INVARIANT – DISCRETE TIME SYSTEMS**	**9 Hours**
Difference equations, Block Diagram representation, Impulse response, Convolution sum, LTI systems analysis using DTFT and Z-transforms, State variable equations and matrix representation of systems.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	P.Ramesh Babu & R.Anandanatarajan, signals and systems, 4th edition, Scitech Publication private limited, 2009.
2.	Allam V. Oppenheim, S.Wilsky and S.H.Nawab, Signals and systems, Pearson Education, 2007.
Reference Book(s)	
1.	Robert A.Gabel and Richard A.Roberts, Signals & Linear Systems, John Wiley & Sons 2004.
2.	Simon Haykins and Barry Van Veen, Signals and Systems, John Wiley & Sons, 2004.

Course Code	BECF183T60	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**NETWORK THEORY**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite	Mathematics - II, Basic Electronics							

Course Objectives:

The course should enable the students

1. To create circuits involving different active and passive elements.
2. To analyze the behavior of the circuit's response in time domain.
3. To analyze the behavior of the circuit's response in frequency domain.
4. To interpret the significance of network function.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Analyze the behavior of different circuits and their response using various circuit analysis tools.	**K4**
CO2	Apply the knowledge of basic circuit law to simplify the networks using network theorems.	**K3**
CO3	Apply and analyze the circuits in time domain and frequency domain.	**K4**
CO4	Understand basic concepts regarding the system definition mathematically and associated network function.	**K2**
CO5	Interpret the concept of Network synthesis.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	M	-	-	-	-	-	-	-	L	M	L	M
CO2	S	S	M	M	-	-	-	-	-	-	-	L	S	L	M
CO3	S	S	M	M	-	-	-	-	-	-	-	L	S	L	M
CO4	S	S	M	M	-	-	-	-	-	-	-	L	S	L	M
CO5	S	S	M	M	-	-	-	-	-	-	-	L	S	L	M

UNIT-I	**NETWORK ANALYSIS**	**9 Hours**

Mesh analysis (DC and AC circuits)-super mesh analysis-nodal analysis (DC and AC circuits) - super nodal analysis- source transformation technique-duals and duality –Wye-deltatransformations.

UNIT-II	**NETWORK THEOREM**	**9 Hours**
Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power Transfer theorem, reciprocity theorem, compensation theorem, Millman's Theorem and Tallegen's theorem as applied to DC and AC Circuits.		
UNIT-III	**TWO PORT NETWORKS AND FILTERS DESIGN**	**9 Hours**
Z parameter, Y parameter, h parameter, ABCD parameter, g parameter, Inter relationship of different parameters-inter connection of two port networks-classification of filters-constant k low pass and high pass filters-m-derived low pass and high pass filters-band pass filter-bandelimination filter.		
UNIT-IV	**TRANSIENT AND S-DOMAIN ANALYSIS**	**9 Hours**
Steady state and transient response-DC response of an R-L,R-C and R-L-C circuit-sinusoidal response of R-L,R-C and R-L-C circuit-concept of complex of frequency-poles and zeros of network function-significance of poles and zeros-properties of driving point and transfer function.		
UNIT-V	**NETWORK SYNTHESIS**	**9 Hours**
Hurwitz polynomial-positive real function, frequency response of reactive one port-synthesis of reactive one port by Foster's Method & Cauer method- synthesis of R-L Network by Foster's Method & Cauer method- synthesis of R-C Network by Foster's Method & Cauer method.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Sudhakar, A., Shyammohan, S. P.; "Circuits and Network"; Tata McGraw-Hill New Delhi, 2000.

Reference Book(s)

1.	A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education, 2004.
2.	Van Valkenburg,"Network analysis", Prentice hall of India, 2000.
3.	Edminister J.A., "Theory and Problems of Electric Circuits", Schaum's outline series McGraw HillBook Company, 2nd Edition, 2000.
4.	Hyatt W.H. and Kemmerly, "Engineering Circuits Analysis", McGraw- Hill International Editions,1993.

Course Code	BECF183T20	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**OBJECT ORIENTED PROGRAMMING**	2	1	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic Knowledge on C Programming							

Course Objectives:

The course should enable the students

1. To understand the concept of OOP as well as the purpose and usage principles of Inheritance, polymorphism, encapsulation and method overloading.
2. To identify classes, objects, members of a class and the relationships among them needed for a specific problem.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Specify simple abstract data types and design implement at ions, using abstraction functions to document them.	**K2**
CO2	Recognize features of object -oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.	**K2**
CO3	Name and apply some common object-oriented design patterns and give examples of their use.	**K3**
CO4	Develop applications using OOPs Concept.	**K3**
CO5	Encapsulation of data in virtual functions.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O 1**	**PS O2**	**PS O3**
CO1	S	S	-	-	-	S	-	-	-	-	-	-	-	L	M
CO2	L	M	-	S	-	-	S	-	-	-	M	-	-	-	M
CO3	L	-	-	-	-	-	-	S	-	L	-	M	-	L	M
CO4	-	-	-	-	-	-	-	-	S	-	-	-	-	L	M
CO5	-	-	-	M	S	-	-	-	-	-	-	-	-	L	M

UNIT-I	**NEED FOR OBJECT ORIENTED PROGRAMMING**	**9 Hours**

Characteristics of object oriented language - objects, classes, Inheritance, Reusability, creating new data types, Polymorphism and overloading. C++ programming basis – Data types, Manipulators, Cin, Cout, Type conversion, arithmetic operators, Loops and decisions.		
UNIT-II	**CLASS AND OBJECTS**	**9 Hours**
A simple class, C++ Objects as physical Objects, C++ Objects as Data Types, Constructors, destructors, objects as function arguments, overloaded constructors, member functions defined outside the class, inline functions, and Returning objects from Functions.		
UNIT-III	**ARRAYS**	**9 Hours**
Defining & accessing Array elements, arrays as class member data, array of Objects. Operator Overloading: Overloading Unary Operators, Operator Arguments, Return Values, nameless Temporary objects, postfix notations. Overloading Binary Operators - Arithmetic operators, Concatenating Strings, Multiple overloading Comparison operators, Arithmetic Assignment Operators.		
UNIT-IV	**INHERITANCE-DERIVED CLASS AND BASE CLASS**	**9 Hours**
Derived class constructors, overriding member functions, Class Hierarchies, Abstract base class, Public and private inheritance, Levels of inheritance, Multiple inheritance. Memory management – new and delete operator, a string class using new, Pointers to Objects –Referring to Members, another Approach to new, An array of pointers to Objects.		
UNIT-V	**VIRTUAL FUNCTIONS**	**9 Hours**
Virtual function, Late Binding, Abstract Classes, Pure virtual functions, Friend Functions–, Friends for functional Notation. Friend Classes -Static Functions, investigating destructors. Assignment and copy–initialization-overloading the assignment operator, the copy constructor ,this pointer. Templates, function template, class template.		
	Total Hours	**45 Hours**
Text Book(s)		
1.	Object Oriented Programming in Microsoft C++ - Robert Lafore, Galgotia Publications 1998.	
2.	Let us C++ - Yaswant Kanitkar, 2000.	
Reference Book(s)		
1.	Object Oriented Programming in C++ - C. Balagurusamy, Tata McGraw Hill, 2002.	

Course Code	BECF183P80	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ELECTRONIC DEVICES LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. To understand various tools used for designing circuits.
2. To analyze the characteristics of Semiconductor devices.
3. To construct semiconductor devices for practical applications.
4. To design of amplifiers and analyze their characteristics.
5. To analyze the frequency response characteristics of small signal amplifier.
6. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Construct and evaluate the Performance characteristics of various semiconductor device.	**K2**
CO2	Integrate the semiconductor devices for Practical Application.	**K3**
CO3	Design amplifier circuit and analyze the design of frequency response of the small Signal Amplifier.	**K3**
CO4	Design various circuits using software tools and integrate and compare the findings in hardware implementation.	**K4**
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

	LIST OF EXPERIMENTS	

1. Study of Labview/Multisim/PSPICE/ELVIS
2. CRO Operation and its Measurements.
3. P-N Junction Diode Characteristics (Forward bias & Reverse bias)
4. Zener Diode Characteristics
    a. PartA: V-I Characteristics
    b. PartB: Zener Diode act as a Voltage Regulator
5. BJT Characteristics (CE Configuration)
    a. PartA: Input Characteristics
    b. PartB: Output Characteristics
6. FET Characteristics (CS Configuration)
    a. PartA: Drain (Output) Characteristics
    b. PartB: Transfer Characteristics
7. LED and PHOTO DIODE Characteristics
8. SCR Characteristics
9. UJT Characteristics
10. Clipper and Clamper Circuits
11. Design and Simulate basic Common Source / Common Gate / Common Drain Amplifier
12. BJT- CE Amplifier
13. FET- CS Amplifier

Total Hours	**45 Hours**

Text Book(s)	
1.	Donald .A. Neamen, Electronic Circuit Analysis and Design –2 nd Edition, Tata Mc Graw Hill, 2009.
2.	R.S.Sedha, “Text book of Applied Electronics”, Second edition, S Chand publishing, 2008.
Reference Book(s)	
1.	R. A. Gayakwad, “Op-Amps And Linear Integrated Circuits”, PHI, 2010.
2.	Schilling & Belove, “Electronic Circuits, Discrete & Integrated”, TMH.2011 .
3.	Boylestad & Neshelsky, “Electronic Devices & Circuits”, PHI.2012 .

Course Code	BECF183P90	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**DIGITAL SYSTEM DESIGN LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students

1. To understand, the logical behaviors of digital circuits.
2. To design combinational circuit.
3. To analyze the operation of logic gates and flip-flops.
4. To Design and Construct Hazard Free digital circuits.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Verify the truth table for logic gates and Flip-flops.	**K2**
CO2	Design and test of combinational Circuits	**K3**
CO3	Design and test of Sequential Circuits.	**K3**
CO4	Design of Hazard Free Switching Devices and integrate high configuration digital circuits.	**K3**
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

	LIST OF EXPERIMENTS	
	1. Study of Multisim and LT spice. 2. Study of Gates & Flip-flops. 3. Half Adder and Full Adder. 4. Encoders and Decoders. 5. Multiplexer and De-multiplexer. 6. Magnitude Comparator (2-Bit) and Code Converter. 7. Synchronous Counters. 8. Ripple Counter and Mod–N Counter. 9. Shift Register–SISO/SIPO/PIPO/PISO 10. Design of Memory Devices 11. Design of Hazard Free Switching circuits. 12. Design of Mealy and Moore Circuits.	
	Total Hours	**45 Hours**

Text Book(s)	
1	M. Morris Mano, "Digital Design", 4th edition , Prentice Hall of India Pvt. Ltd., 2008 .
2	Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.
Reference Book(s)	
1	John Yarb rough, "Digital Logic Applications and Design", Thomson Learning, 2006.
2	Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.

Course Code	BECF183P70	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**OBJECT ORIENTED PROGRAMMING LABORATORY USING C++**	0	0	3	2	40	60	100
Course Category	ENGINEERING SCIENCE COURSE (ESC)	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. To be familiar with C programming
2. To learn how to implement the concepts of object oriented programming.
3. To learn how to implement features of C++.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Design, implement C++ programs and Understand the features of C++ supporting object oriented programming.	**K2**
CO2	Understand the relative merits of C++ as an object oriented programming language.	**K3**
CO3	Understand how to apply the major object oriented concepts to implement class, object, friend function, constructor and overloading.	**K3**
CO4	Creating object based programs in C++ such as inheritance and polymorphism .	**K3**
CO5	Understand advanced features of C++ specifically template, and operator overloading.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

	LIST OF EXPERIMENTS	

1. Illustrate class & objects.
2. To demonstrate the use of Switch –Case statement and to perform arithmetic operations.
3. To demonstrate the use of constructor types and destructor.
4. To demonstrate the use of following
    i. this pointer
    ii. inline functions
5. To enter the records of n number of students and then display them using nested structure.
6. To demonstrate the use of
    i. Unary operator.
    ii. Binary operator.
7. Illustrate operator overloading.
8. To demonstrate the concept of polymorphism applied to the member functions.
9. To demonstrate the use of different types of Inheritance.
10. To demonstrate the use of Demonstration of New & Delete Operator.
11. To demonstrate the Pure Virtual Function.
12. To demonstrate the use of Friend Function.
13. To demonstrate the use of class template.

Total Hours	**45 Hours**

Text Book(s)

1.	Object Oriented Programming in Microsoft C++ - Robert Lafore, Galgotia Publications, 1998.
2.	Let us C++ - Yaswant Kanitkar, 2000.

Reference Book(s)

1.	Object Oriented Programming in C++ - C. Balagurusamy, Tata McGraw Hill, 2002.

SEMESTER - IV

Course Code	CBSMAJ8T10	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**MATHEMATICS - IV (CALCULUS, SPECIAL FUNCTIONS AND DESIGN OF EXPERIMENTS)**	3	1	0	4	40	60	100
Course Category	BASIC SCIENCE COURSES (BSC)	**Syllabus Revision**				V.1.0		
Pre-requisite	Knowledge of Mathematics – I and Mathematics – II							

Course Objectives:

The course should enable the students

1. To understand the homogeneous functions for two variables and its total derivatives.
2. To understand the applications of vector products.
3. To analyze the solutions of a differential equation in terms of series.
4. To know about the special functions and its properties.
5. To investigate the experiments which are in terms of one, two and three factors.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Calculate the maximum and minimum values for functions of two variables and aware about the Lagrange multipliers.	**K3**
CO2	Identify the relation between the line integral, surface integral and volume integral.	**K3**
CO3	Find the series solution for Bessel function.	**K3**
CO4	Find the solutions for various problems by using recurrence relations.	**K3**
CO5	Analyze the various factors and capable to conclude about the decisions.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	M	M	-	-	-	-	-	-	-	-	L	M	S	-
CO2	M	S	L	-	-	-	-	-	-	-	-	L	L	M	S
CO3	S	S	M	-	-	-	-	-	-	-	-	L	M	-	S
CO4	M	L	S	-	-	-	-	-	-	-	-	L	M	S	S
CO5	L	L	L	S	-	-	-	-	-	-	-	L	S	-	S

UNIT-I	**CALCULUS**	**9 Hours**
Homogeneous Functions-Total derivative-Change of variables-Jacobian-Taylor's theorem for function of two variables-Maxima and Minima of functions of two variables-Lagranges method of undermined multipliers.		
UNIT-II	**MULTI VARIABLE CALCULUS**	**9 Hours**
Directional derivatives-Gradient-curl and divergence-Problems on Green-Gauss and Stokes theorems- orthogonal curvilinear coordinates-Simple applications involving cubes, sphere and rectangular parallelepipeds.		
UNIT-III	**SPECIAL FUNCTIONS -I**	**9 Hours**
Validity of series solution - Series solution when x=0 is an ordinary point - Frobenius method(Series solution when x=0 is a regular singularity) - Bessel's equation (Bessel's functions of the first and second kind) - Recurrence formulae for Jn(x) - Expansions for J0 and J1: Value of J1/2 - Generating function for Jn(x) - Equations reducible to Bessel's equation – Orthogonality of Bessel functions.		
UNIT-IV	**SPECIAL FUNCTION-II**	**9 Hours**
Legendre's Equation –Rodrigue's Formula – Legendre Polynomials – Generating Function for $P_n(x)$-Recurrence formula for $P_n(x)$-Orthogonality of Legendre Polynomials–Hermite Polynomials-Recurrence formulae-Rodrigue's formula-Orthogonality of Hermite polynomials.		
UNIT-V	**DESIGN OF EXPERIMENT**	**9 Hours**
Design of experiments – Completely randomized design: Analysis of variance for one factor of classification – Randomized block design: Analysis of variance for two factors of classification – Latin square design.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Grewal B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publishers, New Delhi, 2011.
2.	Gupta S.P, "Statistical Methods", 28th Edition, Sultan Chand and Sons., New Delhi, 1997.

Reference Book(s)

1.	Alan Jeffrey, "Advanced Engineering Mathematics", First Edition, Academic Press, 2001.
2.	Gerald C.F and Wheatley P.O, "Applied Numerical Analysis", Seventh Edition, Addison-Wesley Publishing Company, 2004.
3.	Erwin Kreyszig, "Advanced Engineering Mathematics", Tenth Edition, John Wiley & Sons, 2011.

Course Code	BECF184T20	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ANALOG ELECTRONICS**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	Electronic Devices							

Course Objectives:

The course should enable the students

1. To develop fundamental knowledge about biasing and its various methods.
2. To analyze small signal equivalent circuits using BJT and JFET.
3. To understand methods of constructing feedback amplifiers, oscillators & tuned amplifiers.
4. To understand basic concepts of operational amplifier and its various applications.
5. To know about various analog switches, A/D and D/A convertors.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Determine the configuration and apply the characteristics of diodes and transistors.	**K2**
CO2	Design and construct various types of amplifier circuits.	**K4**
CO3	Design and construct sinusoidal and non-sinusoidal oscillators.	**K4**
CO4	Characterize the functioning of OP-AMP and design application based circuits.	**K3**
CO5	Design and construct ADC and DAC circuits.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	M	-	-	-	-	-	-	-	-	L	M	-	-
CO2	S	S	S	-	-	-	-	-	-	-	-	L	L	L	S
CO3	S	S	M	-	-	-	-	-	-	-	-	L	M	-	S
CO4	S	S	S	-	-	-	-	-	-	-	-	L	M	S	S
CO5	S	S	-	-	-	-	-	-	-	-	-	L	-	-	S

UNIT-I	**AMPLIFIER MODELS**	**9 Hours**

Voltage amplifier, Current amplifier, Trans-conductance amplifier and Trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, Bias stability, Various configurations (CE/CS, CB/CG, CC/CD) and their features, Small signal analysis, Estimation of voltage gain, input resistance, output resistance etc., Low frequency and High frequency transistor models, Design Procedure for particular

specifications, Low frequency analysis of multistage amplifiers.		
UNIT-II	**POWER & FEEDBACK AMPLIFIERS**	**9 Hours**
Frequency response of single stage and multistage amplifiers, Cascode amplifier. Various classes of operation (Class A, B, AB, C), their power efficiency and linearity issues - Feedback Topologies: Voltage series, Current series, Voltage shunt, Current shunt, Effect of feedback on gain and bandwidth, Calculation with practical circuits, Concept of stability, gain margin and phase margin.		
UNIT-III	**OSCILLATORS & DIFFERENTIAL AMPLIFIERS**	**9 Hours**
Review of Basic Concept, Barkhausen criterion, RC oscillators (Phase shift, Wien Bridge), LC oscillators (Hartley, Colpitts, Clapp), Non- sinusoidal oscillators. Current mirror: Basic topology and its variants, V-I characteristics, output resistance, minimum sustainable voltage and maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP-AMP design: Design of differential amplifier for a given specification, Designof gain and output stages, compensation.		
UNIT-IV	**OP-AMP APPLICATIONS**	**9 Hours**
Review of Inverting and Non-inverting amplifiers, Integrator and differentiator, Summing amplifier, Precision rectifier, Schmitt trigger and its applications- Active filters: Low pass, high pass, band pass and band stop, design guidelines.		
UNIT-V	**DAC & ADC**	**9 Hours**
Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, Resistor string. Analog to-digital converters (ADC): Single slope, Dual slope, Successive approximation, Flash type - Switched capacitor circuits: Basic concept, practical configurations, Application in amplifier, integrator, ADC etc.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Paul R. Gray and Robert G.Meyer, "Analysis and Design of Analog Integrated Circuits", JohnWiley, 3rd Edition, 1992.
2	J.V. Wait, L.P. Huelsman and GA Korn, "Introduction to Operational Amplifier theory and applications",McGraw Hill, 1992
Reference Book(s)	
1	A.S. Sedra and K.C. Smith, "Microelectronic Circuits", Oxford University Press, 5th Edition, 2004.
2.	P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 2nd Edition, 1989.
3	J. Millman and A. Grabel, "Microelectronics", McGraw Hill, Second Edition, 1988.

Course Code	BECF184T30	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ANALOG AND DIGITAL COMMUNICATION**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	Electronic Devices, Digital System Design, Signals & Systems							

Course Objectives:

The course should enable the students:

1. To analyze and compare different analog modulation schemes.
2. To analyze the behavior of communication systems in the presence of noise.
3. To investigate pulse modulation systems and analyze their system performance.
4. To analyze different modulation schemes and compute bit error performance.
5. To study demodulation of digital signals.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Compare different analog modulation schemes for their efficiency and bandwidth.	**K2**
CO2	Analyze the behavior of communication systems in the presence of noise.	**K4**
CO3	Investigate pulse modulation systems and analyze their system performance.	**K4**
CO4	Compute bit error performance of various modulation schemes.	**K3**
CO5	Gain knowledge on demodulation of digital signals.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	M	-	-	-	-	-	-	-	L	S	-	-
CO2	S	S	S	M	-	-	-	-	-	-	-	L	M	-	S
CO3	S	S	S	-	-	-	-	-	-	-	-	L	M	-	S
CO4	S	S	S	-	-	-	-	-	-	-	-	L	M	S	S
CO5	S	S	-	-	-	-	-	-	-	-	-	L	-	-	-

UNIT-I	AMPLITUDE AND ANGLE MODULATION	9 Hours
Review of signals and systems-Frequency domain representation of signals - Amplitude modulation systems-DSB-SC, SSB and VSB modulation - Superhetrodyne Receiver - Angle modulation-Representation of FM and PM signals-Relationship between FM and PM-Narrow band and widebandFM-Transmission bandwidth of FM wave- Generation and detection of FM wave.		
UNIT-II	**INFORMATION THEORY AND NOISE**	**9 Hours**
Entropy – Discrete memory less channels – Channel capacity – Hartley Shannon Law – Source Coding theorem – Huffman & Shannon- Fano codes - Noise in amplitude and frequency modulation systems- Pre-emphasis and De-emphasis-White noise – Narrowband noise -Threshold effect in angle modulation.		
UNIT-III	**PULSE MODULATION**	**9 Hours**
Sampling process -Pulse Amplitude Modulation (PAM)-Pulse Position Modulation (PPM)-Quantization Process-Pulse Code Modulation (PCM) - Delta Modulation - Differential Pulse Code Modulation-Line codes-Noise consideration in PCM-Time Division Multiplexing-Digital Multiplexers.		
UNIT-IV	**BASEBAND MODULATION TECHNIQUES**	**9 Hours**
Baseband transmission of digital data-Inter Symbol interference(ISI) problem - Nyquist channel-Binary Amplitude shift keying(ASK)-Phase-Shift Keying(PSK) - Frequency Shift Keying(FSK)-Quadrature Amplitude Modulation(QAM)-Continuous phase modulation and Minimum shift keying-Elements of detection theory-optimum detection of signals in noise-coherent communication with waveform-Probability of error calculation.		
UNIT-V	**DEMODULATION OF DIGITAL SIGNALS**	**9 Hours**
Digital Modulation tradeoffs-optimum demodulation of digital signal over band limited channels-Maximum likelihood sequence detection (Viterbi receiver)-Equalization techniques-Synchronization and carrier recovery of digital modulation.		
	Total Hours	**45 Hours**

Text / Reference Book(s)

1.	Dr.Sanjay Sharma, “Analog and Digital Communication”, SK Kataria & Son’s publication, Seventh Edition, 2017.
2	Haykin.S and Michel Moher,” Introduction to Analog and Digital Communication”, John Wiley, Second Edition, 2012.
3	Taub H and Schilling D.L., “Principles of Communication Systems”, Tata McGraw Hill, 2001.
4	Prokis J.G.,” Digital Communications”, Tata McGraw Hill, Fourth Edition, 2000.

Course Code	BECF184T40	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**MICROPROCESSOR AND MICROCONTROLLERS**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	Electronic Devices, Digital System Design							

Course Objectives:

The course should enable the students

1. To study architecture of 8085 Microprocessor and its instruction set.
2. To study architecture of 8086 Microprocessor and its instruction set.
3. To learn design aspects of I/O and Memory interfacing circuits.
4. To study architecture of 8051 microcontroller and its applications.
5. To know about RSIC processors and design ARM processor based systems.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Execute programs using assembly language of 8085 Microprocessor.	**K3**
CO2	Execute programs using assembly language of 8086 Microprocessor.	**K3**
CO3	Design interfacing circuits using I/O and Memory devices.	**K3**
CO4	Develop systems using different microcontrollers.	**K4**
CO5	Design ARM microcontroller based systems.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	S	S	-	-	-	-	-	-	-	-	L	M	M	-
CO2	S	S	S	-	-	-	-	-	-	-	-	L	M	M	-
CO3	S	S	S	M	-	-	-	-	-	-	-	L	M	L	S
CO4	S	S	S	M	M	-	-	-	-	-	-	L	M	S	S
CO5	S	S	S	-	M	-	-	-	-	-	-	L	-	M	M

UNIT-I	**8085 MICROPROCESSOR**	**9 Hours**

Microprocessor architecture and its operation, memory, I/O devices, 8085 microprocessor – Core architecture - Various registers- Bus Timings, Multiplexing and De-multiplexing of Address Bus, Decoding and Execution, Instruction set – Classification, Instruction Format, Addressing Modes, 8085 Interrupt Process, Hardware and Software Interrupts**.**

UNIT-II	**8086 MICROPROCESSOR**	**9 Hours**

Core Architecture of the 8086 - Memory Segmentation, Minimum mode Operation and Maximum Mode Operation, Instruction Set of the 8086 processor- Classification - Instruction Format Addressing modes, Simple Assembly Language Programs - Arithmetic operations, Data transfer, String Manipulation, Searching and Sorting.		
UNIT-III	**I/O INTERFACING**	**9 Hours**
Memory Interfacing and I/O interfacing - Parallel communication interface – Serial Communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.		
UNIT-IV	**MICROCONTROLLER**	**9 Hours**
Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits – Instruction set- Addressing modes - Assembly language programming - Programming 8051 Timers, Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation.		
UNIT-V	**ADVANCED MICROPROCESSOR & MICROCONTROLLER**	**9 Hours**
Advanced Microprocessor Architectures- 286, 486, Pentium - RISC Processors- RISC Vs CISC, RISC properties and evolution- ARM Processor – CPU: programming input and output supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance- CPU power consumption.		
	Total Hours	**45 Hours**

Text Book(s)	
1	R. S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085/8080A", Penram International Publishing, Third Edition, 1996.
2	D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface" Morgan Kaufman Publishers, Fourth Edition, 2011.
Reference Book(s)	
1	Douglas Hall, "The Microprocessors and its Interfacing", Tata McGraw Hill, Third Edition, 2012.
2	Kenneth J. Ayala, "The 8051 Microcontroller: Architecture Programming & Applications", Penram International Publishing, Second Edition, 1996.

Course Code	BECF186T10	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**CONTROL SYSTEM**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	BECF183T60 – Network Theory							

Course Objectives:

The course should enable the students

1. To introduce the elements of control system and various representations.
2. To provide knowledge on the time response and stability of systems.
3. To introduce the various frequencies response plots and analyzes the stability of systems.
4. To introduce state variable representation of physical systems and study the effect of state feedback.
5. To design various types of compensators.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Compute the transfer function of different physical systems.	**K3**
CO2	Analyze the time domain specifications and calculate the steady state error.	**K4**
CO3	Illustrate the frequency response characteristics of systems.	**K3**
CO4	Analyze the state space model of continuous and discrete systems.	**K4**
CO5	Design compensators that can be used to design control systems with required specifications.	**K5**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	M	-	L	L	L	L	L	L	L	S	L	M
CO2	S	S	S	M	-	M	L	L	L	M	L	M	S	L	M
CO3	S	S	S	M	-	M	L	L	L	L	L	M	M	L	M
CO4	S	S	S	M	-	M	M	L	L	L	L	M	S	L	M
CO5	S	S	S	M	-	M	L	L	L	M	L	M	S	L	M

UNIT-I	**CONTROL SYSTEM MODELING & SYSTEM REPRESENTATION**	**9 Hours**

Basic Elements of Control System – Open loop and Closed loop systems - Differential equation -

Transfer function, Modeling of Electric systems, Translational and Rotational mechanical systems – Transfer function – AC & DC Servomotor and Synchros -Block diagram reduction Techniques - Signal flow graph.		
UNIT-II	**TIME RESPONSE AND STABILITY ANALYSIS**	**9 Hours**
Time response analysis - First Order Systems - Impulse and Step Response analysis of Second order systems - Steady state errors- Concepts of Stability-Routh-Hurwitz Criterion-Root Locus Technique-Application of Root Locus Diagram- Relative Stability.		
UNIT-III	**FREQUENCY RESPONSE AND STABILITY ANALYSIS**	**9 Hours**
Frequency response – Frequency domain specifications - Correlation between frequency domain and time domain specifications – Stability analysis - Bode plot – Polar plot - Nyquist Stability criterion.		
UNIT-IV	**STATE VARIABLE ANALYSIS**	**9 Hours**
State space representation of Continuous Time systems – State equations – Transfer function from State Variable Representation – Solutions of the state equations - Concepts of Controllability and Observability.		
UNIT-V	**COMPENSATOR DESIGN**	**9 Hours**
Compensators - Effect of adding poles and zeros - Lag, lead and lag-lead compensators design using Bode plot – Design of State feedback controller - P, PI, PD and PID Controller.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Nagarath I.J. and Gopal M., "Control Systems Engineering", New Age International Publishers,2017.
2.	Norman S Nise, "Control Systems Engineering", 7th Edition, Wiley, 2015.
3.	Benjamin C. Kuo, "Automatic Control systems", Wiley, 2014.
Reference Book(s)	
1.	M. Gopal, "Control Systems, Principles and Design", 4th Edition, Tata McGraw Hill, New Delhi,2012.
2.	S.K.Bhattacharya, "Control System Engineering", 3rd Edition, Pearson, 2013.
3.	Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Prentice Hall, 2012.
4.	K. Ogata, "Modern Control Engineering", 5th edition, PHI, 2012.
5.	NPTEL Online Courses on "Control Engineering" and "Digital Control Systems".

Course Code	BECF184T60	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ELECTROMAGNETIC FIELDS AND WAVEGUIDES**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite	Physics and Mathematics							

Course Objectives:
The course should enable the students
1. To study the basics of Electromagnetic.
2. To understand the propagation and polarization of Electromagnetic waves.
3. To analyze wave propagation in Transmission Lines and its applications.
4. To analyze wave propagation in metallic waveguides.
5. To know the radiation characteristics of an antenna.

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

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Gain knowledge on basics of Electro- magnetic.	**K1**
CO2	Understand the propagation of Electromagnetic Waves.	**K2**
CO3	Determine the characteristics and wave propagation on transmission lines.	**K3**
CO4	Analyze wave propagation on metallic waveguides .	**K4**
CO5	Determine the radiation and radiation characteristics of an antenna.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	-	-	-	-	-	-	-	-	L	S	-	-
CO2	S	S	S	-	-	-	-	-	-	-	-	L	-	-	S
CO3	S	S	S	-	-	-	-	-	-	-	-	L	M	-	S
CO4	S	S	S	-	-	-	-	-	-	-	-	L	M	S	S
CO5	S	S	S	-	-	-	-	-	-	-	-	L	M	S	-

UNIT-I	**BASICS OF ELECTROMAGNETICS**	**9 Hours**

Vector algebra-Coordinate Systems-Vector differential operator-Gradient-Divergence-Curl-Divergence Theorem-Stokes theorem-Coulombs law-Electric field intensity-Electric flux density-Gauss law and its applications-Biot Savart Law-Ampere's law-Faradays law- Maxwell's Equations in Integral and differential form-Electric and magnetic boundary conditions at the media interface.

UNIT-II	**ELECTROMAGNETIC WAVES**	**9 Hours**

Uniform Plane Waves-Uniform plane wave propagation-Wave propagation in conducting medium-Wave Polarization-Reflection by perfect conductor (normal and oblique incidence)- Reflection by perfect insulator(normal and oblique incidence)-plane waves in arbitrary direction-Brewster angles-Total internal reflection-poynting vector and power flow-Power loss in plane conductor.		
UNIT-III	**TRANSMISSION LINES**	**9 Hours**
Equations of Voltage and Current on TX line- Propagation constant-characteristic impedance-reflection phenomenon-standing waves-Input impedance of dissipation less transmission line-open and short circuited line-power and impedance measurement on TX line-λ/8,λ/4&λ/2 line-λ/4 impedance transformer- Smith chart and its applications-single and double stub matching.		
UNIT-IV	**GUIDED WAVES AND WAVE GUIDES**	**9 Hours**
Waves between parallel planes-TE waves-TM waves-Characteristic of TE and TM waves-TEM waves-Velocities of propagation-Attenuation in parallel plane Guides-Rectangular wave guide-TEand TM waves in rectangular waveguide-Impossibility of TEM wave in rectangular wave guide.		
UNIT-V	**RADIATION**	**9 Hours**
Solution for potential functions-Radiation from oscillating dipole -Power radiated by oscillating dipole- antenna parameters-Gain- directivity-Effective aperture-Radiation Resistance-Bandwidth-Beam width-Input impedance-Matching Baluns-Monopole and dipole antenna.		
	Total Hours	**45 Hours**

Text Book(s) and Reference Books

1	Sadiku MH,"Principles of Electromagnetics", Oxford University Press Inc, New Delhi, 2009. SecondEdition, Prentice Hall of India, 1968.
2	E.C. Jordan & K.G. Balmain, "Electromagnetic Waves & Radiating Systems",
3	John D Ryder," Network lines and fields", Prentice Hall of India, New Delhi, 2005.
4	David K. Cheng, "Field and Wave Electromagnetics", Second Edition, Prentice Hall of India, 1989.
5	Sandeep Wali," Electromagnetic theory", first edition, Macmillan Publishers Private limited, 2011.

Course Code	BECF184P70	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ANALOG ELECTRONICS LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. To understand the basics of linear integrated circuits and available ICs
2. To understand characteristics of operational amplifier.
3. To apply operational amplifiers in linear and nonlinear applications.
4. To analyze the frequency response characteristics of Amplifiers.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Design oscillators and amplifiers using operational amplifiers.	**K2**
CO2	Design filters using Op-amp and perform experiment on frequency response.	**K2**
CO3	Analyze the working of PLL and use PLL as frequency multiplier.	**K3**
CO4	Analyze the performance of oscillators and Multi-vibrators.	**K3**
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LIST OF EXPERIMENTS

1. Characteristics of Opamp–IC741.
2. Inverting and Non-inverting amplifier using IC741.
3. Measurement of op-amp characteristics.
4. Instrumentation amplifier and Differential Amplifier using IC741.
5. Integrator and Differentiator using IC741.

6. Schmitt Trigger using IC741. 7. ADC/DAC using IC741. 8. Astable & Monostable Multi-vibrator using IC555. 9. RC Phase shift oscillator and Wien bridge oscillator using BJT. 10. Hartley & Colpitts oscillator using BJT. 11. Frequency Response of Class B Push Pull Amplifier using BJT. 12. Frequency Response of Voltage Series Feedback Amplifier using BJT. 13. Phase Locked Loop (PLL).	
Total Hours	**45 Hours**
Text Book(s)	
1	J.V. Wait, L.P. Huelsman & GA Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill, 1992.
2	J. Millman and A. Grabel, "Microelectronics", 2nd edition, McGraw Hill, 1988.
3	P. Horowitz and W. Hill, "The Art of Electronics", 2nd edition, Cambridge University Press, 1989.
Reference Book(s)	
1	A.S. Sedra and K.C. Smith, "Microelectronic Circuits", Oxford University Press, V Edition, 2004.
2	Paul R. Gray and Robert G.Meyer, "Analysis and Design of Analog Integrated Circuits", John Wiley, 3rd Edition, 1992.

Course Code	BECF184P80	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ANALOG AND DIGITAL COMMUNICATION LABORATORY**	0	0	3	2	`40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students

1. To construct basic circuits of Analog communication system.
2. To construct basic circuits of Digital communication system.
3. To Design and construct experiments for performing modulation and sampling.
4. To analyze the Performance characteristics of analog and Digital Communication Systems.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Apply the practical knowledge to construct Analog communication circuits.	**K3**
CO2	Apply the practical knowledge to construct Digital communication circuits.	**K3**
CO3	Evaluate Analog and Digital modulated wave form in time /frequency domain .	**K4**
CO4	Analyze and evaluate the performance of Analog and Digital communication systems.	**K3**
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

	LIST OF EXPERIMENTS	

1. Study of Multisim, VisSim and MATLAB.
2. AM modulator and Demodulator.
3. DSB-SC modulator and Demodulator.
4. SSB modulator and Demodulator.
5. FM modulator and Demodulator.
6. PAM modulator and Demodulator.
7. PPM & PWM Modulator.
8. Pre-emphasis and De-emphasis in FM.
9. Signal Sampling and Reconstruction (Sampling Theorem).
10. Pulse Code Modulation and Demodulation.
11. Delta modulation and Adaptive Delta modulation.
12. Amplitude Shift Keying (ASK) and Frequency Shift Keying (FSK) modulator and Demodulator.
13. Phase Shift keying (PSK) and Binary Phase Shift Keying (BPSK) Modulator and Demodulator.

Total Hours	**45 Hours**

Text Book(s)	
1	Haykin.S and Michel Moher," Introduction to Analog and Digital communication", Second edition, John Wiley and sons Inc, 2012.
2	Prokis J.G.," Digital communications", 4th edition, Tata McGraw Hill, 2000.
Reference Book(s)	
1	Taub H and Schilling D.L., "Principles of Communication systems", Tata McGraw Hill, 2001.
2	Dr.Sanjay Sharma, "Analog and Digital communication", seventh edition, K KATARIA & amp; SON'S publication, 2017.

Course Code	BECF184P90	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**MICROPROCESSOR AND MICROCONTROLLER LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students

1. To study architecture of 8086 microprocessor and perform various arithmetic & logical operations.
2. To learn the design aspects of I/O and Memory Interfacing circuits.
3. To analyze the communication between Peripherals and bus interfacing.
4. To Execute Programs using 8051 Microcontroller.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Design and implement programs on 8086 Microprocessor.	**K3**
CO2	Design I/O circuits and analyze the performance.	**K3**
CO3	Design Memory Interfacing circuits.	**K3**
CO4	Integrate Microprocessor and Microcontroller and Peripherals for Various Applications.	**K5**
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

	LIST OF EXPERIMENTS	

8086 Microprocessor Experiments

1. Basic Arithmetic and Logical operations using 8086.
2. Code conversion, decimal arithmetic and Matrix operations.
3. Floating-point operations, string manipulations, sorting and searching.
4. Counters and Time delay.
5. Password Checking, Print RAM size and System Date.

8086 Microprocessor-Peripherals and Interfacing Experiments

6. Traffic Light Control and Stepper Motor Control.
7. Digital Clock.
8. Keyboard and Display.
9. Serial and Parallel Interface.
10. A/D and D/A Interface and Wave form Generation.

8051 Microcontroller Experiments

11. Basic Arithmetic and Logical Operations.
12. Square program, Cube program and Finding 2's complement of a number.
13. Unpacked BCD to ASCII.

Total Hours	**45 Hours**

Text Book(s)

1.	R. S. Gaonkar, "Microprocessor Architecture: Programming and Applications with the 8085/8080A", Penram International Publishing, Third Edition, 1996.
2.	D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface" Morgan Kaufman Publishers, Fourth Edition, 2011.

Reference Book(s)

1.	Douglas Hall, "The Microprocessors and its Interfacing", Tata McGraw Hill, Third Edition, 2012.
2.	Kenneth J. Ayala, "The 8051 Microcontroller: Architecture Programming & Applications", Penram International Publishing, Second Edition, 1996.

SEMESTER - V

Course Code	BECF185T10	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**MICROWAVE ENGINEERING**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	Electromagnetic Fields and Waveguides (BECF184T60), Network Theory (BECF183T60)							

Course Objectives:
The course should enable the students

1. To inculcate the basics and representation of RF and microwave networks.
2. To instill knowledge on the properties of various microwave components.
3. To deal with the principles of microwave system design.
4. To deal with the microwave measurement techniques.
5. To introduce the application areas of microwave Systems.

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

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Illustrate concepts of propagation and analysis in RF and Microwave networks.	**K2**
CO2	Analyze performance of microwave system components and their properties.	**K2**
CO3	Analyze and synthesis the microwave systems.	**K3**
CO4	Apply the measurements of microwave systems.	**K3**
CO5	Design microwave systems for different practical application.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	L	L	-	L	-	-	-	-	L	L	S	M	L
CO2	S	M	-	L	-	L	-	-	-	-	L	L	S	M	L
CO3	S	S	M	L	-	-	-	-	-	-	L	L	S	M	L
CO4	L	L	M	M	-	L	-	-	-	-	L	L	S	M	L
CO5	L	L	S	L	-	-	-	-	-	-	L	L	S	M	L

UNIT-I	INTRODUCTION TO MICROWAVES	9 Hours
History of microwaves, Microwave frequency bands; Applications of microwaves: Civil and Military, Medical, EMI/ EMC. Mathematical model of microwave transmission-Concept of mode, Features of TEM, TE and TM modes, Losses associated with microwave transmission, Concept of impedance in microwave transmission. Analysis of RF and microwave transmission lines- Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line, Microwave network analysis- Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering parameters, Properties of S parameters.		
UNIT-II	**PASSIVE AND ACTIVE MICROWAVE DEVICES**	**9 Hours**
Microwave passive components: Terminations- Variable short circuit, Attenuator, Phase shifters, Directional coupler, Magic Tee, Power divider, Resonator. Microwave active components and circuits: Diodes, Transistors, Oscillators, Mixers. Microwave semiconductor devices: Gunn diodes, IMPATT diodes, Schottky barrier diodes, PIN diodes. Microwave tubes: Klystron, TWT, Magnetron.		
UNIT-III	**MICROWAVE DESIGN PRINCIPLES**	**9 Hours**
Impedance transformation, Impedance matching, Microwave filter design, RF and Microwave amplifier design, Microwave power amplifier design, Low noise amplifier design, Microwave mixer design, Microwave oscillator design. Microwave antennas- Antenna parameters, Antenna for groundbased systems, Antennas for airborne and satellite borne systems, Planar antennas.		
UNIT-IV	**MICROWAVE MEASUREMENTS**	**9 Hours**
Power, frequency and impedance measurement at microwave frequency, Network analyzer and measurement of scattering parameters, Spectrum analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. Measurement of microwave antenna parameters.		
UNIT-V	**MICROWAVE SYSTEMS**	**9 Hours**
Radar, Terrestrial and Satellite communication, Radio aids to navigation, RFID, GPS. Modern trends in microwaves engineering- Effect of microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic compatibility (EMI & EMC), Monolithic microwave ICs, RFMEMS for microwave components, Microwave imaging.		
	Total Hours	**45 Hours**

Text Book(s)

1.	R.E. Collins, "Foundations for microwave engineering", Second edition, Wiley-IEEE press, 2001 (Units I, II and III).
2.	Annapurna Das and Sisir K Das, “Microwave engineering”, Tata McGraw-Hill Pub.Co. Ltd., 2017. (Units III, IV and V).

Reference Book(s)

1	David M. Pozar, “Microwave engineering,” John Wiley and sons, Fourth edition, 2011.
2	Gupta K.C. and Bahl I.J., “Microwave circuits,” Artech house.

3	Samuel. Y. Liao, “Microwave circuit analysis and amplifier design”, Third edition, Pearson, 2003.
4	Ulrich L. Rohde and David P. Newkirk, “RF / Microwave circuit design for wireless applications”, John Wiley, 2000.
5	Gentili C., “Microwave amplifiers and oscillators”, North oxford academic, 1986.
6	John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and wave propagation”, Fourth edition, Tata McGraw-Hill, 2006.

Course Code	BECF185T20	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**COMPUTER ARCHITECTURE**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	Digital System Design (BECF183T40), Microprocessors & Microcontrollers (BECF184T40)							

Course Objectives:

The course should enable the students -

1. To explain the concepts of structure of computers and instructions.
2. To familiarize with implementation of fixed point and floating-point arithmetic operations.
3. To study the design of data path unit and control unit for processor.
4. To understand the concept of various memories and I/O systems and interfacing.
5. To introduce the parallel processing technique and multi-core processors.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the basics structure of computers and instructions.	**K2**
CO2	Illustrate the fixed point and floating-point arithmetic for ALU operation.	**K2**
CO3	Discuss about implementation schemes of data-path and control units and pipeline performance.	**K2**
CO4	Explain the concept, interfacing and organization of various memories and I/O systems.	**K3**
CO5	Discuss parallel processing technique and unconventional architectures.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	L	S	M	L	S	M	L	-	-	-	L	M	S	L
CO2	S	L	S	L	M	S	M	L	-	-	-	L	M	S	L
CO3	S	L	S	L	M	S	M	L	-	-	-	L	M	S	L
CO4	M	L	M	S	M	M	S	L	-	-	-	L	M	S	L
CO5	M	L	S	M	L	M	S	L	-	-	-	L	M	S	L

UNIT-I	**STRUCTURE OF COMPUTERS AND INSTRUCTIONS**	**9 Hours**

Classification of computers and their characteristics –Functional units- Eight ideas — Performance, Instructions: Operations - Operands – Instruction representation – Logical operations – Decision

making operations – Procedures: Stacks, Ques and Subroutines - Program translation.		
UNIT-II	**ARITHMETIC FOR COMPUTERS**	**8 Hours**
Addition and Subtraction – Multiplication – Division – Floating Point arithmetic Operations – IEEE 754 floating point formats - Sub-word Parallelism.		
UNIT-III	**PROCESSOR DATAPATH AND CONTROL UNITS**	**9 Hours**
Fundamental concepts–Instruction execution –-Multiple bus organization – Data path–Hardwired control-Micro-programmed control, Pipelining – Pipelined data path and control, Data Hazards - Control Hazards – Exception handling.		
UNIT-IV	**MEMORY AND I/O SYSTEMS**	**9 Hours**
Memory Hierarchy – Review of memory technologies – Cache memory – Measuring and improving cache performance – Virtual memory - TLB's. Accessing I/O Devices – Interrupts – Direct Memory Access, Bus structure – Bus operation – Arbitration – Interface circuits - Standard I/O Interfaces – PCI, SCSI and USB.		
UNIT-V	**PARALLELISM**	**10 Hours**
Parallel processing challenges, Flynn's classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures, Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors. Introduction to Multiprocessor Network Topologies.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Fifth Edition, Morgan Kauffman / Elsevier, 2014.
2.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, McGraw Hill, 2012.
Reference Book(s)	
1.	Miles J. Murdocca and Vincent P. Heuring, ―Computer Architecture and Organization: An Integrated approach‖, Second edition, Wiley India Pvt Ltd, 2015.
2.	William Stallings, "Computer Organization and Architecture – Designing for Performance", Eighth Edition, Pearson Education, 2010.
3.	John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill,2012.

Course Code	BECF185T30	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**DIGITAL SIGNAL PROCESSING**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	Signal & Systems (BECF183T50), Digital System Design (BECF183T40), NETWORK THEORY (BECF183T60)							

Course Objectives:
The course should enable the students -

1. To learn discrete Fourier transforms, properties of DFT and its application to linear filtering.
2. To understand the characteristics of digital filters, design digital FIR filters and apply these filters to filter undesirable signals in various frequency bands.
3. To design digital IIR filters and apply these filters to filter undesirable signals in various frequency bands.
4. To understand the effects of finite precision representation on digital filters.
5. To understand the fundamental concepts of multi-rate signal processing and its applications.

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

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Apply DFT and FFT algorithms for the analysis of digital signals and systems.	**K3**
CO2	Design FIR filters for various applications.	**K3**
CO3	Design IIR filters for various applications.	**K3**
CO4	Characterize the effects of finite precision representation on digital filters.	**K3**
CO5	Design of multi-rate filters.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO 3**
CO1	S	M	L	L	S	-	-	-	L	-	-	L	S	S	L
CO2	S	M	M	S	M	M	-	-	L	-	-	M	S	S	L
CO3	S	S	M	M	M	-	-	-	L	-	-	M	S	S	L
CO4	S	S	M	M	M	M	-	-	-	-	-	M	S	S	L
CO5	S	S	M	M	M	-	-	-	L	-	-	L	S	S	L

UNIT-I	**DISCRETE FOURIER TRANSFORM**	**9 Hours**

Review of discrete-time signals and systems – Discrete Fourier Transform (DFT) and its properties,

Circular convolution, Linear filtering using DFT, Filtering long data sequences - overlap-save methods - Overlap-add, Fast Fourier Transform (FFT) algorithms – Fast computation of DFT –Radix-2 decimation in time FFT - Decimation in frequency FFT – Linear filtering using FFT.		
UNIT-II	**DESIGN OF FINITE IMPULSE RESPONSE FILTERS**	**9 Hours**
Structures for FIR systems – Transversal and Linear phase structures, Design of FIR filters – Symmetric and Anti-symmetric FIR filters, Design of linear phase FIR filters using Windows (Rectangular, Hamming and Hanning windows) and Frequency sampling methods.		
UNIT-III	**DESIGN OF INFINITE IMPULSE RESPONSE FILTERS**	**9 Hours**
Structures for IIR systems – direct, cascade, parallel forms, Comparison of FIR and IIR, Analog filters– Butterworth filters - Chebyshev type – I filters (upto 3rd order), Analog transformation of prototype LPF to BPF/BSF/HPF, Transformation of analog filters into equivalent digital filters using Impulse invariant method and Bilinear Z-transform method.		
UNIT-IV	**FINITE WORD LENGTH EFFECTS**	**9 Hours**
Representation of fixed and floating point numbers, ADC quantization -truncation and rounding - quantization noise, Coefficient quantization Error – Product quantization error – Overflow error - Round-off noise power, Limit cycle oscillation due to product round-off error- Limit cycle oscillation due to overflow in digital filters – Principle of scaling.		
UNIT-V	**MULTI-RATE SIGNAL PROCESSING**	**9 Hours**
Introduction to multi-rate signal processing – Decimation – Interpolation- Sampling rate conversion by a rational factor - Poly phase decomposition of FIR filter – Multistage implementation of sampling rate conversion – Design of narrow band filters–Applications of multi-rate signal processing.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	John G.Proakis and Dimitris G. Manolakis, “Digital signal processing - Principles, algorithms and applications”, Pearson education / Prentice hall, Fourth edition, 2007.
Reference Book(s)	
1.	Sanjay K.Mithra, “Digital signal processing - A Computer based approach”, Tata McGraw-Hill, 2007.
2.	M.H.Hayes, “Digital signal processing”, Schum’s outlines, Tata McGraw Hill, 2007.
3.	A.V.Oppenheim, R. W. Schafer and J. R. Buck, “Discrete-time signal processing”, Pearson, 2004.
4.	I.C.Ifeachor and B.W.Jervis, “Digital signal processing – A practical approach”, Pearson 2002.
5.	L.R. Rabiner and B. Gold, “Theory and application of digital signal processing”, Prentice Hall, 1992.

Course Code	BECF185T40	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**COMPUTER AIDED SYSTEM DESIGN**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	Network Theory (BECF183T60), Electronic Devices (BECF183T30), Analog Electronics (BECF184T20) and Digital System Design (BECF183T40)							

Course Objectives:

The course should enable the students-

1. To learn electronic design automation techniques for designing analog and digital circuits at circuit level using PSPICE.
2. To study EDA techniques for designing digital circuits at different modeling techniques using VHDL.
3. To learn EDA techniques for designing digital circuits at data flow modeling using VHDL and synthesis concepts.
4. To study EDA techniques for designing digital circuits at different modeling techniques using Verilog HDL.
5. To learn EDA techniques for designing digital circuits at switch level modeling using Verilog HDL and synthesis concepts.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand concepts of simulation components and develop circuits using analog and digital modeling in PSPICE.	**K3**
CO2	Develop programs for combinational and sequential logic circuits by identifying the different abstraction and delay models for digital circuits in VHDL.	**K3**
CO3	Develop programs for combinational and sequential logic circuits at data flow modeling in VHDL and understand VHDL synthesis.	**K3**
CO4	Develop programs for combinational and sequential logic circuits by applying the different abstraction and delay models for digital circuits in Verilog HDL.	**K3**
CO5	Develop programs for combinational and sequential logic circuits at switch level in Verilog HDL and understand Verilog synthesis flow.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	S	S	S	M	S	-	-	-	L	-	-	M	S	S	M
CO2	S	S	S	M	S	-	-	-	L	-	-	M	S	S	M
CO3	S	S	S	M	S	-	-	-	L	-	-	M	S	S	M
CO4	S	S	S	M	S	-	-	-	L	-	-	M	S	S	M
CO5	S	S	S	M	S	-	-	-	L	-	-	M	S	S	M

UNIT-I	OVERVIEW OF EDA AND PSPICE	9 Hours

Evolution of EDA tools, Typical design flow of VLSI IC circuits (ASIC Flow), Design capture and design verification tools. Analog Circuit Techniques: Overview of PSPICE; Types of simulation - DC, AC, Transient, Monte Carlo and Parametric. Simulation devices - Energy sources, Passive components, Semi-conductors, ICs, Special devices – Laplace devices, voltage markers, Initial conditions. Models for RLC, Diode, BJT, and MOSFET. Programming examples of Analog and Digital Circuit Models in the frequency domain and time domain.

UNIT-II	INTRODUCTION TO VHDL	9 Hours

Introduction to VHDL – Entities and architectures, **Behavioral modelling** – Concurrent and sequential processing – if, case, loops, next, exit, wait, and assert statements.

Structural modelling – Port map, components, generics and Technology mapping.

Delay models –Inertial, transport and delta delays.

Data types- Variables, signals, constants, arrays, VHDL operators. Simple programming examples of combinational and sequential circuits.

UNIT-III	ADVANCED TOPICS IN VHDL AND SYNTHESIS	9 Hours

Data flow Description: Highlights of Data flow Description, Structure of Data flow Description, Data type-vectors, Common VHDL programming Errors.

Functions, Procedures, Packages, Libraries and Configurations.

Introduction to VHDL Synthesis: Register Transfer Level Description, Constraints, Technology Libraries, Conversion to Gate Level Netlists using Synthesis. Simple Synthesis Examples - Simple Gate—Concurrent Assignment, IF Control Flow Statements, Case Control Flow Statements.

UNIT-IV	INTRODUCTION TO VERILOG HDL	9 Hours

Introduction to Verilog - Modules and module instances, design blocks and stimulus blocks; Data types and operators, System tasks and Compiler directives. Modeling – Gate level (Structural) modeling, Dataflow modeling- continuous assignments, Behavioral modeling- initial, always, blocking and non-blocking statements. Tasks and functions. Delay modeling- distributed, lumped, and pin-to-pin, rise / fall / turn-off, min / typical / max delays. Simple programming examples of combinational and sequential

circuits.		
UNIT-V	**ADVANCED TOPICS IN VERILOG HDL AND SYNTHESIS**	**9 Hours**
Switch level modeling – PMOS, NMOS and CMOS. Simple programming examples of switch level modeling- CMOS Inverter, CMOS Nand, CMOS Nor gates, CMOS Multiplexers and CMOS latches. **Useful Modeling Techniques:** Procedural continuous assignments, Overriding parameters, Conditional compilation and execution, Useful system tasks. **Introduction to Verilog HDL Synthesis:** Logic Synthesis, Impact of logic synthesis, Verilog HDL Synthesis, Synthesis design flow, Verification of Gate-Level Netlist.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Muhammad Rashid, "Introduction to PSPICE using Orcad for circuits and electronics", Third edition, Pearson education, 2003.
2.	Douglas L. Perry, "VHDL –Programming by Example", Fourth edition, TMH, 2002.
3.	Samir Palnitkar, "Verilog HDL –A guide to Digital Design and Synthesis", Second edition, Pearson Education, 2004.
Reference Book(s)	
1.	Neil Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design", Second edition, Addison Wesley, 1998.
2.	Charles H Roth, Jr., "Digital Systems Design using VHDL", Second edition, Thomson Learning, 2008.
3.	Joseph Cavanagh, "Verilog HDL-Digital design and modelling", CRC press, 2007.

Course Code	BECF184T60	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ELECTRO MAGNETIC FIELD AND MICROWAVE LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. To understand the principle of Electric field and Magnetic field on various conductors.
2. To understand the working Principle of various type of Microwave Oscillators.
3. To know the behavior of microwave components and parameters.
4. To practice microwave measurement procedures.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Learn about the characteristics and measurements of E and H Fields.	**K2**
CO2	Understand the working principle of microwave components.	**K2**
CO3	Know about the behavior of microwave components.	**K3**
CO4	Analyze the S - parameter measurements of various Microwave Components.	**K4**
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LIST OF EXPERIMENTS

1. Determination of Electric Field Pattern between Two Circular Electrodes.
2. Determination of Electric Field between Parallel Conductors.
3. Measurement of Electric Field and Potential inside Parallel Plate Capacitor.
4. Measurement of Capacitance and Inductance of Transmission Lines.
5. Determination of Magnetic Field outside a Straight Conductor.

6. Determination of Magnetic Field of Coils.
7. Verification of Faraday's law of Magnetic Induction.
8. DeterminationofVelocityofelectromagneticwavesforthegiven Co-axialCable.
9. Reflex klystron or Gunn diode characteristics and basic microwave parameter measurement such as VSWR, frequency, wavelength.
10. Directional Coupler Characteristics.
11. Radiation Pattern of Horn Antenna.
12. S-parameter Measurement of the following microwave components (Isolator, Circulator, E Plane Tee, H Plane Tee, Magic Tee).
13. Attenuation and Power Measurement.

Total Hours	**45 Hours**

Text Book(s)

1.	John D Ryder," Network lines and fields", Prentice Hall of India, New Delhi, 2005.
2.	R.E. Collins, "Foundations for microwave engineering", Second edition, Wiley-IEEE press, 2001.
3.	Annapurna Das and Sisir K Das, "Microwave engineering", Tata McGraw-Hill Pub.Co. Ltd., 2017.

Reference Book(s)

1.	E.C. Jordan & K.G. Balmain, "Electromagnetic Waves & Radiating Systems", Second Edition, Prentice Hall of India, 1968.
2.	Samuel. Y. Liao, "Microwave circuit analysis and amplifier design", Third edition, Pearson, 2003.
3.	John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and wave propagation", Fourth edition, Tata McGraw-Hill, 2006.

Course Code	BECF185T30	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**DIGITAL SIGNAL PROCESSING LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. To implement Linear and Circular Convolution.
2. To implement FIR and IIR filters.
3. To study the architecture of DSP processor.
4. To demonstrate Finite word length effect.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Perform simulation of DSP systems using MATALB and analyze the performance.	**K3**
CO2	Analyze Finite word length effect on DSP systems.	**K3**
CO3	Demonstrate the applications of FFT to DSP.	**K3**
CO4	Implement adaptive filters for various applications of DSP.	**K4**
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LIST OF EXPERIMENTS

MATLAB/EQUIVALENT SOFTWARE PACKAGE

1. Generation of sequences (functional & random) & correlation.
2. Linear and Circular Convolutions.
3. Spectrum Analysis using DFT.

4. FIR filters design.
5. IIR filters design.
6. Multi-rate Filters.
7. Equalization Techniques.

DSP PROCESSOR BASED IMPLEMENTATION

8. Study of architecture of Digital Signal Processor.
9. MAC operation using various addressing modes.
10. Linear Convolution.
11. Circular Convolution.
12. FFT Implementation.
13. Wave form generation.
14. IIR and FIR Implementation.
15. Finite Word Length Effect.

Total Hours	**45 Hours**

Text Book(s)

1.	John G.Proakis and Dimitris G. Manolakis, "Digital signal processing - Principles, algorithms and applications", Pearson education / Prentice hall, Fourth edition, 2007.
2.	Sanjay K.Mithra, "Digital signal processing - A Computer based approach", Tata McGraw-Hill, 2007.

Reference Book(s)

1.	M.H.Hayes, "Digital signal processing", Schum's outlines, Tata McGraw Hill, 2007.
2.	A.V.Oppenheim, R. W. Schafer and J. R. Buck, "Discrete-time signal processing", Pearson, 2004

Course Code	BECF185T40	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**COMPUTER AIDED SYSTEM DESIGN LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students

1. To Construct RC circuits and OPAMPS Using PSPICE
2. To Construct Combinational and Sequential circuits Using PSPICE
3. To Simulate and Implement sequential and combinational digital circuits using HDL
4. To design Finite State Machine and Control unit and to study the performance
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Construct Analog and Digital circuits and study their characteristics using PSPICE.	**K3**
CO2	Implement digital circuits using HDL	**K3**
CO3	Design of FSM and control unit and analyze the performance	**K3**
CO4	Implement real time applications using FPGA	**K4**
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

List of Experiments

1. Study of PSPICE, VHDL and Verilog HDL
2. RC Circuits–Transient and AC analysis
3. MOS Device Characterization and CMOS Inverter Characteristics–DC analysis
4. Diode based circuits (like, Rectifiers, Clampers, etc.,)–Transient, Worst-case, MC, Sensitivity analysis, etc.

5. Amplifiers and Current mirrors using BJT/MOSFET
6. Op-Amp based Wein Bridge Oscillator and DAC using sub-circuit and Analog behavioral modeling
7. Digital Circuits–Logic Gates / Multiplexer/ Counter

HDL:(LogicDesignandSimulationofDigitalCircuitsusingVHDL/VerilogHDL/Both)

8. FullAdderandMultiplexerusingdifferentModelling/DescriptionsandConcurrentandSequential executioninVHDL.
9. 8-bit Adder/ Multiplier (min4-bit)–Port Map, Generics, Technology Mapping in VHDL
10. 8-bitCounter–Bottom-up approach design and Test vector generation in Verilog HDL
11. NAND/ NOR/ Transmission gates using Switch level modeling in Verilog HDL
12. FPGA real time programming and I/O Interfacing–Waveform generation / Traffic light controller
13. Design of Arithmetic Logic Unit.

Total Hours	**45 Hours**

Text Book(s)

1.	Muhammad Rashid, "Introduction to PSPICE using Orcad for circuits and electronics", Third edition, Pearson education, 2003.
2.	Douglas L. Perry, "VHDL –Programming by Example", Fourth edition, TMH, 2002
3.	Samir Palnitkar, "Verilog HDL –A guide to Digital Design and Synthesis", Second edition, Pearson Education, 2004

Reference Book(s)

1.	Charles H Roth, Jr., "Digital Systems Design using VHDL", Second edition, Thomson Learning, 2008.
2.	Joseph Cavanagh, "Verilog HDL-Digital design and modelling", CRC press, 2007

SEMESTER VI

Course Code	BECF184T50	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**MEASUREMENTS AND INSTRUMENTATION**	3	0	0	3	40	60	100
Course Category	ENGINEERING SCIENCE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic Electrical and Electronics Engineering							

Course Objectives:

The course should enable the students -

1. To study basic functional elements of Instrumentation.
2. To know working and usage of display instruments.
3. To know different types of digital instruments & signal generators for measurements.
4. To know the usage of different types of waveform analyzers.
5. To study different types of transducers and their applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Have knowledge on basic concepts of measurements.	**K2**
CO2	Can use display instruments for measurements.	**K3**
CO3	Can use both digital instruments and signal generators for experimental purposes.	**K3**
CO4	Can use waveform analyzers for measuring and recording purposes.	**K3**
CO5	Characterize the usage of transducers for design of electronic circuits.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	M	-	-	-	-	-	-	-	-	-	L	S	-	-
CO2	S	M	-	-	-	-	-	-	-	-	-	L	M	-	M
CO3	S	M	-	-	-	-	-	-	-	-	-	L	M	-	M
CO4	S	M	-	-	-	-	-	-	-	-	-	L	M	M	M
CO5	S	S	S	-	-	-	-	-	-	-	-	L	-	-	-

UNIT-I	**BASIC MEASUREMENTS CONCEPTS AND ERRORS**	**9 Hours**
Measurements Systems –Units and standards of Measurements Systems - Static and dynamic Characteristics – Accuracy, Precision, Reproducibility, Repeatability, Fidelity, Lag, Types of errors - Noise, Analog Instruments – Galvano Meter, D'Arsonaval Galvanometer, Moving Coil Instruments, PMMC - Ammeter, Voltmeter & Ohm Meter, Multimeter, Meter Protection, Extension of Range, Loading Effect, Moving Iron Instruments, Electrodynamometer.		
UNIT-II	**DATA DISPLAY AND RECORDING SYSTEMS**	**9 Hours**
Oscilloscope: CRO – CRT, Deflection System, Delay Line, Specifications, Controls, CRO Probes, Measurements of time period and frequency, Lissajous Figures, Dual trace, Dual beam CROs, Storage Oscilloscope, Digital Storage, Sampling Oscilloscope. Display Devises- LED, LCD, Dot Matrix, Nixie, EPID, IPS; Graphic Recording Instruments: Strip Chart Recorders, X_Y Recorder, Plotters.		
UNIT-III	**BRIDGES AND DIGITAL INSTRUMENTS**	**9 Hours**
Bridges for RLC measurements: Wheat Stone Bridge, Kelvin Bridge, Maxwell's Bridge, Hay Bridge and Schering Bridge. Digital Voltmeter system: Types - Ramp-Type DVM, Dual-Slope Integrating Type DVM, Successive-approximation DVM, Digital Multi meter, Vector voltmeter, Q meter, Digital Frequency Meter System – Frequency measurements, Period and Ratio measurements and time interval measurements.		
UNIT-IV	**SIGNAL GENERATORS & WAVEFORM ANALYSERS**	**9 Hours**
Signal Generators: Function Generators, Pulse Generators, RF Signal Generators, Sweep Frequency Generators, Arbitrary Waveform Generator, Frequency Synthesizers. Waveform Analyzers: Harmonic Distortion Analyzers, Heterodyne Wave Analyzers, Distortion Meter, Spectrum Analyzers, Digital Spectrum Analyzer.		
UNIT-V	**TRANSDUCERS**	**9 Hours**
Classification of Transducers- Resistance – Potentiometer, Strain gauges, Resistance Thermometers, Thermistor. Inductive Transducers: LVDT, RVDT. Capacitive Transducers: Piezoelectric, Photoelectric transducers, Thermocouples, Synchros. Digital Transducers – Encoder, Shaft Encoder, Optical Encoder. Measurement of Physical Parameters: Flow, displacement, velocity, force, pressure and temperature.		
	Total Hours	**45 Hours**

Text Book(s)

1.	David A Bell, "Electronic Instrumentation and Measurements", PHI, Second Edition, 2003.
2.	Joseph J.Carr, "Elements of Electronics Instrumentation and Measurement", PearsonEducation, Third Edition, 2003.
3.	A.K. Sawhney: "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai Publications, Eighteenth Edition, 2001.

Reference Book(s)	
1.	Albert D. Helfrick and William D.Cooper "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 2007.
2.	James W. Dally, William F. Riley and Kenneth G. McConnell, "Instrumentation for Engineering Measurements", John Wiley, Second Edition, 2003.
3.	Alan.S. Morris, "Principles of Measurements and Instrumentation", Prentice Hall of India, Second Edition, 2003.
4.	Jones L.D. and Foster Chin A."Electronic Instruments and Measurements", John Wiley and Sons, Second Edition, 1991.
5.	Doeblin: "Measurement Systems - Application and Design", McGraw-Hill, Fourth Edition, 1990.
6.	Copper D, "Electronic Instrumentation and Measurement Techniques", PHI, Second Edition, 1978.

Course Code	BECF186T20	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**COMPUTER NETWORKS**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	BECF184T30 – Analog & Digital Communication							

Course Objectives:

The course should enable the students

1. Introduce the layered communication architectures and understand various physical, data link layer protocols.
2. Perform and understand methods for error detection and correction of data.
3. Be exposed to various addressing schemes and routing protocols.
4. Learn the flow control and congestion control algorithms.
5. Be familiar with real time applications of networks.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Well versed on the layered communication architectures and their interworking.	**K3**
CO2	Analyze Error Detection in data link layer.	**K4**
CO3	Analyze different network protocols and routing algorithms.	**K4**
CO4	Trace the flow of information from one node to another node in the network.	**K3**
CO5	Develop real time applications of networks.	**K5**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	M	L	-	M	M	-	M	S	S	S	S	L	M
CO2	S	S	M	M	-	M	M	L	S	S	S	S	S	M	M
CO3	S	S	S	M	-	L	M	-	S	S	S	S	S	L	M
CO4	S	M	S	M	-	M	M	L	L	M	L	M	S	M	M
CO5	S	M	S	S	-	M	S	L	S	S	S	S	S	L	M

UNIT-I	**FUNDAMENTALS & SIGNAL TRANSMISSION**	**10 Hours**

Fundamentals : Building a network – Requirements - Layering and protocols - OSI Model - Internet Architecture – Performance - Network Topology ; Physical Layer: Data and Signals - Digital Transmission - Analog Transmission - Multiplexing and Spread Spectrum - Transmission Media.

UNIT-II	**MEDIA ACCESS & LOGICAL LINK CONTROL**	**9 Hours**
Framing - Error Detection and Correction - Media access control - Ethernet (802.3) – Wireless LANs - 802.11 – Bluetooth - Switching and bridging - Flow control.		
UNIT-III	**ROUTING & ADDRESSING SCHEMES**	**9 Hours**
Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP) - Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM).		
UNIT-IV	**END TO END COMMUNICATION**	**9 Hours**
Overview of Transport layer - UDP - Reliable byte stream (TCP) - Connection management – Flow control - Retransmission – Queuing Disciplines - TCP Congestion control - Congestion avoidance (DECbit, RED).		
UNIT-V	**APPLICATION LAYER PROTOCOLS**	**8 Hours**
Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS - SNMP - Multimedia applications.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.
2.	Behrouz A. Forouzan, “Data Communications and Networking”, Fourth Edition, McGraw Hill, 2011.
Reference Book(s)	
1.	James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down Approach Featuring the Internet”, Fifth Edition, Pearson Education, 2009.
2.	Nader. F. Mir, “Computer and Communication Networks”, Pearson/Prentice Hall Publishers, 2010.
3.	Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks – An Open Source Approach, First Edition, McGraw Hill, 2011.

Course Code	BECF186ED0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**VLSI DESIGN**	3	0	0	3	40	60	100
Course Category	**PROGRAMME CORE COURSE**	**Syllabus Revision**						V.1.0
Pre-requisite	Electronic Devices (BECF183T30), Analog Electronics (BECF184T20), Digital System Design (BECF183T40), Network Theory (BECF183T60)							

Course Objectives:

The course should enable the students

1. To study the fundamentals of MOS transistor and CMOS circuits and their characteristics.
2. To understand the concepts of CMOS processing technology and design layouts.
3. To discuss the performance trade-offs involved in designing and realizing the circuits in CMOS technology.
4. To discuss architectural choices and design and realization of sub-systems.
5. To learn the different FPGA architectures and testability of VLSI circuits.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand MOS transistor theory and design Inverters.	**K2**
CO2	Realize the concepts of CMOS circuits using processing technology and layouts.	**K2**
CO3	Design and realize the circuits in CMOS logic circuits.	**K3**
CO4	Design arithmetic building blocks and memory subsystems.	**K3**
CO5	Apply and implement FPGA design flow and testing.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)											Program Specific Outcomes (PSOs)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO 6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO 3**
CO1	S	M	M	L	L	L	-	-	-	-	L	L	S	M	L
CO2	S	L	S	M	L	L	-	-	-	-	-	L	S	M	L
CO3	S	M	M	M	L	L	-	-	-	-	L	L	S	M	L
CO4	S	M	M	M	L	L	-	-	-	-	L	L	S	M	L
CO5	S	L	S	M	L	L	-	-	-	-	L	L	S	M	L

UNIT-I	**INTRODUCTION TO VLSI AND MOS TRANSISTOR THEORY**	**9 Hours**
Evolution of IC Technologies: SS1, MSI, LSI, VLSI, ULSI, and GLSI. The Moore's Law, MOS THEORY: The MOS as switch - nMOS and pMOS. CMOS logic and its features, The nMOS Enhancement Transistor - Working and Characteristics. Threshold voltage and Body effect of MOS. MOS device design equations (First order effects).MOS INVERTERS: The CMOS inverter Transfer characteristics, Noise margin. The nMOS and pseudo-nMOS inverter, Tile BiCMOS Inverter, Tile CMOS Transmission gate.		
UNIT-II	**CMOS PROCESSING TECHNOLOGY AND LAYOUTS**	**9 Hours**
Silicon Semiconductor fabrication technology, Fabrication forms and CMOS (Basic n-WELL process) LAYOUTS AND DESIGN RULES: Layout based rules, Simple CMOS Stick Layout diagrams - Inverter, NAND, NOR gates and Multiplexer. Scaling: Constant Field, and Constant voltage.		
UNIT-III	**MOS CIRCUIT PERFORMANCE AND CMOS LOGIC CIRCUITS**	**9 Hours**
Sheet Resistance definition, MOS device capacitances – model, Distributed RC effects, switching characteristics - Rise time, fall time and Delay time. Stage ratio, Simple examples of Combinational and Sequential circuits using CMOS: NANDI NOR gates, and Compound gates, Latches, and Registers.		
UNIT-IV	**SUB SYSTEM DESIGN AND TESTING**	**9 Hours**
General System Design-Design of ALU subsystems, Adder and Multipliers Memories - Static RAM, Control Logic Implementation using PLA's. Testing of VLSI circuits - Need for Testing, Fault models, and ATPG. Design for Testability (DFT) - Scan Based and Self-test approaches.		
UNIT-V	**PROGRAMMABLE LOGICS**	**9 Hours**
Basic ROM structures, PLAs, PALs, PLDs, Implementation of Traffic Light controller using PLD, FPGAs and CPLDs: XILINX and ALTERA series.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Neil Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design"-Addison Wesley, 1998.
2.	Charles H Roth,Jr."Digital Systems Design using VHDL"-Thomson Learning, 2001.
Reference Book(s)	
1.	VLSI Design Principles- John P. Uyemura, John Wiley, 2002.
2.	E. Fabricious, Introduction to VLSI design, McGraw-Hill, 1990.
3.	Wayne Wolf, Modern VLSI Design, Pearson Education, 2003.

Course Code	BECF186T40	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**EMBEDDED SYSTEMS**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite	BECF184T40 – MICROPROCESSORS AND MICROCONTROLLERS							

Course Objectives:
The course should enable the students

1. Learn the architecture and programming of ARM processor.
2. Be familiar with the embedded computing platform design and analysis.
3. Be exposed to the basic concepts and overview of real time Operating system.
4. Learn the system design techniques and networks for embedded systems to industrial applications.

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

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Describe the architecture and programming of ARM processor.	**K2**
CO2	Outline the concepts of embedded systems.	**K3**
CO3	Use the system design techniques to develop software for embedded systems.	**K3**
CO4	Differentiate between the general purpose and real time operating system.	**K3**
CO5	Model real-time consumer/industrial applications using embedded-system concepts.	**K5**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	S	M	S	-	S	-	-	M	S	S	M	S	L	M
CO2	S	M	M	M	-	M	-	-	M	S	M	M	S	M	M
CO3	S	L	M	M	-	L	-	-	M	S	M	M	S	M	M
CO4	S	M	M	S	-	L	-	-	M	M	S	M	S	L	M
CO5	S	S	S	S	-	M	-	-	M	M	M	S	S	L	M

UNIT-I	**INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS**	**9 Hours**

Complex systems and microprocessors– Embedded system design process – Overview on formalisms for system design –Design example: Model train controller– Instruction sets preliminaries – ARM Processor – CPU: programming input and output– supervisor mode, exceptions and traps – Co– processors– Memory system mechanisms – CPU performance– CPU

power consumption– Introduction to Embedded Industrial CPUs for rugged environment.		
UNIT-II	**EMBEDDED COMPUTING PLATFORM DESIGN**	**9 Hours**
The CPU Bus–Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform–level performance analysis – Components for embedded programs– Models of programs– Assembly, linking and loading – compilation Programming techniques– Program level performance analysis – Software performance optimization –Program validation and testing.		
UNIT-III	**PROCESSES AND OPERATING SYSTEMS**	**9 Hours**
Introduction – Kernel, Threads –Multiple tasks and multiple processes – Multirate systems– Pre-emptive real–time operating systems– Priority based scheduling– Interposes communication mechanisms – Evaluating operating system performance– power optimization strategies for processes - GPOS versus RTOS- Classification of RTOS- Example Real time operating systems– POSIX– Windows CE.		
UNIT-IV	**SYSTEM DESIGN TECHNIQUES AND NETWORKS**	**9 Hours**
Design methodologies– Design flows – Requirement Analysis – Specifications–System analysis and architecture design – Quality Assurance techniques– Distributed embedded systems – Multiprocessors–CPUs, accelerators, MPSoCs– Overview on Internet of (robotic) Things– Ubiquitous optimization.		
UNIT-V	**CASE STUDY**	**9 Hours**
Data compressor – Alarm Clock – Audio player – Software modem–Digital still camera – Telephone answering machine–Engine control unit – Video accelerator–Challenges and trends in embedded systems in industrial applications.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition “Morgan Kaufmann Publisher, 2012.

Reference Book(s)

1.	Jonathan W.Valvano, “Embedded Microcomputer Systems Real Time Interfacing”, Third Edition, Cengage Learning, 2012.
2.	David. E. Simon, “An Embedded Software Primer”, 1st Edition, Addison Wesley Professional, 2007.
3.	Raymond J.A. Buhr, Donald L.Bailey, “An Introduction to Real-Time Systems- From Design to Networking with C/C++”, Prentice Hall, 1999.
4.	C.M. Krishna, Kang G. Shin, “Real-Time Systems”, International Editions, McGraw Hill, 1997.
5.	K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design & Programming”, Dream Tech Press, 2005.
6.	Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, McGraw Hill, 2004.

Course Code	BECF186P70	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**COMPUTER NETWORKS LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students

1. To understand the function of various protocols.
2. To construct LAN and WAN in real time environment.
3. To acquire technical competence of the Wired/wireless technologies.
4. To demonstrate designing of real time applications in Wired/wireless technologies.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Ability to design MAC and routing protocols in Wired Environment using NS2/ QUALNET/ NS3/ OMNET/ CISCO.	**K4**
CO2	Ability to design MAC and routing protocols in Wireless Environment using NS2/ QUALNET/ NS3/ OMNET/ CISCO.	**K3**
CO3	Acquire the technical competence to meet out the industry expectation on the state–of the art wired /wireless technologies.	**K3**
CO4	Acquire the ability to design WLAN / LAN system meeting out real time requirements.	**K4**
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LIST OF EXPERIMENTS

1. (a) Study of different types of Network cables and implement cross-wired cable and straight through cable using clamping tool.

(b) Study of Network devices.
(c) Study of Network IP.

2. Configuration of Local Area Network (LAN) and VPN.
3. Wireless LAN protocols.
4. To create scenario and study the performance of network with CSMA/CA protocol and compare with CSMA/CD protocols.
5. Implementation and study of stop and wait protocol.
6. Implementation and study of Go back-Nand selective repeat protocols.
7. Implementation of client server using TCP protocol.
8. Implementation of Remote Procedure Call.
9. Implementation of distance vector routing algorithm.
10. Configure a network using address resolution protocol (ARP) and routing information protocol (RIP) and analyze the performance of the network.
11. Configuration of internet protocol (IP).
12. Configuration of network using Adhoc On demand distance vector (AODV) routing.
13. Configuration of network using Dynamic Source Routing (DSR) routing.

Total Hours	**45 Hours**

Text Book(s)

1.	Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.
2.	Behrouz A. Forouzan, "Data Communications and Networking", Fourth Edition, McGrawHill, 2011.

Reference Book(s)

1.	James F. Kurose, Keith W. Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009.
2.	Nader. F. Mir, "Computer and Communication Networks", Pearson/Prentice Hall Publishers, 2010.

Course Code	BECF186P80	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**EMBEDDED SYSTEM DESIGN LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**					V.1.0	
Pre-requisite								

Course Objectives:

The course should enable the students

1. To learn the working of ARM processor and to understand the Building Blocks of Embedded Systems.
2. To learn the concept of memory map and memory interface.
3. To know the characteristics of Real Time Systems.
4. To write programs to interface memory, I/O, switch processor and to study the interrupt performance.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Write programs in ARM for a specific Application.	**K3**
CO2	Interface memory and Write programs related to memory operations.	**K3**
CO3	Interface A/D and D/A convertors with ARM system.	**K3**
CO4	Analyze the performance of interrupt and interface keyboard ,display, motor and sensor.	**K4**
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LIST OF EXPERIMENTS

1. Study of ARM evaluation system.
2. Study of Keil C Compiler.
3. Interfacing ADC and DAC.
4. Interfacing LED and PWM.
5. Interfacing real time clock and serial port.

6. Interfacing keyboard and LCD. 7. Interfacing EPROM and interrupt. 8. Mailbox. 9. Interrupt performance characteristics of ARM and FPGA. 10. Flashing of LEDS. 11. Interfacing stepper motor and temperature sensor. 12. Implementing Zigbee protocol with ARM.	
Total Hours	**45 Hours**
Text Book(s)	
1.	Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Third Edition "Morgan Kaufmann Publisher, 2012.
2.	Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition, Cengage Learning, 2012.
Reference Book(s)	
1.	David. E. Simon, "An Embedded Software Primer", 1st Edition, Addison Wesley Professional, 2007.
2.	Raymond J.A. Buhr, Donald L.Bailey, "An Introduction to Real-Time Systems- From Design to Networking with C/C++", Prentice Hall, 1999.

Course Code	BECF186P90	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**VLSI DESIGN LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students:

1. To learn Hardware Descriptive Language (Verilog/VHDL).
2. To learn the fundamental principles of VLSI circuit design in digital and analog domain.
3. To familiarize fusing of logical modules on FPGAs.
4. To provide hands on design experience with professional design (EDA) platforms.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Write HDL code for basic as well as advanced digital integrated circuits.	**K3**
CO2	Import the logic modules into FPGA Boards and carry out a series of validations of the design.	**K4**
CO3	Design, Simulate and Extract the layouts of Analog IC Blocks using EDA tools.	**K4**
CO4	Synthesize , Place and Route the digital ICs.	**K4**
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LIST OF EXPERIMENTS

(a) Study of IC design flow using EDA tools of different vendors

(b) Introduction to JTAG

FPGA Based Experiments:

1. HDL based design entry, Test bench creation and simulation of BCD counters /PRBS Generators / Comparators (min 4-bit) / Bothe multiplier / Carry select adder.

2. Synthesis, Placement and Routing (P&R) and post P&R simulation of the components simulated in Expt. No. 1 above

3. Critical paths and static timing analysis results to be identified. Identify and verify possible conditions under which the blocks will fail to work correctly.

4. Hardware fusing and testing of each of the blocks simulated in Expt. 1above (Using either chip scope feature (Xilinx) or equivalent tools).

5. Invoke the PLL and demonstrate the use of the PLL module for clock generation in FPGAs.

IC Design Experiments:

6. Design and PSPICE simulation of

(a) Simple 5 transistor differential amplifier. Measure gain, BW, output impedance, ICMR, and CMRR.

(b) Ring Oscillator

7. Layout generation, DRC and LVS Checking, Parasitic Extraction and Re-simulation of CMOS Inverter.

8. Synthesis and Standard cell-based design of a circuit simulated in Expt. 6-b above - Synthesis principles, Logical Effort, Interpreting Scripts, Constraints and Library preparation and generation, Boolean Optimization, Optimization for Area, Power.

9. For Expt. 6-b above, Floor Planning, Placement and Routing (P&R), Power and Clock Routing, and post P&R simulation

10. Static Timing analyses procedures and constraints. Critical path considerations.

11. DFT - Scan chain insertion / Clock Tree Synthesis / Stick diagrams.

Total Hours	**45 Hours**

Text Book(s)

1.	Muhammad Rashid, "Introduction to PSPICE using Orcad for circuits and electronics", Thirdedition,Pearsoneducation,2003.
2.	Douglas L.Perry, "VHDL–Programming by Example" , Fourth edition,TMH,2002

Reference Book(s)

1.	Neil Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design", Second edition, Addison Wesley,1998.
2.	CharlesHRoth,Jr.,"DigitalSystemsDesignusingVHDL",Secondedition,Thomson Learning, 2008.

Course Code	BECF187T50	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**OPTICAL COMMUNICATION**	3	0	0	3	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite	Analog and Digital Communication							

Course Objectives:
The course should enable the students

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To understand the different kind of losses, signal distortion, SM fibers.
3. To learn the various optical sources, materials and fiber splicing.
4. To learn the fiber optical receivers and noise performance in photo detector.
5. To explore link budget, WDM, solutions and SONET/SDH network.

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

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Demonstrate an understanding of optical fiber communication link, structure, propagation and transmission properties of an optical fiber.	**K5**
CO2	Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers.	**K5**
CO3	Describe the principles of optical sources and power launching-coupling methods.	**K3**
CO4	Compare the characteristics of fiber optic receivers.	**K5**
CO5	Design a fiber optic link based on budgets to assess the different techniques to improve the capacity of the system.	**K6**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	M	L	-	-	-	-	-	-	-	M	L	M	-	S
CO2	M	S	L	-	-	-	L	-	-	-	L	S	M	-	M
CO3	S	L	M	-	-	-	M	-	-	-	S	M	M	L	S
CO4	L	S	S	-	-	-	-	-	-	-	M	L	M	-	M
CO5	L	M	-	-	-	-	S	-	-	-	L	S	M	L	S

UNIT-I	**INTRODUCTION TO OPTICAL FIBERS**	**9 Hours**

Evolution of fiber optic system- Element of an Optical Fiber Transmission link- Total internal reflection- Acceptance angle –Numerical aperture – Skew rays Ray Optics-Optical Fiber Modes and Configurations - Mode theory of Circular Wave guides- Overview of Modes-Key Modal concepts- Linearly Polarized

Modes -Single Mode Fibers-Graded Index fiber structure.		
UNIT-II	**SIGNAL DEGRADATION OPTICAL FIBERS**	**9 Hours**
Attenuation - Absorption losses, Scattering losses, Bending Losses, Core and Cladding losses, Signal Distortion in Optical Waveguides-Information Capacity determination - Group Delay- Material Dispersion, Wave guide Dispersion, Signal distortion in SM fibers - Polarization Mode dispersion, Intermodal dispersion, Pulse Broadening in GI fibers - Mode Coupling -Design Optimization of SM fibers - RI profile and cut-off wavelength.		
UNIT-III	**FIBER OPTICAL SOURCES AND COUPLING**	**9 Hours**
Direct and indirect Band gap Materials -LED structures -Light source materials -Quantum efficiency and LED power, Modulation of a LED, lasers Diodes-Modes and Threshold condition – Rate equations-External Quantum efficiency -Resonant frequencies -Laser Diodes, Temperature effects, Introduction to Quantum laser, Fiber amplifiers- Power Launching and coupling, Lencing schemes, Fiber -to- Fiber joints, Fiber splicing-Signal to Noise ratio , Detector response time.		
UNIT-IV	**FIBER OPTIC RECEIVER AND MEASUREMENTS**	**9 Hours**
Fundamental receiver operation, Pre-amplifiers, Error sources – Receiver Configuration– Probability of Error –Quantum limit, Fiber Attenuation measurements- Dispersion measurements – Fiber Refractive index profile measurements – Fiber cut- off Wave length Measurements – Fiber Numerical Aperture Measurements – Fiber diameter measurements.		
UNIT-V	**OPTICAL NETWORKS AND SYSTEM TRANSMISSION**	**9 Hours**
Basic Networks – SONET / SDH – Broadcast – and – select WDM Networks –Wavelength Routed Networks – Non linear effects on Network performance – Link Power budget - Rise time budget- Noise Effects on System Performance-Operational Principles of WDM Performance of WDM + EDFA system – Solutions – Optical CDMA – Solitons in Optical Fiber -Ultra High Capacity Networks.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Gerd Keiser, “Optical Fiber Communication” Mc Graw-Hill International, 4th Edition, 2010.
2.	John M. Senior, “Optical Fiber Communication”, Second Edition, Pearson Education, 2007.
Reference Book(s)	
1.	Ramaswami, Sivarajan and Sasaki “Optical Networks”, Morgan Kaufmann, 2009.
2.	J.Senior, “Optical Communication, Principles and Practice” Prentice Hall of India, 3rd Edition, 2008.
3.	J.Gower, “Optical Communication System” Prentice Hall of India, 2001.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**CYBER SECURITY**	3	0	0	1	40	60	100
Course Category	MANDATORY COURSE (MC)*	**Syllabus Revision**					V.1.0	
Pre-requisite	Nil							

Course Objectives:

1. To learn the foundations of Cyber security & threat landscape and to equip students with technical knowledge and skills needed to protect and defend against cyber threats.
2. To develop skills that can help plan, implement and monitor cyber security mechanisms for protection of information technology assets.
3. To expose students to governance, regulatory, legal, economic, environmental, social & ethical contexts of cyber security and use of online social media networks.
4. To systematically educate the necessity for understanding impact of cyber crimes and threats with solutions in a global and societal context.
5. To select suitable ethical principles & commit to professional responsibilities and human values and contribute value/wealth for the benefit of the society.

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

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	To understand the concept of Cyber security, Issues and challenges associated with it.	**K3**
CO2	To understand cyber crimes, their nature, legal remedies and report about crimes through available platforms and procedures.	**K3**
CO3	To appreciate various privacy and security concerns on online Social media and understand reporting procedure of inappropriate content, legal aspects and best practices for the use of Social media platforms.	**K3**
CO4	To understand the basic concepts related to E-Commerce and digital payments.	**K3**
CO5	To understand the basic security aspects related to Computer and Mobiles.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	M	-	-	-	-	-	-	-	-	-	S	-	S	-
CO2	S	M	-	-	-	-	-	-	-	-	-	S	-	S	-

CO3	S	M	-	-	-	-	-	-	-	-	-	S	-	S	-
CO4	S	M	-	-	-	-	-	-	-	-	-	S	-	S	-
CO5	S	M	-	-	-	-	-	-	-	-	-	S	-	S	-

UNIT-I	**INTRODUCTION TO CYBER SECURITY**	**9 Hours**

Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Advent of internet, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security, Issues and challenges of cyber security.

UNIT-II	**CYBER CRIME AND CYBER LAW**	**9 Hours**

Classification of cyber crimes, Common cyber crimes- cyber crime targeting computers and mobiles, cyber crime against women and children, financial frauds, social engineering attacks, malware and ransom ware attacks, zero day and zero click attacks, Cybercriminals modus-operandi , Reporting of cyber crimes, Remedial and mitigation measures, Legal perspective of cyber crime, IT Act 2000 and its amendments, Cyber crime and offences, Organisations dealing with Cyber crime and Cyber security in India, Case studies.

UNIT-III	**SOCIAL MEDIA OVERVIEW AND SECURITY**	**9 Hours**

Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media, Flagging and reporting of inappropriate content, Laws regarding posting of inappropriate content, Best practices for the use of Social media, Case studies.

UNIT-IV	**E-COMMERCE AND DIGITAL PAYMENTS**	**9 Hours**

Definition of E- Commerce, Main components of E-Commerce, Elements of E-Commerce security, E-Commerce threats, E-Commerce security best practices, Introduction to digital payments, Components of digital payment and stake holders, Modes of digital payments- Banking Cards, Unified Payment Interface (UPI), e-Wallets, Unstructured Supplementary Service Data (USSD), Aadhar enabled payments, Digital payments related common frauds and preventive measures. RBI guidelines on digital payments and customer protection in unauthorised banking transactions. Relevant provisions of Payment Settlement Act, 2007.

UNIT-V	**DIGITAL DEVICES SECURITY , TOOLS AND TECHNOLOGIES FOR CYBER SECURITY**	**9 Hours**

End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third party software, Device security policy, Cyber Security best practices, Significance of host firewall and Ant-virus, Management of host firewall and Anti-virus, Wi-Fi security, Configuration of basic security policy and permissions.

Total Hours	**45 Hours**

Text Book(s)

1.	R. C. Mishra, "Cyber Crime Impact in the New Millennium", Auther Press Edition, 2010.
2.	Sumit Belapure and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt. Ltd, First Edition, 2011.
Reference Book(s)	
1.	Henry A. Oliver, "Security in the Digital Age: Social Media Security Threats and Vulnerabilities", Create Spac e Independent Publishing Platform, Pearson, 2001.
2.	Elias M. Awad, "Electronic Commerce", Prentice Hall of India Pvt Ltd, 2001.
3.	Kumar K, "Cyber Laws: Intellectual Property & E-Commerce Security", Dominant Publishers.
4.	Eric Cole, Ronald Krutz and James W. Conley, "Network Security Bible", Wiley India Pvt. Ltd, Second Edition, 2008.
5.	E. Maiwald, "Fundamentals of Network Security", McGraw Hill, 2003.

Course Code	BECF197P60	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**OPTICAL COMMUNICATION LABORATORY**	0	0	3	2	40	60	100
Course Category	PROGRAMME CORE COURSE	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. To understand the working principle of optical sources, detector, fibers and optical components.
2. To develop understanding of simple optical communication link.
3. To learn about the characteristics and measurements in optical fibers.
4. To understand various losses involved in OFC.
5. To enable to students to work in a team and build applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the working principle of optical sources, detector, fibers and microwave components.	**K2**
CO2	Develop understanding of simple optical communication link.	**K2**
CO3	Learn about the characteristics and measurements in optical fiber.	**K2**
CO4	Analyze the losses in Optical Fiber Communication.	**K3**
CO5	Demonstrate capability to work in a team and to build circuits for various applications.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO2	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO3	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO4	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S
CO5	S	S	S	S	S	M	M	M	M	M	M	S	S	S	S

LIST OF EXPERIMENTS

1. DC Characteristics of Light Emitting Diode.
2. DC Characteristics of PIN Photo diode.

3. Mode Characteristics of Fibers. 4. Measurement of connector and bending losses. 5. Analysis of Fiber optic Analog -frequency response (analog). 6. Analysis of Fiber optic Digital Link-eye diagram (digital). 7. Numerical Aperture determination for Optical Glass Fibers. 8. Numerical Aperture determination of Plastic Fiber. 9. Attenuation Measurement in Fibers. 10. Bit error rate Measurement. 11. Design of basic Optical Communication system using computational tool. 12. Study experiment – Optical Wavelength Multiple Access. 13. Study of computational tools of Optical Communication.	
Total Hours	**45 Hours**
Text Book(s)	
1.	Gerd Keiser, "Optical Fiber Communication" Mc Graw-Hill International, 4th Edition, 2010.
2.	John M. Senior, "Optical Fiber Communication", Second Edition, Pearson Education, 2007.
Reference Book(s)	
1.	Ramaswami, Sivarajan and Sasaki "Optical Networks", Morgan Kaufmann, 2009.
2.	J.Senior,"Optical Communication, Principles and Practice" Prentice Hall of India, 3rd Edition, 2008.
3.	J.Gower, "Optical Communication System" Prentice Hall of India, 2001.

SEMESTER VIII

Course Code	BECF186T30	L	T	P	C	IA	EA	TM
Course Name	**PRINCIPLE OF MANAGEMENT & PROFESSIONAL ETHICS**	3	0	0	3	40	60	100
Course Category	HUMANITIES / SOCIAL SCIENCES / MANAGEMENT COURSE	Syllabus Revision				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. To develop knowledge on the principles of management essential for all kinds of people in all kinds of organizations.
2. To have a clear understanding of the managerial functions like planning, organizing, leading and controlling.
3. To understand global business and diversity.
4. To gain some basic knowledge on international aspect of management.
5. To understand the concepts of computer ethics in work environment.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Summarize the evolution of management thoughts and various challenges of managerial activities in a global.	K2
CO2	Explain the types of Planning and Decision making at various levels management in the Organizations..	K2
CO3	Discuss various types of Organization structure.	K2
CO4	Understanding the code of ethics and standards of computer professionals.	K2
CO5	Analyze professional responsibility and empowering access to information in the work place.	K3

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	-	-	-	-	-	-	-	M	S	M	M	L	L	-	L
CO2	-	-	-	-	-	L	-	M	S	M	M	L	L	-	M
CO3	-	-	-	-	-	-	-	M	S	M	S	M	L	L	L

CO4	-	-	-	-	-	-	-	S	S	M	M	S	L	-	M
CO5	-	-	-	-	-	M	-	S	M	M	M	S	L	-	M

UNIT-I	**INTRODUCTION TO MANAGEMENT**	**9 Hours**

Definition of Management, process of Management, Planning, Organizing, leading, Controlling Classical Approach-Contribution and Limitation, Management Science Approach, Skills, Roles and Performance: Types of managers Managerial Skills,- Technical Skill, Analytical Skill Decision Making skill, Human Relation skill, Communication skill. Managerial Roles – Interpersonal Role, Informational Role, Decisional Role.

UNIT-II	**PLANNING FUNCTION**	**10 Hours**

Elements of Planning-Objectives, Action, Resource, Implementation, Managerial Decision Making: Types of Decision, Process of Decision Making, Decision Making-Certainty Condition, Uncertainty Condition, Selecting Alternative. Managing Information System; Need for Decision Support System, MIS and DSS Strategic Planning –Organizational Strategy, Business Portfolio Matrix.

UNIT-III	**ORGANIZING FUNCTION**	**9 Hours**

Organizational Structure- Job Design, Departmentation, Span of Control, Delegation of Authority, Decentralized authority, Chain of Command and Authority, Line and Staff concept Matrix organizational Design.

UNIT-IV	**ENGINEERING ETHICS**	**9 Hours**

Senses of 'engineering ethics' – variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – kohlberg's theory – Gilligan's theory – consensus and controversy – professions and professionalism – professional ideas and virtues – theories about right action – self-interest – customs and religion – uses of ethical theories.

UNIT-V	**ENGINEER'S RESPONSIBILITY FOR SAFETY**	**8Hours**

Safety and risk – Assessment of safety and risk – Risk benefit analysis – Reducing risk – The Three Mile Island and Chernobyl- case studies.

	Total Hours	**45 Hours**

Text Book(s)

1.	Mike Martin & Roland schinzinger "Ethics in engineering" McGraw Hill, 2009.
2.	Govindarajan M, Natarajan. S.Senthilkumar V.S, "Engineering Ethics", PHI, 2004.
3	Dr. T. Ramaswamy, Principles of Management, Himalaya Publishing House, 2014.

Reference Book(s)

1.	Charles D.Fleddermamm, "Engineering Ethics", Pearson Hall, 2004.
2.	Charles E.Haris, Michael S.Protchard & Michael J.Rabins, "Engineering Ethics- concepts and cases", Wadsworth Thompson Learning, 2009.
3.	JhonR.Boartright, "Ethics and conduct of Business", Pearson Education, 2003.
4.	Edmund G.See Bauer & Robert L.Bany, "Fundamental of Ethics for Scientists and Engineering", Oxford University, 2005.

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**UNIVERSAL HUMAN VALUES**	2	1	0	3	40	60	100
Course Category	MANDATORY COURSE (MC)*	**Syllabus Revision**					V.1.0	
Pre-requisite	Nil							

Course Objectives:

The course should enable the students:

1. Development of a holistic perspective based on self-exploration about themselves, family, society and nature/existence.
2. Understanding of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act.

Course Outcomes:

On completion of the course, the student will be able to -

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Aware of themselves and their surroundings (family, society, nature)	**K2**
CO2	Become more responsible in life and handling problems with sustainable solutions	**K4**
CO3	Have better critical ability	**K5**
CO4	Become sensitive to their commitment towards what they have understood	**K2**
CO5	Apply what they have learnt to their own self in different day-to-day settings in real life	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O 1**	**PS O2**	**PS O3**
CO1	-	-	-	-	-	M	L	H	-	-	-	M	-	-	-
CO2	-	-	-	-	-	M	L	H	-	-	-	M	-	-	-
CO3	-	-	-	-	-	M	L	H	-	-	-	M	-	-	-
CO4	-	-	-	-	-	M	L	H	-	-	-	M	-	-	-
CO5	-	-	-	-	-	M	L	H	-	-	-	M	-	-	-

UNIT-I	**COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION**	**9 Hours**

Purpose and motivation for the course. Self-Exploration - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. Continuous Happiness and Prosperity- A look at basic Human Aspirations. Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method

to fulfill the above human aspirations: understanding and living in harmony at various levels.		
UNIT-II	**UNDERSTANDING HARMONY IN HUMAN BEING - HARMONY IN MYSELF**	**9 Hours**
Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). Understanding the characteristics and activities of 'I' and harmony in 'I'. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Health.		
UNIT-III	**UNDERSTANDING HARMONY IN FAMILY AND SOCIETY- HARMONY IN HUMAN- HUMAN RELATIONSHIP**	**9 Hours**
Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention and competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family		
UNIT-IV	**UNDERSTANDING HARMONY IN NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE**	**9 Hours**
Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all- pervasive space. Holistic perception of harmony at all levels of existence.		
UNIT-V	**IMPLICATIONS OF ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS**	**9 Hours**
Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize professional competence for augmenting universal human order b. Ability to identify scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations. Sum up.		
	Total Hours	**45 Hours**

Text Book(s)	
1	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.
Reference Book(s)	
1	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3	The Story of Stuff (Book)

4	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5	Small is Beautiful - E. F Schumacher.
6	Slow is Beautiful - Cecile Andrews
7	Economy of Permanence - J C Kumarappa
8	Bharat Mein Angreji Raj – Pandit Sunderlal
9	Rediscovering India - by Dharampal
10	Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11	India Wins Freedom - Maulana Abdul Kalam Azad
12	Vivekananda - Romain Rolland (English)
13	Gandhi – Romain Rolland (English)

Professional Elective Courses

Course Code	BECF185EA0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ANTENNAS AND PROPAGATION**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -I	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Electromagnetic Fields and Wave guides							

Course Objectives:
The course should enable the students:

1. To give insight of radiation phenomena and antenna parameters.
2. To give thorough understanding of the radiation characteristics of different types of antenna arrays.
3. To understand the concept of different types of aperture antennas.
4. To create awareness about different types of Special antennas and measurement of antennas.
5. To understand the concept of antennas propagation.

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

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Antennas Parameters.	**K4**
CO2	Different types of antenna arrays.	**K3**
CO3	Analyze the aperture antennas and their types.	**K4**
CO4	Describe the concepts of Special Antennas.	**K2**
CO5	Describe the different types of propagation in antennas.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	M	S	-	S	-	-	L	-	-	L	-	L	S	L	-
CO2	M	M	-	-	-	-	L	-	M	M	-	-	L	M	M
CO3	S	L	-	L	-	-	M	-	-		-	-	-	-	L
CO4	M	L	-	-	M	-	S	-	-	L	-	L	-	L	L
CO5	L	L	-	-	-	-	S	-	-	S	-	L	L	L	S

UNIT-I	**FUNDAMENTALS OF RADIATION**	**9 Hours**

Definition of antenna parameters – Gain, Directivity, Effective aperture, Radiation Resistance, Band width, Beam width, Input Impedance, Matching Baluns, Polarization mismatch, Antenna noise temperature, Radiation from oscillating dipole, Half wave dipole. Folded dipole.

UNIT-II	**ANTENNA ARRAYS**	**9 Hours**

N element linear array, Pattern multiplication, Broadside and End fire array – Concept of Phased

arrays, Adaptive array, Basic principle of antenna Synthesis-Binomial array, Yagi Arrays.		
UNIT-III	**APERTURE AND SLOT ANTENNAS**	**9 Hours**
Radiation from rectangular apertures, Uniform and Tapered aperture, Horn antenna, Reflector antenna, Aperture blockage, Feeding structures, Slot antennas, Micro strip antennas – Radiation mechanism – Application, Numerical tool for antenna analysis.		
UNIT-IV	**SPECIAL ANTENNAS**	**9 Hours**
Principle of frequency, independent antennas –Spiral antenna, helical antenna, Log periodic, Modern antennas- Reconfigurable antenna, Active antenna, Dielectric antennas, Electronic band gap structure and applications, Antenna Measurements-Test Ranges, Measurement of Gain, Radiation pattern, Polarization, VSWR.		
UNIT-V	**PROPAGATION OF RADIO WAVES**	**9 Hours**
Modes of propagation , Structure of atmosphere , Ground wave propagation, Tropospheric propagation , Duct propagation, Troposcatter propagation , Flat earth and Curved earth concept Sky wave propagation – Virtual height, critical frequency , Maximum usable frequency – Skip distance, Fading , Multi hop propagation.		
	Total Hours	**45 Hours**
Text Book(s)		
1.	John D Kraus," Antennas for all Applications", 4th Edition, McGraw Hill, 2010.	
Reference Book(s)		
1.	Edward C. Jordan and Keith G. Balmain" Electromagnetic Waves and Radiating Systems" Prentice Hall of India, 2nd Edition 2011.	
2.	Rajeswari Chatterjee, "Antenna Theory and Practice" Revised Second Edition New Age International Publishers, 2006.	
3.	Constantine.A. Balanis "Antenna Theory Analysis and Design", Wiley Student Edition, 4th Edition, 2016.	
4.	H. Sizun "Radio Wave Propagation for Telecommunication Applications", First Indian Reprint, Springer Publications, 2007.	

Course Code	BECF185EB0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**INFORMATION THEORY AND CODING**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -I	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic Knowledge of Analog and Digital Communication							

Course Objectives:

The course should enable the students:

1. To provide an insight into the concept of information in the context of communication theory and its significance in the design of communication receivers.
2. To explore in detail, the calculations of channel capacity to support error-free transmission and also, the most commonly used source coding and channel coding algorithms.
3. To encourage and train to design coding schemes for data compression and error correction,
4. They will also get an overall perspective of how this impacts the design of an optimum communication receiver.

Course Outcomes:

On completion of the course, the student will be able to:

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Overview of Probability Theory, significance of "Information" with respect to Information Theory.	**K2**
CO2	Derive equations for entropy, mutual information and channel capacity for all kinds of channels.	**K3**
CO3	Implement the various types of source coding algorithms and analyze their performance.	**K4**
CO4	Explain various methods of generating and detecting different types of error correcting codes.	**K3**
CO5	Understand the fundamentals of Field Theory and polynomial arithmetic.	**K2**
CO6	Design linear block codes and cyclic codes (encoding and decoding).	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	M	-	-	-	-	-	-	-	-	-	-	S	L	-
CO2	S	S	L	-	-	-	-	-	-	-	-	-	S	L	-
CO3	S	S	-	M	S	-	-	-	-	-	-	-	S	L	-

CO4	S	S	-	L	-	-	-	-	-	-	-	-	S	L	-
CO5	S	L	-	-	-	-	-	-	-	-	-	-	S	L	-
CO6	S	M	-	-	L	-	-	-	-	-	-	-	S	M	-

UNIT-I	**SOURCE CODING AND ENTROPY**	**9 Hours**

Definition and Examples- Uniquely Decodable Codes-Instantaneous Codes-Constructing Instantaneous Codes- Kraft's Inequality - McMillan Inequality- Information and Entropy- properties of the Entropy function - Entropy and Average Word-Length- Shannon-Fano coding- Entropy of Extensions and products-Shannon's First Theorem.

UNIT-II	**INFORMATION CHANNEL**	**9 Hours**

Information Channel- Definitions- Binary Symmetric channel-System Entropies-system entropies forthe Binary Symmetric Channel-Extension to Shannon's First Theorem to information channels- Mutual Information-Mutual information for the Binary Symmetric channel-Channel Capacity.

UNIT-III	**CHANNELS AND OPTIMAL CODES**	**9 Hours**

Decision rules- Improved Reliability- hamming Distance- Statement and proof of Shannon's Theorem- Converse of Shannon's Theorem- Optimality-Binary Huffman Codes-Average Word-length of Huffman codes-Optimally of Binary Huffman codes-r-ary Huffman codes-Extensions of source.

UNIT-IV	**CYCLIC CODES**	**10 Hours**

Description of cyclic codes- Generator and parity check matrices of Cyclic codes- Encoding of cyclic codes- Cyclic hamming codes- Syndrome Computation and error Detection- Decoding of cyclic codes- Cyclic Hamming Codes- Error- Trapping Decoding- Improved error-Trapping Decoding- The (23,12) Golay code- shortened Cyclic codes-Cyclic Product codes- Quasi-Cyclic codes.

UNIT-V	**CONVOLUTIONAL ARITHMETIC CODES**	**8 Hours**

Encoding of Convolutional codes - Structural properties of Convolutional codes- Distance propertiesof Convolutional codes.

	Total Hours	**45 Hours**

Text Book(s)

1.	N.Abramson, "Information and Coding", McGraw Hill, 1963.
2.	M. Mansurpur, "Introduction to Information Theory", McGraw Hill, 1987.

Reference Book(s)

1.	R.B. Ash, "Information Theory", Prentice Hall, 1970.
2.	Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.
3.	G.A.Jones and J.Mary Jones, "Information and Coding Theory", Springer SUMS.

Course Code	BECF187EJ0	L	T	P	C	IA	EA	TM
Course Name	**ADVANCED MICROCONTROLLERS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -I	**Syllabus Revision**				V.1.0		
Pre-requisite	Microprocessors and Microcontrollers							

Course Objectives:

The course should enable the students :

1. To study architecture and instruction set of RISC and CISC processors.
2. To study architecture and instruction set of R8C microcontroller.
3. To study architecture and instruction set of MSP 430 microcontroller
4. To gain knowledge on development of embedded software.
5. To gain knowledge on development of system and applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Use RISC and CISC processors for system development.	**K3**
CO2	Use R8C microcontroller for system development.	**K3**
CO3	Use MSP 430 microcontroller for system development.	**K3**
CO4	Write software for embedded systems.	**K3**
CO5	Design and develop microcontroller based systems.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	S	S	-	-	-	-	-	-	-	-	L	S	-	-
CO2	S	S	S	-	-	-	-	-	-	-	-	L	S	-	-
CO3	S	S	S	-	-	-	-	-	-	-	-	L	S	-	-
CO4	S	S	S	M	-	-	-	-	-	-	-	L	S	M	-
CO5	S	S	S	M	-	-	-	-	-	-	-	L	S	S	M

UNIT-I	**RISC PROCESSORS**	**9 Hours**

RISC Vs CISC, RISC properties and evolution, Advanced RISC microcontrollers, PIC 8-bit Microcontrollers.

UNIT-II	**R8C 16-BIT MICROCONTROLLER**	**9 Hours**
The R8C Architecture, CPU Registers, Instruction Set, On-Chip Peripherals, R8C Tiny Development Tools, ADC, PWM, UART, Timer Interrupts, System design using R8C Microcontroller.		
UNIT-III	**MSP430 16 - BIT MICROCONTROLLER**	**9 Hours**
The MSP430 Architecture, CPU Registers, Instruction Set, On-Chip Peripherals, MSP430 Development Tools, ADC, PWM, UART, Timer Interrupts, System design using MSP430 Microcontroller.		
UNIT-IV	**EMBEDDED SOFTWARE DEVELOPMENT**	**9 Hours**
Cross development tools, Debugging techniques, Real-time Operating System, Memory Management, scheduling techniques.		
UNIT-V	**SYSTEM DEVELOPMENT**	**9 Hours**
Microcontroller based System Design, Peripheral Interfacing, Inter-Integrated Circuit Protocol for RTC, EEPROM, ADC/DAC, CAN BUS interfacing, Application in Automobiles, Robotic and consumer Electronics.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Julio Sanchez Maria P.Canton, Microcontroller Programming: The microchip PIC, CRCPress, Taylor & Francis Group, 2007.

Reference Book(s)

1.	D. E. Simon, An Embedded Software Primer, Addison-Wesley, 1999.
2.	Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2006.
3.	John H.Davis, MSP 430 Micro controller basics¦ Elsevier, 2008.

Course Code	BECF186EE0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**MULTIMEDIA COMPRESSION TECHNIQUES**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -II	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Coding Theory and Communication Systems							

Course Objectives:

The course should enable the students

1. To have a complete understanding of error–control coding.
2. To understand encoding and decoding of digital data streams.
3. To introduce methods for the generation of the secodes and their decoding techniques.
4. To have a detailed knowledge of compression and decompression techniques.
5. To introduce the concepts of multimedia communication.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Describe various multimedia components.	**K4**
CO2	Describe compression and decompression techniques.	**K4**
CO3	Apply the compression concepts in multimedia communication.	**K3**
CO4	Understand The VOIP Technology.	**K2**
CO5	Describe Multimedia Networking.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	S		-	-	S	-	-	-	-	-	-	-	M	-	-
CO2	S	M	-		S	-	-	-	-	-	-	L	M	L	S
CO3	S	L	-	-	M	-	-	-	-	-	-	L	L	M	S
CO4	S	S	S	-	M	-	-	-	-	-	-	M	L	M	L
CO5	S	S	-	-	M	-	-	-	-	-	-	M	M	M	M

UNIT-I	**MULTIMEDIA COMPONENTS**	**9 Hours**

Introduction - Multimedia skills - Multimedia components and their characteristics - Text, sound, images, graphics, animation, video, hardware.		
UNIT-II	**AUDIO AND VIDEO COMPRESSION**	**9 Hours**
Audio compression–DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive coding-code excited LPC-perpetual coding Video compression–principles-H.261-H.263-MPEG 1, 2, and 4.		
UNIT-III	**TEXT AND IMAGE COMPRESSION**	**9 Hours**
Compression principles-source encoders and destination encoders-lossless and lossy compression- entropy encoding–source encoding-text compression–static Huffman coding dynamic coding–arithmetic coding– Lempel ziv-welsh Compression-image compression.		
UNIT-IV	**VOIP TECHNOLOGY**	**9 Hours**
Basics of IP transport, VoIP challenges, H.323/ SIP –Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service- CODEC Methods- VOIP applicability.		
UNIT-V	**MULTIMEDIA NETWORKING**	**9 Hours**
Multimedia networking -Applications-streamed stored and audio-making the best Effort service-protocols for real time interactive Applications-distributing multimedia-beyond best effort service-secluding and policing Mechanisms-integrated services-differentiated Services-RSVP.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Fred Halshall "Multimedia communication-Applications, Networks, Protocols and Standards", Pearson Education, 2007.

Reference Book(s)

1.	Tay Vaughan, "Multimedia: Making it work", Seventh Edition, TMH, 2008.
2.	Kurose and W.Ross "Computer Networking- a Top Down Approach", Pearson Education, 2005.
3.	Marcus Goncalves "Voice over IP Networks", McGraw Hill,1999
4.	KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education, 2007.
5.	R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education, 1995.

Course Code	BECF186EF0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**NANO ELECTRONICS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -II	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Material Science and Electronics							

Course Objectives:

The course should enable the students

1. To learn and understand basic concepts of Nano Electronics.
2. To learn the concepts of Nano Scale MOSFET Devices.
3. To know the techniques of fabrication and measurement.
4. To gain knowledge about Nanostructure devices.
5. To understand the concepts of Nanostructure logic devices.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand various aspects of Nano-technology and the basics of Quantum Mechanics.	**K2**
CO2	Understand the processes involved in fabrication of Nano materials and components.	**K2**
CO3	Analyze the various concepts of logic devices and to calculate the power dissipation in reversible computation.	**K4**
CO4	Understand the concepts of Nano structured Devices and their functioning.	**K2**
CO5	Leverage advantages of the Nano-materials and appropriate use in solving practical problems.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	M	-	M	L	-	-	-	-	-	-	L	S	-	-
CO2	S	M	-	M	L	-	-	-	-	-	-	L	S	M	-
CO3	S	M	M	-	S	-	-	-	-	-	-	L	S	M	M
CO4	S	M	-	-	L	-	-	-	-	-	-	L	S	M	M
CO5	S	M	M	M	L	-	-	-	-	-	-	L	S	-	M

UNIT-I	**INTRODUCTION TO NANO TECHNOLOGY**	**9 Hours**
Introduction to nano technology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy, Band Theory of Solids, Kronig-Penny Model, Brillouin Zones.		
UNIT-II	**CMOS SCALING AND ITS LIMITS**	**9 Hours**
Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.), Nano Materials - Measurement and Fabrication of Nano materials.		
UNIT-III	**FUNDAMENTALS OF NANOELECTRONICS**	**9Hours**
Fundamentals of logic devices:- physical limits to computations; concepts of logic devices:- classifications – two terminal devices – field effect devices – coulomb blockade devices – spintronics-quantum cellular automata – quantum computing – DNA computer; Ultimate computation:- powerdissipation limit – dissipation in reversible computation.		
UNIT-IV	**NANO STRUCTURE DEVICES**	**9 Hours**
Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation.		
UNIT-V	**LOGIC DEVICES AND APPLICATIONS**	**9 Hours**
Logic Devices-Silicon MOSFETs-Ferroelectric Field Effect Transistors-Quantum Transport Devices Based on Resonant Tunneling-Single-Electron Devices for Logic Applications-Superconductor Digital Electronics-Quantum Computing Using Superconductors-Carbon Nanotubes for Data Processing- Molecular Electronics. MEMS/NEMS, Future applications and Trends.		
	Total Hours	**45 Hours**

Text Book(s)

1.	G.W. Hanson, Fundamentals of Nano electronics, Pearson, 2009.
2.	W. Ranier, Nano electronics and Information Technology, Wiley-VCH, 2003.
3.	K.E. Drexler, Nano systems, Wiley, 1992.
4.	J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press,1998.

Reference Book(s)

1.	CP. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003.

Course Code	BECF187ER0	L	T	P	C	IA	EA	TM
Course Name	RF DESIGN	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -II	Syllabus Revision				V.1.0		
Pre-requisite	Basic knowledge of Electronic Circuits and Microwave Engineering							

Course Objectives:

The course should enable the students

1. To understand the characteristics of active/passive RF devices and components.
2. To learn the characteristics of RF filters.
3. To learn the design of RF amplifiers and Oscillators.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Interpret the properties of passive components at high frequency applications.	K2
CO2	Develop RF filter design at high frequencies.	K4
CO3	Develop RF components for transmission line.	K2
CO4	Develop RF amplifier design.	K3
CO5	Analyze RF circuits.	K3

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	S	M	M	M	-	L	-	-	-	L	-	M	M	M	L
CO2	M	M	M	M	-	L	-	-	-	L	-	M	S	M	L
CO3	M	M	M	M	-	L	-	-	-	L	-	L	S	M	L
CO4	S	M	M	M	-	L	-	-	-	M	-	M	S	M	L
CO5	M	M	M	M	-	S	-	-	-	S	-	L	S	M	L

UNIT-I	RF ISSUES	9 Hours

Importance of RF design, Electromagnetic Spectrum, RF behavior of passive components, Chip components and Circuit Board considerations, Scattering Parameters, Smith Chart and applications.

UNIT-II	RF FILTER DESIGN	9 Hours

Overview, Basic resonator and filter configuration, Special filter realizations, Filter implementations, Coupled filter.		
UNIT-III	**ACTIVE RF COMPONENTS & APPLICATIONS**	**9 Hours**
RF diodes, BJT, RF FETs, High electron mobility transistors; Matching and Biasing Networks – Impedance matching using discrete components, Micro-strip line matching networks, Amplifier classes of operation and biasing networks.		
UNIT-IV	**RF AMPLIFIER DESIGNS**	**9 Hours**
Characteristics, Amplifier power relations, Stability considerations, Constant gain circles, Constant VSWR circles, Low Noise circuits, Broadband , high power and multistage amplifiers.		
UNIT-V	**OSCILLATORS, MIXERS & APPLICATIONS**	**9 Hours**
Basic Oscillator model, High frequency oscillator configuration, Basic characteristics of Mixers; Phase Locked Loops; RF directional couplers and hybrid couplers; Detector and demodulator circuits.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2001.
2.	Pozar, Microwave Engineering, John Wiley, Third Edition, 2004.
Reference Book(s)	
1.	Joseph. J. Carr, Secrets of RF Circuit Design, McGrawHill, Third Edition, 2000.
2	Mathew M . Radmanesh, Radio Frequency & Microwave Electronics, Pearson, 2001

Course Code	BECF187EG0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**DIGITAL IMAGE & VIDEO PROCESSING**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -III	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Signals & Systems, Digital Signal Processing andDigital System Design							

Course Objectives:

The course should enable the students

1. To study the concepts of complexity of algorithms and understand the analysis of algorithms based on input size.
2. To learn advanced data structure and their fundamentals for application development.
3. To learn use of greedy and dynamic programming techniques and their application in the field of computer science to solve problems.
4. To learn algorithms for graph theory problem like spanning tree problem, single source shortest path and advance features of graph application in field of computer science.
5. To learn string matching algorithms and, P, NP problem in computer science domain.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand theory and models in Image and Video Processing.	**K2**
CO2	Explain the need of spatial and frequency domain techniques for image compression.	**K3**
CO3	Comprehend different methods, models for video processing and motion estimation.	**K3**
CO4	Illustrate quantitative models of image and video segmentation.	**K4**
CO5	Apply the process of image enhancement for optimal use of resources.	**K3**
CO6	Compose various Morphological operations on binary images and Generate their transformed images.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	L	L	M	M	L	-	L	-	-	L	-	S	M	M	-
CO2	M	M	M	L	-	M	L	-	-	L	-	S	M	M	-
CO3	S	M	M	L	-	M	M	-	-	L	-	S	S	M	-
CO4	S	M	M	M	S	L	M	-	-	L	-	S	S	M	-

CO5	L	L		S	-	M	L	-	-	L	-	S	S	M	-
CO6	M	M	M	M	-	L	L	-	-	L	-	S	S	M	-

UNIT-I	**DIGITAL IMAGE FUNDAMENTALS**	**9 Hours**

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - color models. – Neighborhood, adjacency, connectivity, distance measures.

UNIT-II	**IMAGE ENHANCEMENT**	**9 Hours**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering – Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters. Color Image Processing-Color models–RGB, YUV, HSI; Color transformations–formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

UNIT-III	**IMAGE RESTORATION AND SEGMENTATION**	**9 Hours**

Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering Segmentation: Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation- Morphological processing- erosion and dilation.

UNIT-IV	**WAVELETS AND IMAGE COMPRESSION**	**9 Hours**

Wavelets and Multi-resolution image processing, wavelets and Sub band filter banks, wavelet packets, Image Compression-Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression- predictive and transform coding; Discrete Cosine Transform; Still image compression standards – JPEG and JPEG-2000.

UNIT-V	**VIDEO PROCESSING**	**9 Hours**

Fundamentals of Video Coding- Inter-frame redundancy, motion estimation techniques – full search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X. Video Segmentation- Temporal segmentation–shot boundary detection, hard-cuts and soft-cuts; spatial segmentation – motion-based; Video object detection and tracking.

	Total Hours	**45 Hours**

Text Book(s)

1.	R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education, 2008
2.	Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 2nd edition, 2004.
3.	Murat Tekalp , "Digital Video Processing" Prentice Hall, 2nd edition 2011.

Course Code	BECF187EH0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**WIRELESS SENSOR NETWORKS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -III	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Data Communication Networks							

Course Objectives:

The course should enable the students

1. To understand the basics of Wireless sensor Networks.
2. To learn the Architecture of WSN.
3. To understand the concept of Networking and Networking in WSN.
4. To learn the sensor node hardware platform and software platforms.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Define the overview of wireless sensor networks and enabling technologies for wireless sensor networks.	**K2**
CO2	Apply the design principles of WSN architectures and operating systems for simulating environment situations.	**K3**
CO3	Apply various concepts for assignment of MAC addresses.	**K4**
CO4	Analyse the appropriate infrastructure, topology, joint routing and information aggregation for wireless sensor networks.	**K4**
CO5	Analyse the sensor network platform and tools state-centric programming.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	M	L	-	-	-	-	-	-	-	-	-	-	L	-	-
CO2	S	M	-	-	-	-	-	-	-	-	-	-	M	-	-
CO3	S	M	L	-	L	-	-	-	-	-	-	-	-	-	-
CO4	S	S	M	M	M	-	-	-	-	-	-	-	-	L	-
CO5	S	S	M	S	S	-	-	-	-	-	-	-	-	M	M

UNIT-I	**OVERVIEW OF WIRELESS SENSOR NETWORKS**	**9 Hours**

Single-Node Architecture - Hardware Components- Network Characteristics- unique constraints and challenges, Enabling Technologies for Wireless Sensor Networks- Types of wireless sensor networks.

UNIT-II	**ARCHITECTURES**	**9 Hours**
Network Architecture- Sensor Networks-Scenarios- Design Principle, Physical Layer and Transceiver Design Considerations, Optimization Goals and Figures of Merit, Gateway Concepts, Operating Systems and Execution Environments- introduction to TinyOS and nesC- Internet to WSN Communication.		
UNIT-III	**NETWORKING SENSORS**	**9 Hours**
MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, - B-MAC Protocol, IEEE 802.15.4 standard and ZigBee, the Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols Energy-Efficient Routing, Geographic Routing.		
UNIT-IV	**INFRASTRUCTURE ESTABLISHMENT**	**9 Hours**
Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.		
UNIT-V	**SENSOR NETWORK PLATFORMS AND TOOLS**	**9 Hours**
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
2.	Feng Zhao & Leonidas J.Guibas,“Wireless Sensor Networks - An Information Processing Approach", Elsevier, 2007.
3.	Waltenegus Dargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks - Theory And Practice”, By John Wiley & Sons Publications, 2011.

Reference Book(s)

1.	KazemSohraby, Daniel Minoli, & TaiebZnati, “Wireless Sensor Networks-Technology, Protocols, And Applications”, John Wiley, 2007.
2.	Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.

Course Code	BECF187EI0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ASIC DESIGN**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -III	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Digital System Design and VLSI							

Course Objectives:

The course should enable the students

1. Explain the types of ASICs and design flows.
2. Give the students an understanding of HDL coding guidelines and synthesizable HDL constructs.
3. Explain the RTL synthesis Flow with respect to different cost function..
4. Discuss the various abstraction levels in physical design and guidelines at each abstraction level.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand different types of ASICs and design flows.	**K2**
CO2	Understand concept of different programmable device.	**K5**
CO3	Discuss various types of CLB design by adhering to guidelines.	**K3**
CO4	Design digital systems by adhering to synthesizable HDL constructs	**K5**
CO5	To understand the logic of Floor planning, placement and Routing.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	M	M	L	-	L	-	-	-	-	M	-	S	M	S
CO2	S	M	M	-	-	L	-	-	-	-	M	-	S	M	S
CO3	S	M	M	L	-	M	-	-	-	-	S	-	S	M	S
CO4	S	M	M	L	-	M	-	-	-	-	M	-	S	M	S
CO5	S	M	M	-	-	M	-	-	-	-	M	-	S	M	S

UNIT-I	**INTRODUCTION TO ASICS, CMOS LOGIC & ASIC LIBRARY**	**9 Hours**

Types of ASICs - Design flow - CMOS transistors CMOS Design rules - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors – Transistor Parasitic Capacitance- Logical effort –Library cell design - Library architecture.

UNIT-II	**PROGRAMMABLE ASICS, ASIC LOGIC CELLS AND ASIC I/O CELLS**	**9 Hours**
Anti-fuse - static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT-Xilinx LCA –Altera FLEX-Altera MAX DC & AC inputs and outputs-Clock & Power inputs-Xilinx I/O blocks.		
UNIT-III	**PROGRAMMABLE ASIC INTERCONNECT, ASIC DESIGN SOFTWARE AND LOW LEVEL DESIGNENTRY**	**9 Hours**
Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 – Altera FLEX – Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools -EDIF- CFI design representation.		
UNIT-IV	**LOGIC SYNTHESIS, SIMULATION AND TESTING**	**9 Hours**
Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test- fault simulation - automatic test pattern generation.		
UNIT-V	**ASIC CONSTRUCTION, FLOOR PLANNING, PLACEMENT & ROUTING**	**9 Hours**
System partition - FPGA partitioning - partitioning methods - floor planning - placement - physical design flow–global routing-detailed routing-special routing-circuit extraction -DRC.		
	Total Hours	**45 Hours**

Text Book(s)

1.	M.J.S .Smith, "Application Specific Integrated Circuits, Addison -Wesley Longman Inc., 1997.

Reference Book(s)

1.	Farzad Nekoogar and Faranak Nekoogar, From ASICs to SOCs: A Practical Approach, Prentice Hall PTR, 2003.
2.	Wayne Wolf, FPGA-Based System Design, Prentice Hall PTR, 2004.
3.	R. Rajsuman, System-on-a-Chip Design and Test. Santa Clara, CA: Artech House Publishers, 2000.
4.	F.Nekoogar. Timing Verification of Application-Specific Integrated Circuits (ASICs). Prentice Hall PTR,1999.
5.	Malcolm R.Haskard, Can C.May, Analog VLSI Design – NMOS and CMOS, Prentice Hall,1988.

Course Code	BECF185EC0	L	T	P	C	IA	EA	TM
Course Name	**INTRODUCTION TO MEMS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -III	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic Knowledge of Integrated Circuits, Measurement & Instrumentation							

Course Objectives:

The course should enable the students

1. To introduce the concepts of micro and nano electromechanical devices.
2. To know the fabrication process of Microsystems.
3. To know the design concepts of micro sensors and micro actuators.
4. To understand application of MEMS in different industries & provides real-world case studies.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the historical background of MEMS development and the impact of MEMS on technology advancement.	**K2**
CO2	Recognize the use of materials in micro fabrication and describe the fabrication processes including surface micromachining, bulk micromachining and LIGA.	**K2**
CO3	Analyze the key performance aspects of electromechanical transducers including sensors and actuators.	**K3**
CO4	Analysis of micromachining technique for a specific MEMS fabrication process.	**K4**
CO5	Analysis of MEMS applications in different industries.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	S	L	-	L	-	-	-	-	-	-	-	-	-	-	-
CO3	S	M	-	M	-	-	-	-	-	-	-	-	S	-	-
CO4	S	M	L	M	-	-	-	-	-	-	-	-	-	M	-
CO5	S	S	M	M	M	-	-	-	-	-	-	-	S	M	L

UNIT-I	INTRODUCTION	9 Hours

Introduction and Historical Background of MEMS development, intrinsic characteristics of

MEMS, Overview of Micro fabrication, Microelectronics Fabrication Process flow, Process selection and Design.		
UNIT-II	**SENSORS AND ACTUATORS**	**9 Hours**
Introduction to electrostatic sensors and actuators – parallel plate capacitors and applications – Inertia sensor, pressure sensor, flow sensor, tactile sensor, parallel-plate actuators, Thermal Sensors and actuators. Piezo resistive sensors – piezo resistive sensor materials, stress analysis of mechanical elements and applications. Piezoelectric sensing and actuators – Quartz, PZT, PVDF, ZnO.		
UNIT-III	**LITHOGRAPHY (LIGA) AND ETCHING TECHNIQUE**	**9 Hours**
Lithography's origin, Overview of photolithography, Lithography sensitivity and intrinsic resist sensitivity, resolution in photolithography and its enhancement technique, Dry Etching: Definitions and Jargon, Physical etching, plasma etching, Deep reactive Ion etching, Comparing Wet and Dry etching.		
UNIT-IV	**SURFACE MICROMACHINING**	**9 Hours**
Introduction, Mechanical properties of Thin films, Surface Micromachining processes, Poly-Si surface Micromachining modifications, comparison of bulk micromachining and surface micromachining. Top-Down and Bottom-Up micromachining technique.		
UNIT-V	**APPLICATIONS AND CASE-STUDIES**	**9 Hours**
MEMS in Automotive market, MEMS in Medical and Biomedical Market, Environmental Monitoring, Industrial/Automation, IT/Peripheral, Telecommunication. CASE-STUDIES: Blood Pressure (BP) Sensor, Microphone, Acceleration sensor, Gyros.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	"Foundation of MEMS" Chang Liu, Second Edition, Parson, 2012.
2.	"Fundamentals of Micro fabrication – The Science of Miniaturization" Marc J.Madou, Second Edition, CRC Press, 2011.
Reference Book(s)	
1.	"Micro and Smart Systems" – Anantha suresh & Gopal Krishnan - Wiley India.
2.	"Microsystem Design" - S.D.Senturia, Kluwer Academic Publishers.
3.	"MEMS and Microsystems Design and Manufacture", Tai Ran Hsu,TataMcraw Hill, 2002.
4.	"MEMS and NEMS: Systems, Devices, and Structures" Sergey Edward Lyshevski, CRC Press,2002.

Course Code	BECF187EK0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**MOBILE COMMUNICATION AND NETWORKS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -IV	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge of Digital Communication and Antennas							

Course Objectives:

The course should enable the students

1. To describe the evolution and history of wireless technology and to understand the concept of frequency reuse, cell splitting, sectoring.
2. To understand the fundamental techniques about different fading effects.
3. To analyze the importance of frequency independent antennas and various antenna arrays.
4. To design and implement systems with transmit / receive diversity.
5. To analyze the performance of MIMO systems.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Demonstrate an understanding on functioning of various example wireless communication systems, their evolution and standards.	**K6**
CO2	Demonstrate an understanding on signal propagation in cellular environment.	**K6**
CO3	Develop the mathematical tool to analyze radiation characteristics of antennas for wireless applications.	**K4**
CO4	Understanding of different diversity scheme to enhance system performance.	**K3**
CO5	Application of concepts and techniques from Multiple-Input Multiple-Output (MIMO) theory to communication systems.	**K5**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	M	L	-	-	-	-	M	S	-	L	S	M	S
CO2	S	M	S	M	-	-	-	-	M	L	-	M	S	M	M
CO3	M	L	S	L	-	-	-	-	L	M	-	M	S	L	M
CO4	M	L	M	L	-	-	-	-	M	M	-	M	S	L	M

CO5	M	L	S	L	-	-	-	-	L	S	-	S	S	M	M

UNIT-I	**CELLULAR CONCEPTS**	**9 Hours**

Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

UNIT-II	**THE WIRELESS CHANNEL**	**9 Hours**

Signal Propagation-Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels -Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

UNIT-III	**ANTENNAS FOR MOBILE TERMINALS**	**9 Hours**

Capacity of flat and frequency selective channels, Antennas- Antennas for mobile terminal monopoleantennas, PIFA, base station antennas and arrays

UNIT-IV	**MULTI-ANTENNA COMMUNICATION**	**9 Hours**

Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit Diversity-Altamonte scheme.

UNIT-V	**MIMO AND MULTIPLEXING**	**9 Hours**

MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff. Performance measures- Outage, average SNR, average symbol/bit error rate. System examples- GSM,EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Total Hours	**45 Hours**

Text Book(s)

1.	WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2.	WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.

Reference Book(s)

1.	Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
2.	AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
3.	VK Garg&JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

Course Code	BECF187EL0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**CMOS IC DESIGN**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -IV	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge of VLSI Design							

Course Objectives:

The course should enable the students

1. To understand MOS Devices and CMOS IC's.
2. Design of a CMOS Amplifier, CMOS oscillator circuits and comparators.
3. Understand combinational circuit design.
4. To discuss sequential circuit design and memory devices.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Design different CMOS circuits using various logic families along with their circuit layout.	**K4**
CO2	Understand the concepts of MOS Design.	**K2**
CO3	Design and analysis of Combinational and Sequential MOS Circuits.	**K4**
CO4	Extend the Digital IC Design to Different Applications.	**K3**
CO5	Understand the Concepts of Semiconductor Memories, Flash Memory, RAM array organization.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	M	L	-	L	-	-	-	-	-	-	S	M	M
CO2	S	M	M	-	-	L	L	-	M	-	L	-	S	M	M
CO3	S	M	M	L	-	M	-	-	M	-	M	-	S	L	M
CO4	S	M	M	L	-	M	-	-	M	-	M	-	S	L	M
CO5	S	M	M	-	-	M	-	-	-	-	L	-	S	M	M

UNIT-I	**INTRODUCTION, DESIGN ISSUES AND MANUFACTURING PROCESS**	**9 Hours**

A Historical Perspective, Issues in Digital Integrated Circuit Design, Quality Metrics of a Digital Design, Introduction to Manufacturing Process, Manufacturing CMOS Integrated Circuits,

IntegratedCircuit Layout: Design Rules, Parasitics.		
UNIT-II	**INTERCONNECT AND DELAY MODELS**	**9 Hours**
Interconnect Modelling: Capacitive Parasitics, Resistive Parasitics, Inductive Parasitics, Advanced Interconnect Techniques. **Delay Model & Robustness**: Introduction, RC Delay model, Linear Delay model, logical path effortsof paths. Robustness: Variability- Reliability- Scaling-Variation Tolerant design.		
UNIT-III	**COMBINATIONAL CIRCUIT DESIGN**	**9 Hours**
Review of Circuit Families, Circuit pitfalls and Fallacies- the CMOS Inverters and CMOS Logic Gates – Static View: Introduction to CMOS Inverter, The Static CMOS Inverter – An Intuitive Perspective, Evaluating the Robustness of the CMOS Inverter, Introduction to Static CMOS Design, Complementary CMOS, Ratioed Logic, Pass-Transistor Logic. CMOS Inverter: Dynamic View: Performance of CMOS Inverter: The Dynamic Behavior, Power, Energy, and Energy-Delay, Perspective: Technology Scaling and its Impact on the Inverter Metrics.		
UNIT-IV	**SEQUENTIAL CIRCUIT DESIGN**	**9 Hours**
Static and Dynamic Sequential Circuits -Static Latches and Registers, Dynamic Latches and Registers, Alternative Register Styles: Pulse Registers and Sense-Amplifier Based Registers, Pipelining: An Approach to Optimize Sequential Circuits – Latch Vs Register-Based Pipelines – A Logic Style for Pipelined Structures, Non bistable Sequential Circuits.		
UNIT-V	**DESIGN OF ABB AND MEMORY STRUCTURES**	**9 Hours**
Arithmetic Building Blocks: Introduction, Data paths in Digital Processor Architecture, The Adder, The Multiplier, The Shifter, Other Arithmetic Operators, Power and Speed Trade-off's in Data path Structures, Perspective: Design as a Trade-off. **Memory and Array Structures**: Introduction, The Memory Core, Memory Peripheral Circuitry, Memory Reliability and Yield, Power Dissipation in Memories, Case Studies in Memory Design: The PLA, A 4-Mbit SRAM and A 1-Gbit NAND Flash memory, Perspective: Semiconductor Memory Trends and Evolution.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits – A Design Perspective, 2nd edn., Pearson Education, 2003.
2.	Digital Integrated Circuits – A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2nd Ed., PHI.
Reference Book(s)	
1.	N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India, 2011.
2.	C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.

3.	J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.
4.	P. Douglas, VHDL: programming by example, McGraw Hill, 2013.
5.	L. Glaser and D. Dobberpuhl, Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

Course Code	BECF187EM0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**SPEECH AND AUDIO PROCESSING**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -IV	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge Signal & Systems and Digital Signal Processing							

Course Objectives:

The course should enable the students

1. To introduce speech production and related parameters of speech.
2. To learn the computation and use of techniques in the analysis of speech.
3. To understand different speech modeling procedures and their implementation issues.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	To understand basic concepts and methodologies for the analysis and modeling of speech signal.	**K2**
CO2	To understand the mechanism of speech and audio perception, and the motivation of short-term analysis of speech and audio.	**K3**
CO3	Analyze the quality and properties of speech signal.	**K4**
CO4	To perform the analysis of speech signal using LPC.	**K4**
CO5	Identify different problems in real time speech processing.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	L	-	L	-	-	-	-	-	-	-	-	S	S	L
CO2	S	M	-	L	-	-	-	-	-	-	-	-	S	M	-
CO3	S	M	L	M	M	-	-	-	-	-	-	-	M	S	L
CO4	S	S	M		M	-	-	-	-	-	-	-	S	M	-
CO5	S	M	-	M	S	-	-	-	-	-	-	M	S	S	M

UNIT-I	**INTRODUCTION TO SPEECH PRODUCTION AND**	**9 Hours**

	MODELING	
Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness. Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.		
UNIT-II	**LINEAR PREDICTION OF SPEECH**	**9 Hours**
Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals – prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.		
UNIT-III	**SPEECH QUANTIZATION**	**9 Hours**
Scalar quantization–uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.		
UNIT-IV	**SCALAR QUANTIZATION OF LPC**	**9 Hours**
Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF Linear Prediction Coding- LPC model of speech production; Structures of LPC encoders and decoders; Voicing detection; Limitations of the LPC model.		
UNIT-V	**CODE EXCITED LINEAR PREDICTION**	**9 Hours**
CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zero-state method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP. Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729 standards.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	"Digital Speech" by A.M.Kondoz, Second Edition, Wiley, 2004.
2.	"Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu,Wiley Inter science, 2003.
Reference Book(s)	
1.	Ben Gold And Nelson Morgan, "Speech And Audio Signal Processing, Processing AndPerception Of Speech And Music", Wiley- India Edition, 2006.

Course Code	BECF187EN0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**HIGH SPEED ELECTRONICS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -IV	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic Knowledge in Electronic Circuits and Transmission Lines							

Course Objectives:

The course should enable the students -

1. To understand significance and the areas of application of high-speed electronics circuits.
2. To understand the importance of high-speed electronics circuits in various applications.
3. To learn the characteristics of various components used in high speed electronics.
4. To implement the design of High-speed electronic system using those components.
5. To understand the significance of noise analysis.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand significance and the areas of application of high-speed electronics circuits.	**K2**
CO2	Understand the properties of various components used in high speed electronics.	**K2**
CO3	Design High-speed electronic system using appropriate components.	**K6**
CO4	Understand about CAD tools for PCB Design.	**K2**
CO5	Understand about noise analysis.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	L	S	M	-	-	-	-	-	-	-	-	-	M	-	-
CO2	M	L			-	-	-	-	-	-	-	L	L	-	-
CO3	S	L	S	-	-	-	-	-	-	-	-	L	M	L	
CO4	S		S		S	-	-	-	-	-	-	L	M	M	
CO5	M	S	-	-	-	-	-	-	-	-	-	L	M	-	M

UNIT-I	**TRANSMISSION LINE THEORY CROSSTALK AND NONIDEAL EFFECTS**	**9 Hours**

Signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency power delivery, methodologies for design of high speed buses; radiated emissions and minimizing system noise.		
UNIT-II	**DEVICES**	**8 Hours**
Passive and active, Lumped passive devices (models), Active (models, low vs. high frequency).		
UNIT-III	**RF AMPLIFIER**	**10 Hours**
Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages Mixers –Up conversion Down conversion, Conversion gain and spurious response. Oscillators.		
UNIT-IV	**PRINCIPLES**	**9 Hours**
PLL Transceiver architectures Printed Circuit Board Anatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.		
UNIT-V	**NOISE ANALYSIS**	**9 Hours**
Sources, Noise Figure, Gain compression, Harmonic distortion, Inter-modulation, Cross-modulation, Dynamic range.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", August 2000, Wiley-IEEE.

Reference Book(s)

1.	Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 2004.
2.	Behzad Razavi, "RF Microelectronics", Prentice-Hall 1998.
3.	Guillermo Gonzalez, "Microwave Transistor Amplifiers", 2nd Edition, Prentice Hall.
4.	Kai Chang, "RF and Microwave Wireless systems", Wiley, 2000.
5.	R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011.
6.	Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 2004.

Course Code	BECF187EO0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**BIO-MEDICAL ELECTRONICS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -V	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic Knowledge in Electronic Devices and Circuits							

Course Objectives:

The course should enable the students

1. To learn the electrical and non-electrical physiological measurements.
2. To understand the basic theory of Bio potential Electrodes and Bio potential measurement.
3. To understand the function of bio amplifiers.
4. To know the configuration of various electrodes.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Describe the electrode behaviour and circuit models.	**K2**
CO2	Describe the fundamentals of Bio potential recording.	**K2**
CO3	Design various bio amplifiers.	**K5**
CO4	Measure various nonelectrical physiological parameters.	**K3**
CO5	Measure various biochemical parameters.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	L	-	-	S	L	-	M	-	S	M	M	L	S
CO2	S	L	M	-	-	S		-	M	-	M	M	M	L	S
CO3	M	L	-	-	-	M	L	-	M	-	M	M	M	L	S
CO4	L	M	L	-	-	L		-	L	-	S	L	M	M	S
CO5	S	L	-	-	-	M	L	-	L	-	S	L	S	M	S

UNIT-I	**BIO POTENTIAL ELECTRODES**	**9 Hours**

Origin of bio potential and its propagation, Electrode-electrolyte interface, electrode–skin interface, half cell potential, impedance, polarization effects of electrode – non polarisable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits, Recording problems - measurement with two electrodes.

UNIT-II	**ELECTRODE CONFIGURATIONS**	**9 Hours**
Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode, EMG– unipolar andbipolar mode.		
UNIT-III	**BIO AMPLIFIER**	**9 Hours**
Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier – right leg driven ECG amplifier. Bands pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier, Power line interference.		
UNIT-IV	**MEASUREMENT OF NON-ELECTRICAL PARAMETERS**	**9 Hours**
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers- systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.		
UNIT-V	**BIO-CHEMICAL MEASUREMENT**	**9 Hours**
Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), immunologically sensitive FET (IMFET), Blood glucose sensors - Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).		
	Total Hours	**45 Hours**

Text Book(s)

1.	John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons,2004.
2.	Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 2003.

Reference Book(s)

1.	Leslie Cromwell, "Biomedical Instrumentation and measurement", PHI, 2007.
2.	Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill,2003.
3.	Joseph J. Carr & John M. Brown, "Introduction to Biomedical Equipment Technology", PearsonEducation, 2004.

Course Code	BECF187EP0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**MIXED SIGNAL DESIGN**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -V	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic Knowledge in Signals & Systems and Analog Electronics							

Course Objectives:

The course should enable the students

1. To understand the analysis of mixed signals for various applications.
2. To learn the inter-conversions between signals.
3. To design systems involving mixed signals.
4. To discuss different types of data convertors.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the practical situations where mixed signal analysis is required.	**K3**
CO2	Analyze and handle the inter-conversions between signals.	**K3**
CO3	Design different types of data convertors.	**K4**
CO4	Design systems involving mixed signals.	**K4**
CO5	Understand the Concepts of frequency synthesizers.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	M	L	-	L	-	-	-	-	M	-	S	L	M
CO2	S	M	M	-	-	L	-	-	-	-	M	-	S	L	M
CO3	S	M	M	L	-	M	-	-	-	-	S	-	S	L	M
CO4	S	M	M	L	-	M	-	-	-	-	M	-	S	L	M
CO5	S	M	M	-	-	M	-	-	-	-	M	-	S	M	M

UNIT-I	**ANALOG AND DISCRETE-TIME SIGNAL PROCESSING**	**9 Hours**

Introduction to sampling theory; Analog continuous-time filters: passive and active filters; Basics ofanalog discrete-time filters and Z-transform.

UNIT-II	**SWITCHED CAPACITOR FILTERS**	**9 Hours**
Non idealities in switched-capacitor filters; Switched-capacitor filter architectures; Switched-capacitorfilter applications.		
UNIT-III	**BASICS OF DATA CONVERTERS**	**9 Hours**
Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADCstructures, High-resolution ADCs, DACs.		
UNIT-IV	**MIXED SIGNAL LAYOUT**	**9 Hours**
Interconnects and data transmission; Voltage-mode signaling and data transmission; Current-mode signaling and data transmission.		
UNIT-V	**INTRODUCTION TO FREQUENCY SYNTHESIZERS & SYNCHRONIZATION**	**9 Hours**
Basics of PLL, Analog PLLs; Digital PLLs, DLLs.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008.
2.	BehzadRazavi , Design of analog CMOS integrated circuits, McGraw-Hill, 2003.
3.	R. Jacob Baker, CMOS circuit design, layout and simulation, revised second edition, IEEE press, 2008.
4.	Rudy V. dePlassche, CMOS Integrated ADCs and DACs, Springer, Indian edition, 2005.
Reference Book(s)	
1.	Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill, 1981.
2.	R. Schauman, Design of analog filters, Prentice-Hall 1990.
3.	M. Burns et al., An introduction to mixed-signal IC test and measurement, Oxford universitypress, first Indian edition, 2008.

Course Code	BECF187EQ0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ADAPTIVE SIGNAL PROCESSING**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -V	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic Knowledge in Signals & Systems and Digital Signal Processing							

Course Objectives:

The course should enable the students

1. To introduce the adaptive filter for estimation and tracking.
2. To develop various adaptive algorithms for communication systems.
3. To apply the adaptive theory to a variety of practical problems.
4. This course demonstrates the design of important class of adaptive filters, LMS, RLS and Kalman filters.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Able to analyze the filtering tasks and identify the need for adaptation in filtering.	**K3**
CO2	Able to design filter to meet performance requirements derived from various real life applications.	**K2**
CO3	Able to develop algorithms for the design of filters to track variations of non-stationary random process.	**K3**
CO4	Able to evaluate the performance of the developed filter in terms of computational complexity convergence time and stability.	**K4**
CO5	Implement LMS algorithm for signal processing applications.	**K3**
CO6	Design kalman filter for adaptive noise cancellation.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M	L	L	L	L	-	-	-	-	-	-	M	-	-
CO2	S	M	L	M	L	L	-	-	-	-	-	-	M	-	-
CO3	S	L	M	S	L	L	-	-	-	-	-	-	S	-	-
CO4	M	M	M	S	L	L	-	-	-	-	-	-	S	-	-
CO5	M	M	S	L	M	M	-	-	-	-	-	M	L	M	-

CO6	M	M	M	L	S	S	-	-	-	-	-	M	L	M	-

UNIT-I	**INTRODUCTION TO ASP**	**9 Hours**

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

UNIT-II	**LMS AND FILTERS**	**9 Hours**

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complex valued The LMS algorithm (real, complex), convergence analysis, weight error correlation matrix, excess mean squareerror and MIS-adjustment.

UNIT-III	**LMS ALGORITHM**	**9 Hours**

Variants of the LMS algorithm the sign LMS family, normalized LMS algorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering. Signal space concepts - introduction to finite dimensional vector space theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, Gram Schmidt orthogonalization, concepts of orthogonal projection, orthogonal decomposition of vector spaces.

UNIT-IV	**RANDOM VARIABLES**	**9 Hours**

Vector space of random variables, correlation as inner product, forward and backward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

UNIT-V	**INTRODUCTION TO RECURSIVE LEAST SQUARES**	**9 Hours**

Vector space formulation of RLS estimation, pseudo inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

	Total Hours	**45 Hours**

Text Book(s)

1.	S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
2.	C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

Reference Book(s)

1.	Adaptive Signal Processing, Bernie Widrow and Stearns, Prentice Hall.
2.	Fundamentals of Adaptive Filtering, Ali Sayed, Wiley, 2003.
3.	Kernel Adaptive Filtering, Liu, Principe and Haykin, Wiley, 2010.

Course Code	BECF187OEL	L	T	P	C	IA	EA	TM
Course Name	**ADHOC NETWORKS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -V	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Data Communication Networks							

Course Objectives:

At the end of the course, the student will be able:

1. To study the wireless networks.
2. To understand the concept of wireless protocols.
3. Provide an overview of Transport layer and Security Protocols.
4. To understand the concept of Wireless Sensor Networks.
5. To enable the learner to identify the different methods of battery and system power management.

Course Outcomes:

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

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	At the end of the course, the student should be able to: Ad hoc networks will give ability to a student to know the concepts of different wireless networks.	**K2**
CO2	This course is aimed to offer training which prepare students to embark on MAC and Multicast routing protocols.	**K2**
CO3	Analyze the Transport layer and Security protocols for real time applications.	**K4**
CO4	Students can find the solutions and design of wireless sensor networks.	**K6**
CO5	Gain knowledge about the concepts of different energy management schemes.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	-	-	-	S	M	-	-	-	L	-	M	M	-	S
CO2	S	M	-	M	S	L	-	-	-	M	-	M	M	-	S
CO3	S	M		M	S	M	-	-	-	M	-	M	L	-	S
CO4	S	M	M	L	M	M	-	-	-	L	-	L	L	-	S

CO5	S	L	M	M		M	L	-	-	L	-	L	M	M	S

UNIT-I	**INTRODUCTION TO WIRELESS NETWORKS**	**9 Hours**

Characteristics of wireless channels, Fundamentals of WLANs, IEEE 802.11 standard, HIPERLAN Standard, First-, Second, third and beyond 3G - generation cellular systems, WLL, Wireless ATM, IEEE 802.16 standard, HIPERACCESS, AdHoc Wireless Internet.

UNIT-II	**MAC, ROUTING AND MULTICAST ROUTING PROTOCOLS**	**9 Hours**

MAC Protocols: Design issues, goals and classification, Contention –based protocols with reservation and scheduling mechanisms, Protocols using directional antennas. Routing protocols: Design issues and classification, Table-driven, On-demand and Hybrid routing protocols, Routing protocols with efficient flooding mechanisms, Hierarchical and power-aware routing protocols. Multicast Routing Protocols: Design issues and operation, Architecture reference model, classification, Tree based and Mesh-based protocols, Energy-efficient multicasting.

UNIT-III	**TRANSPORT LAYER AND SECURITY PROTOCOLS**	**9 Hours**

Transport layer Protocol: Design issues, goals and classification, TCP over Ad Hoc wireless Networks, Security, Security requirements, Issues and challenges in security provisioning, Network security attacks, Security routing. Quality of Service: Issues and challenges in providing QoS, Classification of QoS solutions, MAC layer solutions, Network layer solutions, QoS frameworks.

UNIT-IV	**WIRELESS SENSOR NETWORKS**	**9 Hours**

Architecture, Data dissemination, Date gathering, MAC protocols, location discovery, Quality of a sensor network.

UNIT-V	**ENERGY MANAGEMENT**	**9 Hours**

Classification of battery management schemes, Transmission power management schemes, System power management schemes. Performance Analysis -ABR beaconing, Performance parameters, Route-discovery time, End-to-end delay performance, Communication throughput performance, Packet loss performance, Route reconfiguration repair time, TCP/IP based applications.

Total Hours	**45 Hours**

Text Book(s)

1.	C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004.
2.	C.K.Toh, AdHoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall PTR, 2001.

Reference Book(s)	
1.	Mohammad Ilyas, The Handbook of AdHoc Wireless Networks, CRC press, 2002.
2.	Charles E. Perkins, AdHoc Networking, Addison – Wesley, 2000.
3.	Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile AdHocNetworking, Wiley – IEEE press, 2004.

Course Code		L	T	P	C	IA	EA	TM
Course Name	**EMBEDDED PRODUCT DEVELOPMENT**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -V	**Syllabus Revision**				V.1.0		
Pre-requisite	Embedded Systems							

Course Objectives:

The course should enable the students

1. To provide the basic concepts of product design, product features and its architecture.
2. To introduce the possible approaches for product development.
3. To understand the concepts of industrial design strategies.
4. To explore the stages of electronic product development.
5. To study about the embedded product design.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Use the integration of customer requirements in product design.	**K2**
CO2	Apply structural approach to concept generation, creativity, selection and testing.	**K3**
CO3	Outline various aspects of design such as industrial design, design of Consumer specific product and product architecture.	**K2**
CO4	Define various aspects of its Reverse Engineering manufacture, economic analysis.	**K3**
CO5	Design an embedded product.	**K3**
CO6	Apply the various tool to design and simulate the performance of the product.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	M	S	M	S	M	M	L	M	L	L	L	S	S	M
CO2	S	M	S	M	S	M	M	L	M	L	M	S	L	S	L
CO3	S	M	S	M	S	M	M	L	M	L	M	M	S	M	M
CO4	S	M	S	M	S	M	M	L	M	L	M	L	S	L	M
CO5	S	M	S	M	S	M	M	L	M	L	L	L	S	S	L
CO6	M	L	M	-	M	-	-	L	-	-	-	-	L	S	M

UNIT-I	CONCEPTS OF PRODUCT DEVELOPMENT	9 Hours
Need for PD- Generic product Development Process Phases- Product Development Process Flows- Product Development organization structures Strategic importance of Product Planning process – Product Specifications Target Specifications-Plan and establish product specifications - integration of customer, designer, material supplier and process planner, Competitor and customer – Understanding customer and behaviour analysis. Concept Generation, Five Step Method-Basics of Concept selection- Creative thinking –creativity and problem solving- creative thinking methods- generating design concepts-systematic methods for designing –functional decomposition – physical decomposition.		
UNIT-II	**INTRODUCTION TO APPROACHES IN PRODUCT DEVELOPMENT**	**9 Hours**
Product development management - establishing the architecture - creation - Product Architecture changes - variety – component standardization , clustering -geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems - architecture of the chunks - creating detailed interface specifications-Portfolio Architecture competitive benchmarking- Approach for the benchmarking process-Design for manufacturing - Industrial Design-Robust Design – Prototype basics - Principles of prototyping - Planning for prototypes Economic & Cost Analysis -Testing Methodologies- Product Branding.		
UNIT-III	**INDUSTRIAL DESIGN STRATEGIES**	**9 Hours**
Role of Integrating CAE, CAD, CAM tools for Simulating product performance and manufacturing processes electronically- Basics on reverse engineering – Reverse engineering strategies – Finding reusable software components. Recycling real-time embedded software based approach and its logical basics Incorporating reverse engineering for consumer product development –case study on DeskJet Printer.		
UNIT-IV	**ELECTRONIC PRODUCT DEVELOPMENT STAGES**	**9 Hours**
Product Development Stages-Embedded product modeling- Linear, Iterative, Prototyping, Spiral - Selection of Sensor, Voltage Supply, Power supply protection, Grounding and noise elimination methods, Thermal protection with heat management – PCB design steps – Software design and testing method – documentation.		
UNIT-V	**EMBEDDED PRODUCTSDESIGN**	**9 Hours**
Creating general Embedded System Architecture (with Case study example: Mobile Phone / DeskJet Printer./ Robonoid as a product) –Architectural Structures- Criteria in selection of Hardware Software Components, processors, input/output interfaces & connectors, ADC System ,Memory, choosing Bus Communication Standards, Criteria in selection of Embedded OS/Device Drivers, Need for Developing with IDE, Translation & Debugging Tools & ApplicationSoftware, Performance Testing, Costing, Benchmarking, Documentation.		
	Total Hours	**45 Hours**
Text Book(s)		
1.	Anita Goyal, Karl T Ulrich, Steven D Eppinger, "Product Design and Development", McGraw	

	–Hill International Edns.1999/ Tata McGraw Education, ISBN-10-007-14679-9.
2.	R.G. Kaduskar and V.B. Baru, " Electronic Product Design", Wiley, 2014.
3.	George E.Dieter, Linda C.Schmidt, "Engineering Design", McGraw-Hill International Edition, Fourth Edition, 2009, ISBN 978-007-127189-9.
4.	Stephen Armstrong, "Engineering and Product Development Management; The Holistic Approach", Cambridge University Press (CUP),2014.
Reference Book(s)	
1.	Rajkamal, "Embedded system-Architecture, Programming, Design" TMH,2011.
2.	KEVIN OTTO & KRISTIN WOOD, "Product Design and Development", Fourth Edition, 2009, Product Design Techniques in Reverse Engineering and New Product Development , Pearson Education (LPE),2001.
3.	Yousef Haik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141
4.	Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", Third Edition, John Wiley & Sons, 2009, ISBN 978-0- 470- 22596-7.

Course Code	BECF188ES0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**NEURAL NETWORKS & FUZZY LOGIC**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -VI	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Mathematics, Linear algebra, advanced calculus, discrete mathematics, Boolean algebra or equivalent.							

Course Objectives:

The course should enable the students

1. To learn the basics of Neural Networks and essentials of Artificial Neural Networks with ADALINE and MADALINE Networks.
2. The main objective of this course is to provide the student with the basic understanding of neural networks and Fuzzy logic fundamentals.
3. It deals with Associate Memories and CPN.
4. To learn the various architectures of building an ANN and its applications.
5. To learn the fundamentals of Crisp sets, Fuzzy sets and Fuzzy Relations.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Students learn about the principles of neural networks and fuzzy Logic fundamentals.	**K2**
CO2	Students can get thorough knowledge in biological neuron and artificial neurons.	**K2**
CO3	Student can design the required and related systems.	**K3**
CO4	Students will understand and compare analysis between human and computer**.**	**K4**
CO5	Students understand concept of classical and fuzzy sets fuzzification and defuzzification, with which they can be able to apply the conceptual things to the real world electronics problems and applications.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	**S**	**M**	**S**	**M**	**S**	**L**	**-**	**-**	**-**	**-**	**-**	**L**	**L**	**S**	**M**
CO2	**S**	**M**	**S**	**S**	**M**	**M**	**-**	**-**	**-**	**-**	**-**	**L**	**M**	**S**	**L**
CO3	**S**	**M**	**S**	**M**	**S**	**L**	**-**	**-**	**-**	**-**	**-**	**M**	**L**	**S**	**M**
CO4	**S**	**M**	**S**	**M**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**L**	**L**	**M**	**L**

CO5	**M**	**L**	**M**	**-**	**M**	**-**	**-**	**L**	**-**	**-**	**-**	**L**	**L**	**S**	**M**

UNIT-I	**INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS**	**9 Hours**

Neuro-physiology - General Processing Element - ADALINE - LMS learning rule – MADALINE – XOR Problem – MLP - Back Propagation Network - updation of output and hidden layer weights - application of BPN.

UNIT-II	**ASSOCIATIVE MEMORY & CPN**	**9 Hours**

Associative memory - Bi-directional Associative Memory – Hopfield memory - travelling sales man problem Annealing, Boltzmann machine-learning–application-Counter Propagation network–architecture–training Applications.

UNIT-III	**SELF ORGANIZING MAP & ART**	**9 Hours**

Self-organizing map - learning algorithm - feature map classifier – applications - architecture of Adaptive Resonance Theory - pattern matching in ART network.

UNIT-IV	**CRISP SETS AND FUZZY SETS**	**9 Hours**

Introduction – crisp sets an overview – the notion of fuzzy sets –Basic concepts of fuzzy sets – classical logic and overview – Fuzzy logic- Operations on fuzzy sets - fuzzy complement – fuzzy union – fuzzy intersection combinations of operations – general aggregation operations.

UNIT-V	**FUZZY RELATIONS**	**9 Hours**

Crisp and fuzzy relations – binary relations – binary relations on a single set– equivalence and similarity relations – Compatibility or tolerance relations– orderings – morphisms-fuzzy relation equations.

	Total Hours	**45 Hours**

Text Book(s)

1.	Freeman J.A. and Skapura B.M., "Neural Networks, Algorithms Applications and Programming Techniques", Addison-Wesley, 1990.
2.	George JKlir and TinaA Folger, "Fuzzysets, uncertainty and information", PHI, 1988.

Reference Book(s)

1.	Laurene Fausett," Fundamentals of Neural Networks: Architecture, Algorithms and Applications", Pearson Education, 1994.
2.	H.J. Zimmerman, "Fuzzy set theory and its Applications", Allied Publishers Ltd, 1996.

Course Code	BECF188ET0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**5G / 4G CELLULAR SYSTEMS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -VI	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Cellular Mobile Communication							

Course Objectives:

The course should enable the students

1. To categorize the current wireless cellular standards of LTE and LTE advanced.
2. To analyze the effective utilization of spectrum and RF requirements for LTE.
3. To discriminate the LTE Air Interface, OFDMA, MIMO, SDR and CoMP technology.
4. To describe the relay deployment and overview of WiMAX.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Describe the different standards of LTE and LTE –advanced such as SAE, EPC.	**K1**
CO2	Different types of spectrum and RF characteristics.	**K3**
CO3	Discriminate 4G Technology.	**K4**
CO4	Describe the concepts of COMP transmission and reception.	**K1**
CO5	Differentiate relay schemes and compare LTE with Wi MAX.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	L	S	-	S	-	-	-	-	-	L	-	L	S	-	L
CO2	M	M	-	-	-	-	-	-	M	M	-	-	L	-	M
CO3	S	L	-	S	-	-	M	-	-		-	L	M	-	L
CO4	M	L	-	-	M	-	L	-	-	L	-	L	M	-	M
CO5	L	M	-	-	-	-	S	-	-	S	-	M	S	L	S

UNIT-I	**STANDARDIZATION OF LTE**	**10 Hours**

3rd Generation Partnership Project (3GPP); The 3G Evolution to 4G; Long Term Evolution (LTE) and System Architecture Evolution (SAE), LTE and LTE-Advanced; LTE-Advanced E- UTRAN architecture; Protocol stack: NAS (Non- Access Stratum), RRC (Radio Resource Control), PDCP

(Packet Data Convergence Protocol), RLC (Radio Link Control), MAC (Medium Access Control); Evolved Packet Stratum: Mobility Management Entity (MME), Serving Gateway (S- GW), Packet Data Network Gateway (PDN-GW).		
UNIT-II	**SPECTRUM AND RF CHARACTERISTICS**	**9 Hours**
Carrier aggregation: LTE and LTE-Advanced carrier aggregation scenario; Control channels; Multiple access scheme; Transceiver architecture; Spectrum sharing; Research challenges: Transceiver design; Increased FFT size, Resource management; Retransmission control; Overview of RF Requirements for LTE.		
UNIT-III	**KEY 4G TECHNOLOGIES**	**9 Hours**
OFDMA; SOFTWARE DEFINED RADIO, Enhanced MIMO, HANDOVER AND MOBILITY, Enhanced MIMO: Single-User MIMO (SU- MIMO): MIMO adaptive switching scheme. LTE-Advanced main MIMO modes; Multi-User MIMO (MU-MIMO); Cooperative MIMO; Single- site MIMO: Advanced precoding concept. Downlink MIMO transmission; Uplink MIMO transmission.		
UNIT-IV	**COMP TRANSMISSION & RECEPTION**	**9 Hours**
CoMP architecture: Centralized architecture, Distributed architecture,. Mixed architectures: The CoMP schemes: Downlink, Uplink, Relays: Relay basic scheme, Relay deployment scenarios; Types; Duplexing schemes: Integration into RAN, Add-ons; Backhaul Design for Inband Relaying.		
UNIT-V	**LTE VS WIMAX**	**8 Hours**
WiMAX Overview: WiMAX Standards Evolution, WiMAX Deployment; Technology Comparison between LTE and WiMAX.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Erik Dahlman, Stefan Parkvall, John Skold,"4G:LTE Advanced for Mobile Broadband, 2nd Edition, 2011.
2.	Erik Dahlman, Stefan Parkvall , John Skold, "4G ,LTE Advanced Pro and The Road to 5G", 3rd Edition.
Reference Book(s)	
1.	Christopher Cox, Wiley, "An introduction to LTE: LTE Advanced, SAE and 4G Mobile Communication, 2012.

Course Code	BECF188EU0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ERROR CORRECTING CODES**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -VI	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic Knowledge of Analog and Digital Communication							

Course Objectives:

The course should enable the students

1. To understand about the concepts of various types of error sources.
2. To learn the error control coding techniques applied in the field of Digital Communication.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Able to understand and analyze Linear block codes.	**K2**
CO2	To understand and analyze Cyclic codes.	**K2**
CO3	Able to understand and analyze BCH codes.	**K2**
CO4	Able to understand and analyze Reed solomon codes.	**K2**
CO5	Able to understand and analyze Convolution codes.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	S	M	S	M	-	-	-	-	-	-	L	L	S	M	L
CO2	S	M	S	M	-	-	-	-	-	-	L	L	S	M	L
CO3	S	M	S		-	-	-	-	-	-	L	L	S	M	L
CO4	S	M	S	M	-	-	-	-	-	-	L	L	S	M	L
CO5	S	M	S		-	-	-	-	-	-	L	L	S	M	L

UNIT-I	**LINEAR BLOCK CODES**	**9 Hours**

Introduction- Mathematics of Binary Codes- Parity Checks- Systematic codes- Minimum HammingDistance of a linear block code- How to Encode - Generator Matrix-Encoding with parity check matrix- Decoding with parity check matrix- Decoding by Standard Array- Codec Design for linear Block Codes- Modifications to Block Codes-Dorsch Algorithm Decoding, Syndrome decoding on symmetric channels- Hamming codes- Weight enumerators and the McWilliams identities; Perfect codes, Introduction to finite fields and finite rings- factorization of (X^n-1) over a finite field.

UNIT-II	**CYCLIC CODES**	**9 Hours**

Introduction- Definition of a cyclic code- Example of a cyclic code- Polynomial Representation- Encoding by convolution- Establishing the cyclic property -Deducing the properties of a cyclic code- Primitive Polynomials- Systematic Encoding of cyclic codes- Syndrome of a cyclic code- Implementation of Encoding- Decoding-Decoder operation - Multiple Error Correction-Example of Multiple Error Correction- Shortened Cyclic codes- Expurgated Cyclic codes-Cyclic codes for Burst - Error correction- Spectral properties of cyclic codes.

UNIT-III	**BCH CODES**	**9 Hours**

Introduction- Specifying Cyclic codes by roots-Definition of BCH codes-Construction of BCH codes- roots and parity check matrices- Algebraic Decoding- BCH Decoding and the BCH Bound- Decoding in the frequency domain-Decoding examples for binary BCH codes- Polynomial form of the key equation- Euclid's method-Berlekamp- Massey Algorithm- Massey's minimum shift register synthesistechnique and its relation to Berlekamp's algorithm- A fast Berlekamp - Massey algorithm.

UNIT-IV	**REED SOLOMON CODES**	**9 Hours**

Introduction- Generator Polynomial for a Reed Solomon Code-Time domain encoding for Reed Solomon Code-Decoding Reed Solomon Codes- Reed Solomon Code Decoding Example-FrequencyDomain Encoded Reed Solomon Code-Erasure Decoding- Generalized Minimum Distance Decoding- Welch-Berlekamp Algorithm- Singly Extended Reed Solomon Codes-Doubly Extended Reed Solomon Codes- Justeen codes, MDS codes, Alterant, Goppa codes.

UNIT-V	**CONVOLUTION CODES**	**9 Hours**

Introduction- General properties of Convolutional codes- Generator Polynomials – Terminology- Encoder State Diagram- Distance Structure of Convolutional codes-Evaluating Distance and weight Structures- Maximum Likelihood Decoding- Viterbi Algorithm- General properties –Example of viterbi decoding- issues arising- Practical implementations of viterbi decoding-Performance of Convolutional codes- Good Convolutional codes- punctured Convolutional codes- Applications of Convolutional codes- codes for multilevel modulations- Wozencraft's sequential decoding algorithm,Fann's algorithm.

	Total Hours	**45 Hours**

Text Book(s)

1.	F.J. McWilliams and N.J.A. Slone, "The theory of error correcting codes", 1977.
2.	R.E. Balahut, "Theory and practice of error control codes", Addison Wesley, 1983.

Reference Book(s)

1.	Peter Sweeney, "Error Control Coding from theory to practice", John Wiley & Sons ltd, 2002.
2.	Shu Lin and D.J. Costello Jr., "Error Control Coding", Prentice Hall, 1983.

Course Code	BECF188EV0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**VLSI TESTING**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -VI	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Digital Circuits							

Course Objectives:

The course should enable the students

1. To understand the basics of VLSI testing.
2. To learn the concepts of testing equipments in VLSI.
3. To understand the analog and Digital testing methods in VLSI.
4. To learn the concepts of Loaded board testing in VLSI.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Explain the fundamentals of VLSI Testing.	**K2**
CO2	Discuss the need for test process.	**K2**
CO3	Perform analog and digital VLSI Testing.	**K3**
CO4	Design the different testing schemes for a circuit.	**K3**
CO5	Design a functional block functional block level design of in-circuit test equipment.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	S	-	-	L	-	-	-	-	-	-	L	L	-	S
CO2	S	S	L	M	M	-	-	-	-	-	-	L	M	M	S
CO3	S	S	L	M	M	-	-	-	-	-	-	L	M	M	S
CO4	S	S	S	M	M	-	-	-	-	-	-	L	M	M	S
CO5	S	S	S	M	M	-	-	-	-	-	-	L	M	M	S

UNIT-I	**INTRODUCTION**	**9 Hours**
Test process and automatic test equipment, test economics and product quality, fault modeling.		
UNIT-II	**DIGITAL TESTING**	**9 Hours**
Logic and fault simulation, testability measures, combinational and sequential circuit test generation.		
UNIT-III	**ANALOG TESTING**	**9 Hours**
Memory Test, DSP Based Analog and Mixed Signal Test, Model based analog and mixed signaltest, delay test, IIDQ test.		
UNIT-IV	**DESIGN FOR TESTABILITY**	**9 Hours**
Built-in self-test, Scan chain design, Random Logic BIST, Memory BIST, Boundary scan test standard, Analog test bus, Functional Microprocessor Test, Fault Dictionary, Diagnostic Tree, Testable System Design, Core Based Design and Test Wrapper Design, Test design for SOCs.		
UNIT-V	**LOADED BOARD TESTING**	**9 Hours**
Unpowered short circuit tests, unpowered analog tests, Powered in-circuit analog, digital and mixed signal tests, optical and X-ray inspection procedures, functional block level design of in-circuit test equipment.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Michael L. Bushnell and Vishwani D. Agarwal, “Essentials of Electronic Testing for Digital, Memory & Mixed-Signal VLSI Circuits”, Springer, 2006.
2.	Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, "VLSI Test Principles and Architectures Design For Testability", Elsevier, 2006.

Reference Book(s)

1.	Dimitris Gizopouilos, “Advances in Electronic Testing”, Springer, 2006.

Course Code		L	T	P	C	IA	EA	TM
Course Name	**SMART ANTENNA FOR MOBILE COMMUNICATION AND GPS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -VI	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:
The course should enable the students
1. To understand the applications of antenna arrays to Mobile Communications.
2. To learn the architecture of smart antenna systems.
3. To learn the Smart Antennas Techniques for CDMA.
4. To acquire knowledge on GPS and GPS Signals.
5. To understand GPS orbits and GPS position determination.

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

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Examine the application of smart antennas of mobile communications.	**K3**
CO2	Analyze Beam forming considerations and Spatial Processing for Wireless Systems.	**K4**
CO3	Discuss smart antenna configurations for mobile communication and GPS.	**K3**
CO4	Describe Smart Antennas Techniques for SDMA and CDMA.	**K2**
CO5	Explain Global Positioning Systems and Orbital Parameters.	**K5**
CO6	Design GPS/GNSS smart antennas for the satellite position, navigation, timing and Signal corrections.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	S	M	M	M	L	L	-	-	-	-	-	L	L	S	L
CO2	S	S	S	S	S	L	-	-	-	-	-	L	L	S	M
CO3	S	S	M	M	S	M	-	-	-	-	-	M	M	S	L
CO4	S	S	S	M	S	M	-	-	-	-	-	M	M	M	L
CO5	S	S	S	M	S	M	-	-	-	-	-	M	M	M	L
CO6	S	S	S	M	S	M	-	-	-	-	-	M	M	M	L

UNIT-I	**INTRODUCTION TO SMART ANTENNAS**	**9 Hours**
Spatial Processing for Wireless Systems, Key Benefits of Smart Antennas, Smart antenna introduction, smart antenna configuration, SDMA, architecture of smart antenna systems.		
UNIT-II	**APPLICATIONS OF SMART ANTENNAS IN MOBILE COMMUNICATIONS**	**9 Hours**
Mobile communication systems with smart antennas, Application of Antenna Arrays to Mobile Communications, Beam Forming and Direction-of-Arrival Considerations.		
UNIT-III	**SMART ANTENNAS TECHNIQUES FOR CDMA**	**9 Hours**
Non-Coherent CDMA Spatial Processors, Coherent CDMA Spatial Processors and the Spatial Processing Rake Receiver, Multi-User Spatial Processing, Dynamic Re-sectoring Using Smart Antennas, Downlink Beam forming for CDMA.		
UNIT-IV	**OVERVIEW OF GPS & GPS SIGNALS**	**9 Hours**
Overview of GPS- Global Positioning Systems: Basic concept, system architecture, space segment, user segment, GPS aided Geo-augmented navigation (GAGAN) architecture. Signal structure, anti-spoofing (AS), selective availability, Difference between GPS and GALILEO satellite construction.		
UNIT-V	**GPS ORBITS AND SATELLITE POSITION DETERMINATION**	**9 Hours**
GPS orbital parameters, description of receiver independent exchange format (RINEX) –Observation data and navigation message data parameters, GPS position determination. GPS / GNSS Smart antennas.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	T.S. Rappaport and J.C. Liberti, “Smart Antennas for Wireless Communications”, Prentice Hall India. 1999.
2	Tapan K Sarkar ,” Smart Antennas “, IEEE Press, John Wiley & Sons Publications,2003.
Reference Book(s)	
3.	Hoffman – Wellenhof, H. Liehtenegger and J. Collins, “GPS – Theory and Practice”, Springer – Wien, New York, 2001.
4.	Gottapu Sasibhushana Rao, “Global Navigation Satellite Systems”, McGraw Hill Education, New Delhi, 2010.

Course Code	BECF188EW0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**SATELLITE COMMUNICATION**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -VII	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Antennas and Digital Communication							

Course Objectives:

The course should enable the students

1. To understand the basics of satellite orbits.
2. To understand the satellite segment and earth segment.
3. To analyze the various methods of satellite access.
4. To understand the applications of satellites.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the basic concepts of Satellite orbits using Kepler's laws.	**K2**
CO2	Space craft technology in space segment and Computation of link budget for satellites to calculate received power.	**K2**
CO3	Understand the various earth station sub systems to transmit and receive signals.	**K2**
CO4	Understand and analyze the different losses and noise in earth segment.	**K3**
CO5	Apply the different accessing techniques, encryption techniques to communicate satellite systems.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO 2**	**PSO3**
CO1	S	M	M	-	-	-	-	-	-	-	-	-	M	L	-
CO2	M	S	M	-	M	-	-	-	-	-	-	L	M	M	L
CO3	S	S	S	L	L	-	-	-	-	-	-	-	L	L	L
CO4	M	S	M	L	M	-	-	-	-	-	-	L	M	M	M
CO5	M	M	L	-	-	-	-	-	-	-	-	M	L	S	S

UNIT-I	SATELLITE ORBITS	9 Hours
Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility –eclipse- Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.		
UNIT-II	**SPACE SEGMENT AND SATELLITE LINK DESIGN**	**9 Hours**
Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, Communication Payload and supporting subsystems, Telemetry, Tracking and command. Satellite Uplink and Downlink Analysis and Design, Link Power Budget, C/N calculation, G/T ratio- Performance Impairments-System noise, Inter-modulation Noise, Noise Temperature, Propagation Factors, Rain and Ice effects, Polarization.		
UNIT-III	**EARTH SEGMENT**	**9 Hours**
Introduction – Receive – Only home TV systems (TVRO) – Outdoor UNIT – Indoor UNIT for analog (FM) TV – Master antenna TV system (MATV) – Community Antenna TV system (CATV) – Transmit – Receive earth stations, Antennas, Terrestrial Interface, Equipment Measurements on G/T, C/N, EIRP, Antenna Gain.		
UNIT-IV	**SATELLITE ACCESS**	**9 Hours**
Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication, compression – encryption.		
UNIT-V	**SATELLITE APPLICATIONS**	**9 Hours**
INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. Direct Broadcast satellites (DBS)- Direct to home Broadcast (DTH), Digital audio broadcast (DAB)- World space services, Business TV (BTV), GRAMSAT, Specialized services – E –mail, Video conferencing, Internet.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Dennis Roddy, "Satellite Communication", Fourth Edition, McGraw Hill, 2006.

Reference Book(s)

1.	Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall, 2007.
2.	N. Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.
3.	Bruce R. Elbert, "Satellite Communication Applications", Hand Book, Artech House Bostan London, 1997.
4.	Emanuel Fthenakis, "Manual of Satellite Communications", McGraw Hill, 1984
5.	Robert G. Winch, "Telecommunication Transmission Systems", McGraw-Hill, 1983.
6.	M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan, 2003.

Course Code	BECF188EX0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**RADAR AND NAVIGATIONAL AIDS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -VII	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Antenna Propagation and Digital communication							

Course Objectives:

The course should enable the students

1. To become familiar with fundamentals of RADAR.
2. To gain in depth knowledge about the different types of RADAR and their operations.
3. To Learn Need for signal detection in RADAR and various detection techniques.
4. To become familiar with RADAR navigation techniques.
5. To understand Satellite navigation system.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Graduates will demonstrate the ability to identify RADAR, formulate and solve engineering problems**.**	**K2**
CO2	Graduates will demonstrate the ability to design a RADAR system, component or process as per needs and specifications.	**K3**
CO3	Graduates will demonstrate the ability to identify, signal detection in RADAR and various detection techniques.	**K2**
CO4	Graduates will demonstrate the ability to familiar with RADAR navigation techniques.	**K4**
CO5	Graduates will demonstrate the ability to design a system, Distance Measuring Equipment and Microwave Landing System.	**K5**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	**S**	**M**	**M**	**M**	**L**	**L**	**-**	**-**	**-**	**-**	**-**	**L**	**L**	**S**	**M**
CO2	**S**	**S**	**S**	**S**	**M**	**L**	**-**	**-**	**-**	**-**	**-**	**L**	**L**	**S**	**M**
CO3	**S**	**S**	**M**	**M**	**S**	**M**	**-**	**-**	**-**	**-**	**-**	**M**	**M**	**S**	**L**
CO4	**S**	**S**	**S**	**M**	**S**	**M**	**-**	**-**	**-**	**-**	**-**	**M**	**M**	**S**	**L**
CO5	**S**	**S**	**S**	**M**	**S**	**M**	**-**	**-**	**-**	**-**	**-**	**M**	**L**	**S**	**L**

UNIT-I	INTRODUCTION TO RADAR EQUATION	9 Hours
Introduction- Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar Frequencies –Applications of Radar – The Origins of Radar - Detection of Signals in Noise- Receiver Noise and the Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm- Integration of Radar Pulses- Radar Cross Section of Targets- Radar cross Section Fluctuations- Transmitter Power-Pulse Repetition Frequency- Antenna Parameters- System losses – Other Radar Equation Considerations.		

UNIT-II	MTI AND PULSE DOPPLER RADAR	9 Hours
Introduction to Doppler and MTI Radar- Delay –Line Cancellers- Staggered Pulse Repetition Frequencies –Doppler Filter Banks - Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance - MTI from a Moving Platform (AMIT) – Pulse Doppler Radar– Other Doppler Radar Topics- Tracking with Radar –Monopulse Tracking –Conical Scan and Sequential Lobing – Limitations to Tracking Accuracy - Low-Angle Tracking - Tracking in Range - Other Tracking Radar Topics - Comparison of Trackers - Automatic Tracking with Surveillance Radars(ADT).		

UNIT-III	DETECTION OF SIGNALS IN NOISE	9 Hours
Matched –Filter Receiver –Detection Criteria – Detectors –-Automatic Detector - Integrators - Constant-False-Alarm Rate Receivers - The Radar operator - Signal Management - Propagation Radar Waves - Atmospheric Refraction -Standard propagation - Nonstandard Propagation - The Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters- Frequency-Scan Arrays Radar Transmitters and Receivers - Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron - Crossed Field Amplifiers - Other RF Power Sources – Other aspects of Radar Transmitter.- The Radar Receiver - Receiver noise Figure – Super heterodyne Receiver - Duplexers and Receiver Protectors- Radar Displays.		

UNIT-IV	RADIO DIRECTION AND RANGES	9 Hours
Introduction - Four methods of Navigation .- The Loop Antenna - Loop Input Circuits - An Aural Null Direction Finder - The Goniometer - Errors in Direction Finding - Adcock Direction Finders - Direction Finding at Very High Frequencies - Automatic Direction Finders – The Commutated Aerial Direction Finder - Range and Accuracy of Direction Finders - The LF/MF Four course Radio Range - VHF Omni Directional Range(VOR) - VOR Receiving Equipment - Range and Accuracy of VOR – Recent Developments. Hyperbolic Systems of Navigation (Loran and Decca) - Loran-A - Loran-A Equipment - Range and precision of Standard Loran - Loran-C - The Decca Navigation System -Decca Receivers - Range and Accuracy of Decca - The Omega System		

UNIT-V	SATELLITE NAVIGATION SYSTEM	9 Hours
Distance Measuring Equipment - Operation of DME - TACAN - TACAN Equipment – Instrument Landing System - Ground Controlled Approach System - Microwave Landing System (MLS) The Doppler Effect - Beam Configurations -Doppler Frequency Equations – Track		

Stabilization - Doppler Spectrum - Components of the Doppler Navigation System - Doppler range Equation - Accuracy of Doppler Navigation Systems. Inertial Navigation - Principles of Operation - Navigation over the Earth – Components of an Inertial Navigation System - Earth Coordinate Mechanization - Strapped- Down Systems - Accuracy of Inertial Navigation Systems- The Transit System - Navistar Global Positioning System (GPS).	
Total Hours	**45 Hours**
Text Book(s)	
1.	Merrill I. Skolnik," Introduction to Radar Systems", 3rd Edition, McGraw-Hill, 2003.
2.	N.S. Nagaraja, "Elements of Electronic Navigation Systems", 2nd Edition, TMH, 2000.
Reference Book(s)	
1.	Peyton Z. Peebles: "Radar Principles", John Wiley, 2002.
2.	J.C Toomay, "Principles of Radar", 2nd Edition, PHI, 2004

Course Code	BECF188EY0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**WAVELET AND ITS APPLICATIONS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE -VII	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Signals & Systems and Digital Signal Processing							

Course Objectives:

The course should enable the students

1. To understand the fundamentals of Wavelet Transform.
2. To learn the multi-resolution analysis technique with respect to Wavelet Transform.
3. To know the characteristics of types of wavelet transforms and their applications.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the concept of Fourier transform and short time Fourier transform.	**K2**
CO2	Analyze the need for time frequency analysis.	**K3**
CO3	Acquire Knowledge about various wavelet transform and design wavelet transform.	**K3**
CO4	Analyze the relationship between the filter bank and wavelet.	**K4**
CO5	Analyze the application of wavelet.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	S	M	L	S	-	-	-	-	-	-	S	S	S	L
CO2	S	S	M	L	S	-	-	-	-	-	-	S	S	M	L
CO3	S	S	M	L	S	-	-	-	-	-	-	S	M	L	-
CO4	S	S	M	L	S	-	-	-	-	-	-	S	S	S	L
CO5	S	S	M	L	S	-	-	-	-	-	-	S	S	S	-

UNIT-I	**FUNDAMENTALS OF WAVELET TRANSFORMS**	**9 Hours**

Vector Spaces – Properties– Dot Product – Basis – Dimension, Orthogonality and Orthonormality – Relationship Between Vectors and Signals – Signal Spaces – Concept of Convergence – Hilbert Spaces for Energy Signals- Fourier Theory: Fourier series expansion, Fourier transform, Short time

Fourier transform, Time-frequency analysis.		
UNIT-II	**MULTI RESOLUTION ANALYSIS**	**9 Hours**
Definition of Multi Resolution Analysis (MRA) – Haar Basis – Construction of General Orthonormal MRA – Wavelet Basis for MRA – Continuous Time MRA Interpretation for the DTWT – Discrete Time MRA – Basis Functions for the DTWT – PRQMF Filter Banks.		
UNIT-III	**CONTINUOUS WAVELET TRANSFORMS**	**9 Hours**
Wavelet Transform – Definition and Properties – Concept of Scale and its Relation with Frequency – Continuous Wavelet Transform (CWT) – Scaling Function and Wavelet Functions (Daubechies Coiflet, Mexican Hat, Sinc, Gaussian, Bi Orthogonal) – Tiling of Time – Scale Plane for CWT.		
UNIT-IV	**DISCRETE WAVELET TRANSFORM**	**9 Hours**
Filter Bank and Sub Band Coding Principles – Wavelet Filters – Inverse DWT Computation by Filter Banks – Basic Properties of Filter Coefficients – Choice of Wavelet Function Coefficients – Derivations of Daubechies Wavelets – Mallat's Algorithm for DWT – Multi Band Wavelet Transforms Lifting Scheme- Wavelet Transform Using Polyphase Matrix Factorization – Geometrical Foundations of Lifting Scheme – Lifting Scheme in Z –Domain.		
UNIT-V	**APPLICATIONS**	**9 Hours**
Wavelet methods for signal processing- Image Compression Techniques: EZW–SPHIT Coding – Image Denoising Techniques: Noise Estimation – Shrinkage Rules – Shrinkage Functions – Edge Detection and Object Isolation, Image Fusion, and Object Detection.		
	Total Hours	**45 Hours**

Text Book(s)

1.	R. Rao R M and A S Bopardikar, “Wavelet Transforms Introduction to theory and Applications”, Pearson Education, Asia, 2000.
2.	L.Prasad & S.S.Iyengar, “Wavelet Analysis with Applications to Image Processing”, CRC Press, 1997.

Reference Book(s)

1.	J. C. Goswami and A. K. Chan, “Fundamentals of wavelets: Theory, Algorithms and Applications" John Wiley, 1999.
2.	M. Vetterli, J. Kovacevic, “Wavelets and sub band coding" Prentice Hall Inc, 1995.
3.	Stephen G. Mallat, “A wavelet tour of signal processing" 2 nd Edition Academic Press, 2000.
4.	Soman K P and Ramachandran K I, “Insight into Wavelets from Theory to practice” Prentice Hall, 2004

Course Code	BECF188EZ0	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**SOFTWARE DEFINED RADIO**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE - VII	**Syllabus Revision**				V.1.0		
Pre-requisite	Analog & Digital Communication (BECF184T30)							

Course Objectives:

The course should enable the students

1. To understand Software Defined radio Architectures and design principles.
2. To learn radio frequency implementation components, functions and capabilities.
3. To discuss multi rate signal processing and digital generation of signals.
4. To acquire knowledge on Data converters and Smart Antennas in SDR.
5. To learn the digital Hardware and Software methods for SDR

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Demonstrate the understanding of software defined radio architecture and design principles.	**K2**
CO2	Design and demonstrate on Radio frequency implementation issues.	**K3**
CO3	Implement smart antennas in SDR.	**K3**
CO4	Analyze complex problems critically in the domain of SDR using Smart antenna techniques.	**K3**
CO5	Analyze complex problems critically in the domain of SDR using Smart antenna techniques.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O 1**	**PS O2**	**PS O3**
CO1	S	S	S	M	M	-	-	-	L	L	M	M	S	M	L
CO2	S	S	S	M	M	-	-	-	L	L	M	M	S	M	L
CO3	S	S	S	M	M	-	-	-	L	L	M	M	S	M	L
CO4	S	S	S	M	L	-	-	-	L	L	M	M	S	M	L
CO5	S	S	S	M	S	-	-	-	L	M	M	M	S	M	L

UNIT-I	**INTRODUCTION TO SOFTWARE RADIO CONCEPTS**	**9 Hours**

Evolution, Need, Goals, Characteristics, benefits, definitions and architectures of Software Defined

Radio; Design Principles; Relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.		
UNIT-II	**RADIO FREQUENCY IMPLEMENTATION**	**9 Hours**
The purpose of the RF Front End, Dynamic Range, RF receivers front end Topologies, Importance of the components to Overall performance, Transmitter Architecture, Noise and Distortion in the RF Chain, ADC and DAC Distortion, Flexible RF systems using MEMS.		
UNIT-III	**MULTIRATE SIGNAL PROCESSING AND DIGITAL GENERATION OF SIGNALS**	**9 Hours**
Sample rate conversion principles. Digital filter Banks. Timing recovery in Digital Receivers using Multi rate Digital filters. Approaches to Direct Digital Synthesis. Analysis of spurious signal Band pass signal generation, Generation of Random sequences.		
UNIT-IV	**DATA CONVERTERS AND SMART ANTENNAS**	**9 Hours**
Parameters of Ideal and practical Data Converters, Techniques to Improve Data Converter performance, Common ADC and DAC Architectures. Smart Antennas- Hardware implementation of Smart Antennas.		
UNIT-V	**DIGITAL HARDWARE AND SOFTWARE CHOICES**	**9 Hours**
DSP Processors, FPGA, ASIC s. Tradeoffs, Object oriented programming, Object Brokers, GNU Radio-USRP.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Jeffrey H.Reed, "Software Radio: A Modern Approach to Radio Engineering, Prentice Hall, 2002.
2.	Joseph Mitola, "Software Radio Architecture: Object Oriented Approaches to Wireless System Engineering", Wiley-Inter science; I Edition 2000.
Reference Book(s)	
1.	Tony J Rouphael, “RF and DSP for SDR,” Elsevier Newnes Press, 2008.
2.	S.Shanmugavel, M.A.Bhagyaveni, R.Kalidoss, “Cognitive Radio-An Enabler for Internet of things”, River Publishers,2017, Modems”, John Wiley & Sons, 2000.
3.	Paul Burns, “Software Defined Radio for 3G,” Artech House, 2002.
4.	P. Kenington, “RF and Baseband Techniques for Software Defined Radio,” Artech House, 2005.

Course Code	BECF188OET	L	T	P	C	IA	EA	TM
Course Name	**IOT ARCHITECTURE & PROTOCOLS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE - VII	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Data Communication							

Course Objectives:

The course should enable the students

1. To understand the Architectural Overview of IoT.
2. To understand the IoT Reference Architecture and Real World Design Constraints.
3. To understand the various IoT Protocols (Data link, Network, Transport, Session, Service).

Course Outcomes:

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

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the basic concepts of IoT.	K2
CO2	Study the architecture model of IoT.	K2
CO3	Describe the different communication protocols used in IoT.	K2
CO4	Analyze the different standards used in IoT Systems.	K2
CO5	Analyze applications of IoT in real time scenario.	K2
CO6	Infer the role of Data Analytics and Security in IoT.	K2

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	-	-	-	-	-	-	-	L	L	-	M	-	M	-
CO2	S	-	-	-	-	-	-	-	L	L	-	M	-	M	-
CO3	S	-	-	-	-	-	-	-	L	L	-	M	M	M	-
CO4	S	L	M	-	-	-	-	-	L	L	-	M	-	M	-
CO5	-	S	S	M	-	-	-	-	M	M	-	M	M	M	-
CO6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

UNIT-I	OVERVIEW	9 Hours

IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management		
UNIT-II	**REFERENCE ARCHITECTURE**	**9 Hours**
IoT Architecture-State of the Art – Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real-World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.		
UNIT-III	**IOT DATA LINK LAYER & NETWORK LAYER PROTOCOLS**	**9 Hours**
PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP		
UNIT-IV	**TRANSPORT & SESSION LAYER PROTOCOLS**	**9 Hours**
Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT.		
UNIT-V	**SERVICE LAYER PROTOCOLS & SECURITY**	**9 Hours**
Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4, 6LoWPAN, RPL, Application Layer.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Aves and, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
2.	Peter Waher, “Learning Internet of Things”, PACKT publishing, Birmingham – Mumbai.

Reference Book(s)

1.	Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642-19156-5, Springer.
2.	Daniel Minoli, “Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications”, ISBN: 978-1-118- 47347-4, Willy Publications.

Course Code		L	T	P	C	IA	EA	TM
Course Name	**5G WIRELESS COMMUNICATION SYSTEMS**	3	0	0	3	40	60	100
Course Category	PROFESSIONAL ELECTIVE COURSE - VII	**Syllabus Revision**					V.1.0	
Pre-requisite	Wireless communication							

Course Objectives:

The course should enable the students

1. Understand the Basics of 5G and Beyond Wireless communication.
2. Bring a basic understanding of the key technologies, enablers of 5G and beyond communication systems.
3. Study 5G Radio Access Technology.
4. Learn massive MIMO and mm Wave communication.
5. Understand 6G Technology.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Describe 5G architectures and millimeter-wave communication.	K3
CO2	Illustrate the 5G techniques for the design of communication systems	K2
CO3	Describe various modulation and multiplexing techniques for 5G.	K4
CO4	Discuss the machine learning algorithms for resource allocation in 5G MIMO systems.	K2
CO5	Explain the 6G technology.	K3

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	S	S	S	L	M	L						S	S	S	L
CO2	S	S	M	L	S	L						S	S	M	S
CO3	S	S	M	L	S	L						S	S	M	L
CO4	S	S	M	L	L	S						S	S	S	M
CO5	S	S	M	L	S	L						S	S	S	M

UNIT-I	DRIVERS FOR 5G	9Hours

Evolution of LTE Technology to Beyond 4G – Pillars of 5G – Standardization Activities - Use cases and Requirements – System Concept – Spectrum and Regulations: Spectrum for 4G –

Spectrum Challenges in 5G – Spectrum Landscape and Requirements – Spectrum Access Modes and Sharing Scenarios.		
UNIT-II	**5G ARCHITECTURE AND MILLIMETER WAVE COMMUNICATION**	**9 Hours**
5G Architecture: Software Defined Networking – Network Function Virtualization – Basics about RAN Architecture –High-Level Requirements for 5G Architecture – Functional Architecture and 5G Flexibility – Physical Architecture and 5G Deployment Millimeter Wave Communication: Channel Propagation – Hardware Technologies for mmW Systems.		
UNIT-III	**5G RADIO ACCESS TECHNOLOGIES**	**9 Hours**
Access Design Principles for Multi-user Communications – Multi-carrier with Filtering – Non - orthogonal Schemes for Efficient Multiple Access – Radio Access for Dense Deployments – Radio Access for V2X Communication.		
UNIT-IV	**MASSIVE MULTIPLE-INPUT MULTIPLE–OUTPUT SYSTEMS**	**9 Hours**
MIMO in LTE – Single-user MIMO – Multi-user MIMO – Capacity of Massive MIMO – Pilot Design of Massive MIMO – Resource Allocation and Transceiver Algorithms for Massive MIMO.		
UNIT-V	**6G OVERVIEW**	**9 Hours**
Introduction to 6G Key Enablers: Wireless energy harvesting, machine learning, visible light communication - IRS.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Asif Oseiran, Jose F.Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2016.
2	Jonathan Rodriquez, "Fundamentals of 5G Mobile Networks", Wiley, 2015.

Reference Book(s)

3.	Patrick Marsch, Omer Bulakci, Olav Queseth and Mauro Boldi, "5G System Design – Architectural and Functional Considerations and Long Term Research", Wiley, 2018.

Open Elective Courses

Course Code	BECF185OEA	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**DISASTER MANAGEMENT**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE -I	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic Knowledge of Management							

Course Objectives:

The course should enable the students

1. To provide students an exposure to disasters, their significance and types.
2. To ensure begin to understand the relationship between vulnerability, Disasters, disaster prevention and risk reduction.
3. To gain a preliminary understanding of approaches of disaster risk reduction (drr).
4. To enhance awareness of institutional processes in the country.
5. To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Basic knowledge and understanding of the analysis and design of complex systems.	**K2**
CO2	Ability to apply software engineering principles and techniques.	**K2**
CO3	Design and implement innovative features in a development process	**K4**
CO4	To study the concept of disaster risk management in India.	**K2**
CO5	Understand the concept of disaster management.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	-	-	-	-	M	S	-	M	-	-	-	-	M	-	L
CO2	L	-	-	-	-	-	-	M	S	S	S	-	L	-	M
CO3	L	-	-	-	-	M	-	-	-	S	-	-	M	-	L
CO4	-	-	-	-	-	-	-	S	S	M	-	M	L	-	M
CO5	L	-	-	-	-	-	-	S	-	-	-	-	L	-	L

UNIT-I	**INTRODUCTION TO DISASTERS**	**9 Hours**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters –

Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability – Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.		
UNIT-II	**APPROACHES TO DISASTER RISK REDUCTION (DRR)**	**9 Hours**
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- non structural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA)– Early Warning System – Advisories from Appropriate Agencies.		
UNIT-III	**INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT**	**9 Hours**
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.		
UNIT-IV	**DISASTER RISK MANAGEMENT IN INDIA**	**9 Hours**
Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.		
UNIT-V	**DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELDWORKS**	**9 Hours**
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field worksrelated to disaster management.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427.
2.	Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India EducationPvt. Ltd., 2012.

3.	Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management,NIDM,
4	Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers,New Delhi, 2010.
Reference Book(s)	
1.	Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2.	Government of India, National Disaster Management Policy, 2009.

Course Code	BECF185OEB	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**CRYPTOGRAPHY & NETWORK SECURITY**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE -I	**Syllabus Revision**					V.1.0	
Pre-requisite	Digital Communication							

Course Objectives:

The course should enable the students

1. To understand OSI security architecture and classical encryption techniques.
2. To acquire fundamental knowledge on the concepts of finite fields and number theory.
3. To understand various block cipher and stream cipher models.
4. To describe the principles of public key cryptosystems, hash functions and digital signature.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the basic concepts of classical encryption techniques.	**K2**
CO2	Understand and apply principles and techniques of number theory relevant to cryptography.	**K3**
CO3	Apply modern algebra and number theory to understand block cipher and public key cryptography algorithm.	**K3**
CO4	Understand and analyze the authentication functions and digital signatures.	**K4**
CO5	Design and implementation of security systems using firewalls and intrusion detection system.	**K5**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	M	L	-	-	-	-	-	-	-	-	L	M	-	-
CO2	S	S	L	-	-	-	-	-	-	-	-	L	M	-	-
CO3	S	S	L	-	M	-	-	-	-	-	-	S	-	M	-
CO4	S	S	M	-	M	-	-	-	-	-	-	M	-	M	-
CO5	S	S	S	S	S	S	-	-	L	-	L	S	-	-	S

UNIT-I	**INTRODUCTION & NUMBER THEORY**	**9 Hours**

Services, Mechanisms and attacks-the OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).FINITE FIELDS AND NUMBER THEORY: Groups, Rings, Fields-Modular arithmetic- Euclid's algorithm-Finite fields- Polynomial Arithmetic – Prime numbers-Fermat's and Euler's theorem- Testing for primality -The Chinese remainder theorem- Discrete logarithms.		
UNIT-II	**BLOCK CIPHERS & PUBLIC KEY CRYPTOGRAPHY**	**9 Hours**
Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm. Public key cryptography: Principles of public key cryptosystems-The RSA algorithm-Key management - Diffie Hellman Key exchange- Elliptic curve arithmetic-Elliptic curve cryptography.		
UNIT-III	**HASH FUNCTIONS AND DIGITAL SIGNATURES**	**9 Hours**
Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – MD5 - SHA - HMAC – CMAC - Digital signature and authentication protocols– DSS – EI Gamal – Schnorr.		
UNIT-IV	**SECURITY PRACTICE & SYSTEM SECURITY**	**9 Hours**
Authentication applications – Kerberos – X.509 Authentication services - Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions. Intruder – Intrusion detection system – Virus and related threats – Countermeasures – Firewalls design principles – Trusted systems – Practicalimplementation of cryptography and security.		
UNIT-V	**E-MAIL, IP & WEB SECURITY**	**9 Hours**
E-mail Security: Security Services for E-mail-attacks possible through E-mail - establishing keys privacy-authentication of the source-Message Integrity-Non-repudiation-Pretty Good Privacy- S/MIME. IP Security: Overview of IP sec-IP and IP v6 -Authentication Header-Encapsulation Security Payload (ESP)- Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding). Web Security: SSL/TLS Basic Protocol computing the keys- client authentication-PKI as deployed by SSL Attacks fixed in v3- Exportability-Encoding-Secure Electronic Transaction (SET).		
	Total Hours	**45 Hours**

Text Book(s)	
1.	William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education,March 2013.
2.	Charlie Kaufman, Radia Perlman and Mike Speciner,“ Network Security”, Prentice Hall ofIndia, 2002.
Reference Book(s)	
1.	Behrouz A. Ferouzan, “Cryptography & Network Security”, Tata McGraw Hill, 2007.

2.	Man Young Rhee, "Internet Security: Cryptographic Principles", "Algorithms and Protocols",Wiley Publications, 2003.
3.	Charles Pfleeger, "Security in Computing", 4th Edition, Prentice Hall of India, 2006.
4.	Ulysses Black, "Internet Security Protocols", Pearson Education Asia, 2000.
5.	Charlie Kaufman and Radia Perlman, Mike Speciner, "Network Security, Second Edition,Private Communication in Public World", PHI 2002.
6.	Bruce Schneier and Neils Ferguson, "Practical Cryptography", First Edition, Wiley Dreamtech India Pvt Ltd, 2003.
7.	Douglas R Simson "Cryptography – Theory and practice", First Edition, CRC Press, 1995.

Course Code	BECF185OED	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**NANO SCIENCE**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE -I	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Material Science & Electronics							

Course Objectives:

The course should enable the students

1. To understand carbon nano structures.
2. To understand carbon nano tubes for data processing.
3. To gain knowledge on Dynamic Random Access Memory.
4. To understand mass storage device.
5. To understand data transmission interfaces and displays.

Course Outcomes:

At the end of the course, the student should be able to:

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the basic structure and functioning of carbon nano tube	**K2**
CO2	Leverage concepts of Super conductors in digital electronics	**K2**
CO3	Understand about Materials and material processing for DRAMs	**K2**
CO4	Understand Techniques for mass storage devices	**K2**
CO5	Understand Data transmission interfaces and displays	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	S	-	-	S	-	-	-	-	-	-	L	M	-	S
CO2	S	S	-	S	-	-	-	-	-	-	-	L	M	-	S
CO3	S	S	M	M	-	-	-	-	-	-	-	L	L	L	S
CO4	S	S	S	-	-	-	-	-	-	-	-	L	L	L	S
CO5	S	S	-	M	-	-	-	-	-	-	-	L	M	M	S

UNIT-I	**TECHNOLOGY AND ANALYSIS**	**9 Hours**

Film Deposition Methods, Lithography, Material Removing Technologies, Etching and Chemical, Mechanical Processing, Scanning Probe Techniques, Carbon Nano Structures:

Carbon Clusters, Carbon Nano tubes, Fabrication, Electrical, Mechanical and Vibrational Properties, Applications of Carbon Nano Tubes.		
UNIT-II	**LOGIC DEVICES**	**9 Hours**
Silicon MOSFETS, Novel Materials and Alternative Concepts, Ferro Electric Filed Effect Transistors, Super Conductor Digital Electronics, Carbon Nano Tubes for Data Processing.		
UNIT-III	**RANDOM ACCESS MEMORIES**	**9 Hours**
High Permittivity Materials for DRAMs, Ferro Electric Random Access Memories, and Magneto- Resistive RAM.		
UNIT-IV	**MASS STORAGE DEVICES**	**9 Hours**
Hard Disk Drives, Magneto Optical Disks, Rewriteable DVDs based on Phase Change Materials, Holographic Data Storage.		
UNIT-V	**DATA TRANSIMISSION, INTERFACES AND DISPLAYS**	**9 Hours**
Photonic Networks, Microwave Communication Systems, Liquid Crystal Displays, Organic Light Emitting Diodes.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Rainer Waser, "Nano Electronics and Information Technology", Wiley VCH, April 2003.
2.	Charles Poole, "Introduction to Nano Technology", Wiley Inter science, May 2003.
Reference Book(s)	
1.	K.E. Drexler, Nano systems, Wiley, 1992.
2.	J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

Course Code	BECF185OEC	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**PLC AND DISTRIBUTED CONTROL SYSTEM**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE -I	**Syllabus Revision**				V.1.0		
Pre-requisite	Digital Electronics							

Course Objectives:

The course will enable the students to

1. To study the evolution and advantages of PLC.
2. To understand the various PLC instructions.
3. To study the used of PLC for some specific applications.
4. To understand the need of computer control in automation and SCADA.
5. To study the distributed control systems.

Course Outcomes:

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

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the fundamental of PLC.	**K2**
CO2	Program a PLC with different logical languages.	**K4**
CO3	Various industrial applications of PLCs are studied.	**K3**
CO4	Able to understand the need of computers in Automation and SCADA.	**K2**
CO5	Understand the basics of distributed control systems.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	M	-	L	-	M	-	M	-	-	-	-	-	L	-	M
CO2	L	-	M	-	L	L	L	-	-	-	-	-	M	-	L
CO3	S	L	-	-	-	M	M	-	-	-	-	-	L	-	M
CO4	M	M	S	L	-	-	S	-	-	-	M	L	M	-	L
CO5	L	S	L	-	S	-	S	-	-	-	L	M	L	-	M

UNIT-I	**BASICS OF PLC**	**9 Hours**

Definition and History of PLC, PLC advantage and disadvantages, Over all PLC systems, CPU and Programmer/Monitors-PLC input and output models – Architecture, PLC Programming language, Types of PLC, Creating Ladder diagrams, Programming - On-Off inputs/ outputs, Programming of Gates, PLC Basic Functions .Connecting PLC to computer , PLC Troubleshooting and Maintenance.

UNIT-II	**PLC PROGRAMMING**	**9 Hours**
Programming of Timers – Introduction - ON delay, OFF delay, Retentive Timers – PLC Timer functions – Examples of timer function Industrial application. Programming Counters – up/down counter – Combining counter - Examples of counter function Industrial application.PLC Arithmetic Functions – PLC number Comparison function.		
UNIT-III	**PLC DATA HANDLING FUNCTIONS**	**9 Hours**
PLC Program Control Instructions: Master Control Reset - Skip – Jump and Move Instruction. Sequencer instructions - Types of PLC Analog modules and systems, PLC analog signal processing – BCD or multi bit data processing – Case study of Tank level control system, bottle filling system and Sequential switching of Motors.		
UNIT-IV	**SCADA BASICS**	**9 Hours**
Computer Process interface for Data Acquisition and control – Computer control loops. Supervisory Control and Data Acquisition System (SCADA) - introduction and brief history of SCADA – SCADA Hardware and software - Remote terminal units- Master station.		
UNIT-V	**DISTRIBUTED CONTROL SYSTEM**	**9 Hours**
Elements of DCS –Evolution of DCS - Building blocks- Detailed descriptions and functions of field control units-LCUs and Redundancy concepts.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Petrezeulla, “Programmable Logic Controllers”, McGraw Hill, 1989.
2.	Michael P. Lukas, “Distributed Control Systems: Their Evaluation and Design”, Van Nostrand Reinhold Co., 1986.
3.	Stuart A. Boyer, "SCADA supervisory control and data acquisition” ISA - The Instrumentation, Systems, and Automation Society, 2004.

Reference Book(s)

1.	G.B.Clayton,” Data Converters”, The Mac Millian Press Ltd., 1982.
2.	John W.Webb & Ronald A.Reis., “Programmable logic controllers - principles and applications”,5th Edition – PHI Learning Pvt. Ltd, New Delhi 2010.
3.	Hughes .T, “Programmable Logic Controllers”, ISA Press, 1989.
4.	Curtis D. Johnson,” Process Control Instrumentation Technology”, 8th edition Prentice Hall June2005.

Course Code	BECF185OEE	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**AUTOTRONICS**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE -I	**Syllabus Revision**				V.1.0		
Pre-requisite								

Course Objectives:

The course should enable the students

1. To make the students understand the evolution of electronics in automobiles and basics of charging and starting system.
2. To provide student with knowledge on ignition and injection systems.
3. To make the students learn about various sensors and actuators for controlling engine parameters.
4. To acquaint students with various engine control systems.
5. To teach the students about various chassis and safety system operation and applications.

Course Outcomes:

At the end of the course, the student should be able:

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the evolution of automotive electronics and charging system	**K2**
CO2	Develop through basic knowledge about various ignition and injection systems.	**K5**
CO3	Analyze required sensors and actuators for an automotive application.	**K4**
CO4	Understand the automotive electronics for engine management system	**K2**
CO5	Acquire knowledge on the safety systems of the automobile.	**K1**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO2**	**PSO3**
CO1	L	M	-	-	-	-	-	-	-	-	-	-	M	-	L
CO2	M	L	L	-	L	-	-	-	-	-	-	-	L	-	M
CO3	S	M	S	-	M	-	-	-	-	-	-	-	L	-	M
CO4	L	S	M	-	S	-	-	-	-	-	-	-	M	-	L
CO5	M	L	S	-	M	S	-	-	-	-	-	-	M	-	M

UNIT-I	**INTRODUCTION**	**9 Hours**
Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards, Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.		
UNIT-II	**IGNITION AND INJECTION SYSTEMS**	**9 Hours**
Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuelinjection – Diesel fuel injection.		
UNIT-III	**SENSOR AND ACTUATORS**	**9 Hours**
Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator.		
UNIT-IV	**ENGINE CONTROL SYSTEMS**	**9 Hours**
Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU"s used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.		
UNIT-V	**CHASSIS AND SAFETY SYSTEMS**	**9 Hours**
Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Ribbens, "Understanding Automotive Electronics", 7th Edition, Elsevier, Indian Reprint,2013.

Reference Book(s)

1.	Tom Denton, "Automobile Electrical and Electronics Systems", Edward Arnold Publishers,2000.
2.	Barry Hollembeak, "Automotive Electricity, Electronics & Computer Controls", DelmarPublishers, 2001.
3.	Richard K. Dupuy "Fuel System and Emission controls", Check Chart Publication, 2000.
4.	Ronald. K. Jurgon, "Automotive Electronics Handbook", McGraw-Hill, 1999.

Course Code	BECF186OEF	L	T	P	C	IA	EA	TM
Course Name	**REMOTE SENSING & GIS**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE - II	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic Knowledge of Science & Engineering							

Course Objectives:

The course should enable the students

1. To make the students understand the concepts, components and source of remote sensing.
2. To gain knowledge about different types of remote sensing platforms and sensors To explain the concept of satellite image interpretation.
3. To understand the applications of remote sensing in Civil Engineering
4. To introduce the fundamentals and components of Geographic Information System.
5. To provide details of spatial data structures and management, input and output processes. To explain the various case studies on application of integration of GIS and Remote Sensing.

Course Outcomes:

At the end of the course, the student should be able to:

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Understand the concepts, platforms and laws related to remote Sensing.	**K2**
CO2	Understand the interaction of electromagnetic radiation with atmosphere and earth material.	**K2**
CO3	Acquire knowledge about satellite orbits, different types of satellites and the different types of remote sensors.	**K1**
CO4	Understand the fundamentals of GIS, maps, data structures and analysis of data.	**K4**
CO5	Gain knowledge about the concepts of interpretation of satellite imagery and civil engineering applications.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO	**PO**	**PO**	**PO**	**PO**	**P**	**PO**	**PO8**	**PO**	**PO**	**P**	**PO**	**PSO**	**PSO**	**PS**

	1	2	3	4	5	O6	7		9	10	O 1 1	12	1	2	O3
CO1	S	-	-	-	S	M	-	-	-	L	-	M	L	-	M
CO2	S	M	-	M	S	M	-	-	-	M	-	M	M	-	L
CO3	S	M	M	M	S	M	-	-	-	M	-	M	L	-	M
CO4	S	M	M	L	M	M	-	-	-	L	-	L	M	-	M
CO5	S	M	M	M	L	M	L	-	-	L	-	L	L	-	L

UNIT-I	**REMOTE SENSING**	**9 Hours**

Definition – Components of Remote Sensing – Energy, Sensor, Interacting Body - Active and Passive Remote Sensing – Platforms – Aerial and Space Platforms – Balloons, Helicopters, Aircraft and Satellites – Synoptivity and Repetivity – Electro Magnetic Radiation (EMR) – EMR spectrum – Visible, Infra Red (IR), Near IR, Middle IR , Thermal IR and Microwave – Black Body Radiation - Planck's law – Stefan-Boltzman law.

UNIT-II	**EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIALS**	**9 Hours**

Atmospheric characteristics – Scattering of EMR – Raleigh, Mie, Non-selective and Raman Scattering – EMR Interaction with Water vapour and ozone – Atmospheric Windows Significance of Atmospheric windows – EMR interaction with Earth Surface Materials – Radiance, Irradiance, Incident, Reflected, Absorbed and Transmitted Energy – Reflectance – Specular and Diffuse Reflection Surfaces- Spectral Signature – Spectral Signature curves – EMR interaction with water, soil and Earth Surface.

UNIT-III	**OPTICAL AND MICROWAVE REMOTE SENSING**	**9 Hours**

Satellites - Classification – Based on Orbits – Sun Synchronous and Geo Synchronous – Based on Purpose – Earth Resources Satellites, Communication Satellites, Weather Satellites, Spy Satellites – Satellite Sensors - Resolution – Spectral, Spatial, Radiometric and Temporal Resolution – Description of Multi Spectral Scanning – Along and Across Track Scanners – Description of Sensors in Landsat, SPOT, IRS series – Current Satellites - Radar – Speckle – Back Scattering – Side Looking Airborne Radar – Synthetic Aperture Radar – Radiometer – Geometrical characteristics.

UNIT-IV	**GEOGRAPHIC INFORMATION SYSTEM**	**9 Hours**

GIS – Components of GIS – Hardware, Software and Organizational Context – Data – Spatial and Non-Spatial – Maps – Types of Maps – Projection – Types of Projection - Data Input – Digitizer, Scanner – Editing – Raster and Vector data structures – Comparison of Raster and Vector data structure – Analysis using Raster and Vector data – Retrieval,

Reclassification, Overlaying, Buffering– Data Output – Printers and Plotters.		
UNIT-V	**MISCELLANEOUS TOPICS**	**9 Hours**
Visual Interpretation of Satellite Images – Elements of Interpretation - Interpretation Keys Characteristics of Digital Satellite Image – Image enhancement – Filtering – Classification - Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS – Urban Applications - Integration of GIS and Remote Sensing – Application of Remote Sensing and GIS – Water resources – Urban Analysis – Watershed Management – Resources Information Systems.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Anji Reddy, Remote Sensing and Geographical Information Systems, BS Publications 2001.
2.	M.G. Srinivas, Remote Sensing Applications, Narosa Publishing House, 2001.
Reference Book(s)	
1.	Lillesand T.M. and Kiefer R.W. Remote Sensing and Image Interpretation, John Wiley and Sons, Inc, New York.
2.	Janza.F.J., Blue, H.M., and Johnston, J.E., "Manual of Remote Sensing Vol.I, AmericanSociety of Photogrammetry", Virginia, U.S.A, 1975.

Course Code	BECF186OEG	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**BIG DATA ANALYTICS**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE -II	**Syllabus Revision**				V.1.0		
Pre-requisite	knowledge of one Programming Language (Java preferably) Practice of SQL (queries and sub queries) Exposure to Linux Environment							

Course Objectives:

The course should enable the students

1. To understand Big Data models and structure.
2. Introduction to Analytic Tool –R.
3. Mining Data streams for Analytics.
4. Understanding Map Reduce Framework.
5. Applications of big data from the technology perspective.

Course Outcomes:

At the end of the course, the student should be able to:

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Have Strong Foundations on Data Analytics Models and structure	**K2**
CO2	Understand the Role of Big Data Analytical Tool	**K2**
CO3	Understand Data modeling and Link stream Analysis	**K2**
CO4	Able to setup Map reduce framework	**K3**
CO5	Understand the concept of big data from the technology perspective	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	M	-	-	M	-	-	-	-	L	S	-	-	M	-	S
CO2	-	M	L	S	-	-	S	-	-	-	-	-	M	-	S
CO3	-	S	M	-	S	-	-	-	-	-	-	-	L	-	S
CO4	-	-	-	M	S	-	-	-	M	L	-	-	L	-	S
CO5	-	-	-	M	S	-	-	-	S		-	-	M	M	S

UNIT-I	**OVERVIEW OF DATA ANALYTICS**	**9 Hours**

Introduction to Big Data Analytics -definition -overview of big data - Characteristics– Importance of Big Data - data preparation -model planning,-Use cases-critical activities in each Phase of the lifecycle

UNIT-II	**INTRODUCTION TO ANALYTIC TOOL**	**9 Hours**
R Using R for Initial Analysis of the Data -Introduction to R programming, initial exploration - analysis of the data using R - basic visualization using R –Basic Scripting-Data Set Analysis.		
UNIT-III	**MINING DATA STREAMS**	**9 Hours**
The Stream Data Model .-Sampling Data in a Stream -Filtering Streams - Counting Distinct Elementsin a Stream -Estimating Moments .- Counting Ones in a Window Link Analysis : Page Rank -Topic-Sensitive Page Rank -Link Spam -Hubs and Authorities.		
UNIT-IV	**MAP REDUCE AND THE NEW SOFTWARE STACK**	**9 Hours**
Distributed File Systems-Map Reduce Algorithms Using Map Reduce-Extensions to Map Reduce theCommunication Cost Model-Complexity Theory for Map Reduce.		
UNIT-V	**BIG DATA FROM THE TECHNOLOGY PERSPECTIVE**	**9 Hours**
Introduction to Hadoop –Components of Hadoop –Application Development in Hadoop –Pig Hive- Jaql, Getting Data in Hadoop-copy Data-Flume, Other Hadoop Components-Zoo Keeper HBase- Oozie.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Jure Leskovec ,Anand Rajaraman, Jeffrey D.Ullman, “Mining of Massive Datasets” ,SecondEdition, Cambridge University Press, 2014.
2.	Paul Zikopoulos, “Understanding Big Data”, First Edition, McGraw Hill Corporations-2012.

Reference Book(s)

1.	Garrett Grolemund,” Introduction to Data Science with R “,O'Reilly media, 2014.
2.	Garrett Grolemund,”Hands-On Programming with R: Write Your Own Functions and Simulations Paperback”, O'Reilly media,2014.

Course Code	BECF186OEJ	L	T	P	C	IA	EA	TM
Course Name	**3D PRINTERS & APPLICATIONS**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE -II	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Control & Instrumentation							

Course Objectives:

The course should enable the students:

1. To develop CAD models for 3D printing.
2. To import and export CAD data and generate. STL file.
3. To select a specific material for the given application.
4. To select a 3D printing process for an application.
5. To produce a product using 3D printing or Additive Manufacturing (AM).

Course Outcomes:

Upon completion of the course, the student should be able to:

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Develop CAD models for 3D printing.	**K2**
CO2	Import and Export CAD data and generate STL file.	**K2**
CO3	Select a specific material for the given application.	**K3**
CO4	Select a 3D printing process for an application.	**K4**
CO5	Produce a product using 3D Printing or Additive Manufacturing (AM).	**K6**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	S	-	-	S	-	-	-	-	-	-	L	M	-	S
CO2	S	S	-	S	-	-	-	-	-	-	-	L	M	-	S
CO3	S	S	-	M	-	-	-	-	-	-	-	L	L	-	S
CO4	S	S	S	-	-	-	-	-	-	-	-	L	L	-	S
CO5	S	S	-	M	-	-	-	-	-	-	-	L	M	M	S

UNIT-I	3D PRINTING (ADDITIVE MANUFACTURING)	9 Hours

Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing

processes, Applications.		
UNIT-II	**CAD FOR ADDITIVE MANUFACTURING**	**9 Hours**
CAD Data formats, Data translation, Data loss, STL format.		
UNIT-III	**ADDITIVE MANUFACTURING TECHNIQUES**	**9 Hours**
Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology. Process, Process parameter, Process election for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, HealthCare, Defence, Automotive, Construction, Food Processing, Machine Tools.		
UNIT-IV	**MATERIALS**	**9 Hours**
Polymers, Metals, Non-Metals, Ceramics. Various forms of raw material – Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials.		
UNIT-V	**ADDITIVE MANUFACTURING EQUIPMENT AND POST PROCESSING**	**9 Hours**
Process equipment- design and process parameters Governing bonding mechanism Common faults and troubleshooting Process design Post processing: requirement and techniques Product quality, Inspection and testing Defects and their causes.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1.
2.	Ian Gibson, David W. Rosen and Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 2nd edition, Springer., United States, 2015, ISBN-13: 978-1493921126.

Reference Book(s)

1.	Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.
2.	CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping- Principles and Applications”,World Scientific, 2017.
3.	J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series in Material Science, 2013.
4.	L. Lu, J. Fuh and Y.S. Wong, “Laser-Induced Materials and Processes for Rapid Prototyping”,Kulwer Academic Press, 2001.
5.	Zhiqiang Fan And Frank Liou, “Numerical Modeling of the Additive Manufacturing (AM)Processes of Titanium Alloy”, InTech, 2012.

Course Code		L	T	P	C	IA	EA	TM
Course Name	**GLOBAL POSITIONING SYSTEMS**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE -II	**Syllabus Revision**					V.1.0	
Pre-requisite	Communication Systems							

Course Objectives:

The course should enable the students

1. To understand the basics of GPS.
2. To know the concepts of different coordinate system and its services.
3. To learn various codes and range models.
4. To understand the concepts of GPS propagation.
5. To study the various applications of GPS.

Course Outcomes:

On completion of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Analyze the basics of GPS.	**K4**
CO2	Demonstrate the impact of various coordinate system and its services.	**K3**
CO3	Analyze the various codes and range models.	**K4**
CO4	Describe the concepts of GPS propagation.	**K2**
CO5	Analyze the various applications of GPS.	**K4**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	M	S	-	-	-	-	L	-	-	L	-	L	L	L	-
CO2	M	M	-	-	-	-	L	-	-	M	-	-	L	L	M
CO3	S	L	-	-	-	-	M	-	-	M	-	-	-	-	L
CO4	M	L	-	-	-	-	S	-	-	L	-	L	-	L	M
CO5	L	L	-	-	-	-	S	-	-	S	-	L	L	L	S

UNIT-I	INTRODUCTION TO GPS	9 Hours

History of GPS – BC-4 System – HIRAN – NNSS – NAVSTAR GLONASS and GNSS Systems –GPS Constellation – Space Segment – Control Segment – User Segment – Single and Dual Frequency– Point – Relative – Differential GPS – Static and Kinematic Positioning – 2D and 3D – reportingAnti Spoofing (AS); Selective Availability (SA) – DOP Factors.

UNIT-II	COORDINATE SYSTEMS AND SERVICES	9 Hours

Coordinate Systems – Geo Centric Coordinate System – Conventional Terrestrial Reference

System – Orbit Description – Keplerian Orbit – Kepler Elements – Satellite Visibility – Topocentric Motion – Disturbed Satellite Motion – Perturbed Motion – Disturbing Accelerations - Perturbed Orbit – Time Systems – Astronomical Time System – Atomic Time – GPS Time – Need for Coordination – Link to Earth Rotation – Time and Earth Motion Services.

UNIT-III	CODES AND MODELS	9 Hours

C/A code; P-code; Y-code; L1, L2 Carrier frequencies – Code Pseudo Ranges – Carries Phases – Pseudo Ranges – Satellite Signal Signature – Navigation Messages and Formats – Undifferenced and Differenced Range Models – Delta Ranges – Signal Processing and Processing Techniques – Tracking Networks – Ephemerides – Data Combination: Narrow Lane; Wide Lane – OTF Ambiguity.

UNIT-IV	PROPAGATION CONCEPTS	9 Hours

Propagation Media – Multipath – Antenna Phase Centre – Atmosphere in brief – Elements of Wave Propagation – Ionospheric Effects on GPS Observations – Code Delay – Phase Advances – Integer Bias – Clock Error – Cycle Slip – Noise-Bias – Blunders – Tropospheric Effects on GPS Observables– Multipath Effect – Antenna Phase Centre Problems and Correction.

UNIT-V	GPS APPLICATIONS	9 Hours

Inter Disciplinary Applications – Crystal Dynamics – Gravity Field Mapping – Atmospheric Occulation– Surveying – Geophysics – Air borne GPS – Ground Transportation – Space borne GPS –Metrological and Climate Research using GPS.

	Total Hours	**45 Hours**

Text Book(s)

1.	B.Hoffman - Wellenhof, H.Lichtenegger and J.Collins, "GPS: Theory and Practice", 4threvised edition, Springer, Wein, New york, 1997
2.	A.Leick, "GPS Satellites Surveying", 2nd edition, John Wiley & Sons, NewYork, 1995

Reference Book(s)

1.	B.Parkinson, J.Spilker, Jr. (Eds), "GPS: Theory and Applications", Vol.I & Vol.II, AIAA,Enfant Promenade SW, Washington, DC 20024, 1996.
2.	A.Kleusberg and P.Teunisen (Eds), “GPS for Geodesy”, Springer-Verlag, Berlin, 1996

Course Code		L	T	P	C	IA	EA	TM
Course Name	**MACHINE LEARNING**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSES -II	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge of Communication							

Course Objectives:
The course should enable the students

1. To acquire theoretical Knowledge on setting hypothesis for pattern recognition.
2. To apply suitable machine learning techniques for data handling and to gain knowledge from it.
3. To evaluate the performance of algorithms and to provide solution for various real- world applications.

Course Outcomes:
At the end of the course, the student will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Recognize the characteristics of Machine Learning techniques that enable to solve realworld problems.	K2
CO2	Recognize the characteristics of machine learning strategies.	K2
CO3	Apply various supervised learning methods to appropriate problems.	K4
CO4	Identify and integrate more than one techniques to enhance the performance of learning.	K6
CO5	Create probabilistic and unsupervised learning models for handling unknown pattern.	K2

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	-	-	-	S	M	-	-	-	L	-	M	M	-	S
CO2	S	M	-	M	S	L	-	-	-	M	-	M	M	-	S
CO3	S	M		M	S	M	-	-	-	M	-	M	L	-	S
CO4	S	M	M	L	M	M	-	-	-	L	-	L	L	-	S
CO5	S	L	M	M		M	L	-	-	L	-	L	M	M	S

UNIT-I	**INTRODUCTION TO MACHINE LEARNING**	**9 Hours**
Introduction, Examples of Various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces, PAC Learning, VC Dimension.		
UNIT-II	**SUPERVISED LEARNING**	**9 Hours**
Decision Trees: ID3, Classification and Regression Trees, Regression: Linear Regression, Multiple Linear Regression, Logistic Regression, Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K- Nearest Neighbours.		
UNIT-III	**ENSEMBLE LEARNING**	**9 Hours**
Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking.		
UNIT-IV	**UNSUPERVISED LEARNING**	**9 Hours**
Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional: K-means clustering, K-Mode Clustering, Expectation Maximization, Gaussian Mixture Models.		
UNIT-V	**PROBABILISTIC LEARNING**	**9 Hours**
Bayesian Learning, Bayes Optimal Classifier, Naıve Bayes Classifier, Bayesian Belief Networks, Mining Frequent Patterns.		
	Total Hours	**45 Hours**

Reference Book(s)

1.	Ethem Alpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India,Third Edition2014.
2.	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press,2012.
3.	Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
4.	Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014.
5.	Charu C. Aggarwal, "DATA CLUSTERING Algorithms and Applications", CRC Press, 2014.
6.	Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012
7.	Jiawei Hanand Micheline Kambers and Jian Pei, "Data Mining Concepts and Techniques", 3rd edition, Morgan Kaufman Publications, 2012.

Course Code	BECF187OEK	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**SENSORS & ACTUATORS**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE - III	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge of Basic Electronics							

Course Objectives:

The course should enable the students:

1. To acquire knowledge about the principles and analysis of sensors.
2. To emphasis on characteristics and response of micro sensors.
3. To acquire adequate knowledge of different transducers and Actuators.
4. To learn about the Micro sensors and Micro actuators.
5. To select sensor materials for fabrication for different applications.

Course Outcomes:

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

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Analyze the basics and design the resistive sensors.	**K4**
CO2	Identify the materials and designing of inductive and capacitive sensors.	**K5**
CO3	Analyze various types of Actuators.	**K4**
CO4	Design Micro sensors and Micro actuators for various applications.	**K6**
CO5	Implement fabrication process and technologies and compare various Micro-machiningprocesses	**K5**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	S	-	-	S	-	-	-	-	-	-	L	M	-	S
CO2	S	S	-	S	-	-	-	-	-	-	-	L	M	-	S
CO3	S	S	-	M	-	-	-	-	-	-	-	L	L	-	S
CO4	S	S	S	-	-	-	-	-	-	-	-	L	L	-	S
CO5	S	S	-	M	-	-	-	-	-	-	-	L	M	M	S

UNIT-I	**SENSORS**	**9 Hours**

Difference between sensor, transmitter and transducer - Primary measuring elements -

selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. Signal transmission - Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Principle of operation, construction details, characteristics and applications of potentiometer, Proving Rings, Strain Gauges, Resistance thermometer, Thermistor, Hot-wire anemometer, Resistance Hygrometer, Photo-resistive sensor.		
UNIT-II	**INDUCTIVE AND CAPACITIVE TRANSDUCERS**	**9 Hours**
Inductive transducers: - Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer, variable reluctance transducer, synchros, microsyn. Capacitive transducers: - Principle of operation, construction details, characteristics of Capacitive transducers– different types & signal conditioning- Applications:- capacitor microphone, capacitive pressure sensor, proximity sensor.		
UNIT-III	**ACTUATORS**	**9 Hours**
Definition, types and selection of Actuators; linear; rotary; Logical and Continuous Actuators, Pneumatic actuator- Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator - Control valves; Construction, Characteristics and Types, Selection criteria. Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.		
UNIT-IV	**MICRO SENSORS AND MICRO ACTUATORS**	**9 Hours**
Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors. **Micro Actuators:** Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.		
UNIT-V	**SENSOR MATERIALS AND PROCESSING TECHNIQUES**	**9 Hours**
Materials for sensors: Silicon, Plastics, metals, ceramics, glasses, nano materials. Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography, silicon micro machining: Bulk silicon micromachining, Surface silicon micromachining, LIGA process.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Patranabis.D, Sensors and Transducers, Wheeler publisher, 1994.
2.	Sergej Fatikow and Ulrich Rembold, Microsystem Technology and Microbotics First edition, Springer –Verlag Newyork, Inc, 1997.

3.	Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application" Fourthedition, Springer, 2010.
Reference Book(s)	
1.	Robert H Bishop, "The Mechatronics Hand Book", CRC Press, 2002.
2.	Thomas. G. Bekwith and Lewis Buck.N, Mechanical Measurements, Oxford and IBHpublishing Co. Pvt. Ltd.,
3.	Massood Tabib and Azar, Micro actuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures, First edition, Kluwer academic publishers, Springer, 1997.
4.	Manfred Kohl, Shape Memory Actuators, first edition, Springer.

Course Code	BECF187OEM	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ARTIFICIAL INTELLIGENCE**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE -III	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Computer Architecture							

Course Objectives:

The course should enable the students:

1. To understand the basic building blocks of Intelligent Systems.
2. To gain knowledge in problem formulation and building intelligent agents.
3. To understand some of the searching approaches to build Intelligent Systems.
4. To understand the types of logic and knowledge representation schemes.
5. To acquire knowledge in planning and learning algorithms.

Course Outcomes:

At the end of the course students should able to:

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the basic concepts and techniques of Artificial Intelligence.	**K2**
CO2	Acquire Knowledge on intelligent agents and problem solving by using various search strategies.	**K2**
CO3	Apply AI algorithms for solving practical problems.	**K3**
CO4	Design and Implement an example using Knowledge representation.	**K6**
CO5	Apply planning and reasoning algorithms for solving real life problems.	**K3**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO3**
CO1	S	M	S	M	-	-	-	-	-	-	-	-	-	-	-
CO2	L	S	S	S	L	-	-	-	-	-	-	M	M	M	M
CO3	L	S	S	S	L	-	-	-	-	-	-	S	M	M	S
CO4	L	S	S	S	L	-	-	-	-	-	-	M	-	-	M
CO5	L	S	S	M	-	-	-	-	-	-	-	M	-	-	M

UNIT-I	**INTRODUCTION TO AI-AI TECHNIQUES**	**9 Hours**

Introduction – Foundations of AI, the History of AI –Intelligent Agent – Agent and Environment, Good Behavior: The Concept of Rationality, Nature of Environments, Structure of Agents- Problem Solving Agents -Example Problems.		
UNIT-II	**SEARCHING TECHNIQUES- UNIFORMED SEARCH ALGORITHM**	**9 Hours**
Uninformed Searching strategies-Breadth First Search, Depth First search, Depth limited search, Iterative deepening search, Bidirectional Search - Avoiding repeated States - Searching with Partial information –Informed search strategies – Greedy Best First Search-A* Search-Heuristic Functions- Local Search Algorithms for Optimization Problems-Local search in Continuous Spaces.		
UNIT-III	**SEARCHING TECHNIQUES- ONLINE SEARCH ALGORITHM**	**9 Hours**
Online Search Agents and Unknown Environments-Online Search Problems, Online Search Agents- Online Local search, learning in Online Search – Constraint Satisfaction Problems-Backtracking CSP, The Structure of Problems-Adversarial Search-Games, Optimal Decisions in Games, Alpha- Beta Pruning.		
UNIT-IV	**KNOWLEDGE AND REASONING**	**9 Hours**
Logical agents – Knowledge Based Agents, The Wumpus World, Propositional Logic-A very simple Logic –First Order logic– inferences in first order logic – forward chaining – backward chaining – Unification – Resolution.		
UNIT-V	**PLANNING**	**9 Hours**
Planning with state space search – Partial-order planning – Planning graphs – Planning and acting in the real world.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	S. Russel and P. Norvig, "Artificial Intelligence –A Modern Approach", Second Edition, Pearson Education 2003.
Reference Book(s)	
1.	David Poole, Alan Mackworth, Randy Goebel, "Computational Intelligence: a Logical Approach", Oxford University Press, 2004.
2.	G. Luger, "Artificial Intelligence: Structures and Strategies for Complex Problem Solving", Fourth Edition, Pearson Education, 2002.

Course Code	BECF188OEP	**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**ROBOTICS AND AUTOMATION**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE -III	**Syllabus Revision**				V.1.0		
Pre-requisite	Sensors and Transducers							

Course Objectives:
The course will enable the students to:
1. To familiarize the student with the anatomy of robots and their applications.
2. To specify and provide the knowledge of techniques involved in robot vision system.
3. To provide knowledge about various kinds of end effectors.
4. Understand the various kinematics and inverse kinematics of robots.
5. To equip students with latest robot languages implemented in industrial manipulators.

Course Outcomes:
At the end of the course the students will be able to

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	Demonstrate the mechanical structures of industrial robots.	**K2**
CO2	Understand the importance of robot vision.	**K2**
CO3	Apply knowledge and choose the best end effectors for specific applications.	**K3**
CO4	Forward and inverse kinematics of Robotics is learned.	**K2**
CO5	Program and industrial robot through different methods and languages.	**K6**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	M	-	-	-	-	-	-	-	-	-	-	-	L	-	M
CO2	L	-	-	-	L	M	S	-	-	-	-	-	M	-	M
CO3	S	-	L	-	M	L	L	-	-	-	-	-	M	-	L
CO4	M	L	S	L	M		M	-	-	-	-	-	M	-	L
CO5	S	L	M	-	L	M	S	-	-	-	-	-	L	-	M

UNIT-I	**INTRODUCTION TO ROBOTICS**	**9 Hours**

Need for Robots, Asimov's laws of robotics, Basic components-Classification,

Characteristics-Work volume, spatial resolution and repeatability, Precision and accuracy. Coordinate system- Drives & Control systems, Actuators, Applications of Robots.		
UNIT-II	**SENSORS IN ROBOTICS**	**9 Hours**
Position sensors (Piezo Electric sensor, LVDT, Optical Encoders)-Proximity (Inductive, Capacitive, Hall Effect & Ultrasonic), Range sensors (Laser Meters, Lighting Approach & Time of Flight Range Finder)-Image Processing & Analysis:-Image Data reduction-Feature extraction-Object Recognition.		
UNIT-III	**END EFFECTORS**	**9 Hours**
Wrist configuration, Pitch, Yaw, Roll – Types of Grippers -Mechanical Grippers- Pneumatic and Hydraulic Grippers-Vacuum Cups-Magnetic Grippers –Two Fingered and Three fingered Grippers- Robot/End effectors Interface-Selection and Design Considerations.		
UNIT-IV	**ROBOT KINEMATICS**	**9 Hours**
Forward Kinematics, Inverse Kinematics and the difference, Forward Kinematics and Inverse Kinematics of manipulators with two, three degrees or freedom (in two dimensional), four degrees of freedom (in three dimensional) – derivations. Homogenous transformation matrix, translational and rotational matrix, Denavit & Hartenberg representation.		
UNIT-V	**ROBOT PROGRAMMING**	**9 Hours**
Teach pendant programming, Lead through programming, Robot languages: VAL Programming, Motion command, Sensor command, End Effectors command. RGV, AGV, Implementation of robots in industries, various steps, Safety considerations for robot operations. Economic analysis of robots: Pay back methods, EUAC method and Rate of return method.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Ganesh. S. Hedge, “A Textbook of Industrial Robotics”, Lakshmi Publications, 2008.
2.	Mikell.P.Groover,” Industrial Robotics-Technology, Programming and Applications”, McGraw Hill, second edition 2012.
Reference Book(s)	
1.	Oran Koren, “Robotics for Engineers”, McGraw Hill, 1985.
2.	Fu K.S.Gonalz R.C. and ice C.S.G.”Robotics, Control, Sensing, Vision and Intelligence”McGraw Hill Ltd., 2007.
3.	Deb.S.R.”Robotics Technology and Flexible Automation”, Tata McGraw Hill, 2010.

Course Code	BECF188OES	L	T	P	C	IA	EA	TM
Course Name	**CLOUD COMPUTING**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE -III	**Syllabus Revision**				V.1.0		
Pre-requisite	Basic knowledge of Computer Networks							

Course Objectives:

The course will enable the students to:

1. To understand the concept of cloud computing.
2. To understand the cloud services.
3. To know the concept of VDC
4. To know the application of VDC
5. To understand the concept of cloud infrastructure and management.

Course Outcomes:

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

Course Outcomes	Description	Highest Bloom's Taxonomy
CO1	To understand basic concepts, types, characteristics of cloud computing and service models	**K2**
CO2	To identify the significance of Classic Data Center and its type's in cloud computing.	**K4**
CO3	To identify the significance of implementing virtualization techniques.	**K6**
CO4	To understand the need of security in Cloud computing.	**K6**
CO5	To understand Cloud Infrastructure and Cloud Migration.	**K6**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	S	M	M	-	L	L	L	-	L	-	-	-	L	M	M
CO2	S	M	M	-	L	L	L	-	L	-	-	-	L	M	S
CO3	S	M	M	-	L	L	L	-	L	-	-	-	L	M	S
CO4	-	S	M	-	-	-	-	-	-	L	L	S	M	M	M
CO5	-	-	-	-	-	L	-	L	L	M	M	S	M	M	S

UNIT-I	CLOUD COMPUTING PRIMER	9 Hours
Cloud computing characteristics, cloud definition -cloud deployment models – private, public, hybrid and Community cloud, cloud services – SaaS, PaaS, and IaaS, Drivers for cloud computing, building cloud infrastructure – a phased approach- virtualization and its benefits- cloud economics and challenges.		
UNIT-II	**CLASSIC DATA CENTER (CDC)**	**9 Hours**
Key elements of data center - application, DBMS, compute, storage and network, server clustering, RAID technology, intelligent storage system, DAS, FC-SAN – components, port type, addressing, and zoning, IP- SAN – iSCSI and FCIP, converged network - FCoE, NAS, object based and unified storage, business continuity terminologies, backup-recovery and duplication, local and remote replication, CDC monitoring and management, Information lifecycle strategy.		
UNIT-III	**VIRTUALIZED DATA CENTER (VDC)**	**9 Hours**
Compute: Compute virtualization benefits, hypervisor types, virtual machine (VM) - resources, V M resource management, physical to virtual conversion – process, benefits. Storage: Storage virtualization benefits, storage for VMs, block and file level storage virtualization, virtual Provisioning – benefits and best practices, storage tiering. Networking: Network virtualization benefits, VDC network infrastructure components, VLANs, and Network traffic management techniques.		
UNIT-IV	**VIRTUALIZED DATA CENTER – DESKTOP AND APPLICATION**	**9 Hours**
Desktop, application, and user state virtualization – benefits, tools, and deployment methods, Business Continuity in VDC:-Eliminating single points of failure, clustering, fault tolerance, and NIC teaming, backup and replication in VDC, VM templates and VM migration. Cloud Security:-Basic information security concepts, cloud security concerns and threats, security mechanisms in cloud at compute, storage, and network layer, Governance, Risk and compliance in Cloud.		
UNIT-V	**CLOUD INFRASTRUCTURE AND MANAGEMENT**	**9 Hours**
Cloud infrastructure framework -components, infrastructure management and service creation tools- processes – asset - configuration management, service catalog management, financial management, capacity, performance availability management, incident, problem and compliance management. Cloud Migration Considerations:- Considerations for choosing right application and cloud model, service provider specific considerations, cloud adoption phases, Financial and technical feasibility assessment, migration and optimization considerations.		
	Total Hours	**45 Hours**

Text Book(s)

1.	Cloud Infrastructure and Services Student Guide - EMC Education Services- 2011.

Reference Book(s)	
1.	EMC IT's Journey to the Private Cloud: A Practitioner's Guide -2011.
2.	EMC IT'S "ON-RAMP" TO THE JOURNEY TO THE PRIVATE CLOUD Replat form to an Open Scalable Infrastructure-2011.
3.	EMC IT's Journey to the Private Cloud: Applications & Cloud Experience.
4.	EMC IT's Journey to the Private Cloud: Server virtualization.
5.	EMC IT's Journey to the Private Cloud: Backup & Recovery Systems.
6.	EMC IT's Journey to the Private Cloud: Virtual Desktop-2011. (Incl.Ref.no: 3, 4, 5, 6).

Course Code		**L**	**T**	**P**	**C**	**IA**	**EA**	**TM**
Course Name	**BLOCK CHAIN TECHNOLOGY**	3	0	0	3	40	60	100
Course Category	OPEN ELECTIVE COURSE –III	**Syllabus Revision**					V.1.0	
Pre-requisite	Basic knowledge of Data Communication							

Course Objectives:

The course should enable the students

1. To understand the technology behind block chain.
2. To comprehend the issues related to block chain.
3. To study the real-world applications of block chain.

Course Outcomes:

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

Course Outcomes	**Description**	**Highest Bloom's Taxonomy**
CO1	Understand the requirements of the basic design of block chain.	**K2**
CO2	Identify the need of block chains to find the solution to the real-world problems.	**K2**
CO3	Summarize the working of block chain.	**K2**
CO4	Recognize the underlying technology of transactions, blocks, proof-of-work, and consensusbuilding.	**K2**
CO5	Design and implement new ways of using block chain for applications.	**K2**

Correlation between Course Outcomes (COs) and Program Outcomes (POs):

COs	**Program Outcomes (POs)**												**Program Specific Outcomes (PSOs)**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	S	-	-	-	-	-	-	-	L	L	-	M	-	M	-
CO2	S	-	-	-	-	-	-	-	L	L	-	M	-	M	-
CO3	S	-	-	-	-	-	-	-	L	L	-	M	M	M	-
CO4	S	L	M	-	-	-	-	-	L	L	-	M	-	M	-
CO5	-	S	S	M	-	-	-	-	M	M	-	M	M	M	-

UNIT-I	**INTRODUCTION**	**9 Hours**

Blockchain concepts, evolution, structure, characteristics, a sample blockchain application, the blockchain stack, benefits and challenges.

UNIT-II	**BLOCKCHAIN: HOW DO THEY WORK?**	**9 Hours**

What is a Blockchain? Public Ledgers, Blocks in a Blockchain, Blockchain as public ledgers, Transactions, Distributed consensus. Building a block: Elements of Cryptography-Cryptographic Hash functions, Merkle Tree, Elements of Game Theory.		
UNIT-III	**BLOCKCHAIN ARCHITECTURE AND USE CASES**	**9 Hours**
Design methodology for Blockchain applications, Blockchain application templates, Blockchain application development, Ethereum, Solidity, Sample use cases from Industries, Business problems.		
UNIT-IV	**SMART CONTRACTS**	**9 Hours**
Smart contract, structure of a contract, interacting with smart contracts using Geth client and Mist wallet, smart contract examples, smart contract patterns.		
UNIT-V	**DECENTRALIZED AND REAL WORLD APPLICATIONS**	**9 Hours**
Dapps, implementing Dapps, Ethereum Dapps, case studies related to Dapps, Internet of things, healthcare.		
	Total Hours	**45 Hours**

Text Book(s)	
1.	Blockchain applications: a hands-on approach, Bahga A., Madisetti V., VPT, 2017.
Reference Book(s)	
1.	Beginning Blockchain, A Beginner's Guide to Building Blockchain Solutions, Bikramadity Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress, 2018.
2.	Blockchain A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph J. Bambara and Paul R. Allen, McGraw Hill, 2018.
3.	Blockchain enabled Applications Vikram Dhillon, David Metcalf and Max Hooper, Apress, 2017.
4.	The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology, William Mougayar, Wiley, 2016.
5.	Blockchain Science: Distributed Ledger Technology, Roger Wattenhofer, Inverted Forest Publishing; 3rd edition, 2019.