1.1.3

List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

Colour Codes		
Name of the Subjects	Yellow	
Employability Contents	Green	
Entrepreneurship Contents	Light Blue	
Skill Development Contents	Pink	

List of Courses Focus on Employability/ Entrepreneurship/ Skill Development

Department : *Electronics & Communication Engineering*

Programme Name : *B.Tech.*

Academic Year: 2023-24

List of Courses Focus on Employability/ Entrepreneurship/Skill Development

Sr. No.	Course Code	Name of the Course
1	AMUATB4	Engineering Mathematics - B
2	PPUATB2	Engineering Physics
3	ITUATE2	Introduction to Information Technology
4	ECUATE3	Basic Electrical Engineering
5	ELUATH1	English for Communication
6	ECUATH2	Human Values & Ethics
7	PPUALB2	Engineering Physics Laboratory
8	MEUALL1	Engineering Graphics
9	ECUALE3	Basic Electrical Engineering Laboratory
10	NSUALS1	NSS
11	AMUBTB1	Engineering Mathematics - A
12	CYUBTB3	Engineering Chemistry
13	CSUBTE5	Computer Programming
14	ECUBTE7	Introduction to Electronics & Communication Engineering
15	LAUBTC1	Indian Constitution
16	FOUBTC2	Environmental Science and Ecology
17	CYUBLB3	Engineering Chemistry Laboratory
18	IPUBLL2	Engineering Workshop Practices
19	CSUBLE5	Computer Programming Laboratory
20	PEUBLS2	Sports and Yoga
21	ECUCTE1	Engineering Economics
22	ECUCTT1	Electronic Devices
23	ECUCTT2	Digital Logic Design
24	ECUCTT3	Networks, Signals and Systems
25	ECUCTK1	Transmission Line & Electromagnetic Waves
26	ECUCTK2	Electronic Measurements and Instrumentation

27	EC UCTO1	Data Communication
28	CSUCTO1	Data Structure with C++
29	ITUCTO1	Computer Organization & Architecture
30	CEUCTO1	Green Buildings
31	CHUCTO1	Engineering Materials
32	MEUCTO1	Introduction to Thermodynamics
33	IPUCTO1	I.C. Engine
34	ECUCLT1	Electronics Devices Lab
35	ECUCLT2	Digital Logic Design Lab
36	ECUDTT1	Analog Circuits
37	ECUDTT2	Analog and Digital Communication
38	ECUDTT3	Control Systems
39	ECUDTK1	Probability Theory & Random Process
40	ECUDTK2	Sensors & Actuators
41	ECUDTK3	Antenna & Wave Propagation
42	ECUDTO1	Introduction to Electronics Devices and Circuits
43	ITUDTO1	Computer Network
44	ITUDTO2	Fundamentals of Python Programming
45	CSUDTO1	Introduction to Information Science
46	CEUDTO1	Remote Sensing & GIS
47	CHUDTO1	Fluidization Engineering
48	MEUDTO1	Introduction to Fluid Mechanics
49	IPUDTO1	Automobile Engineering
50	ECUDLT1	Analog Circuits Lab
51	ECUDLT2	Analog and Digital Communication Lab
52	ECUDPV1	Mini Project
53	EC205TPC08	LIC & its Application
54	EC205TPC09	Digital Communication
55	EC205TPC10	Digital Signal Processing
56	EC205TES06	Electromagnetic Waves
57	EC205THS03	Probability Theory & Random Process
58	EC205THS04	Effective Technical Communication
59	EC205PPC06	LIC Lab
60	EC205PPC07	Analog and Digital Communication Lab
61	EC205PPC08	Digital Signal Processing Lab

62	EC206TPC11	CMOS Digital VLSI Design
63	EC206TPC12	Data Communication & Computer Networks
64	EC206TPC13	Microprocessor & Microcontroller
65	EC206TES07	Electronic Measurements and Sensors
66	EC206TPE01	Information Theory & Coding
67	EC206TPE02	Advance Signal Processing
68	EC206TPE03	Renewable Energy Sources
69	EC206TPE04	Introduction to MEMS
70	CE206TOE01	Metro System and Engineering
71	CH206TOE01	Industrial Utilities and Safety
72	CS206TOE01	Object Orient Programming with C++
73	IT206TOE01	Computer Graphics
74	ME206TOE01	Automobile Engineering
75	EC206TOE01	Introduction to Electronic Devices & Circuits
76	EC206PPC09	CMOS Digital VLSI Design Lab
77	EC206PPC10	Data Communication & Computer Networks Lab
78	EC206PES06	Electronic Measurement and Sensors Lab
79	EC207TPE05	Mobile Communication & Network
80	EC207TPE06	Digital Image Processing
81	EC207TPE07	Analog CMOS IC Design
82	EC207TPE08	Fiber Optic Communication
83	EC207TPE09	Microwave Theory & Techniques
84	EC207TPE10	Power Electronics
85	EC207TPE11	Estimation and Detection Theory
86	EC207TPE12	Radar & Satellite Communication
87	EC207TPE13	Pattern Recognition & Machine Learning
88	EC207TOE02	CMOS Digital VLSI Design (For students other than ECE)
89	CE207TOE02A	Green Building and Sustainable Materials
90	ME207TOE02	Principles of Management
91	CH207TOE02	Waste to Energy
92	IT207TOE01	Machine Learning
93	CS207TOE01	GIS & Remote sensing
94	EC207PPC11	Design & Simulation Lab
95	EC207PPS01	Seminar on Industrial Training
96	EC207PPS02	Project-I

97	EC208TPE14	VLSI Fabrication Methodology
98	EC208TPE15	Millimeter Wave Technology
99	EC208TPE16	Video Processing
100	EC208TPE17	Wireless Sensor Networks
101	EC208TPE18	Low Power VLSI Design
102	EC208TPE19	Biomedical Instrumentation
103	EC208TPE20	Neural Network & Fuzzy Logic
104	EC208TPE21	Next Gen. Comm. Technology
105	EC208TOE03	Introduction to IoT(For students other than ECE)
106	CE208TOE03	Infrastructure Planning and Management
107	ME208TOE0	Supply Chain Management
108	CH208TOE03	Plant Engineering Economics and Management
109	IT208TOE01	Soft Computing
110	CS208TOE01	Artificial Intelligence
111	EC208PPS03	Project-II
112	EC208PPS04	Comprehensive Viva
113	ECPATT01	Linear Algebra
114	ECPATP01	Wireless Communication & Network
115	ECPATP02	Introduction to Embedded System & IoT
116	ECPATP03	Microstrip Antenna
117	ECPATP04	Optoelectronic Devices
118	ECPATP05	Solid State Devices
119	ECPATP06	Antenna for Modern Wireless Communication
120	ECPATP07	Analog CMOS VLSI Design
121	ECPATP08	Digital Image Processing
122	ECPATP09	Modern Digital Communication
123	ECPATP10	Network Security & Cryptography
124	ECPATP11	Introduction to Signal Processing
125	ECPATP12	Satellite Communication
126	ECPATC01	Research Methodology & IPR
127	ECPALT01	Adv Simulation Lab
128	ECPBTT01	Estimation and Detection Theory
129	ECPBTP01	Low Power VLSI Design
130	ECPBTP02	Adv Digital Signal Processing
131	ECPBTP03	Optical Instrumentation

132	ECPBTP04	Pattern Recognition & Machine Learning
133	ECPBTP05	Optical Communication System
134	ECPBTP06	Next Gen. Comm. Technology
135	ECPBTP07	Computer Vision
136	ECPBTP08	Digital Communication Receiver
137	ECPBTP09	Millimeter Wave Technology
138	MSPBTO1	Business Analysis
139	IPPBTO2	Industrial Safety
140	IPPBTO3	Operations Research
141	CEPBTO4	Cost Management of Engineering Projects
142	MEPBTO5	Composite Materials
143	CHPBTO6	Waste to Energy
144	ECPBTO7	Internet of Things
145	ITPBTO9	Software Engineering Techniques
146	MCPBTO8	MOOCs
147	ELPBTX1	English for Research Paper Writing
148	PEPBTX2	Stress Management by Yoga
149	CEPBTX3	Disaster Management
150	LAPBTX4	Constitution of India
151	ECPCPT01	Dissertation Stage-I
152	ECPDPT01	Dissertation Stage-II
153	ECDATT1	Research Methodology in Engineering
154	ECDATP1	Vacuum Technology
155	ECDATP2	Antenna For Modern Wireless Communication
156	ECDATP3	Microstrip Antenna
157	ECDATP4	Wireless Communication & Network
158	ECDATP8	Tunnel Field Effect Transistor
159	ECDATP9	MIMO Communication System
160	ECDATP10	Deep Learning
161	ECDATP11	Machine Learning
162	ECDATP13	Introduction to IoT
163	ECDATP14	Satellite Communication
164	ECDATP23	Digital Image Processing
165	ECDATP24	Medical Image Processing
166	ECDATP25	Convex Optimization

SCHOOL OF STUDIES OF ENGINEERING AND TECHNOLOGY

Scheme of Teaching and Evaluation 2022-2023 (As per NEP-2020)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

(Effective from the Academic year 2023-2024)

I-SEMESTER BTech ECE/ IT/CSE

S.N.	Course Code	Course Title	Teaching Hours/ week			Examination				Credits
			Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIA Marks	SEA Marks	Total Marks	
			L	T	P					
1	AMUATB4	Engineering Mathematics - B	3	1	-	03	40	60	100	4
2	PPUATB2	Engineering Physics	3	1	-	03	40	60	100	4
3	ITUATE2	Introduction to Information Technology	3	-	-	03	40	60	100	3
4	ECUATE3	Basic Electrical Engineering	3	-	-	03	40	60	100	3
5	ELUATH1	English for Communication	3	-	-	03	40	60	100	3
6	ECUATH2/ CSUATH2/ITUATH2	Human Values & Ethics	1	-	-	02	50	-	50	1
7	PPUALB2	Engineering Physics Laboratory	-	-	2	03	25	25	50	1
8	MEUALL1	Engineering Graphics	1	-	3	03	25	25	50	3
9	ECUALE3	Basic Electrical Engineering Laboratory	-	-	2	03	25	25	50	1
10	NSUALS1	NSS	-	-	2	01	25	25	50	1
Total			**17**	**2**	**09**	**27**	**350**	**400**	**750**	**24**

Note: AM:Mathematics, PP:Physics, ME: Mechanical Engineering, IP: Industrial & Production Engineering, CE: Civil Engineering, CS: Computer Sc. & Engg., IT: Information Technology, PE: Physical Education, NS: NSS, U: Undergraduate, T: Theory, L: Laboratory,

BASIC SCIENCE (B)	ENGINEERING SCIENCE (E)	SKILL ENHANCEMENT COURSE (L)	HUMANITIES SCIENCE (H)	MANDATORY COURSE (C)	EXTRA-CURRICULAR ACTIVITIES (S)
1. Mathematics – A 2. Physics 3. Chemistry 4. Mathematics - B	1. Engineering Mechanics 2. Introduction to Information Technology 3. Basic Electrical Engineering 4. Basic Electrical and Electronics Engineering 5. Computer Programming 6. Basic Communication Engineering	1. Engineering Graphics 2. Engineering Workshop Practices	1. English for communication 2. Human Values and Ethics	1. Indian Constitution 2. Environmental Science & Ecology	1. NSS 2. Sports and Yoga

Credit Definition:

- 1-hour lecture **(L)** per week per semester = **1Credit**
- 1-hour tutorial **(T)** per week per semester = **1Credit**
- 2-hour Practical/Drawing**(P)** per week per semester = **1 Credit**

- **Four credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **30** hours of Teaching-Learning process.
- **One credit** courses are to be designed for **15** hours of Teaching-Learning process

Note: The above is applicable only to THEORY courses

AICTE Activity Points to be earned by students admitted to B.Tech. programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines):

Over and above the academic grades, every regular student admitted to the 4 years Degree program and every student entering 4years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. The Activity Points earned shall be reflected on the student's eighth semester Grade Card.

The activities can be spread over the years, any time during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) donot affect SGPA/CGPA and shall not be considered for vertical progression.

Eligibility for UG Certificate:

A. **Undergraduate Certificate course will be offered by all departments of SoS(E&T), GGV.**
B. **For applicability of UG Certificate, the candidate who wants to exit after completing 1st year (02 semesters) BTech degree with 10 credits of skill-based courses lasting two months, including atleast 06 credits job specific internship/apprenticeship with NHEQF level 5/UCF level 4.5.**
C. **A student shall report to the concerned Head on or before the date notified by the Department/School/University, if he/she is interested to exit with UG Certificate**

SCHOOL OF STUDIES OF ENGINEERING AND TECHNOLOGY

Scheme of Teaching and Evaluation 2022-2023 (As per NEP-2020)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

(Effective from the Academic year 2023–2024)

II-SEMESTER BTech ECE/ IT/CSE

S. N.	Course Code	Course Title	Teaching Hours/week			Examination				Credits
			Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIA Marks	SEA Marks	Total Marks	
			L	T	P					
1	AMUBTB1	Engineering Mathematics - A	3	1	-	03	40	60	100	4
2	CYUBTB3	Engineering Chemistry	3	-	-	03	40	60	100	3
3	CSUBTE5	Computer Programming	3	-	-	03	40	60	100	3
4	ECUBTE7	Introduction to Electronics & Communication Engineering	3	-	-	03	40	60	100	3
5	LAUBTC1	Indian Constitution	1	-	-	01	50	-	50	1
6	FOUBTC2	Environmental Science and Ecology	2	-	-	03	40	60	100	2
7	CYUBLB3	Engineering Chemistry Laboratory	-	-	2	03	25	25	50	1
8	IPUBLL2	Engineering Workshop Practices	-	-	2	03	25	25	50	1
9	CSUBLE5	Computer Programming Laboratory	-	-	2	03	25	25	50	1
10	PEUBLS2	Sports and Yoga	-	-	2		25	25	50	1
Total			**15**	**1**	**08**	**25**	**350**	**400**	**750**	**20**

Note: AM:Mathematics, PP:Physics, ME: Mechanical Engineering, IP: Industrial & Production Engineering, CE: Civil Engineering, CS: Computer Sc. & Engg., IT: Information Technology, PE: Physical Education, FO: Forestry, LA: Law, NS: NSS, U: Undergraduate, T: Theory, L: Laboratory,

BASIC SCIENCE (B)	ENGINEERING SCIENCE (E)	SKILL ENHANCEMENT COURSE (L)	HUMANITIES SCIENCE (H)	MANDATORY COURSE (C)	EXTRA-CURRICULAR ACTIVITIES (S)
1. Mathematics – A 2. Physics 3. Chemistry 4. Mathematics - B	1. Engineering Mechanics 2. Introduction to Information Technology 3. Basic Electrical Engineering 4. Basic Electrical and Electronics Engineering 5. Computer Programming 6. Basic Communication Engineering	1. Engineering Graphics 2. Engineering Workshop Practices	1. English for communication 2. Human Values and Ethics	1. Indian Constitution 2. Environmental Science & Ecology	1. NSS 2. Sports and Yoga

Credit Definition:

- 1-hour lecture **(L)** per week per semester = **1Credit**
- 1-hour tutorial **(T)** per week per semester = **1Credit**
- 2-hour Practical/Drawing**(P)** per week per semester = **1 Credit**

- **Four credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **30** hours of Teaching-Learning process.
- **One credit** courses are to be designed for **15** hours of Teaching-Learning process

Note: The above is applicable only to THEORY courses

AICTE Activity Points to be earned by students admitted to B.Tech. programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines):

Over and above the academic grades, every regular student admitted to the 4 years Degree program and every student entering 4years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. The Activity Points earned shall be reflected on the student's eighth semester Grade Card.

The activities can be spread over the years, any time during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) donot affect SGPA/CGPA and shall not be considered for vertical progression.

Eligibility for UG Certificate:

A. Undergraduate Certificate course will be offered by all departments of SoS(E&T), GGV.

B. For applicability of UG Certificate, the candidate who wants to exit after completing 1st year (02 semesters) BTech degree with 10 credits of skill-based courses lasting two months, including atleast 06 credits job specific internship/apprenticeship with NHEQF level 5/UCF level 4.5.

C. A student shall report to the concerned Head on or before the date notified by the Department/School/University, if he/she is interested to exit with UG Certificate

III-SEMESTER SCHEME OF TEACHING & EVALUATION 2023-24

S. N.	Course Type	Course Code	Course Title	Teaching Hours/week			Examination				Credits
				Theory lectures	Tutorial	Practical/Drawing	Examination in Hrs	CIA Marks	SEA Marks	Total Marks	
				L	T	P					
1	Ancient Science/Management/ Psychology	ECUCTE1	Engineering Economics	3	-	-	03	40	60	100	3
2	Department Core	ECUCTT1	Electronic Devices	3	-	-	03	40	60	100	3
3	Department Core	ECUCTT2	Digital Logic Design	3	-	-	03	40	60	100	3
4	Department Core	ECUCTT3	Networks, Signals and Systems	3	1	-	03	40	60	100	4
5	Department Elective	ECUCTK1	Transmission Line & Electromagnetic Waves	3	-	-	03	40	60	100	3
		ECUCTK2	Electronic Measurements and Instrumentation								
6	Institute Core/OE	EC UCTO1	Data Communication	3	-	-	03	40	60	100	3
		CSUCTO1	Data Structure with C++								
		ITUCTO1	Computer Organization & Architecture								
		CEUCTO1	Green Buildings								
		CHUCTO1	Engineering Materials								
		MEUCTO1	Introduction to Thermodynamics								
		IPUCTO1	I.C. Engine								
7	Practical	ECUCLT1	Electronics Devices Lab	-	-	2	03	25	25	50	1
8	Practical	ECUCLT2	Digital Logic Design Lab	-	-	2	03	25	25	50	1
Total				**18**	**1**	**04**	**24**	**290**	**410**	**700**	**21**

IV-SEMESTER SCHEME OF TEACHING & EVALUATION 2023-24

S. N.	Course Type	Course Code	Course Title	Teaching Hours/ week			Examination				Credits
				Theory lectures	Tutorial	Practical/Drawing	Examination in Hours	CIA Marks	SEA Marks	Total Marks	
				L	T	P					
1	Department Core	ECUDTT1	Analog Circuits	3	-	-	03	40	60	100	3
2	Department Core	ECUDTT2	Analog and Digital Communication	3	1	-	03	40	60	100	4
3	Department Core	ECUDTT3	Control Systems	3	-	-	03	40	60	100	3
4	Department Elective	ECUDTK1	Probability Theory & Random Process	3	-	-	03	40	60	100	3
		ECUDTK2	Sensors & Actuators								
		ECUDTK3	Antenna & Wave Propagation								
5	Institute Core/OE	ECUDTO1	Introduction to Electronics Devices and Circuits	3	-	-	03	40	60	100	3
		ITUDTO1	Computer Network								
		ITUDTO2	Fundamentals of Python Programming								
		CSUDTO1	Introduction to Information Science								
		CEUDTO1	Remote Sensing & GIS								
		CHUDTO1	Fluidization Engineering								
		MEUDTO1	Introduction to Fluid Mechanics								
		IPUDTO1	Automobile Engineering								
6	Practical	ECUDLT1	Analog Circuits Lab	-	-	2	03	25	25	50	1
7	Practical	ECUDLT2	Analog and Digital Communication Lab	-	-	2	03	25	25	50	1
8	Mini Project	ECUDPV1		-	-	4	03	50	50	100	2
Total				**15**	**1**	**08**	**24**	**300**	**400**	**700**	**20**

Credit Definition:

- 1-Hour lecture **(L)** per week per semester = **1Credit**
- 1-Hour tutorial **(T)** per week per semester = **1Credit**
- 2-Hour Practical/Drawing**(P)** per week per semester = **1 Credit**

- **Four credit** courses are to be designed for **50** Hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** Hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **30** Hours of Teaching-Learning process.
- **One credit** courses are to be designed for **15** Hours of Teaching-Learning process

Note: The above is applicable only to THEORY courses

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY

GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)

(A CENTRAL UNIVERSITY)

CBCS-NEW, EVALUATION SCHEME

(W.E.F. SESSION 2022-23)

B. TECH. THIRD YEAR (SEMESTER- V)

(Electronics and Communication Engineering)

S. No.	COURSE No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	IA	ESE	TOTAL	
THEORY									
1.	EC205TPC08	LIC & its Application	3	1	-	30	70	100	4
2.	EC205TPC09	Digital Communication	3	1	-	30	70	100	4
3.	EC205TPC10	Digital Signal Processing	3	1	-	30	70	100	4
4.	EC205TES06	Electromagnetic Waves	3	-	-	30	70	100	3
5.	EC205THS03	Probability Theory & Random Process	3	-	-	30	70	100	3
6.	EC205THS04	Effective Technical Communication	2	-	-	-	-	-	-
		TOTAL	**17**	**3**	**-**	**150**	**350**	**500**	**18**
PRACTICALS									
1	EC205PPC06	LIC Lab	-	-	2	30	20	50	1
2.	EC205PPC07	Analog and Digital Communication Lab	-	-	2	30	20	50	1
3.	EC205PPC08	Digital Signal Processing Lab	-	-	2	30	20	50	1
		TOTAL	**-**	**-**	**6**	**90**	**60**	**150**	**3**
		GRAND TOTAL	**17**	**3**	**6**	**240**	**410**	**650**	**21**

Total Credits: **21** Total Contact Hours**: 26** Total Marks**: 650**

L**:** LECTURE, T**:** TUTORIAL, P**:** PRACTICAL, IA**:** INTERNAL ASSESSMENT, ESE**:** END SEMESTER EXAMINATION

*INTERNAL ASSESSMENT- Two Class Test of 15 Marks each will be conducted.

SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY

GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)

(A CENTRAL UNIVERSITY)

CBCS-NEW, EVALUATION SCHEME

PROPOSED (W.E.F. SESSION 2022-23)

B. TECH. THIRDYEAR (SEMESTER- VI)

(Electronics and Communication Engineering)

S. No.	COURSE No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	IA	ESE	TOTAL	
THEORY									
1.	EC206TPC11	CMOS Digital VLSI Design	3	1	-	30	70	100	4
2.	EC206TPC12	Data Communication & Computer Networks	3	-	-	30	70	100	3
3.	EC206TPC13	Microprocessor & Microcontroller	3	-	-	30	70	100	3
4.	EC206TES07	Electronic Measurements and Sensors	3	-	-	30	70	100	3
5.	EC206TPE0X	**Program Elective-1**	3	-	-	30	70	100	3
6.		**Open Elective-1**	3	-	-	30	70	100	3
		TOTAL	**18**	**1**	**-**	**180**	**420**	**600**	**19**
PRACTICALS									
1.	EC206PPC09	CMOS Digital VLSI Design Lab	-	-	2	30	20	50	1
2.	EC206PPC10	Data Communication & Computer Networks Lab	-	-	2	30	20	50	1
3.	EC206PES06	Electronic Measurement and Sensors Lab	-	-	2	30	20	50	1
		TOTAL	**-**	**-**	**6**	**90**	**60**	**150**	**3**
		GRAND TOTAL	**18**	**1**	**6**	**270**	**480**	**750**	**22**

Total Credits**: 22** Total Contact Hours**: 25** Total Marks**: 750**

L**:** LECTURE, T**:** TUTORIAL, P**:** PRACTICAL, IA**:** INTERNAL ASSESSMENT, ESE**:** END SEMESTER EXAMINATION

*INTERNAL ASSESSMENT- Two Class Test of 15 Marks each will be conducted.

Program Elective - 1	
EC206TPE01	Information Theory & Coding
EC206TPE02	Advance Signal Processing
EC206TPE03	Renewable Energy Sources
EC206TPE04	Introduction to MEMS
Open Elective – 1 (for other branches)	
EC206TOE01	Introduction to Electronic Devices & Circuits

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, (A CENTRAL UNIVERSITY)BILASPUR (C.G.)
EVALUATION SCHEME
B. TECH. FOURTH YEAR (W.E.F. SESSION 2023-24)

SEMESTER- VII

S.N.	COURSE No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	IA	ESE	TOTAL	
1.	**Program Elective-2**		3	-	-	30	70	100	3
	EC207TPE05	Mobile Communication & Network							
	EC207TPE06	Digital Image Processing							
	EC207TPE07	Analog CMOS IC Design							
2.	**Program Elective-3**		3	-	-	30	70	100	3
	EC207TPE08	Fiber Optic Communication							
	EC207TPE09	Microwave Theory & Techniques							
	EC207TPE10	Power Electronics							
3.	**Program Elective-4**		3	-	-	30	70	100	3
	EC207TPE11	Estimation and Detection Theory							
	EC207TPE12	Radar & Satellite Communication							
	EC207TPE13	Pattern Recognition & Machine Learning							
4.	**Open Elective-2**		3	-	-	30	70	100	3
1.	EC207PPC11	Design & Simulation Lab	-	-	2	30	20	50	1
2.	EC207PPS01	Seminar on Industrial Training	-	-	-	30	20	50	1
3.	EC207PPS02	Project-I	-	-	10	60	40	100	5
		GRAND TOTAL	**12**	**-**	**12**	**240**	**360**	**600**	**19**

Total Credits: **19** Total Contact Hours**: 24** Total Marks**: 600**

SEMESTER- VIII

S.N.	COURSE No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	IA	ESE	TOTAL	
1.	**Program Elective-5**		3	-	-	30	70	100	3
	EC208TPE14	VLSI Fabrication Methodology							
	EC208TPE15	Millimeter Wave Technology							
	EC208TPE16	Video Processing							
	EC208TPE17	Wireless Sensor Networks							
2.	**Program Elective-6**		3	-	-	30	70	100	3
	EC208TPE18	Low Power VLSI Design							
	EC208TPE19	Biomedical Instrumentation							
	EC208TPE20	Neural Network & Fuzzy Logic							
	EC208TPE21	Next Gen. Comm. Technology							
3.	**Open Elective-3**		3	-	-	30	70	100	3
1.	EC208PPS03	Project-II	-	-	18	120	80	200	9
2.	EC208PPS04	Comprehensive Viva	-	-	-	30	20	50	1
		GRAND TOTAL	**09**	**0**	**18**	**240**	**310**	**550**	**19**

Total Credits**: 19** Total Contact Hours**: 27** Total Marks**: 550**

L:LECTURE, T:TUTORIAL, P:PRACTICAL, IA: INTERNAL ASSESSMENT, ESE:END SEMESTER EXAMINATION

*INTERNAL ASSESSMENT- Two Class Test of 15 Marks each will be conducted.

SEMESTER- I

SN	COURSE No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	IA	ESE	TOTAL	
1.	ECPATT01	Linear Algebra	3	-	-	40	60	100	3
2.		**Elective-1**	3	-	-	40	60	100	3
	ECPATP01	Wireless Communication & Network							
	ECPATP02	Introduction to Embedded System & IoT							
	ECPATP03	Microstrip Antenna							
3.		**Elective-2**	3	-	-	40	60	100	3
	ECPATP04	Optoelectronic Devices							
	ECPATP05	Solid State Devices							
	ECPATP06	Antenna for Modern Wireless Communication							
4.		**Elective-3**	3	-	-	40	60	100	3
	ECPATP07	Analog CMOS VLSI Design							
	ECPATP08	Digital Image Processing							
	ECPATP09	Modern Digital Communication							
5.		**Elective-4**	3	-	-	40	60	100	3
	ECPATP10	Network Security & Cryptography							
	ECPATP11	Introduction to Signal Processing							
	ECPATP12	Satellite Communication							
6.	ECPATC01	Research Methodology & IPR	2	-	-	-	50	50	2
7.	ECPALT01	Adv Simulation Lab	-	-	4	30	20	50	2
		TOTAL	**17**	**0**	**4**	**230**	**370**	**600**	**19**

SEMESTER- II

SN	COURSE No.	SUBJECT	PERIODS			EVALUATION SCHEME			CREDITS
			L	T	P	IA	ESE	TOTAL	
1.	ECPBTT01	Estimation and Detection Theory	3	-	-	40	60	100	3
2.		**Elective-5**	3	-	-	40	60	100	3
	ECPBTP01	Low Power VLSI Design							
	ECPBTP02	Adv Digital Signal Processing							
	ECPBTP03	Optical Instrumentation							
3.		**Elective-6**	3	-	-	40	60	100	3
	ECPBTP04	Pattern Recognition & Machine Learning							
	ECPBTP05	Optical Communication System							
	ECPBTP06	Next Gen. Comm. Technology							
4.		**Elective-7**	3	-	-	40	60	100	3
	ECPBTP07	Computer Vision							
	ECPBTP08	Digital Communication Receiver							
	ECPBTP09	Millimeter Wave Technology							
5.		**Open Elective**	3	-	-	40	60	100	3
6.		**Audit Course/Value Added Course**	2	-	-	40	60	100	2
7.	ECPBLT01	Semiconductor Device Design and Simulation Lab	-	-	4	30	20	50	2
8.	ECPBLT02	RF & Microwave Component Design Lab	-	-	4	30	20	50	2
		TOTAL	**17**	**0**	**08**	**300**	**400**	**700**	**21**

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, (A CENTRAL UNIVERSITY)BILASPUR (C.G.)

SCHEME
Pre-PhD Course Work
(W.E.F. SESSION 2022-23)

S.N.	SUBJECT CODE	SUBJECT NAME	PERIODS /WEEK			ESE DURATION	ESE MARKS		CREDIT
			L	T	P		MAX	MIN	
1.	ECDATT1	Research Methodology in Engineering	3	1	0	3Hrs	100	40	4
2.		Elective-I	3	1	0	3Hrs	100	40	4
3.		Elective-II	3	1	0	3Hrs	100	40	4

S.N.	SUBJECT CODE	SUBJECT NAME	S.N.	SUBJECT CODE	SUBJECT NAME
1.	ECDATP1	Vacuum Technology	8.	ECDATP11	Machine Learning
2.	ECDATP2	Antenna For Modern Wireless Communication	9.	ECDATP13	Introduction to IoT
3.	ECDATP3	Microstrip Antenna	10.	ECDATP14	Satellite Communication
4.	ECDATP4	Wireless Communication & Network	11.	ECDATP23	Digital Image Processing
5.	ECDATP8	Tunnel Field Effect Transistor	12.	ECDATP24	Medical Image Processing
6.	ECDATP9	MIMO Communication System	13.	ECDATP25	Convex Optimization
7.	ECDATP10	Deep Learning	14.	ECDATP26	Introduction to Signal Processing

ESE: End Semester Examination, **L**: Lecture, **T**: Theory, **P**: Practical
Max: Maximum Marks in ESE
Min: Minimum Pass Marks in each subject as 40%

- Duration of the semester will be 6 months.
- Candidate has to score minimum 55% of aggregate marks to qualify in ESE.
- Two subjects as Electives (4 credits each) can be taken from the list of Electives

SYLLABUS	(SEMESTER-I)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	ECUATH2 (for ECE) CSUATH2 (for CSE) ITUATH2 (for IT)	L	T	P	CT-1	CT-II	Attendance & Assignments	TOTAL	-	50	1
Subject:	HUMAN VALUES & ETHICS	1	0	-	20	20	10	50			

COURSE OBJECTIVE:

1. To create an awareness on Engineering Ethics and Human Values.
2. To understand social responsibility of an engineer.
3. To appreciate ethical dilemma while discharging duties in professional life.

UNIT I: Introduction to Value Education

1. Value Education, Definition, Concept and Need for Value Education.
2. The Content and Process of Value Education.
3. Basic Guidelines for Value Education.
4. Self exploration as a means of Value Education.
5. Happiness and Prosperity as parts of Value Education.

UNIT II: Harmony in the Human Being

1. Human Being is more than just the Body.
2. Harmony of the Self („I“) with the Body.
3. Understanding Myself as Co-existence of the Self and the Body.
4. Understanding Needs of the Self and the needs of the Body.
5. Understanding the activities in the Self and the activities in the Body.

UNIT III: Harmony in the Family and Society and Harmony in the Nature

1. Family as a basic unit of Human Interaction and Values in Relationships.
2. The Basics for Respect and today“s Crisis: Affection, e, Guidance, Reverence, Glory,Gratitude and Love.
3. Comprehensive Human Goal: The Five Dimensions of Human Endeavour.
4. Harmony in Nature: The Four Orders in Nature.
5. The Holistic Perception of Harmony in Existence.

UNIT IV: Social Ethics

1. The Basics for Ethical Human Conduct.
2. Defects in Ethical Human Conduct.
3. Holistic Alternative and Universal Order.
4. Universal Human Order and Ethical Conduct.
5. Human Rights violation and Social Disparities.

UNIT V: Professional Ethics

1. Value based Life and Profession.
2. Professional Ethics and Right Understanding.
3. Competence in Professional Ethics.
4. Issues in Professional Ethics – The Current Scenario.
5. Vision for Holistic Technologies, Production System and Management Models.

TEXT/ REFERENCE BOOKS:

1.A.NTripathy, New Age International Publishers, 2003.
2. Bajpai. B. L , , New Royal Book Co, Lucknow, Reprinted, 2004
3. Bertrand Russell Human Society in Ethics & Politics
4. Corliss Lamont, Philosophy of Humanism
5. Gaur. R.R. ,Sangal. R, Bagaria. G.P, A Foundation Course in Value Education, Excel Books, 2009.
6. Gaur. R.R. ,Sangal. R ,Bagaria. G.P, Teachers Manual Excel Books, 2009.
7. I.C. Sharma . Ethical Philosophy of India Nagin & co Julundhar
8. Mortimer. J. Adler, – Whatman has made of man
9. William Lilly Introduction to Ethic Allied Publisher

COURSE OUTCOME:

On completion of this course, the students will be able to

1. Understand the significance of value inputs in a classroom and start applying them in their life and profession
2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
3. Understand the role of a human being in ensuring harmony in society and nature.
4. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

SYLLABUS	(SEMESTER-I)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	ELUATH1	L	T	P	CT-1	CT-II	Attendance & Assignments	TOTAL	60	100	03
Subject:	ENGLISH FOR COMMUNICATION	3	0	-	15	15	10	40			

COURSE OBJECTIVE:

- To build up word power, to brush up the knowledge of English grammar, to develop good writing and speaking skills in the students

UNIT I: Vocabulary Building: 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: 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: Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies,Clichés

UNIT IV: Nature and Style of sensible Writing: Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion.

UNIT V: Writing Practices: Comprehension, Précis Writing, Essay Writing. Oral Communication (This unit involves interactive practice sessions in Language Lab), Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations

COURSE OUTCOME: At the end of the course students will be able to learn a lot of new words. They also learnt the particularities and peculiarities of English grammar. As a result, they could speak and write English with the least possible error.

TEXT/ REFERENCE BOOKS:

1. Practical English Usage. Michael Swan. OUP.1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007 (iii)On Writing Well. William Zinsser. Harper Resource Book.2001
3. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press.2006.
4. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press.2011.
5. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

SYLLABUS	(SEMESTER-I)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	AMUATB4	L	T	P	CT-1	CT-II	Attendance & Assignments	TOTAL	60	100	04
Subject:	ENGINEERING MATHEMATICS - B	3	1	-	15	15	10	40			

UNIT I: Linear Algebra

Vector space, linear dependence and linear independence of vectors, linear transformations, rank and inverse by elementary transformations, system of linear equations – consistency and inconsistency, eigen value and eigen vectors, Caley-Hamilton theorem and its application to find the inverse.

UNIT II: Theory of equations

Polynomial and polynomial equations, division algorithm, roots of equations, remainder theorem, factor theorem, synthetic division, fundamental theorem of algebra, multiplication of roots, descarte‟s rule of sign, Descarte‟s method.

UNIT III: Vector Calculus

Vector functions, differentiation of vectors, velocity and acceleration, scalar and vector fieldm gradient of scalar field, directional derivative, properties of gradient, divergence of vector, curl of vector, point function, properties of divergence and curl, integration of vector function, line integral, surface integral, Green‟s theorem, gauss theorem, Stoke‟s theorem (without proof) and their simple applications,

UNIT IV: Complex Number

Complex numbers and its properties, conjugate complex numbers, standard form of complex numbers, De-Moivre‟s theorem, Roots of complex numbers, exponential function of complex variable, circular form of complex variable, Hyperbolic function of complex numbers, Logarithmic function of complex numbers.

UNIT V: Infinite Series

Sequence, convergent, divergent, oscillating sequence, infinite series, behavior of infinite series, ratio test, root test, comparison test, Raabe‟s test, Logarithmic test.

TEXT/ REFERENCE BOOKS:

1. N.P. Bali, A Textbook of Engineering Mathematics, Laxmi publications, 10th edition, 2016.
2. H.K. Das, Higher Engineering Mathematics, S. Chand, 2014
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th edition

SYLLABUS	(SEMESTER-I)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	PPUATB2	L	T	P	CT-1	CT-II	Attendance & Assignments	TOTAL	60	100	04
Subject:	ENGINEERING PHYSICS	3	1	-	15	15	10	40			

COURSE OBJECTIVE:

- To know the basic principles, effects and applications such as physical, optical parameters used for engineering applications.
- To learn about various laws and applications of electromagnetic theory.
- To know the basic structure, working principles and applications of lasers and optical fibre communication.
- To know the basics of semiconductor physics, semiconductor materials and devices and its characterization for advance technological applications
- To familiarize the basis of quantum theory and to make students to solve the physical problems for

advancement of the technology.

UNIT I: Optics: Interference and Diffraction: Introduction, Young‟s experiment theory of interference, Coherent and non-coherent sources, Fresnel‟s Bi- prism and Newton‟s ring experiment. Diffraction of light, Fresnel and Fraunhofer‟s diffraction, diffraction due to plane diffraction grating.

UNIT II: Electromagnetic Theory: Coulomb‟s law electrostatics field and potential, electric flux, Gauss‟ law, Poisson‟s and Laplace‟s equation. Equation of continuity for charge conservation, Ampere‟s and Faraday‟s laws, Maxwell‟s Electromagnetic equations.

UNIT III: Laser and Fiber optics: Introduction, elementary idea of spontaneous and stimulated emission, active medium population inversion, Einstein‟s coefficients, Types of lasers and important applications of lasers. Introduction to optical fibers, basic principles of optical fiber, critical angle numerical aperture, maximum acceptance angle, classification of optical fiber.

UNIT IV: Semiconductor physics and Devices: Formation of energy in solids, Energy band gap of metals, insulators and semiconductors, classification of semiconductor: Intrinsic and Extrinsic semiconductors, Fermi levels in intrinsic and extrinsic semiconductors, Electrical conductivity in conductors and semiconductors, working of P-N junction diodes and bipolar junction transistor.

UNIT V: Introduction to Quantum Mechanics: Introduction to QuantumMechanics, photoelectric effect, Compton effect, wave-particle duality, uncertainty principle, wave function, De-Broglie waves, phase and Group velocity, Davisson and Germer experiment, Schrodinger wave equation, particle in a box (I-Dimensional)

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

- Student‟s ability to understand the basic principles and applications of physical optics for physical parameters measurements such as length, thickness, aperture size etc.
- Student‟s will be able to design, characterized the lasers and optical fibers and their effective utilization in optical communications, imaging etc.
- Students demonstrate appropriate competence and working knowledge of laws of electromagnetic theory and semiconductor physics and devices for their advance applications.

TEXT/ REFERENCE BOOKS:

1. Applied physics-I and II By Navneet Gupta, Dhanpat Rai &Co.
2. Engg. Physics by S.K.Srivastava and R.A. Yadav, New Age Pub. NewDelhi
3. Engg. Physics by Uma Mukherjee, NarosaPublication.
4. Engg. Physics by M.N. Avadhanulu, S. ChandPub.
5. Electricity and Magnetism by Rangwala and Mahajan, Tata McGraw Hill.1998
6. Concepts of Physics Part-II by H.C.Verma, BharatiBhawan (P&D),1998
7. Modern physics by Beiser, McGraw Hill Inc. New York, Publication1995
8. Modern physics by Mani and Mehta, East-West PressPvt.Ltd.1998
9. Introduction to Electrodynamics, DavidGriffith
10. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-HillInc.(1995).
11. B.E.A. Saleh and M.C. Teich, Fundamentals of Photonics, John Wiley & Sons.Inc.2007).
12. S.M. Sze, Semiconductor Devices: physics and Technology, Wiley(2008)
13. Yariv and p.yeh, Photonics Optical Electronics in Modern Communications, Oxford University press, New York(2007)
14. P. Bhattacharya, Semiconductor Optoelectronic Devices, prentice Hall of India(1997)
15. Online course: “Semiconductor Optoelectronics” by M. R. Shenoy onNPTEL.
16. Online course: “Optoelectronic Materials and Devices” by Monica Katiyar and Deepak onNPTEL.

SYLLABUS	(SEMESTER-I)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	ITUATE2	L	T	P	CT-1	CT-II	Attendance & Assignments	TOTAL	60	100	03
Subject:	INTRODUCTION TO INFORMATION TECHNOLOGY	3	-	-	15	15	10	40			

COURSE OBJECTIVE:

- To illustrate the concepts of cyber security and familiar and aware with various cybercrimes attack and their prevention.
- To describe the different services model of Cloud Computing and understand Understanding of different evaluating computer model of cloud computing.
- To relate theoretical concepts with problem solving approach in IoT and assess the comparative advantages and disadvantages of Virtualization technology.
- To provides the basic knowledge of use appropriate storage and access structures. the student must be able to analyse familiar with the machine learning algorithms and applications of various data science.
- To integrate classroom learning into an everyday communicative activity in distributed system. Familiar with various web services activity.

UNIT I: Cyber Security Fundamentals Security Concepts: Authentication, Authorization, Non-repudiation, Confidentiality, Integrity, availability. Cyber Crimes and Criminals: Definition of cyber-crime, types of cyber-crimes and types of cyber-criminals.

UNIT II: Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud computing, Cloud Computing Is a Service, Cloud Computing Is a Platform, Principles of Cloud computing, Five Essential Characteristics, Four Cloud Deployment Models.

UNIT III: Internet of Things–Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, IOT Communication APIs IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates Domain Specific IoTs – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

UNIT IV: Data Science: -Introduction and Importance of Data Science, Statistics, Information Visualisation, Data Mining, Data Structures, and Data Manipulation, Algorithms used in Machine Learning, Data Scientist Roles and Responsibilities. Data Acquisition and Data Science Life Cycle.

UNIT V: Evaluation and Emergence of Web Services – Evaluation of Distributed Computing, Core Distributed Technologies, Challenges in Distributed System, and Introduction to web services, Web Services Architecture, Basic steps of implementing web services

COURSE OUTCOME:

1. Ability to learn about cybercrimes and how they are planned.
2. Ability to understand the cloud computing concepts and services model.
3. Ability to understand Internet of Things –Definition and Characteristics of IoT.
4. Explain how data is collected, managed and stored for data science. Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists
5. Understand the details of web services Evolution of Distributed Computing.

TEXT/ REFERENCE BOOKS:

1. Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunil Belapure, Wiley INDIA.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J.David Irwin.CRC Press T&F Group
3. Cloud Computing Principles and Paradigm by Rajashekar Buyya, James Broberg, Andhrz M. Wiley 2011.

4. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547.
5. Mining of Massive Datasets, by Leskovec, Rajaraman, and Ullman.
6. R. Nagappan, R.Scokzylas, R.P. Sriganesh, Developing Web Services, Wiley India.

SYLLABUS	(SEMESTER-I)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	ECUATE3	L	T	P	CT-1	CT-II	Attendance & Assignments	TOTAL	60	100	03
Subject:	BASIC ELECTRICAL ENGINEERING	3	-	-	15	15	10	40			

COURSE OBJECTIVE:

- To analyse basic concepts of DC and AC circuits.
- To explain construction and operation of transformers,
- To explain the concept and working of DC machines and Induction motor.
- To explain electric installation, wiring, billing and safety measures.

UNIT I: DC CIRCUITS: Electrical circuit elements (R, L and C), voltage and current sources, Ohms Law, Kirchhoff‟s current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin andNorton Theorems. Time-domain analysis of first-order RL and RC circuits. Mesh & nodal analysis, Star-Delta transformation and circuits.

UNIT II: AC CIRCUITS: Representation of sinusoidal waveforms, average 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. Three-phase power measurement- Two-Wattmeter method.

UNIT III: ELECTROMAGNETISM: Concept of Magnetic effect of electric current, faraday‟s law of electromagnetism. BH curve, Analogy of Electric and magnetic Circuits. Concept of flux flow in magnetic circuits. TRANSFORMERS Construction, classification, ideal and practical transformer, equivalent circuit, losses in transformers, tests, voltage regulation and efficiency. Introduction to three phase transformers.

UNIT IV: DC AND AC MACHINES: Construction, Working Principle, losses and efficiency of DC Machines and three phase Induction Machine, Torque Equations, DC motor: Principle of operation, speed control.

UNIT V: ELECTRICAL INSTALLATIONS& SAFETY: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, Earthing – Types of earthing and its importance. Electrical wiring: Conduit and concealed wiring, Two way and Three-way control of lamps. Safety precautions for electrical appliances. Calculations for energy consumption and billing.

COURSE OUTCOME: At the end of the course, the student will be able to

CO1: Analyse basic DC and AC electric circuits.

CO2: Explain the working principles of transformers and its tests.

CO3: Explain the concepts of DC and AC machines and their applications

CO4: Understand the wiring methods, working principles of circuit protective devices, electrical billing and safety measures.

TEXT/ REFERENCE BOOKS:

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.

3. B L Theraja and AK Theraja," A Textbook of Electrical Technology- Vol-I & II, S. CHAND &Co ltd, 2013.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
5. P.V. Prasad et al., Basic Electrical Engineering, Cengage 2019

SYLLABUS	(SEMESTER-I)	Periods/ Week			INTERNAL ASSESSMENT (IA)			ESE	Grand total	Credits
Subject Code:	ECUALE3	L	T	P	IA	MSE	TOTAL	25	50	01
Subject:	BASIC ELECTRICAL ENGINEERING LABORATORY	-	-	2	25	--	25			

COURSE OBJECTIVE:

- To understand basic instruments and safety measures.
- To practically provide the concept of different theorems.
- To understand the concept of RLC circuits.
- To understand the working of transformers
- To understand the concept of DC and AC machines.

List of experiments/demonstrations:

- Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
- To verify various theorems on DC circuits
- Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope).
- Sinusoidal steady state response of R-L-C circuits – Single-phase and Three-phase circuit measurement
- Transformers: Polarity test, OC & SC tests. Loading of a transformer: measurement of primary and secondary voltages and currents and power.
- Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), and single-phase induction machine.

COURSE OUTCOME:

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

- Acquire knowledge about different types of meters and construct circuits and measure different electrical quantities.
- Analyse the DC circuits
- Analyse Single Phase and Three phase AC Circuits, the representation of alternating quantities and determining the power in these circuits
- Work on machines like transformers
- Understand the construction of DC and AC machines

SYLLABUS	(SEMESTER-I)	Periods/ Week			INTERNAL ASSESSMENT (IA)			ESE	Grand total	Credits
Subject Code:	PPUALB2	L	T	P	IA	MSE	TOTAL	25	50	01
Subject:	ENGINEERING PHYSICS LABORATORY	-	-	2	25	--	25			

COURSE OBJECTIVE:

- To learn and perform the various practical related to optical components characterization, semiconductor material and devices characterization and know their applications in advance areas such as communication, industries, defence, navigationetc.

List of experiments/demonstrations:

1. To determine the wavelength of sodium light with help of Fresnel‟sBi-prism.
2. To determine the refractive index and dispersive power of the material of prism with the help of spectrometer.
3. To determine the sodium light by Newton‟s ringmethod.
4. To determine the wavelength of sodium light by plane diffraction grating usingspectrometer.
5. To demonstrate the diffraction pattern and determine the wavelength of different colours of mercury (white) light using plane diffraction grating andspectrometer.
6. To determine the wavelength and number of line per cm on a diffraction grating using semiconductor laserdiode.
7. To determine the specific rotation of sugar solution with the help ofpolarimeter.
8. Determine the width of the single slit and diameter of circular aperture using Fraunhofer diffraction pattern produced by semiconductor laserdiode.
9. To determine the energy band gap (E_g) of a semiconductor material using P-N junctiondiode.
10. To determine the e/m ratio by the Thomson‟smethod.
11. To study the P-N junction diode characteristics, in forwarded and reverse biasconditions.
12. To study the Zener diodecharacteristics.
13. To study the characteristics and gain of Transistor in C-B and C-Emode.
14. Determine the Planck‟sconstant.

COURSE OUTCOME: At the end of the course students will be able to:

- Know about basic optical facts and phenomenon, characterization of optical components anddevices
- To know the basic semiconductor materials and devices and theirapplications
- To know how the performance of semiconductor devices can beimproves.

SYLLABUS	(SEMESTER-I)	Periods/ Week			INTERNAL ASSESSMENT (IA)			ESE	Grand total	Credits
Subject Code:	MEUALL1	L	T	P	IA	MSE	TOTAL	25	50	01
Subject:	ENGINEERING GRAPHICS	1	-	3	25	--	25			

COURSE OBJECTIVE:

- To learn the basic of Engineering Drawing and Orthographic Projections
- To learn the Sections and Sectional Views of Right Angular Solids
- To learn the Isometric Projections covering and overview of Computer Graphics

UNIT I: Introduction Engineering Graphics and Engineering Curves: Principles of engineering graphics and their significance – drawing instruments and their use – conventions in drawing – lettering – BIS conventions. Dimensioning rules, geometrical construction. Engineering Curves - Conic Sections, Special Curves-Cycloids, Epicycloids, Hypocycloids, Involutes and trochoid.

UNIT II: Projection of Points, Straight lines and Planes: Principles of orthographic projections –

conventions – first and third angle projections. Projections of points and lines inclined to both the planes. Projections of regular planes, inclined to both planes

UNIT III: Projections Solids: Introduction, Type of solid, Projections of solids in simple position, Projection of solids with axes inclined to one of the reference planes and parallel to the other, Projections of solids with axes inclined to both H.P. and the V.P.

UNIT IV: Section of Solids and Development of Surfaces: Sectioning of regular solids - Section planes perpendicular to one plane and parallel or inclined to other plane - Development of surfaces of right, regular solids – development of prisms, cylinders, pyramids, cones and their parts.

UNIT V: Isometric Projections and Orthographic Views: Principles of Isometric Projections-Isometric Scale- Isometric Views Conventions-Plane Figures, Simple and Compound Solids. Conversion of isometric views to orthographic views. Conversion of orthographic views to isometric projections, vice-versa. Introduction to perspective projection. **Computer Aided Drafting:** Introduction to computer aided drafting package to make 2-D drawings. Demonstration purpose only - not to be included in examinations.

COURSE OUTCOME: At the end of the course, the student shall be able to:

1. Draw engineering curves, orthographic projections of lines, planes and solids.
2. Draw sections of solids including cylinders, cones, prisms and pyramids.
3. Make development of surfaces, Orthographic and Isometric projections
4. Overview of Computer Graphics.

TEXT/ REFERENCE BOOKS:

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, PearsonEducation
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
5. CAD Software Theory and User Manuals

SYLLABUS	(SEMESTER-I)	Periods/ Week			INTERNAL ASSESSMENT (IA)			ESE Viva/ Assessment	Grand total	Credits
Subject Code:	NSUALS1	L	T	P	Attendance	Activities	TOTAL	25	50	01
Subject:	NSS	-	-	2	5	20	25			

S.N.	PROGRAM HEADS	HOURS/SEM
1	Cleaning program	06
2	Plantation	06
3	Health Camp/Special Days celebration	10
4	Awareness program/Rally	06

SYLLABUS	(SEMESTER-II)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	LAUBTC1	L	T	P	CT-1	CT-II	Attendance & Assignments	TOTAL	-	50	01
Subject:	INDIAN CONSTITUTION	1	-	-	20	20	10	50			

COURSE OBJECTIVE:

- To the importance of preamble of the constitution of India.
- To understand the fundamental rights and duty as a citizen of India.
- To understand the functioning of union and state government and their inter-relationship.

UNIT I: Introduction: Constitution-meaning of the term, Sources and constitutional theory, Features, Citizenship. Preamble**.**

UNIT II: Fundamental Rights and Duties: Fundamental Rights, Fundamental Duties, Directive Principles of State Policy

UNIT III: Union Government: Structure of Indian Union: Federalism, Centre-State relationship President: Role. Power and position, Prime Minister and council of ministers, Cabinet and Central Secretariat, Lok Sabha. Rajya Sabha

UNIT IV: State Government: Governor: Role and position, Chief Minister and council of ministers, State Secretariat

UNIT V: Relationship between Centre and States: Distribution of Legislative Powers, Administrative Relations, Coordination between States

COURSE OUTCOME: At the end of the course students will be able to:

- Describe the salient features of the Indian Constitution
- List the Fundamental Rights and Fundamental Duties of Indian citizens
- Describe the Directive Principles of State Policy and their significance

TEXT/ REFERENCE BOOKS:

1. Constitution of India, V.N. Shukla
2. The Constitutional Law of India, J.N. Pandey
3. Indian Constitutional Law. M.P. Jain

SYLLABUS	(SEMESTER-II)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	FOUBTC2	L	T	P	CT-1	CT-II	Attendance & Assignments	TOTAL	60	100	02
Subject:	ENVIRONMENTAL SCIENCE AND ECOLOGY	2	-	-	15	15	10	40			

UNIT I: Introduction: Environment - Components of Environment Ecosystem: Types & Structure of Ecosystem, Balanced ecosystem Human Activities – Food, Shelter, Economic & Social Security.
Definition, Scope and basic principles of ecology and environment, Fundamentals of Ecology and Ecosystem – Structural and Functional Components. Food chain & Food webs. Ecological pyramids; Energy flow

UNIT II: Air Pollution & Automobile Pollution: Definition, Effects – Global Warming, Acid rain & Ozone layer depletion, controlling measures.

UNIT III: Solid Waste Management, E - Waste Management & Biomedical Waste Management - Sources, Characteristics & Disposal methods.

UNIT IV: Natural Resources, Water resources – Availability & Quality aspects, Water borne diseases &

water induced diseases, Fluoride problem in drinking water, Mineral resources, Forest Wealth, Material Cycles – Carbon Cycle, Nitrogen Cycle & Sulphur Cycle.

UNIT V: Energy – Different types of energy, Conventional sources & Non Conventional sources of energy: solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as an alternative energy.

TEXT/ REFERENCE BOOKS:

1. Fundamentals of Ecology (3rd Ed.) 2001- MC Dash, Tata - McGraw Hill, New Delhi.
2. Introduction to Environmental Engg. (1991). - GM Masters, Prentice Hall of India.
3. Benny Joseph (2005), "Environmental Studies", Tata McGraw – Hill Publishing Company Limited.
4. R.J.Ranjit Daniels and Jagadish Krishnaswamy, (2009), "Environmental Studies",Wiley India Private Ltd., New Delhi.
5. R Rajagopalan, "Environmental Studies – From Crisis to Cure",Oxford University Press, 2005,
6. Aloka Debi, "Environmental Science and Engineering", Universities Press (India) Pvt. Ltd. 2012

SYLLABUS	(SEMESTER-II)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	AMUBTB1	L	T	P	CT-1	CT-II	Attendance & Assignments	TOTAL	60	100	04
Subject:	ENGINEERING MATHEMATICS - A	3	1	-	15	15	10	40			

UNIT I: Differential Calculus: Leibnitz theorem, Roll‟s theorem, Lagrange‟s theorem, Mean value theorem, Expansions of functions by McLaurian and Taylor‟s series, Tangents and normal, Maxima and minima

UNIT II: Indeterminate forms, Asymptotes, Radius of curvature, Partial differentiation, Total differentiation

UNIT III: Integral Calculus: Reduction formulae, Curve tracing, Area, Volume, Length, Surface area, Double and triple integrals, Gamma and beta function.

UNIT IV: Differential Equations: Differential equations of first order, Linear differential equation of higher order with constant coefficient, Equations reducible to linear equations with constant coefficients, Cauchy‟s homogeneous linear equations, Application of linear differential equations, Simultaneous differential equations.

UNIT V: Series solution of differential equations about ordinary point, Partial differential equations, linear homogeneous partial differential equations, application of partial differential equations: One dimensional heat equation and wave equation.

TEXT/ REFERENCE BOOKS:

1. N.P. Bali, A Textbook of Engineering Mathematics, Laxmi publications, 10th edition, 2016.
2. H.K. Das, Higher Engineering Mathematics, S. Chand, 2014
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th edition

SYLLABUS	(SEMESTER-II)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	CYUBTB3	L	T	P	CT-1	CT-II	Attendance & Assignments	TOTAL	60	100	03
Subject:	ENGINEERING CHEMISTRY	3	-	-	15	15	10	40			

COURSE OBJECTIVE:

To make aware and enrich the the students about the basic concept and understanding of chemical concepts of basic Chemistry and spectroscopic techniques.

UNIT I: Concept of Quantum Energy and Spectroscopy: Quantization of Energy, Regions of spectrum. Electronic Spectroscopy: Electronic Transition, Woodward Fieser rules for calculating λ_{max} of conjugated dienes & α, β-unsaturated carbonyl compound, various shifts in λ_{max} and intensities. Infra-Red Spectroscopy: Conditions for Infra-Red Spectroscopy, Molecular vibrations & factors affecting Infra-Red frequencies**.**

UNIT II: Chemical Bonding in Molecules: Introduction of chemical bonding, VSEPER Theory, V.B.Theory and Molecular Orbital Theory. Energy level diagrams of diatomic molecules and ions.

UNIT III: Concept of Chirality, Enantiomers, Diastereomers,Meso-compounds and Racemic mixtures. Conformation of Acyclic hydrocarbons (Ethane, Propane & n-Butane) and cyclic hydrocarbon (Cyclohexane), Plane of symmetry, Centre of symmetry, Absolute and Relative Configuration (R &S, D & L and E & Z).

UNIT IV: Reactivity of Organic Molecules, Factors influencing acidity, basicity and nucleophilicity of molecules, kinetic vs thermodynamic control of reactions.

UNIT V: Strategy for Synthesis of Organic Compounds: Reaction intermediates: Stability of Free Radicle, Carbocation and Carbanion. Introduction to reaction eg. Elimination and Substitution, Mechanisms of some named reactions.

COURSE OUTCOME: At the end of the course students will be able to:

Understand and solve the practical problems of their higher Engineering classes on the basis of understanding of Chemistry developed in their B. Tech. I sem classes.

TEXT/ REFERENCE BOOKS:

1. Engineering Chemistry by Jain and Jain; Dhanpat Rai PublicationCo.
2. Engineering Chemistry by Shikha Agarwal; Cambridge University Press, 2015edition.
3. Engineering Chemistry of Wiley India Pvt. Ltd., Vairam and others, 2014 edition(second).
4. Engineering Chemistry by Prasanth Rath, Cengage Learning, 2015edition.
5. A textbook of Engineering Chemistry by S. S. Dara; S. Chand & Co Ltd., LatestEdition
6. Applied Chemistry by H.D. Gesser, SpringerPublishers
7. Textbook of Nano-science and nanotechnology by B.S. Murthy, P. Shankar and others, University Press,IIM
8. B. Siva Shankar, “Engineering Chemistry”, Tata Mc Graw Hill Publishing Limited, 3rd Edition, 2015.
9. S. S. Dara, Mukkanti, “Text of Engineering Chemistry”, S. Chand & Co, New Delhi, 12th Edition, 2006.
10. C. V. Agarwal, C. P. Murthy, A. Naidu, “Chemistry of Engineering Materials”, Wiley India, 5th Edition, 2013.

SYLLABUS	(SEMESTER-II)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	CSUBTE5	L	T	P	CT-1	CT-II	Attendance & Assignments	TOTAL	60	100	03
Subject:	COMPUTER PROGRAMMING	3	-	-	15	15	10	40			

COURSE OBJECTIVE:

- To understand the basic of Idea of Algorithm.
- To understand the programing concept of Arithmetic expressions and Basic Algorithms
- To learn the Functions and Structure of array.

UNIT I: Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - **Idea of Algorithm:**steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples.From algorithms to programs; source code, variables (with data types) variables and memory locations,Syntax and Logical Errors in compilation, object and executablecode.

UNIT II: Arithmetic expressions and precedence: Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching Iteration and loops, Arrays(1-D,2-D) Character arrays and strings.

UNIT III: Basic Algorithms: Searching, concept of binary search etc, Basic Sorting Algorithms Bubble sort etc,Finding roots of equations, introduction of Algorithm complexity

UNIT IV: Function: Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference binary search etc. Recursion functions Recursion, as a different way of solving problems. Example programs, such as, Finding Factorial, Fibonacci series, etc.

UNIT V: Structure: Structures, Defining structures and Array of Structures, Pointers Idea of pointers, defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

COURSE OUTCOME: At the end of the course students will be able to:

- Develop the algorithm and programmers for various applications using Arithmetic expressions, arrays, pointers and Functions.

TEXT/ REFERENCE BOOKS:

1. Byron Gottfried, Schaum's Outline of Programming with C,McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, TataMcGraw-Hill
3. Brian W. Kernighan and Dennis M. Ritchie, the C Programming Language, Prentice Hall of India

SYLLABUS	(SEMESTER-II)	Periods/ Week			Internal Assessment (IA)				ESE	Grand Total	Credits
Subject Code:	ECUBTE7	L	T	P	CT-1	CT-II	Attendance & Assignments	TOTAL	60	100	03
Subject:	INTRODUCTION TO ELECTRONICS & COMMUNICATION ENGINEERING	3	-	-	15	15	10	40			

COURSE OBJECTIVE:

- To equip students with foundational knowledge and a comprehensive overview in the field of electronics and communication engineering.
- To provide students with a fundamental grounding in electronic engineering principles essential for understanding the functionality and utilization of electronic devices, circuits, logic design, and communication systems.
- To cultivate ethical and professional attitudes in first-year engineering students, creating an academic environment that encourages teamwork, the ability to contextualize engineering issues within a broader social framework, and the pursuit of lifelong learning essential for a successful professional career.

UNIT I: Introduction to Electronics Engineering: Outline, Scope and goal of learning electronics engineering, **Introduction to semiconductor devices:** Energy bands in solids, Semiconductor & its classification, Energy band model of semiconductor, Equilibrium carrier concentration inside the energy bands, Basic principle and operation of semiconductor devices-diode, bipolar junction transistor, field effect transistors, Introduction to VLSI.

UNIT II: Applications of Semiconductor Devices: Basic concepts of rectifiers, Filters, Voltage regulators, Amplifiers and Oscillators.

UNIT III: Introduction to Digital Systems: Numbers systems, Number base conversion, Complements, Basic theorems and properties of Boolean algebra, Boolean functions, Logic gates, Logic circuit implementation using diodes and transistors, Reduction of Boolean expressions and implementation with logic gates, Karnaugh‟s Map and Combinational circuits.

UNIT IV: Transducers and Sensors: Introduction, Passive Electrical Transducers, Resistive Transducers, Resistance Thermometers, Thermistor. Active Electrical Transducers, Piezoelectric Transducer, Photoelectric Transducer.

UNIT V: Basics of Communication System: Definition of signal, Standard test signals, Signals operations and its representation: shifting, folding and scaling, Classification of signals, Definition of system, System classification, System properties: additivity and homogeneity, Causality, Stability, Invertibility. Electromagnetic spectrum used for communication, Fourier transform, Elements of a communication system-transmitter and receiver, Need of modulation, Introduction to analog and digital communication systems, Examples of telecommunication systems-telephone, radio, television, mobile communication and satellite communication.

COURSE OUTCOME: At the end of the course students will be able to:

CO1 Describe the overview of electronics and illustrate the concepts of semiconductor devices.
CO2 Elucidate and analyze the application of semiconductor device.
CO3 Develop competence knowledge to construct basic digital circuit by use of basic gate & its function.
CO4 Illustrates the principle of Transducers and sensors.
CO5 Comprehend the need of communication & explain the different modes of communications from wired to wireless and the computing involved.

TEXT/ REFERENCE BOOKS:

1. M. S. Tyagi, “Introduction to Semiconductor Materials and Devices” Wiley, 2008.
2. D. A. Neamen, “Electronic Circuits,” Tata McGrawHill Education, 2006.
3. S. C. Lee, “Digital Circuits and Logic Design,” PHI Learning, 2009.
4. J. G. Proakis and M. Salehi, “Fundamentals of Communication Systems,” Prentice Hall, 2004.
5. G. Kennedy, B. Davis, “Electronic Communication Systems”, TMH, 4th ed., 2008.
6. W. Tomasi, “Advanced Electronic Communication Systems”, Pearson/Prentice-Hall, 6th ed., 2004.
7. A. K. Sawhney, “A Course in Electrical and Electronics Measurements and Instrumentation”, 18th ed., Dhanpat Rai & Company Private Limited, 2007.

SYLLABUS	(SEMESTER-II)	Periods/ Week			INTERNAL ASSESSMENT (IA)			ESE	Grand total	Credits
Subject Code:	CYUBLB3	L	T	P	IA	MSE	TOTAL			
Subject:	ENGINEERING CHEMISTRY LABORATORY	-	-	2	25	--	25	25	50	01

COURSE OBJECTIVE:

- Application of iodo metrically& titration in lab.
- Recognition of different chemical reaction.
- Advanced lab methods like Spectrophotometry and chromatography

Course Content:

Group – A:

1. Standardization of sodium thiosulphate solution by standard potassium dichromate solution.
2. To determine the Normality and Strength (g/L) of given Ferrous Ammonium Sulphate solution „A" using standard Ferrous Ammonium Sulphate (N/30) solution „B" taking KMnO4 solution as an intermediate.
3. To determine the concentration of hypo solution ($Na_2S_2O_3.5H_2O$) iodometrically with given Iodine (N/50) solution.
4. Find out the Temporary hardness of given water sample using 0.01M EDTA solution, buffer solution (pH-10) and EBT as an indicator.
5. To determine chloride ion in a given water sample by Argentometric method (Mohr"smethod)

Group – B:

6. Preparation of Urea Formaldehyde resin.
7. Acetylation of Primary Amine: Preparation of Acetanilide.
8. Base Catalyzed Aldol Condensation: Synthesis of dibenzalpropanone.
9. [4+2] Cycloaddition Reaction: Diels-Alde reaction.
10. Preparation of aspirin and calculate its yield.

Group – C:

11. To calculate the λ_{max} of a given compound using UV-visible spectrophotometer.
12. To separate the metallic ions by paper chromatography.
13. To determine the surface tension of a liquid by stalagmometer.
14. To determine the percentage composition of the given mixture consisting of two liquids A and B (non- interacting system) by viscosity method.
15. To determine the relative viscosity of given liquids by Ostwald"s viscometer.

Note: At least two Experiments from each group must be performed.

COURSE OUTCOME: At the end of the course students will be able to:

Handle the chemicals of synthesis as well as titration that will ultimately make them efficient and develop their future chemistry laboratory skills.

SYLLABUS	(SEMESTER-II)	Periods/ Week			INTERNAL ASSESSMENT (IA)			ESE	Grand total	Credits
Subject Code:	IPUBLL2	L	T	P	IA	MSE	TOTAL	25	50	01
Subject:	ENGINEERING WORKSHOP PRACTICES	-	-	2	25	--	25			

COURSE OBJECTIVE:

- To impart student knowledge on various hand tools for usage in engineering applications.
- Be able to use analytical skills for the production of components.
- Design and model different prototypes using carpentry, sheet metal and welding.
- Make electrical connections for daily applications.
- To make student aware of safety rules in working environments.

Course Content:

1. Study of M/C tools in lathe machine
   Demonstration of different operations of lathe machine
   Practice of facing plain turning, taper turning etc
2. Study of Carpentry tools, equipments and different jobs
   Practice of Lap joints, Butt joints, T-Lab joints
3. Practice of Lap joint, Butt Joint, T-joint
4. Preparation of ¥ shape, square shape, work pieces as per the given specification
5. Replacement of fuse, condenser of fan/motor and fan regulator;
   Installation of switch board with wiring;
   Concepts of measuring instruments.
6. Identification of various electronics components and their terminals;
   Study of logic gates AND, OR, XOR and NOT, NAND, NOR;
   Study of Basic ICs.

COURSE OUTCOME: At the end of the course students will be able to:

- Make half lap joint, Dovetail joint and Mortise &Tenonjoint
- Produce Lap joint, Tee joint and Butt joint using Ga swelding
- Prepare trapezoidal tray, Funnel and T-joint using sheet metal tools
- Make connections for controlling one lamp by a single switch, controlling two lamps by a single switch and stair case wiring

TEXT/ REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of WorkshopTechnology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited,Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition,2002.
3. Gowri P. Hariharan and A. Suresh Babu, "Manufacturing Technology – I" Pearson Education, 2008. (iv)Roy A. Lindberg, "Processes and Materials of Manufacture", 4thedition, PrenticeHallIndia, 1998.
4. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata Mc-Graw Hill House,2017.

SYLLABUS	(SEMESTER-II)	Periods/ Week			INTERNAL ASSESSMENT (IA)			ESE	Grand total	Credits
Subject Code:	CSUBLE5	L	T	P	IA	MSE	TOTAL	25	50	01
Subject:	COMPUTER PROGRAMMING LABORATORY	-	-	2	25	--	25			

COURSE OBJECTIVE:

- To learn the Branching and logical expressions and Loops
- To learn the Arrays and Function
- To understand the Numerical methods and Recursion

Course Content: The laboratory should be preceded or followed by a tutorial to explain the approach or Algorithm to be implemented for the problem given.

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation
Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value:
Lab 7: Simple functions
Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical Integration):
Lab 8 and 9: Programming for solving Numerical methods problems
Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions
Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

COURSE OUTCOME: At the end of the course students will be able to:

- Utilization of Branching and logical expressions and Loops, Arrays and Function and Numerical methods and Recursion for writing the programmes for various engineering applications

SYLLABUS	(SEMESTER-II)	Periods/ Week			INTERNAL ASSESSMENT (IA)			ESE Assessment	Grand total	Credits
Subject Code:	PEUBLS2	L	T	P	Attendance	Activities	TOTAL			
Subject:	SPORTS AND YOGA		-	2	5	20	25	25	50	01

Physical Fitness Tests

- AAHPER youth fitness test
- Cooper‟s 12 Minute run-walk test

General Introduction of games and sports

Fundamental skills, history and development of the following games and sports:

- Athletics
- Batminton
- Basketball
- Cricket
- Football
- Hockey
- Handball
- Kabaddi
- Kho-kho
- Volley-ball
- Yoga

Note:

1. Each student will have to clear one of the physical fitness tests by the end of the semester.
2. One project is to be prepared by the students at least for two games.

TEXT/ REFERENCE BOOKS:

1. Barron H M, McGhee R (1997) A Practical Approach to Measurement in Physical Education.
2. Kansal D K (1996), Test and Measurement in sports and physical education, New Delhi, D V S Publication

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUCTE1	3	-	-	3 Hours	40	60	100	3

ENGINEERING ECONOMICS

Course Objectives:

- To analyze cost/revenue data and carry out make economic analyses in the decision-making process
- To justify or reject alternatives/projects on an economic basis.

UNIT-I

Basic concepts and definitions, Methodology of economics, Demand and supply-elasticity, Theory of the firm and market structure, Price and output determinations in different types of market.

UNIT-II

Public sector economics, Welfare economics, Central and commercial marks and their functions, Industrial policies, Theory of localization, Weber & surgent florence theory, Investment analysis-NPV, ROI, IRR, Payback period, SWOT analysis.

UNIT-III

Monetary and fiscal Policy, Tools, Impact on the economy, Inflation, Business cycle, Cash flow- 2, 3, 4 model.

UNIT-IV

Business forecasting, Elementary techniques, Cost and revenue analysis, Capital budget, Break even analysis.

UNIT-V

Indian economy, Urbanization, Unemployment–poverty, Regional disparities, Unorganized sectors- roll of plans, Reforms-post independent period.

Text/Reference Books:

1. N. M. Gregory, "Principles of Economics", Thompson Asia, 2002.
2. V. Mote, S. Paul, and G. Gupta, "Managerial Economics", Tata McGraw Hill, 2004.
3. S. K. Misra and V. K. Puri, "Indian Economy", Himalaya, 2009.
4. P. Saroj, "Textbook of Business Economics", Sunrise Publishers, 2003.
5. U. Kapila, "Indian Economy Since Independence", Academic Foundation, New Delhi
6. R. Dutt and K. P. M. Sundharam, "Indian Economy", S. Chand & Company Ltd., New Delhi.

Course Outcomes:

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

CO1 Aware of the basic theoretical framework underlying the field of microeconomics, macroeconomics, Indian economy, public finance etc.

CO2 Understand the operations of money and banking and their interaction with the rest of the economy.

CO3 Realize how monetary forces operate through a multitude of channels-market, non- market, institutions and among others.

CO4 Understand the various issues/components of the Indian economy so that they are able to comprehend and critically appraise current Indian economic problems.

CO5 Understand the major developments in the Indian economy before independence, at the time of Independence and during the post-Independence period.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		1	1	1		1			2		2	2	1		
CO2		1	1	1		1			2		2	2	1		
CO3		1	1	1		1			2		2	2	1		
CO4		1	1	1		1			2		2	2	1		
CO5		1	1	1		1			2		2	2	1		

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUCTT1	3	-	-	3 Hours	40	60	100	3

ELECTRONIC DEVICES

Course Objectives:

- To develop basic concept of semiconductor materials and physics.
- To introduce different methods of DC analysis semiconductor devices.
- To develop the concept and analysis of transistor characteristics, biasing and thermal stabilization.
- To introduce the concept of special semiconductor devices.

UNIT-I

Semiconductor Concept: Review of semiconductor & energy band diagram, The k-space diagrams of Si and GaAs, Density of states function, The fermi–dirac probability function, The distribution function and the fermi energy, Semiconductor in equilibrium, Carrier transport phenomena, Carrier generation and recombination, Characteristics of excess carriers.

UNIT-II

Junction Diode Characteristics: Description of pn junction action, The abrupt & linearly graded junction, The ideal diode model, Temperature dependence of I-V characteristics, Breakdown mechanism, Diode resistance, Diode capacitance, Clipper, Clamper, Rectifier.

UNIT-III

Transistor Characteristics: NPN, PNP, Operations, Early effect, Input and output characteristics of CE, CB, CC, Transistor as a switch & amplifier, Transistor biasing and thermal stabilization.

UNIT-IV

Field Effect Transistor (FET): JFET construction, operation & device characteristics, Pinch off voltage and its significance, Classification of MOSFET, The two-terminal MOS structure, C-V characteristics, The Basic structure & operating principal of MOSFET, Threshold voltage, Current-voltage characteristics, Biasing of JFET & MOSFET.

UNIT-V

Special Semiconductor Devices: Tunnel diode, Photo diode, Photo voltaic effect, Solar cells, Schottky diode, Varactor diode, Heterojunctions, Dual gate MOSFET, FINFET.

Text/Reference Books:

1. M. S. Tyagi, "Introduction to Semiconductor Materials and Devices", Wiley, 1991.
2. D. A. Neaman, "Semiconductor Physics and Devices- Basic Principles", 4th ed., TMH, 2021.
3. J. Millman and C. C. Halkias, "Electronic Devices and Circuits", 6th ed., Tata McGraw Hill Publishing Limited, New Delhi, 2003.
4. A. Mottershead, "Electronic Devices and Circuits- An Introduction", Prentice Hall of India Private Limited, New Delhi, 2003
5. R. Boylestad and L. Nashelsky, "Electronic Device & Circuit Theory", 11th ed., Pearson, 2013.
6. B. G. Streetman and S. Banerjee, "Solid State Electronic Devices", Pearson Education, 2002.
7. S. M. Sze & K. N. Kwok, "Physics of Semiconductor Devices," 3rd ed., John Wiley & Sons, 2006.

Course Outcomes:

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

CO1 Illustrate the knowledge of semiconductor physics.
CO2 Comprehend the characteristics of the PN junction diode and its application in electronic circuits.
CO3 Elucidate and analyze the characteristics and performance of transistors.
CO4 Analyze the concept of load line and design biasing circuits of transistor.
CO5 Comprehend the operation & characteristics of special semiconductor devices.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1					3	1		2	3		2
CO2	3	3	2	3	3	3			3	1		2	3	2	3
CO3	3	3	2	3	3	3			3	1		2	3	3	3
CO4	3	3	2	3	3	3			3	1		2	3	3	3
CO5	3	3	2	3	3	3			3	1		2	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUCTT2	3	-	-	3 Hours	40	60	100	3

DIGITAL LOGIC DESIGN

Course Objectives:

- To understand number representation and conversion between different representation in digital electronic circuits.
- To analyze logic processes and implement logical operations using combinational logic circuits.
- To understand characteristics of memory and their classification.
- To understand concepts of sequential circuits & analyze sequential systems in terms of state machines.
- To understand concept of Programmable Devices, PLA, PAL, CPLD and FPGA and implement digital system using VHDL.

UNIT-I

Logic Simplification and Combinational Logic Design: Review of Boolean algebra and De-Morgan's theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 4 variables, Binary codes, Code conversion.

UNIT-II

Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and parallel Adders, BCD Adder.

UNIT-III

Sequential Logic Design: Introduction, SR FF, JK FF and Master-Slave JK FF, Edge triggered FF, Ripple and synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorothmic state machine charts, Designing finite synchronous circuits like pulse train generator, Pseudo random binary sequence generator, Clock generation.

UNIT-IV

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, Fan-in, Fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of programmable logic devices, Logic implementation using programmable devices.

UNIT-V

VLSI Design Flow: Design entry, Schematic, FSM & HDL, Different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis & simulation, VHDL constructs and codes for combinational and sequential circuits.

Text/Reference Books:

1. A. A. Kumar, "Fundamentals of Digital Circuits", 2nd ed., PHI, 2009
2. H. Taub and D. Schilling, "Digital Integrated Electronics", 1st ed., TMH, 2008
3. M. M. Mano," Digital Logic and Computer Design", 1st ed., PHI, 2004
4. A. P. Malvino and D. Leach, "Digital Principles and Application", 4th ed., TMH, 1986.
5. D. Perry, "VHDL", Tata McGraw Hill, 4th ed., 2002.
6. C. Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd ed., 201.

Course Outcomes:

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

CO1 Apply the knowledge of number systems and Boolean logic used in the development of digital circuits and analyze digital circuits using Boolean algebra and K-maps.
CO2 Design and implement a variety of logical devices using combinational circuits concepts.
CO3 Design and analyze sequential circuits
CO4 Analyze different circuits using different logic families.
CO5 Comprehend the concept of VHDL and design sequential & combinational circuits using VHDL.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	2	1			1			3	3	1	1
CO2	3	3	3	2	2	1			1			3	3	1	1
CO3	3	3	3	2	2	1			1			3	3	1	1
CO4	3	3	3	2	2	1			1			3	3	1	1
CO5	3	3	3	2	2	1			1			3	3	1	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUCTT3	3	1	-	4 Hours	40	60	100	4

NETWORKS, SIGNALS AND SYSTEMS

Course Objectives:

- Capable for analyzing any given electrical network and understand the significance and practical aspect of two port network.
- To make the students familiarize with the fundamental continuous and discrete signals and systems.
- To explore the concept of continuous to discrete conversion technique needed in communication.
- To introduce different transformation methods used in time and frequency domains.
- Identify the behavior of the electrical network.

UNIT-I

Circuit Concept: Introduction to network elements and sources, Introduction to network theorems, Mutual inductance to magnetic coupled circuits, Series resonance and parallel resonance.

Two Port Networks: Short circuit, Open circuit, Transmission, Hybrid parameters, Relationship between parameter sets, Interconnection of two port networks, T and π section representation in parameter forms.

UNIT-II

Signals and Systems: Introduction to signals and systems, Test signals, Operations on signals, Classification of signals and systems.

Linear Time Invariant (LTI) Systems: Impulse response and step response, Convolution, properties of LTI systems, Eigen functions, System representation through differential and difference equations.

UNIT-III

Fourier Analysis of Continuous Time System: Fourier series representations, Fourier transform, Properties of Fourier transform, Magnitude and phase response.

Continuous to discrete conversion: Sampling, Sampling theorem and signal reconstruction.

Fourier analysis of discrete time system: The discrete-time Fourier transform (DTFT), Properties of DTFT, LTI system representation by DTFT.

UNIT-IV

Laplace transform: The Laplace transform, Region of convergence, Poles and zeros of system, Properties of Laplace transform, Inverse Laplace transform, Laplace domain analysis, Solution to differential equations and system behavior. Solution of network equations using Laplace transform.

Z transform: The Z-Transform, Region of convergence, Properties of Z-transform, Inverse Z-transform, Z-domain analysis, Solution to difference equations and system behavior.

UNIT-V

Transient and study state analysis: Network equation, Transient analysis of DC & AC circuits, Transient and steady state response of RL, RC, LC and RLC circuits in transient with or without stored energy – Solutions in t & s domains, Initial conditions in networks, Step and impulse response, Initial and final value theorem.

Text/Reference Books:

1. M. E. Van Valkenburg, "Network Analysis", 3rd ed., Prentice-Hall India, 201.0
2. F. F. Kuo., "Network Analysis and Synthesis", 2nd ed., Wiley India, 2008.
3. W. H. Hayt and J. E. Kemmerly, "Engineering Circuit Analysis", 8th ed., Tata McGraw-Hill, 2008.
4. Sudhakar and A. Shyammohan, "Circuits and Network", 3rd ed., Tata McGraw Hill, 2006.
5. C. L. Wadhwa, "Network analysis and synthesis", 2nd ed., New Age International, 2006.
6. B. P. Lathi, "Principles of Linear Systems and Signals", Oxford University Press, 2009.
7. H. P. Hsu, "Schaum's outline: Theory and Problem of Signal & Systems", TMH 1995.
8. S. Ghosh, "Signals & Systems", Pearson Education, 2006.
9. S. K. Mitra, "Signals & Systems", Oxford University Press, 2015.

A. V. Oppenheim, A.S. Willsky , and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
10. J. Nagrath, S. N. Sharan, R. Ranjan, and S. Kumar, "Signals and Systems", TMH New Delhi, 2001.

Course Outcomes:

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

CO1 Analyze various electrical networks using advanced theorems and two-port network formulation.

CO2 Analyze and identify behavior & response of different types of continuous & discrete signals, systems & LTI system.

CO3 Represent any aperiodic signal in to a combination of sinusoids and obtain the continuous to discrete conversion using sampling.

CO4 Perform different continuous and discrete time domain transformation technique.

CO5 Obtain the transient and steady-state response of electrical networks.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2						3	3	2	2
CO2	3	3	2	2	2	1						3	3	2	2
CO3	3	3	2	3	3							3	3	2	2
CO4	3	3	2	3	3							3	3	2	2
CO5	3	3	2	3	2							2	3	2	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUCTK1	3	-	-	3 Hours	40	60	100	3

TRANSMISSION LINE & ELECTROMAGNETIC WAVES

Course Objectives:

- To develop the concept of analysis of transmission line
- To develop the design concept of transmission line
- To develop the concepts, working principles, and laws of electromagnetic waves.
- To perform analysis and characterization of uniform plane wave at different media
- To perform analysis and design of the waveguide.

UNIT-I

Transmission Lines: Equations of voltage and current on TX line, Propagation constant and characteristic impedance, Reflection coefficient and VSWR, Impedance transformation on lossless and low loss transmission line, Power transfer on TX line, Smith chart, Admittance smith chart.

Application of Transmission Lines: Applications of transmission lines: Impedance matching, Use of transmission line sections as circuit elements, Types of Transmission line.

UNIT-II

Maxwell's Equations: Basics of vectors, Vector calculus, Basic laws of electromagnetics, Maxwell's equations, Boundary conditions at media interface.

UNIT-III

Uniform Plane Wave: Uniform plane wave, Propagation of wave, Wave polarization, Wave propagation in conducting medium, Phase and group velocity, Power flow and poynting vector, Surface current and power loss in a conductor, Plane waves at a media interface, Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, Wave polarization at media interface.

UNIT-IV

Waveguide: Reflection from a conducting boundary, Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Field visualization.

UNIT-V

Radiation: Solution for potential function, Radiation from the hertz dipole, Power radiated by hertz dipole, Radiation parameters of antenna, Receiving antenna, Monopole and dipole antenna.

Text/Reference Books:

1. R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill India, 2005
2. E. C. Jordan and K. G. Balmain, "Electromagnetic Waves & Radiating Systems, Prentice Hall, India
3. N. Narayana Rao, "Engineering Electromagnetics", 3rd ed., Prentice Hall, 1997.
4. David Cheng, Electromagnetics, Prentice Hall

Course Outcomes:

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

CO1 Impedance transformation on transmission line and evaluate sections of transmission line for realizing circuit elements.

CO2 Selection of transmission line for various applications as feed and impedance matching.

CO3 Apply the basic laws of electromagnetic in high frequency wave propagation.

CO4 Characterize uniform plane wave and to evaluate reflection and transmission of waves at media interface.

CO5 Analyse the wave propagation in metallic waveguides at microwave frequency.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2							1	3	2	
CO2	3	3	2	3								1	3		
CO3	3	3	2	3									3		
CO4	3	3	3	3	2								3	2	
CO5	3	3	1	2	2								3		

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUCTK2	3	-	-	3 Hours	40	60	100	3

ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

Course Objectives:

- To understand the working of basic measurement system and sources in measurement system.
- To study static and dynamic characteristic of instrument.
- To study the design of bridge circuit and different types of electronic voltmeter.
- To understand the working principle of sensors and transducers.
- To study the basic features of Display devices, DVM, Recorders and CRO.

UNIT-I

Measurements and Measurement System: Measurements, Significance, Methods, Instruments and measurement system: Mechanical, Electrical, Electronic instruments, Classification of instruments, Mode of operation, Applications, Characteristics of instrument and measurement system, Elements of a generalized measurement system, Accuracy and precision, Types of error, Probability of error, Limiting error.

UNIT-II

Electromechanical Indicating Instruments: Operating forces, Construction, Torque/weight ratio, Control system, Damping, D´Arsonaval galvanometer, Response of galvanometer, Ballistic galvanometer, PMMC-construction, Torque equation, Voltage/current measurement: Ammeter, Voltmeter, Ohmmeter, Multimeter (V.O.M.), Q-meter Measurement.

UNIT-III

AC Bridge: Introduction, Sources and detectors, General equation for bridge balance, General form, Maxwell´s bridge, Hay´s bridge, Anderson´s bridge, De-Sauty´s bridge, Schering bridge, Wien´sbridge. **Electronic Instruments:** Introduction, Advantage of electronic voltmeter, VTVM, Differential voltmeter, Electronic voltmeter using rectifier, True

RMS reading voltmeter, Calorimeter.

UNIT-IV

Transducer: Classification of transducer, Potentiometer, Loading effect, Strain Gauge, Thermistor, Thermocouple, LVDT, RVDT, Capacitive Transducer, Piezo-electric transducer, Hall effect Transducer, Capacitive Transducer, Pressure Transducer, Mechanical sensors, fiber-optic sensors, nano-sensors, magnetic field, microwave and radiation sensors.

UNIT-V

Instrumentation: Digital display method, Segmental display- 7segment & 14 segment display, dot matrix, LED, LCD, TFT, Plasma display, DLP. Digital voltmeter (DVM), Recorders, CRO: Introduction, Oscilloscope block diagram, CRT, Functional block diagram of sampling, Storage, Dual trace and dual beam oscilloscope.

Text/Reference Books:

1. W. D. Cooper & A. D. Helfrick, "Modern Electronic Instrumentation and Measurement Technique", PHI 2000.
2. A Course in Electrical and Electronic Measurements and Instrumentation, A K Sawhney, Dhanpat Rai & Sons, 2010
3. Eric Udd, Fiber Optics Sensors, Wiley Publishers
4. Krishna kumar, Sensors and instruments in Agriculture: Microprocessor based Instrumentation for Agriculture industry, PHI Publication

Course Outcomes:

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

CO1 Explain the principle of operation of generalized measurement system and different sources of errors in measurements.

CO2 Analyze different static and dynamic characteristics of instrument & based on this will able to select particular instrument for measurement.

CO3 Design AC bridges for relevant parameters measurement and application of electronic voltmeter.

CO4 Classify and select transducer for particular applications.

CO5 Demonstrate the use of different types of Display devices, Digital Voltmeter, Recorders and CRO.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1					3	1		2	3	2	2
CO2	3	3	2	3	3	3			3	1		2	3	2	3
CO3	3	3	2	3	3	3			3	1		2	3	3	3
CO4	3	3	2	3	3	3			3	1		2	3	3	3
CO5	3	3	2	3	3	3			3	1		2	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUCLT1	-	-	2	2 Hours	25	25	50	1

ELECTRONIC DEVICES LAB

Course Objectives:

- To identify and test various electronic components.
- To use CRO/DSO & function generator for various measurements.
- To plot the characteristics of diode and transistor.
- To observe the waveform of rectifiers & filters.

LIST OF EXPERIMENTS:

1. To verify V-I characteristics of PN junction diode.
2. To verify V-I characteristics of zener diode.
3. To verify V-I characteristics of light emitting diode (LED).
4. To study half & full wave rectifier and evaluate the efficiency.
5. To study filter and evaluate the efficiency.
6. To verify V-I characteristics of BJT in CE–mode.

7. To verify V-I characteristics of BJT in CB–mode.
8. To verify V-I characteristics of BJT in CC–mode.
9. To verify V-I characteristics of JFET.
10. To verify V-I characteristics of MOSFET.

Course Outcomes:

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

CO1 Illustrate the characteristics of diode.
CO2 Implement rectifier circuits and evaluate the efficiency.
CO3 Implement the filter circuits and analyze the practical applications for filters.
CO4 Implement the different configuration of BJT and analyze their characteristics.
CO5 Design JFET & MOSFET and analyze their characteristics.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1			2			3	2	2	1
CO2	3	2	1	1	1	1			2			3	2	2	1
CO3	3	2	1	1	1	1			2			3	2	2	1
CO4	3	2	1	1	1	1			2			3	2	2	1
CO5	3	2	1	1	1	1			2			3	2	2	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUCLT2	-	-	2	2 Hours	25	25	50	1

DIGITAL LOGIC DESIGN LAB

Course Objectives:

- To provide hand-on experience in designing and implementing digital/logic circuits.
- The laboratory exercises are designed to enhance students ability to design, build, and implement digital circuits and systems.
- To know the concepts of combinational circuits.
- To understand the concepts of flip flops, registers and counters
- To know the concepts of interfacing of logic family.

LIST OF EXPERIMENTS:

1. To study the 4-binary adder.
2. To study the verification of De-morgan theorem.
3. To study the realization of Boolean expression & law.
4. To study the half/full adder/subtractor.
5. To study the encoder/decoder.
6. To study the one input two output demultiplexer.
7. To study the BCD seven segment decoder.
8. To study the logic gate apparatus.
9. To study the decimal to excess-3 encoder.
10. To study the excess-3 to decimal decoder.
11. To study the 8:1 multiplexer & 1:8 demultiplexer.
12. To study the flip-flop trainer.
13. To study the logic gate using ICS.
14. CMOS: to study the interfacing of TTL & CMOS.
15. To study the johnson ring counter.

Course Outcomes:

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

CO1 Construct Boolean functions using logic gates.
CO2 Construct basic combinational circuits and verify their functionalities
CO3 Apply the design procedures to design basic sequential circuits.

CO4 Comprehend the basic gate ICs & digital circuits and to verify their operation
CO5 Learn & design about counters.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1			2			3	2		1
CO2	3	2	1	1	1	1			2			3	2		1
CO3	3	2	1	1	1	1			2			3	2		1
CO4	3	2	1	1	1	1			2			3	2		1
CO5	3	2	1	1	1	1			2			3	2		1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

INSTITUTE CORE (III SEMESTER)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUCTO1	3	-	-	3 Hours	40	60	100	3

DATA COMMUNICATION

Course Objectives:

- To learn the basic concepts of data communications.
- To learn the layered architecture of communication protocols.
- To learn digital signal transmission and encoding techniques.
- To learn multiplexing techniques.
- To learn the concepts and techniques in error detection and correction.

UNIT-I

Data and Signal: Analog and digital signals, Time and frequency domain, Composite signals, Bandwidth, Bit rate, Bit length, Baseband and broadband transmission, Attenuation, Distortion, Noise, Nyquist bit rate, Shannon capacity.

UNIT-II

Data Communication Concepts: Data transmission, Parallel and serial transmission, Synchronous and asynchronous transmission, Simplex, Half-duplex and full-duplex, Unipolar and polar line codes, Non return to zero codes, Return to zero codes, Bipolar line codes.

UNIT-III

Telephone network, Network topology, Multiplexing, Frequency division multiplexing, Time division multiplexing and wavelength division multiplexing, Pulse code modulation.

UNIT IV

Switching Techniques: Circuit, packet and hybrid switching, Types of error, Vertical redundancy check, Longitudinal redundancy check, Cyclic redundancy check, Error correction, Integrated services digital network.

UNIT-V

Transmission Media: Guided and unguided media, Twisted pair, Unshielded twisted pair and shielded twisted pair, Coaxial cable and fiber optic cable, Radio waves, Microwaves and infrared transmission RJ- 45, Network interface card, Rack, Cable standard-category 5, 6 and 7, Cross connection, Straight connection, Cable coding standards.

Text/Reference Books:

1. "Data communication and networking", Forouzan, TMH.
2. Data communication and Computer Networks, Prakash C Gupta, PHI Learning.
3. "Computer Networks", Tanenbaum, PHI Learning.
4. "Communication Networks-Fundamental concepts and key Architectures",Leon-Garcia,Widjaja,TMH.

5. "Computer Communications & Networking Technologies", Michael A. Gallo & William M. Hancock - Cengage pearsen publications.
6. "Network for computer scientists & engineers", Youlu zheng & shakil akhtar, Oxford pubcation.

Course Outcome:

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

CO1 Understand the basics of data communication, networking, internet and their importance.
CO2 Interpret the components, tools and techniques of communication systems.
CO3 Explain how information can be sent via communication interfaces and links.
CO4 Determine various modulation, error detection & correction techniques & their applications.
CO5 Identify the basic security threats of a network.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1							3	2	1	1
CO2	3	2	3	1	1							3	2	1	1
CO3	3	2	2	2	2							3	2	2	1
CO4	3	3	3	2	2							3	2	2	1
CO5	3	3	3	2	2							3	2	2	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
CSUCTO1	3	-	-	3 Hours	40	60	100	3

DATA STRUCTURE USING C++

Course Objectives:

- Introduce the concept of data structures through array, stack and queues.
- To design and implement various data structure algorithms.
- To introduce various techniques for representation of the data in the real world.
- To develop application using data structure algorithms.

UNIT-I

INTRODUCTION: Functions and parameter, Dynamic memory allocation, Recursion.

LINEAR LISTS: Data objects and structures, Linear list data structures, Array Representation, Vector Representation, Singly Linked lists and chains. L1, L2

UNIT-II

ARRAYS AND MATRICS: Arrays, Matrices, Special matrices, Sparse matrices.

STACKS: The abstract data types, Array Representation, Linked Representation, Applications- Parenthesis Matching & Towers of Hanoi. L1, L2, L3

UNIT-III

QUEUES: The abstract data types, Array Representation, Linked Representation, Applications- Railroad car arrangement.

HASHING: Dictionaries, Linear representation, Hash table representation. L1, L2, L3

UNIT-IV:

BINARY AND OTHER TREES

Trees, Binary trees, Properties and representation of binary trees, Common binary tree operations, Binary tree traversal the ADT binary tree, ADT binary tree and the class linked binary tree. L1, L2, L3

UNIT-V

PRIORITY QUEUES: Linear lists, Heaps, Applications-Heap Sorting.

SEARCH TREES: Binary search trees operations and implementation, Binary Search trees with duplicates. L1, L2, L3

Text/Reference Books:

1. Data structures, Algorithms, and applications in C++, Sartaj Sahni, Universities Press, 2nd Ed, 2005.
2. Data structures, Algorithms, and applications in C++, Sartaj Sahni, Mc. Graw Hill, 2000.

3. Object Oriented Programming with C++, E. Balaguruswamy, TMH, 6th Edition, 2013.
4. Programming in C++, E. Balaguruswamy. TMH, 4th, 2010.

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ITUCTO1	3	-	-	3 Hours	40	60	100	3

COMPUTER ORGANIZATION & ARCHITECTURE

Course Objectives:

- Conceptualize the basics of organizational and architectural issues of a digital computer.
- Analyze processor performance improvement using instruction level parallelism.
- Learn the function of each element of a memory hierarchy.
- Study various data transfer techniques in digital computer.
- Articulate design issues in the development of processor or other components that satisfy design requirements and objectives.

UNIT-I

Basic of Computer Organization & Architecture: Introduction, Computer Organization vs. Computer architecture, Von Neumann Architecture vs. Harvard Architecture. Input & Output Organization: Introduction, Simple Bus Architecture, Types of Buses, I/O Communication Methodologies: Programmed I/O(Polling), Interruptdriven I/O & Direct Memory Access(DMA), I/O channel & I/O Processor, Accessing I/O device: Memory M apped I/O, Isolatedor I/O Mapped.

UNIT-II

Computer Arithmetic: Introduction, Addition & Subtraction: Addition & Subtraction with Signed – Magnitude Data, Hardware Implementation & Algorithm, Addition & Subtraction with Signed - 2's Complement Data, Multiplication Algorithm: Hardware Implementation for Signed – Magnitude Data, Hardware Algorithm, Booth Multiplication Algorithm, Array Multiplier, Division Algorithms: Hardware Implementation for Signed-Magnitude Data & Algorithm, Carry Look Ahead Adder.

UNIT-III

Memory Organization: Introduction, Types of Memory, Memory Hierarchy, Main Memory, Cache Memory, Virtual Memory, Associative Memory. Processor Organization: Introduction, Control Unit: Hardwired Control Unit, Micro programmed Control Unit, Instruction Set Computer: Reduced Instruction Set Computer (RISC) vs. Complex Instruction Set Computer (CISC).

UNIT-IV

Pipelining: Introduction, Concept of Instruction Pipeline, Design Problems with Pipeline: Structural Hazard, Data Hazard & Control Hazard, Extension in Pipeline Designed: Super Pipelining, Superscalar Processor, Very Long Instruction Width (VLIW) Architecture.

UNIT-V

Multiprocessor System: Introduction, Shared Memory Multiprocessor, Distributed Memory Multiprocessor, Flynn's Classification: Single Instruction Single Data (SISD), Single Instruction Multiple Data (SIMD), Multiple Instruction Single Data (MISD), Multiple Instruction Multiple Data (MIMD), Cache Coherence, Message Passing Model, Cluster Computing, Distributed Computing.

Text/Reference Books:

1. Computer System Architecture, M.Morris Mano, Pearson Education India.
2. Computer Organization & Architecture, W. Stalling, Pearson Education India.
3. Computer Architecture & Organization, J. P. Hayes, McGraw-Hill India.
4. Computer System Organization, Naresh Jotwani, Mc Graw Hill, India.
5. Computer System Architecture, P. V. S. Rao, PHI India.
6. Advanced Computer Architecture, Rajiv Chopra, S. Chand India.
7. Computer Organization & Architecture, Lalit K. Arora, Anjali Arora, S.K.Kataria & Sons, India.
8. Computer Fundamentals Architecture & Organization, B Ram, Sanjay Kumar, New Age International,

Course Outcomes:

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

CO1 Understand the computer architecture concepts. C

CO2 Understand and apply different number systems and codes.

CO3 Understand memory hierarchy and its impact on computer cost/performance.

CO4 Design a pipeline for consistent execution of instructions with minimum hazards.

CO5 Understand the concepts of multiprocessor

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
CEUCTO1	3	-	-	3 Hours	40	60	100	3

GREEN BUILDINGS

Course Objectives:

- To understand the basics of Green Buildings.
- To learn the concept of site selection and water conservation.
- To study the use of efficient energies.
- To learn about maintenance of Indoor environmental quality.
- To study various green building rating systems including their mandatory requirements and credit points.

UNIT-I

Green Buildings: Introduction, history and evolution, objectives, benefits, typical features of green buildings, sustainability and green buildings, global trends in green buildings, Examples of green buildings in India and the world (case studies to be presented by students).

UNIT-II

Site selection and building planning: Criteria for site selection, preservation of landscape, soil erosion control, understanding and minimizing urban heat island effect. Water conservation and efficiency: Rainwater harvesting methods for roof & non-roof, water demand, water efficient plumbing systems, water metering, waste water disposal, recycle and reuse systems.

UNIT-III

Energy Efficiency: Concepts of embodied energy, operational energy, demolition energy and life cycle energy. Methods to reduce operational energy: Energy efficient building envelopes, efficient lighting technologies, energy efficient appliances for heating and air conditioning systems in buildings, wind and solar energy harvesting, energy metering and monitoring, concept of net zero buildings.

UNIT-IV

Indoor Environmental Quality for Occupant Comfort: Daylighting, air ventilation, exhaust systems, materials, adhesives, building acoustics. **Environment Quality and Occupational Health:** Air conditioning, air quality, Sick building syndrome, minimum fresh air requirement, improved fresh air ventilation, Measure of Indoor air quality (IAQ), Reasons for poor IAQ, Measures to achieve Acceptable IAQ levels.

UNIT-V

Green Building Rating Systems: Introduction to various rating systems (LEED, GRIHA, IGBC etc.), mandatory requirements and credit points of various rating systems, study of green building rating criteria of IGBC, Understanding the green building measures in the areas of site preservation, energy efficiency, materials, water conservation and indoor air quality.

Text/Reference Books:

1) IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.

2) GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.

3) Alternative building materials and technologies by K.S. Jagadish, B.V. Venkatarama Reddy and K.S. Nanjunda Rao.

4) Non-Conventional Energy Resources by G. D. Rai, Khanna Publishers.
5) Sustainable Building Design Manual, Vol.1 and 2, TERI, New Delhi 2004.
6) Mike Montoya, Green Building Fundamentals, Pearson, USA, 2010.
7) Charles J. Kibert, Sustainable Construction Green Building Design and Delivery, John Wiley & Sons, New York, 2008.
8) Regina Leffers, Sustainable Construction and Design, Pearson / Prentice Hall, USA, 2009.

Course Outcomes:

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

CO1: Apply the concept and knowledge of Green Building in handling any physical projects.
CO2: Conduct a site selection process and apply water conservation techniques for green buildings.
CO3: Make use of technologies with efficient energies.
CO4: Apply the knowledge in maintaining the indoor environmental quality.
CO5: Revise essential parameters of green building rating system.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1		3	3					2	2	1	2
CO2	3	2	1	2		3	3					1	2	2	3
CO3	3	2	1	2		3	3					2	2	2	3
CO4	3	2	2	2		3	3					2	2	2	2
CO5	3	2	1	1		2	2					1	2	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
CHUCTO1	3	-	-	3 Hours	40	60	100	3

ENGINEERING MATERIALS

Course Objectives:

- To provide the understanding of material selections for construction to execute a task for a particular application, its properties and behaviour at different circumstances.
- Properties, behaviour and maintenance of various engineering materials.

UNIT-I

Crystalline and Non-Crystalline Materials: Crystalline state, Atomic bonding, Bravias lattices, Miller indices, Structure of some common inorganic compounds, Structural imperfections. Economic, environmental and social issues of material usage.

UNIT-II

Mechanical properties of materials and their variation with temperature, importance and limitations of these properties on material selection for a particular application. Failure of materials: Failure of materials under service conditions.

UNIT-III

Corrosion: Mechanism of corrosion, Types of corrosion, Factors influencing corrosion, Methods of corrosion control, Inhibition and other precautionary measures.

UNIT-IV

Non-Ferrous Metals: Copper, Brasses, Bronze, Aluminium, their mechanical properties, Workability and applications, Corrosion resistance. Non-metallic materials of construction.

UNIT-V

Phase diagram: Phase rules, Equilibrium phase diagram, cooling curves and their relations to properties of metals and alloys, Iron-carbon equilibrium diagram. Response of materials to chemical environment.

Text/Reference Books:

1. Introduction to Materials Science for Engineers by James F. Shackelford, Pearson.
2. Elements of Materials Science and Engineering by L.H.Van Vlack, Pearson.

3. Materials Science and Engineering by V. Raghavan, PHI Learning Private Limited.
4. Materials Science for Engineers by L. H. VanVlack, Addison-Wesley Publishing Co.
5. Chemistry of Engineering Materials by A. M. Sikkander and T. N. Balu, Raj Publications.
6. Corrosion, Prevention and Control by K.S. Rajagopalan, Scientific Surveys Limited.
7. Corrosion Engineering by M. G. Fontana, McGraw Hill Education.
8. Perry's Chemical Engineers' Handbook by D. W. Green and R. H. Perry, McGraw Hill Publication.

Course Outcomes:

At the end of the course students will be able to:
CO1 Explain different types of materials and their mechanical properties and limitations.
CO2 Explain types of corrosion and various methods to control them.
CO3 Describe phase diagram and its significance.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1		2			1						1	1	
CO2	2	1		2			1						1	1	
CO3	2	1		2			1						1	1	
CO4															
CO5															

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MEUCTO1	3	-	-	3 Hours	40	60	100	3

INTRODUCTION TO THERMODYNAMICS

Course Objectives:

1. To understand the basic laws of thermodynamics and heat transfer
2. To understand the principle of operation of thermal systems like I C Engine, boilers, turbines, condensers etc.

UNIT-I

Fundamental Concepts System, surrounding and universe, Concept of continuum, Property, State, Path, process, Cyclic process, Energy and its form, Work and heat, Enthalpy.

UNIT-II

Laws of thermodynamics: Concepts of Temperature, Zeroth law. First law of thermodynamics. Concept of processes, Flow processes and control volume, Flow work, Steady flow energy equation, Mechanical work in a steady flow of process.
Second law: Essence of second law, Thermal reservoir, Heat engines, COP of heat pump and refrigerator. Statements of second law, Carnot cycle, Concept of Entropy.

UNIT-III

Thermal Power Plant Layout; Rankine Cycle, Major components of thermal power plant, Condensers, Cooling Towers.

UNIT-IV

Power producing machines: Internal combustion engines, basic cycles; Turbines: Basic cycle of turbines, Impulse and Reaction Turbines.

UNIT-V

Power consuming machines: Pumps, compressors; Basic of refrigeration cycles, Environmental- friendly refrigerants, and Air conditioners.

Text/Reference Books:

- Engineering Thermodynamics – P.K. Nag, McGraw Hill
- Basic and Applied Thermodynamics – P.K. Nag, McGraw Hill
- Fundamentals of Thermodynamics – Sonntag, Borgnakke, Van Wylen, Wiley

- Thermodynamics-An engineering approach – Cengel and Boles, McGraw Hill

Course Outcomes:

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

1. Explain the basic concepts of thermodynamics such as heat and work.
2. State and Describe the basic laws of thermodynamics
3. Describe working principle of thermal power plants
4. Understand various energy interactions between heat and work.
5. Understand and describe various thermal machines based on thermodynamics.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										2	1	1
CO2	3	2	2										3	1	1
CO3	3	2	2										3	1	1
CO4	3	2	1										2	1	1
CO5	3	2	1										2	1	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
IPUCTO1	3	-	-	3 Hours	40	60	100	3

I.C. ENGINE

Course Objectives:

1. To study classifications of internal combustion engine.
2. To understand how and why actual cycles deviate from air standard cycle and fuel-air cycle.
3. To understand combustion in spark ignition engine and diesel engines.
4. To impart knowledge about carburetion, gasoline injection and diesel injection.
5. To impart knowledge about ignition, cooling, lubrication and governing systems.
6. To impart knowledge about various engine performance characteristics and its testing.

UNIT-I

Introduction of internal combustion engines, classification of I.C. engines, engines components, basic engine nomenclature, four stroke S.I. and C.I. engine, two stroke engines, comparison of two stroke and four stroke engines, comparison of S.I. and C.I. engines.

UNIT-II

Air Standard Cycle: Otto cycle, Diesel cycle, Dual cycle, comparison between Otto, diesel and dual cycles, fuel-air cycles and actual-cycles.

SI Engines: Combustion phenomenon in S.I. Engines,Flame development and its propagation, ignition lag, knocking in S.I. engines, Carburetor,Theory of carburetion.

UNIT-III

CI Engine: Combustion phenomenon in CI engines, p-v diagram and their study for various stage of combustion, delay period, detonation in C.I. engines, Fuel injection in CI engines

UNIT-IV

Engine Friction and Lubrication: Total engine friction, blow by losses, pumping losses, factors effecting engine friction, mechanism of lubrication, lubrication system.

UNIT-V

Cooling system: Piston and cylinder temperature distribution, principles and various methods of cooling.Measurement of performanceParameters.

Text/Reference Books:

1. A Course in IC Engines - M.L. Mathur and R.P. Sharma, Laxmi Publication.
2. Internal Combustion Engines –V. Ganesan, TMGH Publication.

3. Internal Combustion Engines: Theory and Practice - G.F. Taylor.
4. Introduction to IC Engine -Stone, Richard.
5. Fundamentals of I.C. Engine- Gupta, PHI.

Course Outcomes:

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

CO1: Demonstrate the components & combustion phenomenon of SI and CI engines.
CO2: Perform a thermodynamic analysis of Otto, Diesel, and Dual cycle models
CO3: Demonstrate the combustion phenomenon of SI engine and CI engine
CO4: Understand cooling, friction & lubrication systems in engines
CO5: Evaluate the performance parameters of IC engines.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	1	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	3	1	1
CO4	3	1	-	-	-	-	-	-	-	-	-	1	3	1	-
CO5	3		-	-	-	-	-	-	-	-	-	-	3	-	-

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUDTT1	3	-	-	3 Hours	40	60	100	3

ANALOG CIRCUITS

Course Objectives:

- To introduce low & high frequency model of transistor amplifiers.
- To make students understand and analyze the design and working of amplifiers/oscillators and their configurations.
- To give understanding of power & tuned amplifier.

UNIT-I

Low Frequency Transistor Amplifier: h-parameter models for CB, CE, CC configurations and their inter relationship, Analysis and comparison of the three configurations, Approximate models and calculation of CE and CC amplifiers, CE with emitter resistance, Miller's theorem, Analysis of low frequency CS and CD FET amplifier.

UNIT-II

Multistage & High Frequency Transistor Amplifier: Need for cascading, n-stage cascaded amplifier, Methods of coupling multistage amplifiers, Darlington pair, Bootstrap principle, Cascode, CE hybrid pi model, Current gain with resistive load, Gain-bandwidth product.

UNIT-III

Feedback Amplifiers: Feedback concept, Classification, Properties of negative feedback amplifier, Voltage series feedback, Current series, Current shunt, Voltage shunt feedback, Effect of feedback on amplifier bandwidth and stability.

UNIT-IV

Oscillator: Introduction, Barkhausen criteria, Sinusoidal oscillator, Phase shift oscillator, Wien bridge oscillator, Resonant circuit oscillators: LC Collpit, LC Hartley, General form of oscillator configuration: Crystal oscillator.

UNIT-V

Large Signal/ Power Amplifier: Classification, Large signal amplifier characteristics, Class A, B, AB, C & D amplifiers, Class B push-pull amplifiers, Complementary symmetry push-pull class B amplifier, Harmonic distortion, Cross-over distortion.

Tuned Amplifiers: Classification of tuned amplifier, Analysis of single and double tuned amplifiers.

Text/Reference Books:

1. J. Millman and C. C. Halkias, "Integrated Electronics", 2nd edition, TMH 2001.
2. S. Sedra and K. C. Smith, "Microelectronic Circuits Theory and Applications", 6th ed., Oxford, 2015
3. D. Neamen, "Electronic Circuits-Analysis & Design", Cengage Learning, 2/e, 2011.
4. D. A. Bell, "Electronic Device & Circuits", 5th ed., Oxford Publication, PHI, 2008.
5. R. Boylestad and L. Nashelsky, "Electronic Device & Circuit Theory", 11th ed., Pearson, 2013.

Course Outcomes:

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

CO1 Illustrate and analyze low frequency single stage amplifier.
CO2 Elucidate and analyze multistage & high frequency transistor amplifier.
CO3 Discuss the concept of feedback and construct feedback amplifier.
CO4 Illustrate about oscillator and analyze the oscillating frequency and condition of oscillation for different oscillators.
CO5 Explain about power & tuned amplifier and its type along with characteristics.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2			2			2	3	1	2
CO2	3	3	2	2	1	2			2			2	3	1	2
CO3	3	3	2	2	1	2			2			2	3	1	2
CO4	3	3	2	2	1	2			2			2	3	1	2
CO5	3	3	2	2	1	2			2			2	3	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUDTT2	3	1	-	4 Hours	40	60	100	4

ANALOG AND DIGITAL COMMUNICATIONS

Course Objectives:

- To develop ability to analyze system requirements of analog and digital communication systems.
- To understand the generation, detection of various analog and digital modulation techniques.
- To acquire theoretical knowledge of each block in AM, FM transmitters and receivers.
- To understand the concepts of baseband transmissions.

UNIT-I

Amplitude Modulation: Introduction, Block diagram of communication system, Need for modulation, Amplitude modulation, Generation of AM wave, Detection of AM Wave, DSB-SC modulation, Generation of DSB-SC wave, Detection of DSB-SC modulated waves, SSB-SC modulation, Generation of SSB-SC wave, Demodulation of SSB-SC wave, Principle of vestigial side band modulation.

UNIT-II

Angle Modulation: Principle of frequency modulation (FM) and phase modulation (PM), Relation between FM and PM , Frequency deviation, Bandwidth of FM , Narrow band and wide band FM, FM modulation and detectors.

UNIT-III

Transmitters: Classification of transmitters, AM transmitters, FM transmitters. **Receivers:** Radio receiver-Superhetrodyne receiver, Image frequency, AGC, FM receiver. **Noise in communication system**: Introduction, Receiver model, Significance of signal to noise ratio, Noise in DSB-SC, SSB-SC receivers, Noise in AM receivers (Envelope detector), Noise in FM receivers, Pre-emphasis and de-emphasis in FM.

UNIT-IV

Pulse Modulation Techniques: Pulse Analog Modulation: Introduction, Sampling**,** Nyquist criterion**,** Types of pulse modulation, TDM. **Pulse Digital Modulation:** Block diagram of digital communication system, PCM generation and reconstruction, Quantization: Uniform, Non uniform quantization, Companding, DPCM, Delta modulation and adaptive delta modulation, Noise in PCM and DM.

UNIT-V

Digital Carrier Modulation Schemes: Optimum receiver for AWGN channel, Matched filter and correlation receivers, Generation and detection of ASK, BPSK and BFSK, QPSK and DPSK, Probability of bit error computation for BPSK, BFSK, QPSK, QAM, Comparison of modulation techniques.

Text/Reference Books:

1. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
2. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
3. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
4. Digital Communications –Simon Haykin, Jon Whiley, 2005
5. Sam Shanmugam, "Digital and analog communication system", John Wiley, 2005.
6. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering'',John Wiley, 1965.
7. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication'', Kluwer Academic Publishers, 2004.
8. Proakis J.G., ``Digital Communications'', 4th Edition, McGraw Hill, 2000.

Course Outcomes:

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

CO1 Analyze and design of various continuous wave and amplitude modulation and demodulation techniques.

CO2 Analyze and Design various continuous wave Angle modulation and demodulation techniques.
CO3 Analyze and design the various Pulse Modulation Techniques (Analog and Digital Pulse modulation).
CO4 Attain the knowledge about the functioning of different AM, FM Transmitters and Receivers and understand the effects of noise in AM and FM.
CO5 Understand the concepts of Digital Modulation Technique, Baseband transmission and Optimum Receiver.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2			2			2	3	1	2
CO2	3	3	2	2	1	2			2			2	3	1	2
CO3	3	3	2	2	1	2			2			2	3	1	2
CO4	3	3	2	2	1	2			2			2	3	1	2
CO5	3	3	2	2	1	2			2			2	3	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUDTT3	3	-	-	3 Hours	40	60	100	3

CONTROL SYSTEMS

Course Objectives:

- To make the student familiarize with the fundamental concepts of different control systems.
- To help students develop an understanding the concept of transfer function and representing systems by block diagram, signal flow graph.
- To develop an understanding of transient and steady state behavior of different systems.
- To introduce the concept of absolute and relative stability of control system using Root locus, Bode plot, Polar plot and Nyquist plot.
- To inculcate state variable analysis approach for modern control systems i.e. MIMO systems.

UNIT-I

Introduction to Control Systems: Open & closed-loop systems, Industrial control examples, Transfer function, Block diagram and signal flow graph analysis, Mathematical modeling: Mechanical and electrical systems, Force-voltage and force-current analogy.

UNIT-II

Time Response Analysis: Standard signals, Order and type of system, Time response and performance specifications in transient response, Steady-state analysis, Error constants proportional, Integral and derivative.

UNIT-III

Stability Concept: Absolute and relative stability, Routh Hurwitz stability criterion, Root locus method of design, Stability analysis using root locus, Lead and lag compensation using root locus technique.

UNIT-IV

Frequency Response Analysis: Frequency-domain specifications, Polar plots, Bode plot, Stability in frequency domain, Nyquist plots, Nyquist stability criterion, Compensation Techniques: Lead, Lag and Lag-lead compensation.

UNIT-V

State Variable Analysis: Concepts of state, State variable, State model, State models for MIMO systems, Diagonalization, State transition matrix (STM), Solution of state equations, Concept of controllability & observability, Introduction to nonlinear system.

Text/Reference Books:

1. M. Gopal, "Control Systems: Principles and Design", Tata Mcgraw-Hill, 1997.

2. B. Manke, "Linear Control Systems", Khanna Publication, 2022.
3. B. C. Kuo, "Automatic Control System", 6th ed., Prentice Hall, 1993.
4. K. Ogata, "Modern Control Engineering", 2nd ed., Prentice Hall, 1991.
I. J. Nagrath and M. Gopal, "Modern Control Engineering", 5th ed., New Delhi: New Age International, 2017.

Course Outcomes:

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

CO1 Construct block diagrams, signal flow graphs and mathematical models of systems.
CO2 Analyze transient and steady state response specifications of systems
CO3 Perform stability analysis of linear time invariant system.
CO4 Design a compensator to meet specifications in time or frequency domains.
CO5 Analyze multiple input multiple output modern control system.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1				2			2	3	1	2
CO2	3	3	2	2	2				2			2	3	1	2
CO3	3	3	2	2	2				2			2	3	1	2
CO4	3	3	2	2	2				2			2	3	1	2
CO5	3	3	2	2	2				2			2	3	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUDTK1	3	-	-	3 Hours	40	60	100	3

PROBABILITY THEORY AND RANDOM PROCESSES

Course Objectives:

- To provide mathematical background and sufficient experience so that student can read, write and understand sentences in the language of probability theory.
- To introduce students to the basic methodology of "probabilistic thinking" and apply it to problems.
- To understand basic concepts of probability theory and random variables, how to deal with multiple Random Variables.

UNIT-I

Introduction to Probability: Set theory, Experiments and sample spaces, Discrete and continuous sample spaces, Events, Probability definitions and axioms, Mathematical model of experiments, Joint probability, Conditional probability, Total probability, Bayes' theorem and Independent events, Bernoulli's trials.

UNIT-II

Random Variables : Definition, Conditions for a function to be a random variable, Discrete, continuous and mixed random variable, Distribution and density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Methods of defining conditioning event, Conditional distribution, Conditional density and their properties, Operation on one random variable: Expected value of a random variable, Function of a random variable, Moments about the origin, Central moments, Variance and skew, Characteristic function,Moment generating function, Transformations of a random variable, Monotonic transformations for a continuous random variable, Non monotonic transformations of continuous random variable, Transformations of discrete random variable.

UNIT-III

Multiple Random Variables: Vector random variables, Joint distribution function and its properties, Marginal distribution functions, Conditional distribution and density-point conditioning, Conditional distribution and density-Interval conditioning, Statistical independence, Sum of two random variables, Sum of several random variables, Central limit theorem, (Proof not expected), Unequal distribution, Equal distributions, Expected value of a

function of random variables: Joint moments about the origin, Joint central moments, Joint characteristic functions, Jointly Gaussian random variables: Two random variables case, N random variable case, properties, Transformations of multiple random variables, Linear transformations of Gaussian random variables.

UNIT-IV

Stochastic Processes-Temporal Characteristics: The The stochastic process concept, Classification of processes, Deterministic and nondeterministic processes, Distribution and density functions, Statistical independence and concept of stationary: First-order stationary processes, Second order and wide-sense stationarity, Nth order and strict-sense stationary, Time averages and ergodicity, Mean-ergodic processes, Correlation-ergodic processes, Autocorrelation function and its properties, Cross-correlation function and its properties, Covariance functions and its properties, Gaussian random processes, Linear system response: Mean and mean-squared value, Autocorrelation, Cross-correlation functions..

UNIT-V

Stochastic Processes-Spectral Characteristics: The power spectrum and its properties, Relationship between power spectrum and autocorrelation function, The cross-power density spectrum and properties, Relationship between cross-power spectrum and cross-correlation function. Spectral characteristics of system response: Power density spectrum of response, Cross power spectral density of input and output of a linear system.

Text/Reference Books:

1. H. P. Hsu, "Schaum's outline of theory and problems of probability, random variables, and random processes", New York, 1997.
2. A. Papoulis, "Probability, Random variables and Stochastic Processes", 4th ed., McGraw Hill, 2017.
3. P. Z. Peebles Jr "Probability, random variables, and random signal principles", McGraw-Hill, 2001.
4. W. B. Davenport, "Probability and Random Processes for Scientist and Engineers", McGraw-Hill, 1970.
5. H. Stark and J. W. Woods, "Probability, random processes, and estimation theory for engineers", Prentice-Hall, Inc., 1986.

Course Outcome:

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

CO1 Understand and communicate the axiomatic formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena.

CO2 Characterize probability models and function of random variables based on single & multiples random variables.

CO3 Evaluate and apply moments & characteristic functions and understand the concept of inequalities and probabilistic limits.

CO4 Understand the concept of random processes and determine covariance and spectral density of stationary random processes.

CO5 Demonstrate the specific applications to Poisson and Gaussian processes and representation of low pass and band pass noise models.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1							3	2	1
CO2	3	3	3	1	2	2							3	3	2
CO3	3	3	2	2	2	2							3	3	2
CO4	3	3	3	2	2	2							3	3	2
CO5	3	3	2	3	2	2							3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUDTK2	3	-	-	3 Hours	40	60	100	3

SENSORS & ACTUATORS

Course Objectives:

- The students will have an exposure to sensors and its importance in the real world.
- To understand basics of sensors, actuators and their operating principle.
- To educate the students on different types of micro fabrication techniques for designing and developing sensors.
- To explain working of various types of electrochemical sensors and actuators.
- To provide an understanding on characteristic parameters to evaluate sensor performance.

UNIT-I

Sensors: 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, 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 & Capacitive Transducer: 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: 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 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.

UNIT-V

Sensor Materials and Processing Techniques: 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 micro machining, Surface silicon micro machining, LIGA process.

Text/Reference Books:

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" Fourth edition, Springer, 2010.
4. Robert H Bishop, "The Mechatronics Hand Book", CRC Press, 2002.
5. Thomas. G. Bekwith and Lewis Buck.N, Mechanical Measurements, Oxford and IBH publishing Co. Pvt. Ltd.,
6. Massood Tabib and Azar, "Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures", First edition, Kluwer academic publishers, Springer, 1997.

7. Manfred Kohl, "Shape Memory Actuators", first edition, Springer.

Course Outcome:

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

CO1 Describe fundamental physical and technical base of sensors and actuators,
CO2 Illustrate the concept of inductor & capacitor transducer.
CO3 Analyse various premises, approaches, procedures and results related to sensors and actuators.
CO4 Create analytical design and development solutions for microsensors and microactuators.
CO5 Comprehend the basics of sensor materials & processing techniques.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1			2			2	3	1	1
CO2	3	3	3	1	2	1			2			2	3	2	2
CO3	3	3	2	2	2	1			2			2	3	2	2
CO4	3	3	3	2	2	1			2			2	3	2	2
CO5	3	3	2	2	2	1			2			2	3	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUDTK3	3	-	-	3 Hours	40	60	100	3

ANTENNA & WAVE PROPAGATION

Course Objectives:

- To learn the fundamental parameters of the Antenna.
- To understand the basic concepts of radiation from loop and wire antenna.
- To analyze the principle of aperture antennas and design it for some applications
- To learn about the working principle of modern antennas and design it for some applications.
- To learn about the latest technologies which employ the antenna.

UNIT-I

Fundamental Concepts: Physical concept of radiation, Radiation pattern, Near-and far-field regions, Reciprocity, Directivity and gain, Effective aperture, Polarization, Input impedance, Efficiency, Friis transmission equation, Radiation integrals and auxiliary potential functions.

UNIT-II

Radiation from Wires and Loops- Infinitesimal dipole, Finite-length dipole, Linear elements near conductors, Dipoles for mobile communication, Small circular loop.

UNIT-III

Aperture and Reflector Antennas-Huygens' principle, Radiation from rectangular and circular apertures, Design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, Design concepts, Prime-focus parabolic reflector and cassegrain antennas. Broadband antennas: Log-periodic and yagi-uda antennas, Frequency independent antennas, Broadcast antennas.

UNIT-IV

Micro strip Antennas: Basic characteristics of micro strip antennas, Feeding methods, Methods of analysis, Design of rectangular and circular patch antennas, Dielectric resonator antenna, Antenna arrays-analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes.

UNIT-V

Planar arrays, Smart antennas-concept and benefits of smart antennas, Fixed weight beam forming basics, Adaptive beam forming, Different modes of radio wave propagation used in current practice.

Text/Reference Books:

1. J.D. Kraus, Antennas, McGraw Hill, 1988.
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
3. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4. R.C. Johnson and H. Jasik, Antenna Engineering Handbook, McGraw ill, 1984.
5. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.
6. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005
7. R.E. Crompton, Adaptive Antennas, John Wiley

Course Outcome:

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

CO1 Conduct investigation of the antenna for different applications with an understanding of the fundamental parameters of antennas.
CO2 Design and principle of a dipole antenna.
CO3 Design and evaluate broadband and high gain antennas for various applications.
CO4 Analyze the properties of different types of modern antennas and their design.
CO5 Come up with the design of the antenna of the required specifications for the latest wireless technologies.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	3							1	3	2	
CO2	3	3	2	1	3							1	3	2	
CO3	3	3	2	1								1	3		
CO4	3	3	3	2	3							1	3	2	1
CO5	3	3	1	2	3	3						1	3	2	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUDLT1	-	-	2	2 Hours	25	25	50	1

ANALOG CIRCUITS LAB

Course Objectives:

- To identify and test various electronic components.
- To use DSO for various measurements.
- To plot the characteristics of diode and transistor.
- To design and implement feedback amplifier circuits.
- To measure the frequency of oscillators.

LIST OF EXPERIMENTS:

1. To study the h-parameters of transistor.
2. To study the single stage RC coupled CE, CB, CC amplifier.
3. To study the two stage RC coupled amplifier using transistor.
4. To study the different types of feedback amplifier.
5. To study the wien bridge oscillator.
6. To study the RC phase-shift oscillator.
7. To study the hartley & collpit oscillator.
8. To study the JFET as an amplifier.
9. To study the class A amplifier.
10. To study the class B amplifier.
11. To study the RF single & double tuned amplifier.
12. To study the push-pull amplifier.
13. To study the complementery symmetry push-pull amplifier.

Course Outcomes:

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

CO1 Implement the different configuration of BJT & FET amplifier at different frequencies.
CO2 Implement the RC coupled amplifier and analyze the characteristics at different frequencies.
CO3 Implement different types of feedback amplifier.

CO4 Implement different class of power amplifier with different loads and evaluate the efficiency.
CO5 Design audio & radio frequency oscillator and evaluate the frequency of oscillation.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2					3			3	2	2	1
CO2	3	3	1	2					3			3	2	2	1
CO3	3	3	1	2					3			3	2	2	1
CO4	3	3	1	2					3			3	2	2	1
CO5	3	3	1	2					3			3	2	2	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUDLT2	-	-	2	2 Hours	25	25	50	1

ANALOG SND DIGITAL COMMUNICATION LAB

Course Objectives:

- To Study the basics of analog and digital modulation techniques.
- To get real-time and practical exposure of communication systems with detailed analysis of analog and digital communication techniques.

LIST OF EXPERIMENTS:

1. To study of amplitude modulation and demodulation.
2. To study of DSB-SC, SSB-SC modulation and demodulation.
3. To study of frequency modulation and demodulation.
4. To study of phase modulation and demodulation.
5. To study of sampling techniques.
6. To study of pulse amplitude modulation and time division multiplexing.
7. To study of pulse width modulation & demodulation
8. To study of pulse position modulation & demodulation
9. To study of pulse code modulation & demodulation
10. To study of ASK, FSK and PSK modulation schemes.

Course Outcome:

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

CO1 Analyze the fundamental concepts of analog communication systems.
CO2 Perform the sampling process.
CO3 Implement the various pulse modulation schemes for digital communication
CO4 Examine the performance of coding in digital systems.
CO5 Demonstrate the various digital modulation technique

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	3				1			2	3	1	1
CO2	3	2	1	1	3				1			2	3	1	1
CO3	3	3	2	1	3				1			2	3	1	1
CO4	3	3	2	1	3				1			2	3	1	1
CO5	3	3	2	1	3				1			2	3	1	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

INSTITUTE CORE (IV SEMESTER)

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECUDTO1	3	-	-	3 Hours	40	60	100	3

INTRODUCTION TO ELECTRONIC DEVICES & CIRCUITS

Course Objectives:

- To develop basic concept of semiconductor materials and physics.
- To introduce different methods of DC analysis and AC models of semiconductor devices
- To develop the concept and analysis of transistor characteristics, biasing and thermal stabilization.
- To help students develop various designs of amplifiers and its applications
- To analyze and perform the theoretical concepts through laboratory and simulation experiments.

UNIT-I

Semiconductor Concept: Review of semiconductor & energy band diagram, The k-space diagrams of Si and GaAs, Density of states function, The fermi–dirac probability function, The distribution function and the fermi energy, Semiconductor in equilibrium, Carrier transport phenomena, Carrier generation and recombination.

UNIT-II

Junction Diode Characteristics: Description of pn junction action, The abrupt junction, The ideal diode model, Temperature dependence of I-V characteristics, Breakdown mechanism, Diode resistance, Diode capacitance, Clipper, Clamper, Rectifier.

UNIT-III

Transistor Characteristics: NPN, PNP, Operations, Early effect, Current equations, Input and output characteristics of CE, CB, CC, Transistor as a switch & amplifier, Transistor biasing and thermal stabilization.

UNIT-IV

Field Effect Transistor (FET): JFET construction, operation & device characteristics, Pinch off voltage and its significance, Classification of MOSFET, The two-terminal MOS structure, C-V characteristics, The Basic structure & operating principal of MOSFET, Threshold voltage, Current-voltage characteristics, Biasing of JFET & MOSFET.

UNIT-V

Low Frequency Analysis: h-parameter models for CB, CE, CC configurations and their inter relationship, Analysis and comparison of the three configurations, Approximate models and calculation of CE and CC amplifiers, CE with emitter resistance, Analysis of low frequency CS and CD FET amplifier.

Text/Reference Books:

1. D. A. Neaman, "Semiconductor Physics and Devices- Basic Principles", 4th ed., TMH, 2021.
2. J. Millman and C. C. Halkias, "Electronic Devices and Circuits", 6th ed., Tata McGraw Hill Publishing Limited, New Delhi, 2003.

A. Mottershead, "Electronic Devices and Circuits- An Introduction", Prentice Hall of India Private Limited, New Delhi, 2003

3. R. Boylestad and L. Nashelsky, "Electronic Device & Circuit Theory", 11th ed., Pearson, 2013.
4. B. G. Streetman and S. Banerjee, "Solid State Electronic Devices", Pearson Education, 2002 / PHI
5. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd ed., John Wiley & Sons, 2006.

Course Outcomes:

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

CO1 Illustrate the knowledge of semiconductor physics.
CO2 Comprehend the characteristics of the PN junction diode and its application in electronic circuits.
CO3 Elucidate and analyze the characteristics and performance of transistors.
CO4 Analyze the concept of load line and design biasing circuits of transistor.
CO5 Evaluate low frequency analysis of transistor.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	1			3			2	3	1	2
CO2	3	3	2	3	2	1			3			2	3	2	2
CO3	3	3	2	3	2	1			3			2	3	2	2
CO4	3	3	2	3	2	1			3			2	3	2	2
CO5	3	3	2	3	2	1			3			2	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ITUDTO1	3	-	-	3 Hours	40	60	100	3

COMPUTER NETWORK

Course Objectives:

- Discuss the basic taxonomy and terminology of the computer networking.
- Discuss the functionality of different layers of OSI Model.
- Discuss different protocols of TCP/IP protocol suite.
- Discuss the process of IP addressing and working of routing protocols.
- Discuss the different challenges of Internetworking, Congestion control and Quality of services

UNIT-I

Introduction: Data communications: Components, Data representation, Direction of data flow (simplex, half duplex, full duplex).

Networks: Distributed processing, Network criteria, Physical structure (type of connection, topology), categories of network (LAN, MAN,WAN); Internet: brief history, internet today, Protocols and standard.

Reference models: OSI reference model, TCP/IP reference model, their comparative study.

Physical Layer: Transmission technology.

UNIT-II

Data Link Layer: Types of errors, Error detection & correction methods, Framing (character and bit stuffing), Flow control, Protocols: Stop & wait ARQ Go – Back – N ARQ, Selective repeat ARQ.

Medium access sub layer: Point to point protocol, Multiple Access Protocols: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, Token ring, Reservation, Polling, FDMA, TDMA, CDMA.

UNIT-III

Network Layer:

Internetworking devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway.

Addressing: IP addressing, classful addressing, subnetting.

Routing: Techniques, Static vs. Dynamic routing, Routing table for classful address, Flooding, Shortest path algorithm, Distance vector routing, Link state routing.

Protocols: ARP, RARP, IP, ICMP, IPV6.

UNIT-IV

Transport Layer: Process to process delivery, UDP: Services and applications, TCP: Stream Oriented Service, Segment, Timers, Congestion control techniques: Avoidance and Detection.

UNIT-V

Application Layer: DNS, SMTP, FTP, HTTP & WWW.

Security: Cryptography, User authentication, Security protocols in internet, Firewalls. Recent research topic on networking.

Text/Reference Books:

1. Data Communications and Networking by B.A.Forouzan – TMH Publication.
2. Computer Networks by S. Tanenbaum – Pearson Education / PHI Publication.
3. Internetworking with TCP/IP by Comer - Pearson Education/PHI by Publication.
4. Data and Computer Communications by W.Stallings – PHI Publication.

Course Outcome:

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

1. Upon completion of this course, the students will be able to
2. Understand the working of different internetworking devices.
3. Understand the working of Internet.
4. Understand the difference between OSI and TCP/IP.
5. Understand the security mechanism in Networking.
6. Understand core concept of IP addressing and routing.

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ITUDTO2	3	-	-	3 Hours	40	60	100	3

FUNDAMENTALS OF PYTHON PROGRAMMING

Course Objectives:

- To read and write simple python programs.
- To develop python programs with conditionals and loops.
- To define python functions and call them.
- To use python data structures –- lists, tuples, dictionaries.
- To do input/output with files in python.

UNIT-I

Introduction to Python: Introduction to python and its historical background, Applications, Installation of python and development environments (IDLE, Jupyter), Writing and running python programs, Understanding python's syntax and code structure, Basic input and output operations.

UNIT-II

Data Types and Variables: Data types: integers, floats, strings and Booleans, Variables and variable naming conventions, Type conversion, and typecasting, Python Operators: arithmetic, comparison, logical and assignment operators.

UNIT-III

Python Control Flow and Loops: Python decision-making with if, elif, and else statements, Python loops: while and for loops, Break and continue statements, Python control statements (pass, assert), String operations: concatenation, replication, slicing, and indexing.

UNIT-IV

Python Data Structures and Functions: Python sequences, lists, tuples, and range, Python collections, sets, dictionaries, Functions in python: defining, calling, parameters, return, Work with various data structures and create functions for different tasks.

UNIT-V

Advanced Topics and Modules: File handling in python, Exception handling, Introduction to modules and libraries, Built-in modules in python, Overview of python libraries (e.g., math, random), Explore packages.

Text/Reference Books:

1. Core Python Programming, Wesley J. Chun, Second Edition, Pearson.
2. Think Python, Allen Downey, Green Tea Press.
3. Introduction to Python, Kenneth A. Lambert, Cengage.
4. Python Programming: A Modern Approach, Vamsi Kurama, Pearson.
5. Learning Python, Mark Lutz, O'Really.

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

CO1 Introduce students to Python's history, installation, and basic usage, enabling them to write and execute simple Python programs.

CO2 Familiarize students with Python syntax, data types, variables, and fundamental operators to build a solid programming foundation.

CO3 Teach students how to make decisions and control program flow using conditional statements and loops in Python.

CO4 Enable students to work with various data structures like lists, tuples, sets, dictionaries, and

functions to manipulate data effectively.
CO5 Equip students with essential skills for file handling, and exception handling, and introduce them to modules and libraries in Python for more advanced programming tasks.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2							3	3	3	2
CO2	3	3	2	2	2							3	3	3	2
CO3	3	3	2	2	2							3	3	3	2
CO4	3	3	2	2	2							3	3	3	2
CO5	3	3	2	2	3							3	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
CSUDTO1	3	-	-	3 Hours	40	60	100	3

INTRODUCTION TO INFORMATION SCIENCE

Course Objectives:

1. To understand basic concepts about Coding Theorem.
2. To understand basic concepts about error detection and correction methods.
3. To understand basic concepts about compression techniques.
4. To understand basic concepts about video image compression techniques.
5. To understand basic concepts about cryptography.

UNIT-I

Uncertainty, Information and Entropy Information Measures: Characteristics on information measure, Shannon's concept of information, Shannon's measure of information, Model for source coding theorem, Communication system, Source coding and line/channel coding, channel models, channel mutual information capacity (Bandwidth).

UNIT-II

Channel coding, Theorem for discrete memory less channel, Information capacity theorem, Error detecting and error correcting codes, Types of codes, Block codes, Tree codes, Hamming codes, Description of linear block codes by matrices, Description of linear tree code by matrices, Parity check codes, Parity check polynomials.

UNIT-III

Compression: Lossless and lossy, Huffman codes, Binary Image compression schemes, Runlength Encoding, CCITT group-3 1D compression, CCITT group-3 2D compression, CCITT group-42D compression.

UNIT-IV

Video Image Compression: Requirement of full motion video compression, CCITT H 261video coding algorithm, MPEG compression methodology: MPEG-2 compression, Audio (Speech) compression.

UNIT-V

Cryptography: Encryption, Decryption, Cryptogram (cipher text), Concept of cipher, Cryptanalysis, Keys: Single key (Secret key), Cryptography, two-key (Public key) cryptography, Single key cryptography, Ciphers, Block Cipher code, Stream ciphers, Requirements for secrecy, The data Encryption Standard, Public Key Cryptography, Diffie-Hellmann public key distribution, The Rivest-Shamin Adelman (R-S-A) system for public key cryptography, Digital Signature.

Text/Reference Books:

1. Digital Communication by Das, Mullick & Chatterjee, New Age Pub.
2. Digital Communication by Proakis, TMH.
3. Digital Image Processing by Gonzales & Woods, Pearson.
4. Local Area Network by G. Keiser, TMH.

Course Outcome:

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

1. Student will be able to know about Coding Theorems.
2. Student will be able to know about error detection and correction methods.
3. Student will be able to know about compression techniques.
4. Student will be able to know about video image compression techniques.
5. Student will be able to know about cryptography.

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
CEUDTO1	3	-	-	3 Hours	40	60	100	3

REMOTE SENSING & GIS

Course Objectives:

- Apply the concepts of Photogrametry and its applications such as determination of heights of objects on terrain.
- Understand the basic concept of Remote Sensing and know about different types of satellite and sensors.
- Illustrate Energy interactions with atmosphere and with earth surface features, Interpretation of satellite and top sheet maps.
- Understand different components of GIS and Learning about map projection and coordinate system.
- Develop knowledge on conversion of data from analogue to digital and working with GIS software.

UNIT-I

INTRODUCTION TO PHOTOGRAMMETRY Principles and types of aerial photographs, geometry of vertical and aerial photograph, Scale and Height measurement on single and vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of Stereoscopy, fiducial points, parallax measurement using fiducial line.

UNIT-II

REMOTE SENSING Basic concepts and foundation of Remote Sensing elements, Data information, Remote sensing data collection, Remote sensing advantages and Limitations, Remote sensing process. Electromagnetic spectrum, Energy interaction with atmosphere and with earth surface features (soil, water, and vegetation) Indian Satellites and Sensors characteristics, Map and Image false color composite, introduction to digital data, elements of visual interpretations techniques.

UNIT-III

GEOGRAPHIC INFORMATION SYSTEMS Introduction to GIS, Components of GIS, Geospatial data: Spatial Data – Attribute Data- Joining Spatial and Attribute Data, GIS Operations: Spatial Data input- Attribute Data Management-Data Display-Data Exploration-Data Analysis. **COORDINATE SYSTEMS:** Geographic Coordinate system; Approximation of Earth, Datum: Map Projections; Types of Map Projections-Map Projection Parameters-Commonly used Map Projections – Projected Coordinate Systems.

UNIT-IV

VECTOR DATA MODEL Representation of simple features- Topology and its importance: coverage and its data structure, shape file:, data models for composite features Object Based Vector Data Model; Classes and their Relationships: The geo-based data model: Geometric representation of Spatial feature and data structure: Topology rules.

UNIT-V

RASTER DATA MODEL Elements of Raster data model: Types of Raster data: Raster data structure: Data conversion, Integration of Raster and Vector data. Data Input: Metadata: Conversion of Existing data, Creating new data, Remote sensing data, Field data, Digitizing, Scanning, on screen digitizing, importance of source map, Data Editing.

Text/Reference Books:

1. Bhatta B (2008), Remote sensing and GIS", Oxford University Press
2. Lillesand, T.M, R.W. Kiefer and J.W. Chipman (2013) Remote Sensing and Image Interpretation", Wiley India Pvt. Ltd., New Delhi

3. Schowenger, R. A (2006) Remote Sensing, Elsevier publishers.
4. Parkinson,B. W., Spilker, J. J. (Jr.) (1996). Global Positioning System: Theory & Applications (Volume-I). AIAA, USA
5. Remote Sensing of the environment- An earth resource perspective- 2nd edition- by John R. Jensen, Pearson Education.
6. Introduction to geographic information system- kang – Tsung Chang, Tata McGraw- Hill Education Private Limited.
7. Concepts & Techniques of GIS by C.P.Lo Albert, K.W. Yonng, Prentice Hall (India) Publications. Remote Sensing and Geographical Information systems by M.Anji Reddy JNTU Hyderabad 2001, B.S. Publications.
8. Principals of Geo physical Information System- Peter A Burragh and Rachael A. Mc Donnell, Oxford Publishers 2004
9. Basics of Remote Sensing and GIS by S. Kumar, laxmi Publications.
10. Fundamentals of Remote Sensing by George Joseph, Universities Press, 2013.

Course Outcome:

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

CO1 Understand the principles of aerial and satellite remote sensing, Able to comprehend the energy interactions with earth surface features, spectral properties of water bodies.

CO2 Understand the basic concept of GIS and its applications, know different types of data representation in GIS.

CO3 Understand and Develop models for GIS spatial Analysis and will be able to know what the questions that GIS can answer are.

CO4 Apply knowledge of GIS software and able to work with GIS software in various application fields.

CO5 Illustrate spatial and non spatial data features in GIS and understand the map projections and coordinates systems.

CO6 Apply knowledge of GIS and understand the integration of Remote Sensing and GIS.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3											3		2
CO2	3	2											3	2	
CO3				3			2						3	2	
CO4											2		2	3	
CO5			3	2						2			2	3	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
CHUDTO1	3	-	-	3 Hours	40	60	100	3

FLUIDIZATION ENGINEERING

Course Objectives:

To impart the fundamental knowledge of Fluidization and understand the different aspects of fluidized bed systems applied in various industries.

UNIT-I

Phenomenon of Fluidization, Advantages and disadvantages of fluidization compared to conventional processes, Classification of various industrial beds, Industrial applications of fluidized beds in mineral processing, coal and biomass gasification & combustion FCC petroleum refining, pharmaceuticals, cement and other solid handling systems, Fluidized Bed Drying.

UNIT-II

Gross behavior of fluidized beds-Minimum fluidizing velocity and pressure drops; Voidage, Design of distributors, Effect of temperature and pressure on fluidized bed, Elutriation and entrainment Transport disengaging height.

UNIT-III

Bubbles in dense beds-Davidson Model, stream of bubbles, Bubbling bed models, Geldart classification, Different regimes of Fluidization, Davidson's model, Variation of Bubbling bed and Circulating Fluidized beds.

UNIT-IV

Emulsion phase, Turn-over rate of solids, Residence Time Distribution of Solids, Diffusion model of solids movement, Interchange coefficient of solid into and out of wake.

UNIT-V

Flow Pattern of Gas through fluidized beds, diffusion model for gas flow; two region models, evaluation of interchange coefficients, Heat and Mass transfer in Fluidized Beds.

Text/Reference Books:

1. Fluidization Engineering by D. Kunii and O. Levenpiel, Butterworth-Heinemann, Elsevier.
2. Fluidization by J. F. Davidson and D. Harrison, Academic Press.
3. Fluidization and Fluid Particles Systems by F.A. Zenz and D. F. Othmer, Reinhold Publishing.
4. Handbook of Fluidization and Fluid-Particle Systems, by W. C. Yang, CRC Press. Course

Course Outcome:

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

1. Describe fluidization and its recommendation in various industries exploiting its various advantages evaluating the heat and mass transfer aspects.
2. Apply model equations for fluidized beds for application in various industries.
3. Able to understand various fluidization characteristics like minimum fluidization velocity, complete fluidization velocity and transport disengage height.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	--	--	--	--	--	--	--	3	3	--
CO2	3	3	3	3	3	--	--	--	--	--	--	--	3	3	--
CO3	3	3	3	3	3	--	--	--	--	--	--	--	3	3	--
CO4															
CO5															

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MEUDTO1	3	-	-	3 Hours	40	60	100	3

INTRODUCTION TO FLUID MECHANICS

Course Objectives:

1. To familiarize with the properties of fluids and the applications of fluid mechanics.
2. To formulate and analyze problems related to calculation of forces in fluid structure interaction.
3. To understand the concept of fluid measurement, types of flows and dimensional analysis.
4. To understand boundary layer concepts.

UNIT-I

Fundamentals of Fluid Mechanics: Introduction; Applications; Concept of fluid; Difference between solids, liquids and gases; Concept of continuum; Ideal and real fluids; Fluid properties

UNIT-II

Fluid Statics: Concept of static fluid pressure; Pascal's law and its engineering applications; Hydrostatic paradox; Pressure distribution in a liquids

UNIT-III

Fluid Kinematics: Classification of fluid flows; Lagrangian and Euler flow descriptions; Velocity and acceleration of fluid particle; Local and convective acceleration; Normal and tangential acceleration; Flow rate and discharge mean velocity; One dimensional continuity equation; Continuity equation

UNIT-IV

Fluid Dynamics: Euler's equation of motion; Bernoulli's equation using principle of conservation of energy; equation of motion and its applications to steady state ideal and real fluid flows

UNIT-V

Fluid devices; Conversion of mechanical to fluid energy - applications

Text/Reference Books:

1. S.K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill Publications, 3rd edition, 2011.
2. D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering", S.K. Kataria and Sons Publishers, 1st Edition, 2009.
3. Y.A. Cengel and J.M. Cimbala, "Fluid Mechanics - Fundamentals and Applications", Tata McGraw Hill Publications, 3rd Edition, 2013.
4. V.L. Streeter, E.B. Wylie and K.W. Bedford, "Fluid Mechanics", McGraw Hill BookCompany, New York, 9th Edition, 1998.
5. Frank M. White, "Fluid Mechanics", Tata Mc Graw Hill Publications, 5th Edition, 2012.

Course Outcome:

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

1. Understand the concept of fluids and their properties.
2. Distinguish various types of flows and learn flow measurement methods.
3. Apply the concept to solve the problems related to fluid statics.
4. Apply concepts to solve problems on fluid kinematics.
5. Demonstrate working principle of various fluid-based devices.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										2	1	3
CO2	3	2	2										3	1	3
CO3	3	2	2										3	1	3
CO4	3	2	1										2	1	3
CO5	3	2	1										2	1	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
IPUDTO1	3	-	-	3 Hours	40	60	100	3

AUTOMOBILE ENGINEERING

Course Objectives:

1. To provide the knowledge of basic structure of an automobile.
2. To provide the knowledge of transmission system and its various elements.
3. To provide the knowledge of clutches and suspension system
4. To provide the knowledge of braking system.
5. To provide the knowledge of steering system and engine emissions.

UNIT-I

Introduction of an automobile: Component and basis structure of automobile, classification, difference between automobile and automotive, the chassis construction & classification, defect in frames, frameless construction & specifications. Wheel and tyres: Types of wheel, wheel dimension, desirable tyres properties, types of tyres, tyre material, tyre dimension, factors affecting tyre life.

UNIT-II

Transmission system: Function of transmission types, sliding mesh gear box, constant mesh gear box, synchro mesh gear box, torque converter, propeller shaft, universal joint, hook joint, final drive, differential, performance of gear box.

UNIT-III

Clutches: Requirement, function & type of clutch, dry friction clutch, wet friction clutch, clutch plate, single plate & multiple plate clutch, centrifugal clutch and fluid fly wheel.
Suspension system function and requirement, leaf spring, torsion bar, telescopic shock absorber.

UNIT-IV

Brakes: Function and requirement, brake efficiency, wheel skidding, types of brake, electrical, mechanical and hydraulic & pneumatic brakes, master cylinder, wheel cylinder, self-actualizing brakes, brake drum, brake liners, brake shoe, trouble shooting.

UNIT-V

Front axle and suspension wheel alignment purpose: Factor of front wheel alignment, steering geometry, correct steering angle, steering mechanism, under steer and over steer, steering gear, power steering, reversibility of steering gears, steering gear ratio, calculation of turning radius.
Engine emission: Emission standard of vehicle in India, Euro norms, emission, testing. Principle of multipoint fuel injection (MPFI), component of MPFI, different sensors of MPFI system, vehicle air conditioning.

Text/Reference Books:

1. Automobile Engineering - Kripal Singh Vol. I, II.
2. Automobile Mechanics - Joseph Heitner.
3. Automobile Engineering - N.K Giri
4. Automobile Engineering - Shrinivasan T.M.H.
5. Automobile Engineering - K.K. Jain, R.B. Asthana T.M.H.
6. Automobile Engineering - R.B. Gupta Tech India Publication Series.

Course Outcome:

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

CO1: Graduates will gain a strong foundation in core automobile engineering, both in theoretical and applied concepts.
CO2: Acquire knowledge and hands-on competence in the design and development of automobile.
CO3: Graduates will develop an ability to identify and solve automobile engineering maintenance problems.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	-	-	-	-	-	-	-	1	3	1	1
CO2	3	3	3	3	2	1	-	-	-	-	-	2	3	1	1
CO3	3	3	2	1	-	-	-	-	-	-	-	1	3	1	2
CO4															
CO5															

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC205TPC08	3	1	-	4 Hours	30	70	100	4

LIC & ITS APPLICATIONS

Course Objectives:

- To develop basic concept of differential amplifiers & OPAMP IC 741.
- To analyze and perform different applications and frequency response of OPAMP.
- To develop the concept and analysis of active filters, phase lock loop, multiplier, timer, regulator.
- To help students develop various designs of OPAMP and its applications.
- To analyze and perform the theoretical concepts through laboratory and simulation experiments.

UNIT-I

Basic Building Blocks for ICs & OPAMP: Basic differential amplifiers & analysis, Introduction to OPAMP**,** Ideal OPAMP characteristics, OPAMP ICs: 741Pin diagram and function, Inverting amplifier, Non-inverting amplifier, Definition of OPAMP parameters, Frequency response of OPAMP, Open loop & closed loop configuration of OPAMP and its comparisons, Voltage comparator, Zero crossing detector, Level detector.

UNIT-II

Applications of OPAMP: Introduction, Adder, Substractor/Difference amplifier, Voltage follower, Integrator, Differentiator, Comparator IC such as LM339, Window detector, Current to voltage and voltage to current converter, Instrumentation amplifier, Precision half wave rectifier, Precision full wave rectifier, Log & antilog amplifier, Schmitt trigger, Bridge amplifier, Peak detectors/Peak follower, Sample and hold amplifiers, Square wave generator, Saw-tooth wave generator, Triangular wave generator, Astable multivibrator, Monostable multivibrator, Dead zone circuit with positive output, with negative output, Precision clipper circuit, Generalized Impedance Converter (GIC) and its application.

Frequency Response of OPAMP: Open loop voltage gain as a function of frequency, Unity gain bandwidth, Close loop frequency response, Slew rate.

UNIT-III

Active Filters & PLL - Introduction to filters, Merits & demerits of active filters of over passive filter, Classification of filters, Response characteristics of filter, First order and second order active high pass, Low pass, Band pass and Band reject butterworth filters.

Phase Lock Loop: Operating principle of the PLL, Linear model of phase lock loop, Lock range and capture range, Application of the PLL, Voltage controlled oscillator (VCO).

UNIT-IV

D/A and A/D Converters & Analog Multiplier: D/A converter ladder, R-2R, A/D converters, Ramp, Continuous conversion, Flash ADC, Dual slope ADC, Successive approximation, Voltage to time converters, Timing and circuits comparisons, DAC/ADC specifications.

Analog Multiplier: Basic analog multiplication techniques, Applications of multiplier- frequency

doubling, Phase-angle difference detection, Voltage dividing action, Square root of a signal, Function realization by multiplier, Amplitude modulator, Standard modulator circuit, Demodulation of AM signal.

UNIT-V

Timer & Regulators: Monolithic 555 timer, Functional diagram, Monostable and astable operation using 555 Timer, Voltage regulators: Basic configurations parameters for voltage regulators, Basic blocks of linear IC voltage regulators, Positive and negative voltage regulators, Positive and negative voltage regulators, General purpose IC regulator (723): Important features and internal structure, Switching regulators.

Text/Reference Books:

1. R. A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th ed. PHI, 2015
2. R. F. Coughlin and F. F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 6th ed., PHI/Pearson, 2001.
3. M. H. Rashid, "Microelectronic Circuits Analysis and Design", Cengage Learning, 2nd ed., 2012.
4. S. Franco "Design with Operational Amplifiers and Analog Integrated Circuits", 4th ed., Tata McGraw Hill, 2016.
5. Fiore, "Opamps & Linear Integrated Circuits Concepts & applications", Cengage, 2010.

Course Outcomes:

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

CO1 Understand and analyze DC and AC characteristics of OP-Amp and is effect on output.

CO2 Illustrate and design the linear and non linear application of OP-Amp and its effect on output.

CO3 Design active filters and explains the working of PLL.

CO4 Comprehend the working principle of data converters and multipliers.

CO5 Demonstrate the function of timer and regulators and their applications.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1				3			3	3	1	2
CO2	3	3	2	1	1				3			3	3	1	2
CO3	3	3	2	1	1				3			3	3	1	2
CO4	3	3	2	1	1				3			3	3	1	2
CO5	3	3	2	1	1				3			3	3	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly.**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC205TPC09	3	1	-	4 Hours	30	70	100	4

DIGITAL COMMUNICATIONS

Course Objectives:

- To study process of sampling, quantization that are fundamental to the digital transmission of analog signals.
- To study baseband and band pass signal transmission and reception techniques.
- To Study concept of signaling
- To study digital modulation methods and optimum receiver.
- To study the noise in digital communication, optimum filter and matched filter.
- To study the error control and channel coding concept.

UNIT-I

Digital Transmission of Analog Signal: Sampling theorem, Quantization, Companding, PAM, PWM, PPM, PCM, Differential PCM (DPCM), Delta modulation, Adaptive delta modulation, Delta sigma modulation, Channel bandwidths of PCM, TDM, Noises in PCM PWM, PPM, DM, Noise in PCM and DM, PCM transmission: Calculation of SNR in PCM, Delta modulation transmission: Signals to quantization noise ratio calculation.

UNIT-II

Principle of Digital Data Transmission: Line coding: PSD of various line codes, Polar signaling, On-Off signaling, Bipolar signaling, Pulse shaping: Nyquist criterion for zero ISI, Scrambling, Regenerative repeater: Eye diagram, Detection error probability for polar signal, ON-Off and bipolar signals.

UNIT-III

Digital Modulation Techniques: Fundamentals of BASK, BPSK and BFSK, Generation, Detection, Spectrum and geometrical representation of BPSK and BFSK, Fundamentals of DPSK, DEPSK and QPSK, Generation and detection of DPSK, DEPSK and QPSK, Signal space representation of QPSK, M-ary PSK, MSK signaling scheme.

UNIT-IV

Optimal Reception of Digital Signal: A baseband signal receiver, Probability of error, Optimal receiver design, Signal space representation and probability of error calculation.

UNIT-V

Information Theory and Coding: Introduction, Unit of information, Rate of information, Joint and conditional entropy, Mutual information, Channel capacity: Noise free channel, Symmetrical channel, Binary symmetrical channel, Cascaded channel, Shannon's theorem, Capacity of Gaussian channel, Shannon's Hartley theorem, Bandwidth S/N tradeoff, Coding efficiency, Source coding, Channel coding.

Text/Reference Books:

1. D. L. Schilling and H. Taub, ”Principles of Communication Systems”, Tata Mcgraw Hill Education Private Limited, 2007.
2. B. P. Lathi and Z. Ding, “Modern Digital and Analog Communication Systems”, Oxford University Press, Inc., 2010.
3. S. Haykin, “Communication Systems”, John Wiley & Sons, 2008.
4. J. G. Proakis and M. Salehi, “Fundamentals of Communication Systems”, Pearson Education India, 2007.
5. G. Kennedy, B. Davis, and S. R. M. Prasanna, “Electronic Communication Systems”. vol. 20, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
6. A. Saha, N. Manna, and S. Mandal, “Information Theory, Coding and Cryptography”, Pearson Education India, 2013.
7. S. Lin and D.J. Costello Jr., “Error Control Coding”, Prentice” Hall, 1983.

Course Outcomes:

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

CO1 Acquire idea about analog to digital conversion. Understand simultaneous transmission of digital signals.

CO2 Learn communication techniques for wired and wireless channels.

CO3 Analyze and mitigate interference in wired channels. Differentiate between different coding and modulation strategies.

CO4 Understand the basic concepts of Information theory, source and channel coding, channel capacity and relation among them

CO5 Learn and be able to apply basics of random process, modeling and analysis of systems with random signals.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	-	-	-	-	-	-	-	3	2	2
CO2	3	3	2	3	2	-	-	-	-	-	-	-	3	3	2
CO3	3	3	2	3	2	-	-	-	-	-	-	-	3	3	3
CO4	3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO5	3	3	2	3	2	-	-	-	-	-	-	-	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Credits
EC205TPC10	3	1	-	4 Hours	30	70	4

DIGITAL SIGNAL PROCESSING

Course Objectives:

- To summarize and analyze the concepts of signals, systems in time and frequency domain with corresponding transformations
- To introduce the diverse structures for realizing digital filters.
- To develop the understanding the concept of design and implementation of digital filters.
- To develop basic idea of multi rate filter bank design.
- To utilize the appropriate tools for design and realization of signal processing modules

UNIT-I

Basic Elements of Digital Signal Processing: Introduction of discrete time signals and systems, Discrete time Fourier transform (DTFT), Discrete Fourier series (DFS), Discrete Fourier transform (DFT), Fast Fourier transform (FFT) using DIT and DIF algorithms, Inverse FFT using DIT and DIF algorithms, Circular convolution, Correlation, MATLAB programs based illustrations.

UNIT-II

Realization of Systems: Realization of discrete time systems, Structures for infinite impulse response (IIR) and finite impulse response (FIR) systems, Basic realization block diagram and signal flow graph. **Realization of IIR filter:** Direct forms structure, Transposed structure, Cascade structure, Parallel structure, Lattice structure, Ladder structure. Realization of FIR filter: Direct forms structure, Cascade structure, linear phase realization, Lattice structure.

UNIT-III

FIR Filter Design: Linear phase response, Symmetric and anti-symmetric, Design characteristics of FIR filters, Frequency response of FIR filters, Design FIR filter by window functions: Rectangular, Triangular, Hanning, Hamming, Blackman & Kaiser, Design FIR filter by frequency sampling method, MATLAB programs based illustrations for FIR filters.

UNIT-IV

IIR Filter Design: Transformation of analog filter to digital filters by: Approximation of derivatives, Impulse invariance method, Bilinear transformation method, Design of digital butterworth and chebyshev filter, Frequency transformations in analog and digital domain, MATLAB programs based illustrations for IIR filters.

UNIT-V

Multi-Rate Digital Signal Processing: Introduction of multi rate system, Sampling rate conversion, Decimation, Interpolation, Sampling rate alteration, Poly-phase decomposition, Digital filter bank, Application of DSP: speech and image.

Text/Reference Books:

1. S. K. Mitra, "Digital Signal Processing: A Computer based Approach", McGraw Hill, 2011.
2. A. V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall, 1989.
3. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Prentice Hall, 1997.

4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall, 1992.
5. J. R. Johnson, "Introduction to Digital Signal Processing", Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas, and W. S. Hodgkiss, "Digital Signal Processing", John Wiley & Sons, 1988.
7. A. Kumar, "Digital Signal Processing", PHI 2013.

Course Outcomes:

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

CO1 Represent signals mathematically in discrete-time, and in the frequency domain.

CO2 Realize digital filters by use of systematic structure to simplify the complexity of the system.

CO3 Design and develop digital filters for various applications.

CO4 Analyze different signals using multi-rate systems.

CO5 Apply digital signal processing modules for the analysis of real-life signals.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1						2	3	2	2
CO2	3	3	2	3								2	2	2	2
CO3	3	3	2	1		1						1	2	2	3
CO4	3	3	3	1								2	2	2	3
CO5	3	3	3	1	1	1						1	2	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC205TES06	3	-	-	3 Hours	30	70	100	3

ELECTROMAGNETIC WAVES

Course Objectives:

- To develop the basic concept of analysis and design of transmission line
- To develop the concepts, working principles, and laws of electromagnetic waves.
- To perform analysis and characterization of uniform plane wave at different media
- To perform analysis and design of the waveguide.
- To develop the concept of radiation and antenna.

UNIT-I

Transmission Lines: Equations of voltage and current on TX line, Propagation constant and characteristic impedance, Reflection coefficient and VSWR, Impedance transformation on loss-less and low loss transmission line, Power transfer on TX line, Smith chart, Admittance smith chart, Applications of transmission lines: Impedance matching, Use of transmission line sections as circuit elements.

UNIT-II

Maxwell's Equations: Basics of vectors, Vector calculus, Basic laws of electromagnetic, Maxwell's equations, Boundary conditions at media interface.

UNIT-III

Uniform Plane Wave: Uniform plane wave, Propagation of wave, Wave polarization, Wave propagation in conducting medium, Phase and group velocity, Power flow and poynting vector, Surface current and power loss in a conductor, Plane waves at a media interface, Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, Wave polarization at media interface, Reflection from a conducting boundary.

UNIT-IV

Waveguide: Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide.

UNIT-V

Radiation: Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation parameters of antenna, Receiving antenna, Monopole and dipole antenna

Text/Reference Books:

1. R. K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill India, 2005
2. E. C. Jordan & K. G. Balmain, "Electromagnetic Waves & Radiating Systems", 2nd ed., Prentice Hall, India, 2013.
3. N. N. Rao, "Engineering Electromagnetics", 6th ed., Prentice Hall, 2004.
4. D. K. Cheng, "Field & Wave Electromagnetics", 2nd ed., Prentice Hall, 1989.

Course Outcomes:

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

1. Impedance transformation on transmission line and evaluate sections of transmission line for realizing circuit elements
2. Apply the basic laws of electromagnetic in high frequency wave propagation
3. Characterize uniform plane wave and to evaluate reflection and transmission of waves at media interface
4. Analyze wave propagation in metallic waveguides.
5. Comprehend the principle of radiation and radiation characteristics of an antenna

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2	2				2			3	3	2	2
CO2	3	3	2	3					2			3	3	1	2
CO3	3	3	2	3					2			3	3	1	2
CO4	3	3	3	3	2				2			3	3	2	2
CO5	3	3	1	2	2				2			3	3	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC205THS03	3	-	-	3 Hours	30	70	100	3

PROBABILITY AND RANDOM PROCESSES

Course Objectives:

- To provide mathematical background and sufficient experience so that student can read, write and understand sentences in the language of probability theory.
- To introduce students to the basic methodology of "probabilistic thinking" and apply it to problems.
- To understand basic concepts of Probability theory and Random Variables, how to deal with multiple Random Variables.

UNIT-I

Introduction to Probability: Set theory, Experiments and sample spaces, Discrete and continuous sample spaces, Events, Probability definitions and axioms, Mathematical model of experiments, Joint probability, Conditional probability, Total probability, Bayes' theorem, and Independent events, Bernoulli's trials.

UNIT-II

Random Variables: Definition, Conditions for a function to be a random variable, Discrete, Continuous and mixed random variable, Distribution and density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Rayleigh, Methods of defining conditioning event, Conditional distribution, Conditional density and their properties, Operation on one random variable: Expected value of a random variable, Function of a random variable, Moments about the origin, Central moments, Variance and skew, Characteristic function, Moment generating function, Transformations of a random variable, Monotonic transformations for a continuous random variable, Non monotonic transformations of continuous random variable, Transformations of discrete random variable.

UNIT-III

Multiple Random Variables: Vector random variables, Joint distribution function and its properties, Marginal distribution functions, Conditional distribution and density-point conditioning, Conditional distribution and density-Interval conditioning, Statistical independence, Sum of two random variables, Sum of several random variables, Central limit theorem, (Proof not expected), Unequal distribution, Equal distributions, Expected value of a function of random variables: Joint moments about the origin, Joint central moments, Joint characteristic functions, Jointly Gaussian random variables: Two random variables case, N random variable case, properties, Transformations of multiple random variables, Linear transformations of Gaussian random variables.

UNIT-IV

Stochastic Processes-Temporal Characteristics: The stochastic process concept, Classification of processes, Deterministic and nondeterministic processes, Distribution and density functions, Statistical independence and concept of stationary: First-order stationary

processes, Second order and wide-sense stationarity, Nth order and strict-sense stationary, Time averages and ergodicity, Mean-ergodic processes, Correlation-ergodic processes, Autocorrelation function and its properties, Cross-correlation function and its properties, Covariance functions and its properties, Gaussian random processes, Linear system response: Mean and mean-squared value, Autocorrelation, Cross-correlation functions.

UNIT-V

Stochastic Processes-Spectral Characteristics: The Power spectrum and its properties, Relationship between power spectrum and autocorrelation function, The cross-power density spectrum and properties, Relationship between cross-power spectrum and cross-correlation function. Spectral characteristics of system response: Power density spectrum of response, Cross power spectral density of input and output of a linear system.

Text/Reference Books:

1. H. P. Hsu, "Schaum's outline of theory and problems of probability, random variables, and random processes", New York, 1997.
2. A. Papoulis, "Probability, Random variables and Stochastic Processes", 4th ed., McGraw Hill, 2017.
3. P. Z. Peebles Jr "Probability, random variables, and random signal principles", McGraw-Hill, 2001.
4. W. B. Davenport, "Probability and Random Processes for Scientist and Engineers", McGraw-Hill, 1970.
5. H. Stark and J. W. Woods, "Probability, random processes, and estimation theory for engineers", Prentice-Hall, Inc., 1986.

Course Outcomes:

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

CO1 Understand and communicate the axiomatic formulation of modern Probability Theory and think of random variables as an intrinsic need for the analysis of random phenomena.

CO2 Characterize probability models and function of random variables based on single & multiples random variables.

CO3 Evaluate and apply moments & characteristic functions and understand the concept of inequalities and probabilistic limits.

CO4 Understand the concept of random processes and determine covariance and spectral density of stationary random processes.

CO5 Demonstrate the specific applications to Poisson and Gaussian processes and representation of low pass and band pass noise models.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1							3	2	1
CO2	3	3	3	1	2	2							3	3	2
CO3	3	3	2	2	2	2							3	3	2
CO4	3	3	3	2	2	2							3	3	2
CO5	3	3	2	3	2	2							3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total
EC205THS04	2	-	-	3Hours	-	-	-

EFFECTIVE TECHNICAL COMMUNICATION

Course Objectives:

- To participate actively in writing activities (individually and in collaboration)
- To understand how to apply technical information and knowledge in practical documents
- To practice the unique qualities of professional writing style, including sentence conciseness, readability, clarity, accuracy, honesty, avoiding wordiness or ambiguity, previewing.
- To recognize, explain and use the genres of technical communication: technical abstracts, data based research reports, instructional manuals, technical descriptions, and web pages
- To recognize and develop professional format features in print, html, and multimedia modes, as well as use appropriate nonverbal cues and visual aids.

UNIT I

Information Design and Development: Different kinds of technical documents, Information development life cycle, Organization structures, Factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.

UNIT II

Grammar and Editing: Basics of grammar, Study of advanced grammar, Editing strategies to achieve appropriate technical style.

UNIT III

Oral communication: Public speaking, Group discussion, Oral presentation, Interviews, Graphic presentation, Presentation aids.

UNIT IV

Technical Writing: Writing reports, Project proposals, Brochures, Newsletters, Technical articles, Manuals, Official notes, Business letters, Memos, Progress reports, Minutes of meetings, Event report.

UNIT V

Ethics: Business ethics, Engineering ethics, Etiquettes in social and office settings, Email etiquettes, Telephone etiquettes, Work culture in jobs.

Text/Reference Books:

1. D. F. Beer and D. McMurrey, "Guide to Writing as an Engineer", John Willey, NewYork, 2004.
2. D. Hacker, "Pocket Style Manual", Bedford Publication, New York, 2003.
3. S. Khera, "You Can Win", Macmillan Books, New York, 2003.
4. R. Sharma, "Technical Communications", Oxford Publication, London, 2004.
5. D. Jungk, "Applied Writing for Technicians", McGraw Hill, New York, 2004.
6. R. Sharma, K. Mohan, "Business Correspondence and Report Writing", TMH New Delhi 2002.
7. Xebec, "Presentation Book", TMH New Delhi, 2000.

Course Outcomes:

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

CO1 Develop employability skill.

CO2 Improved their technical vocabulary & their accent.

CO2 Comprehend technical communication strategies and personality skills.

CO4 Illustrate various technical scripts/letters.

CO5 Demonstrate ethical awareness and the ability to apply ethical principles in decision-making

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1			1			2			3	2		1
CO2	2	1	1			1			2			3	2		1
CO3	2	1	1			1			2			3	2		1
CO4	2	1	1			1			2			3	2		1
CO5	2	1	1			1			2			3	2		1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC205PPC06	-	-	2	2 Hours	30	20	50	1

LIC & ITS APPLICATIONS LAB

Course Objectives:

- To develop basic operations of IC 741.
- To design and implement different linear and nonlinear applications of OPAMP.
- To design different filter, oscillator, and waveform generator circuits using OPAMP ICs.
- To design different multivibrator, modulator circuits using IC 555.

LIST OF EXPERIMENTS:

1. To use IC 741 as inverting and non-inverting amplifier and to study the effect of frequency on the performance (frequency response) of OPAMP IC 741.
2. To use IC 741 as adder and subtractor circuit.
3. To use IC 741 as an integrator and differentiator and to study corresponding effect of frequency on the performance (frequency response).
4. To study IC 741 performance as LOG and ANTI-LOG amplifier.
5. To design and study the performance of timer IC 555 as multivibrator: i) astable, ii) bistable and iii) monostable modes of operation.
6. To design and study IC 741 and IC 555 performance as schmitt trigger circuit.
7. To design and study IC 741 performance as low-pass filter of 1^{ST} and 2^{ND} order.
8. To design and study IC 741 performance as high-pass filter of 1^{ST} and 2^{ND} order.
9. To design and study IC 741 performance as wide and narrow band-pass filter of 1^{st} and 2^{nd} order.
10. To design and study IC 741 performance as phase-shift oscillator.
11. To design and study IC 741 performance as wein-bridge oscillator.
12. To design and study IC 741 performance as half-wave rectifier.
13. To design and study IC 741 performance as full-wave rectifier.
14. To design and study timer IC 555 performance as PWM modulator.

Course Outcomes:

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

CO1 Design and develop different linear and nonlinear applications of OPAMP.

CO2 Implement different multivibrator circuits.

CO3 Demonstrate and design filter using OPAMP ICs.

CO4 Demonstrate and design oscillator and waveform generator circuits using OPAMP ICs.

CO5 Implement different multivibrator circuits.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1			2			3	2		1
CO2	3	2	1	1	1	1			2			3	2		1
CO3	3	2	1	1	1	1			2			3	2		1
CO4	3	2	1	1	1	1			2			3	2		1
CO5	3	2	1	1	1	1			2			3	2		1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC205PPC07	-	-	2	2 Hours	30	20	50	1

ANALOG AND DIGITAL COMMUNICATION LAB

Course Objectives:

- Introduce the basic principles of continuous wave modulation and pulse modulation
- To Study the basics analog and digital modulation techniques
- To get the real time and practical exposure of communication system with detailed analysis of analog and digital communication techniques.

LIST OF EXPERIMENTS:

1. To study of amplitude modulation and demodulation.
2. To study of SSB-SC modulation and demodulation.
3. To study of frequency modulation and demodulation.
4. To study of phase modulation and demodulation.
5. To study of sampling techniques.
6. To study of pulse amplitude modulation and time division multiplexing.
7. To study of pulse width modulation & demodulation.
8. To study of pulse position modulation & demodulation.
9. To study of pulse code modulation & demodulation.
10. To study of line coding, performance of unipolar and bipolar systems.
11. To study of ASK, FSK and PSK modulation schemes.

Course Outcomes:

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

CO1 Analyze the fundamental concepts of analog communication systems.

CO2 Perform sampling process.

CO3 Implement the various the pulse modulation schemes for digital communication.

CO4 Examine the performance of coding in digital system.

CO5 Demonstrate the various digital modulation techniques.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1		1			2			3	2		1
CO2	3	2	2	1		1			2			3	2		1
CO3	3	2	2	1		1			2			3	2		1
CO4	3	2	2	1		1			2			3	2		1
CO5	3	2	2	1		1			2			3	2		1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC205PPC08	-	-	2	2 Hours	30	20	50	1

DIGITAL SIGNAL PROCESSING LAB

Course Objectives:

1. To develop basic signal operation such as linear and circular convolution.
2. To implement different transformation algorithms
3. To design FIR and IIR filters using different methods.
4. To analyze the concept of sampling rate conversion.
5. To implement real DSP modules for real time application.

LIST OF EXPERIMENTS:

1. To generate the random sequences and determine the correlation.
2. To verify linear and circular convolutions.
3. To compute DFT of sequence and its spectrum analysis.
4. To implement 8-point FFT algorithm.
5. To design of FIR filters using rectangular window techniques.
6. To design of FIR filters using triangular window techniques.
7. To design of FIR filters using kaiser window.
8. To design of butterworth IIR filter.
9. To design of chebyshev IIR filter.
10. To generate the down sample (decimation) by an integer factor,
11. To generate the up sample (interpolation) by an integer factor
12. To remove the noise in 1-D and 2-D signals

Course Outcomes:

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

CO1 Design and develop basic modules for signal generation and its operation

CO2 Demonstrate the applications of FFT to DSP.

CO3 Implement digital filters for various applications of DSP.

CO4 Implement multirate system

CO5 Analyze effect of DSP systems.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1		1						3	2		1
CO2	3	2	2	1		1						3	2		1
CO3	3	2	2	1		1						3	2		1
CO4	3	2	2	1		1						3	2		1
CO5	3	2	2	1		1						3	2		1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC206TPC11	3	1	-	4 Hours	30	70	100	4

CMOS DIGITAL VLSI DESIGN

Course Objectives:

- To introduce the physics of MOSFETs.
- To understand MOS inverter and switching characteristics.
- To build upon the theoretical, mathematical and physical analysis of digital VLSI circuits, for proper understanding of concept, working, analysis and design.
- To impart knowledge of VHDL language.

UNIT-I

Fundamentals of MOSFETS: Introduction to MOS transistor, Basic operation, Threshold voltage, V-I characteristic, Depletion MOSFET, Transconductance, PMOS and its V-I characteristic, Aspect ratio and its implication, Channel length modulation, Substrate bias effect, Electrical parameters of MOSFETS, PMOS and NMOS Inverters.

UNIT-II

CMOS INVERTER: Introduction, Ideal inverter, Logic level standards, VTC of inverter, Noise margin, Basic NMOS inverter, CMOS inverter, Design technique, Inverter switching characteristic, Delay times, Transient effects, Power dissipation, Introduction to Bi-CMOS inverter

UNIT-III

Static and Dynamic Logic Circuits: Introduction, Various Static CMOS logic gate design, Pseudo-NMOS gates, Pass transistor logic, Transmission gates, Tristate buffer, Dynamic logic, Evaluate logic, Domino CMOS logic, Non ideal effects of dynamic logic circuits

UNIT-IV

Sequential and Combinational Circuits: Types of regenerative circuits, Bi-stability principle, Basics S-R flip flop, JK flip-flop, Master slave flip flop, D latch, Static Vs dynamic latch, Memory system, Types of semiconductor memory, Dynamic RAM, Static RAM.

UNIT-V

Introduction to VHDL: Introduction and use of VHDL, Entity and architecture declaration, Types of models of architecture, Data objects, Data types, Operators, Concurrent and sequential statements, Process statements, Case, If, When statements, Design of sequential and combinational circuits.

Text/Reference Book:

1. D. A. Pucknell & K. Eshraghian "Basic VLSI Design", 3rd ed., New York: Prentice Hal, 1994.
2. S. M. Kang and Y. Leblebici, "CMOS Digital Integrated Circuits", McGraw Hill, 2003.
3. N. H. E. Weste, D. Harris, and A. Banerjee, "CMOS VLSI Design- A Circuits and Systems Perspective", 3rd ed., Pearson Education, 2011.
4. J. Bhaskar, "A VHDL Primer", Revised ed., Prentice Hall, 1994.
5. S. Brown and Z. Vranesic, "Fundamentals of VLSI Design Techniques with VHDL", 3rd ed., McGraw

Hill, 2009.

Course Outcomes:

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

CO1 Comprehend the fundamental of MOS transistor and short channel effects.

CO2 Design a MOS inverter with different loads and analyze switching characteristics.

CO3 Understanding and designing of static & dynamic logic circuits.

CO4 Illustrate and design CMOS combinational & sequential Circuits.

CO5 Design an application using VHDL.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1			2			2	3	1	2
CO2	3	3	2	1	1	1			2			2	3	1	2
CO3	3	3	3	1	1	1			2			2	3	3	2
CO4	3	3	3	1	1	1			2			2	3	3	2
CO5	3	3	1	1	1	1			2			2	3	1	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC206TPC12	3	-	-	3 Hours	30	70	100	3

DATA COMMUNICATION & COMPUTER NETWORK

Course Objectives:

- Build an understanding of the fundamental concepts of data communication in computer networking.
- Familiarize the student with the basic taxonomy and terminology of the computer networking area.
- Introduce the student to advanced networking concepts, preparing the student for entry Advanced courses in computer networking.
- Develop an understanding of modern network architectures from a design and performance perspective.

UNIT-I

Model of a digital communication system, OSI reference model, TCP/IP, Analog and digital transmission, Parallel and serial transmission, Asynchronous and synchronous transmission, Introduction to computer networks and the internet: Application layer, Principles of network applications, The web and hyper text transfer protocol, File transfer, Electronic mail, Domain name system, Peer-to-peer file sharing, Layering concepts, Review of different types of encoding.

UNIT-II

Switching in networks: Classification and requirements of switches, A generic switch, Circuit switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, Buffering, Multicasting.

UNIT-III

Multiplexing, Transport layer, Connectionless transport, User datagram protocol, Connection oriented transport, Transmission control protocol, Transport layer: Connectionless transport, User datagram protocol, Connection-oriented transport, Transmission control protocol, Congestion control and resource allocation, Issues in resource allocation, Queuing disciplines, TCP congestion control, Congestion avoidance mechanisms and quality of service.

UNIT-IV

Network layer: Virtual circuit and datagram networks, Router, Internet protocol, Routing algorithms, Broadcast and multicast routing.

UNIT-V

Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local area networks, Addressing, Ethernet, Hubs, and Switches.

Text/Reference Book:

1. W. Stallings, "Data and computer communications", 9th ed., Pearson Education, India, 2013.
2. B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 4th ed., 2017.

3. J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuring the Internet", Pearson Education, 6th ed., Pearson Education, 2017.
4. L. Peterson and B. Davie, "Computer Networks – A Systems Approach" 5th ed., Morgan Kaufmann, 2011.
5. T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall Ltd., 1994.
6. A. Tanenbaum, "Computer networks", 6th ed., Prentice Hall, 2022.
7. D. Comer, "Computer Networks and Internet/TCP-IP", 8th ed., Prentice Hall, 2007.

Course Outcomes:

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

CO1 Contrast the concept of signals, OSI & TCP/IP reference models and discuss the functionalities of each layer in these models.

CO2 Comprehend and analyze the concepts of networking switching.

CO3 Illustrates the details of transport layer protocols (UDP, TCP) and suggest appropriate protocol in reliable/unreliable communication.

CO4 Describe and analyze the function of the network layer.

CO5 Discuss and analyze the function of the link layer.

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Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	2				2			2	2	1	2
CO2	3	2	2	1	2				2			2	2	1	2
CO3	3	2	2	1	2				2			2	2	1	2
CO4	3	2	2	1	2				2			2	2	1	2
CO5	3	2	2	1	2				2			2	2	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC206TPC13	3	-	-	3 Hours	30	70	100	3

MICROPROCESSOR AND MICROCONTROLLER

Course Objectives:

- To develop basic concept of microprocessor and learn assembly language programming.
- To learn about the memory interfacing and concept of advance microprocessor.
- To learn the basic concept of various programmable interfacing devices.
- To get the basic knowledge of concept of microcontroller and its programming tools.
- To learn the interfacing of various devices with microcontroller and also learn the introductorypart of embedded system.

UNIT-I

History and evolution of microprocessor and microcontroller, Microprocessor based system, Architecture and pin diagram of 8085 microprocessor, Register organization, Timing and control module, Multiplexing concept of buses, Instruction set and assembly language program.

UNIT-II

Addressing modes, Memory interfacing, I/O interfacing, Address decoding, Interrupts, Instruction execution cycle, Subroutine instructions, Stack, Stack related instructions.

Advanced microprocessor, Intel 8086 Architecture, Register organization, Memory organization, Pipeline structure, Instructions set, 8086 Interrupt.

UNIT-III

8255 PPI, Various modes of operation, 8254 timer/ counter, Serial communication standards, Serial data transfer schemes, 8251 USART architecture and interfacing, DMA controller and its operation, Interrupt controller, LCD & keyboard interfacing-ADC, DAC & sensor interfacing, External memory interface, Stepper motor and waveform generation.

UNIT-IV

Microcontroller: Introduction to microcontroller, Embedded Vs external memory devices, CISC and RISC processor, Harvard and von neumann architecture, 8051 Microcontroller, Architecture, Register and memory organization, 8051 Assembly language programming tools.

UNIT-V

PIC Microcontrollers: Introduction to PIC 16C6X/7X, Family microcontroller, Architectures, Registers, Register file structure, Addressing mode, Instruction set, Interrupt structure, Timers, Counters, I/O port concepts, Peripheral interfacing and application.

Basic of ARM Architecture: Introduction to ARM, Microprocessor and its features, Architecture, Programming model, CISC and RISC architectures comparison, Advantages of RISC.

Introduction to embedded system, Characteristics of embedded system, Designing issues and challenges in embedded system, Various designing methods of embedded system.

Text/Reference Book:

1. D. V. Hall, "Microprocessors and Interfacing", Tata McGraw Hill, 2nd ed., 2006.
2. A. K. Ray and K. M. Bhurchandani, "Advanced Microprocessors and Peripherals", 3rd ed., Tata

McGraw Hill, 2013.
3. R. S. Gaonkar, "Microprocessor Architecture, Programming and Application with the 8085", 6th ed., Penram International Publishing, 2013.
4. Liu and G. A. Gibson, "Microcomputer System 8086/8088 Family Architecture, Programming and Design", 2nd ed., Prentice Hall India Learning Private Ltd., 1985.
5. K. J. Ayala, "The 8051 Microcontroller", Cengage Learning India, 2007.
6. K. U. Rao and A. Pallavi, "The 8051 Microcontrollers, Architecture, Programming and Applications", Pearson, 2009.
7. A. V. Deshmukh, "Microcontrollers and Application", Tata McGraw Hill, 2005.

Course Outcomes:

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

CO1 Make Assembly language program and project based on it.

CO2 Apply the knowledge of interfacing and advanced level of programming.

CO3 Apply the knowledge of interfacing devices and its modes of operations.

CO4 Apply the knowledge of microcontroller and its programming.

CO5 Make the project based on the microcontroller and can design the embedded system.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2							3	3	2	
CO2	3	3	3	2	1							3	3	2	
CO3	3	2	2	2	1							3	3	2	
CO4	3	2	2	2	1							3	2	2	
CO5	3	2	2	2	2							3	3	2	

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC206TES07	3	-	-	3 Hours	30	70	100	3

ELECTRONIC MEASUREMENTS AND SENSORS

Course Objectives:

- To understand the working of basic measurement system and sources in measurement system.
- To study static and dynamic characteristic of instrument.
- To study the design of bridge circuit and different types of electronic voltmeter.
- To understand the working principle of sensors and transducers.
- To study the basic features of display devices, DVM, Recorders and CRO.

UNIT-I

Measurements and Measurement System: Measurements, Significance of measurement, Methods of measurement- Direct and indirect method, Instruments and measurement system: Mechanical, Electrical, Electronic instruments, Classification of instruments: Deflection and null type instruments, Analog and digital mode of operation, Application of measurement system, Characteristics of instrument and measurement system: static & dynamic, Elements of a generalized measurement system: Primary sensing element, Variable conversion element, Data presentation element, Accuracy and precision, Significant figure, Types of error, Gross error, Systematic error, Instrumental, Environmental, Observational errors, Random error, Probability of error, Probable error of a finite number of readings for combination of components, Limiting error.

UNIT-II

Electromechanical Indicating Instruments: Operating forces, Constructional details, Types of support, Torque/weight ratio, Control system, Damping-air friction and eddy current damping, D'Arsonaval galvanometer construction, Torque equation, Dynamic behavior, Undamped, Damped, Over damped motion, Response of galvanometer, Ballistic galvanometer, PMMC-construction, Torque equation, Voltage/current measurement: Ammeter, Voltmeter, Ohmmeter, Multimeter (V.O.M.), Ratiometer, Megger, High frequency measurement: Q-meter.

UNIT-III

AC Bridge: Introduction, Sources and detectors, General equation for bridge balance, General form of AC bridge, Maxwell's bridge, Hay's bridge, Anderson's bridge, De-Sauty's bridge, Schering bridge, Wien's bridge, Electronic Instruments: Introduction, Advantage of electronic voltmeter, VTVM, Differential voltmeter, Electronic voltmeter using rectifier, True RMS reading voltmeter, Calorimeter, Power meter, Energy meter.

UNIT-IV

Sensor & Transducers: Classification of transducer, Primary & secondary, Passive & active, Analog & digital, Potentiometer, Loading effect, Strain Gauge, Thermistor, Construction of thermistor, Thermocouple, LVDT, Advantage & disadvantage of LVDT, RVDT, Capacitive transducer, Piezo-electric transducer, Hall effect transducer, Capacitive transducer, Pressure

transducer, Mechanical sensors, Fiber-optic sensors, Nano-sensors, Magnetic field, Microwave and radiation sensors, Vision and imaging sensors, Chemical sensor, Comparisons and selection.

UNIT-V

Display Devices: Digital display method, Segmental display-7segment & 14 segment display, Dot matrix, LED, LCD, TFT, Plasma display, DLP, Digital voltmeter (DVM): Types of DVM, Ramp type DVM, Integrating type DVM, Potentiometer type (non-integration type), Recorder: Analog recorder, Null type recorder, Single point recorder, Graphical strip chart, X-Y recorders, Magnetic tape recorder, FM recorder CRO: Introduction, Oscilloscope block diagram, CRT, Functional block diagram of sampling, Storage, Dual trace and dual beam oscilloscope.

Text/Reference Book:

1. W. D. Cooper and A. D. Helfrick, "Modern Electronic Instrumentation and Measurement Technique", PHI, 2000.
2. A. K. Sawhney, "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Sons, 2010.
3. E. Udd and W. B. Spillman Jr., "Fiber Optics Sensors: An Introduction for Engineers and Scientists", Wiley Publishers, 2011.
4. K. Kant, "Microprocessor based Instrumentation for Agriculture Industry", PHI Publication, 2010.

Course Outcomes:

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

CO1 Explain the principle of operation of generalized measurement system and different sources of errors in measurements.

CO2 Analyze different static and dynamic characteristics of instrument & based on this will able to select particular instrument for measurement.

CO3 Design AC bridges for relevant parameters measurement and application of electronic voltmeter.

CO4 Classify and select transducer for particular applications.

CO5 Demonstrate the use of different types of display devices, digital voltmeter, recorders and CRO.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1					3	1		2	3	2	2
CO2	3	3	2	3	3	3			3	1		2	3	2	3
CO3	3	3	2	3	3	3			3	1		2	3	3	3
CO4	3	3	2	3	3	3			3	1		2	3	3	3
CO5	3	3	2	3	3	3			3	1		2	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC206PPC09	-	-	2	2 Hours	30	20	50	1

CMOS DIGITAL VLSI DESIGN LAB

Course Objectives:

- To know the basic language features of verilog HDL and the role of HDL in digital logic design.
- To know the behavioural modeling of combinational and simple sequential circuits.
- To know the data flow modeling of combinational and simple sequential circuits.
- To know the structural modeling of combinational and simple sequential circuits.
- To know the synthesis of combinational and sequential descriptions.

LIST OF EXPERIMENTS:

1. To design and simulate various gates using VHDL.
2. To design and simulate half adder using VHDL.
3. To design and simulate full adder using VHDL.
4. To design and simulate multiplexer using VHDL.
5. To design and simulate demultiplexer using VHDL.
6. To design and simulate encoder using VHDL.
7. To design and simulate decoder using VHDL.
8. To design and simulate parity generator using VHDL.
9. To design different types of flip flops using VHDL.
10. To design and different types of counters using VHDL.

Course Outcomes:

CO1 Demonstrate knowledge on HDL design flow, digital circuits design, counter's flip flops.
CO2 Design and develop the combinational and sequential circuits using behavioral modeling.
CO3 Design and develop the combinational and sequential circuits using Data flow modeling.
CO4 Design and develop the combinational and sequential circuits using Structural modeling.
CO5 Analyze the process of synthesizing the combinational and sequential descriptions.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3				3			3	3	2	2
CO2	3	2	2	2	3				3			3	3	2	2
CO3	3	2	2	2	3				3			3	3	3	2
CO4	3	2	2	2	3				3			3	3	3	3
CO5	3	2	2	2	3				3			3	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC206PPC10	-	-	2	2 Hours	30	20	50	1

DATA COMMUNICATION AND COMPUTER NETWORK LAB

Course Objectives:

- Channel capacity theorem and its analysis.
- Details of ethernet and network topologies.
- Details of different network protocols.

LIST OF EXPERIMENTS:

1. Study of channel capacity theorems.
2. Study of shannon- feno code.
3. Study of differential manchester code.
4. Program to calculate channel capacity and its plot.
5. Program to calculate received SINR from given channel capacity and bandwidth and also its plot.
6. Design of Ethernet.
7. Study of network topologies.
8. Study of flow control protocols.
9. Study of selective repeat protocol.
10. Study of pure aloha protocol.

Course Outcomes:

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

CO1 Analyze channel capacity and its analysis.

CO2 Comprehend different types of ethernet and its design.

CO3 Comprehend different types of network topologies and its working.

CO4 Illustrates different types of flow control methods and its working

CO5 Illustrates different other network protocols.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2	3							3	3	2	1
CO2	3	1	2	2	3							3	3	2	1
CO3	3	1	2	2	3							3	3	2	2
CO4	3	1	2	2	3							3	3	2	2
CO5	3	1	2	2	3							3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC206PES06	-	-	2	2 Hours	30	20	50	1

ELECTRONIC MEASUREMENT AND SENSORS LAB

Course Objectives:

- To introduce students to monitor, analyze and control any physical system.
- To understand students how different types of meters work and their construction.
- To introduce students a knowledge to use modern tools necessary for electrical projects.

LIST OF EXPERIMENTS:

1. Measurement of unknown self-inductance using Maxwell inductance bridge.
2. Measurement of unknown self-inductance of high quality factor using Hay's bridge.
3. Measurement of unknown self-inductance using Anderson bridge.
4. Measurement of unknown capacitance using De-Saunty's bridge.
5. Measurement of unknown capacitance using Wein's series resistance bridge.
6. Measurement of unknown capacitance using Schering's bridge.
7. To determine the sensitivity of LVDT and hence to show linear range of operation of LVDT.
8. To study the input/output characteristics of LVDT.
9. To study the characteristics of the thermocouple.
10. To study Galvanometer.

Course Outcomes:

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

CO1 Identify different measuring instruments for the measurement of various electrical and non-electrical parameters.

CO2 Design different bridges to find unknown values of self-inductance.

CO3 Design different bridges to find unknown values of capacitance.

CO4 Analyze the sensitivity and characteristics of LVDT

CO5 Analyze the characteristics of thermocouple.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	2					2			2	3	2	1
CO2	3	1	2	2					2			2	3	2	1
CO3	3	1	2	2					2			2	3	2	1
CO4	3	1	2	2					2			2	3	2	1
CO5	3	1	2	2					2			2	3	2	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

PROGRAM ELECTIVE

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC206TPE01	3	-	-	3 Hours	30	70	100	3

INFORMATION THEORY & CODING

Course Objectives:

- To study the concept of information and entropy
- To study Shannon's theorem for coding
- To analyze channel capacity
- To study various channel coding techniques for error correction and detection

UNIT-I

Source Coding: Introduction to information theory, Uncertainty and information, Average mutual information and entropy, Information measures for continuous random variables, Source coding theorem, Huffman coding.

UNIT-II

Channel Capacity Coding: Channel models, Channel capacity, Channel coding, Information capacity theorem, Shannon limit, Markov sources.

UNIT-III

Error Control Coding (Channel Coding) Linear Block Codes for Error Correction & Cyclic Codes: Introduction to error correcting codes, Basic definitions, Matrix description of linear block codes, Equivalent codes, Parity check matrix, Decoding of a linear block code, Syndrome decoding, Hamming codes. Cyclic Codes: Polynomials, The division algorithm for polynomials, A method for generating cyclic codes, Matrix description of cyclic codes, Burst error correction.

UNIT-IV

Convolution Codes: Introduction to convolution codes, Tree codes and Trellis codes, Polynomial description of convolution codes (analytical representation), Distance notions for convolution codes, The generating function, Matrix description of convolution codes, Viterbi decoding, Distance bounds for convolution codes.

UNIT-V

Turbo Codes: Turbo codes, Turbo decoding, Distance properties of turbo codes, Convergence of turbo codes.

Text/Reference Books:

1. R. Bose, "Information Theory, Coding and Cryptography," Tata McGraw-Hill Education, 2008.
2. S. Haykin, "Digital Communications," Wiley India Edition, 2009.
3. N. Abramson, "Information and Coding," McGraw Hill, 1963.
4. M. Mansurpur, "Introduction to Information Theory," McGraw Hill, 1987.
5. R.B. Ash, "Information Theory," Prentice Hall, 1970.

6. S. Lin and D.J. Costello Jr., "Error Control Coding," Prentice Hall, 1983.

Course Outcomes:

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

CO1 Analyze the self and mutual information and apply the concept of information theory.

CO2 Evaluate the information capacity of discrete memory-less channels and determine possible code rates achievable on such channels.

CO3 Apply linear block and cyclic codes for error detection and correction.

CO4 Apply convolution codes for error detection and correction.

CO5 Apply turbo coding and decoding for error detection and correction.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1							3	3	1	2
CO2	3	3	2	2	2							3	3	2	2
CO3	3	3	2	3	2							3	3	1	2
CO4	3	3	2	3	2							3	3	1	2
CO5	3	3	2	3	2							3	3	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC206TPE02	3	-	-	3 Hours	30	70	100	3

ADVANCE SIGNAL PROCESSING

Course Objectives:

1. To develop basic idea of multi rate filter bank design
2. To develop the understanding the concept of prediction of future signals
3. To introduce the fundamental concepts for adaptive filter designs.
4. To analyze the concept of estimation theory for signal analysis
5. To explore the concept of multi-resolution transformation.

UNIT-I

Multirate Digital Signal Processing: Decimation and interpolation, Multistage implementation of sampling rate conversion, Applications of multirate signal processing, Digital filter banks, Two channel quadrature mirror filter banks.

UNIT-II

Linear Prediction and Optimum Linear Filters: Random signals, Correlation functions and power spectra, Innovations representation of a stationary random process, Forward and backward linear prediction, Solution of the normal equations, The Levinson-Durbin algorithm, Properties of the linear prediction-error filters.

UNIT-III

Adaptive Filters: Applications of adaptive filters, Adaptive channel equalization, Adaptive noise cancellation, Linear predictive coding of speech signals, Adaptive direct form FIR filters, The LMS algorithm, Properties of LMS algorithm, Adaptive direct form filters, RLS algorithm.

UNIT-IV

Power Spectrum Estimation: Parametric and non parametric methods for power spectrum estimation, Methods for the AR model parameters, ARMA model for power spectrum estimation.

UNIT-V

Wavelet Transform: Origin of wavelets, Wavelets and other reality transforms, History and future of wavelets, Short time Fourier transform, Continuous wavelet, Discrete wavelet transform.

Text/Reference Books:

1. J. G. Proakis and D. G. Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", 4th ed., Pearson, 2007.
2. S. Haykin, "Adaptive Filter Theory", Prentice Hall, Englewood Cliffs, NJ, 1991.
3. K. P. Soman, Ramachandran, Resmi, "Insight into Wavelets- from Theory to Practice", 3rd ed., PHI, 2010.
4. P. P. Vaidyanathan, "Multi Rate Systems and Filter Banks", Prentice Hall, 1993.
5. S. Mallet, "A Wavelet Tour of Signal Processing", Academic Press, 1998.

Course Outcomes:

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

CO1 Apply knowledge of multi-rate signal processing and concept of decimators and interpolators.

CO2 Analyze the signals using prediction based filtering.

CO3 Design adaptive filters for a given application.

CO4 Implement various estimation algorithm for signal analysis.

CO5 Develop advanced signal processing tools, including wavelet transform.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	1	1						1	2	3	3
CO2	3	3	3	3								1	2	3	3
CO3	3	3	2	1		1						1	2	2	3
CO4	3	3	3	2								1	2	3	3
CO5	3	3	3	2	1	1						1	2	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC206TPE03	3	-	-	3 Hours	30	70	100	3

RENEWABLE ENERGY SOURCES

Course Objectives:

- Awareness about renewable Energy Sources and technologies.
- Adequate inputs on wind power plants
- To learn basics of solar energy and its extraction
- To learn power generation process using biomass and hydroelectric system
- To know details of other renewable energy sources and their storage.

UNIT-I

Renewable Energy (RE) Sources: Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable design and development, Types of RE sources, Limitations of RE sources, Present Indian and International energy scenario of conventional and RE sources

UNIT-II

Wind Energy: Power in the wind, Types of wind power plants (WPPs), Components of WPPs, Working of WPPs, Siting of WPPs, Grid integration issues of WPPs.

UNIT-III

Solar PV and Thermal Systems: Solar radiation, Radiation measurement, Solar thermal power plant, Central receiver power plants, Solar ponds, Thermal energy storage system with PCM, Solar photovoltaic systems, Basic principle of SPV conversion, Types of PV systems, Types of solar cells, Photovoltaic cell concepts: cell, module, array, PV module, I-V characteristics, Efficiency & quality of the cell, Series and parallel connections, Maximum power point tracking, Applications.

UNIT-IV

Biomass Energy: Introduction, Bio mass resources, Energy from bio mass: conversion processes, Biomass cogeneration, Environmental benefits, Geothermal energy: Basics, Direct use, Geothermal electricity, Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.

UNIT-V

Other Energy Sources: Tidal Energy: Energy from the tides, Barrage and non barrage Tidal power systems, Wave energy: Energy from waves, Wave power devices, Ocean thermal energy conversion (OTEC), Hydrogen production and storage, Fuel cell: Principle of working, Various types, Construction and applications, Energy storage system, Hybrid energy systems.

Text/ Reference Books:

1. J. Earnest and T. Wizeliu, "Wind Power Plants and Project Development", PHI Learning Pvt.Ltd, New Delhi, 2011.
2. D. P. Kothari, K.C Singal, and R. Ranjan, "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.
3. S. Grinnell, "Renewable Energy & Sustainable Design", Cengage Learning, USA, 2016.
4. B. A. Striebig, A. A. Ogundipe, and M. Papadakis, "Engineering Applications in Sustainable Design and Development", Cengage Learning India Private Limited, Delhi, 2016.
5. S. N. Singh, "Non-conventional Energy Resources", Pearson Education, 2015

Course Outcomes:

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

CO1 Create awareness about renewable energy Sources and technologies.

CO2 Comprehend basics of wind energy and grid integration issues

CO3 Acquire knowledge about solar energy extraction and their usage

CO4 Comprehend basics about biomass energy and hydroelectric systems

CO5 Illustrates the various renewable other energy resources and technologies and their applications.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1		2	3					2	1		2
CO2	3	1	2	2		2	3					2	1		2
CO3	3	2	3	2		2	3					2	1		2
CO4	3	2	3	2		2	3					2	1		2
CO5	3	2	3	2		2	3					2	1		2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC206TPE04	3	-	-	3 Hours	30	70	100	3

INTRODUCTION TO MEMS

Course Objectives:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of micro fabrication techniques.
- To introduce various sensors and actuators.
- To introduce different materials used for MEMS.
- To educate on the applications of MEMS to disciplines beyond electrical and mechanical engineering.

UNIT-I

Introduction: Intrinsic characteristics of MEMS, Energy domains and transducers, Sensors & actuators, Introduction to micro-fabrication, Silicon based MEMS processes, New materials, Review of electrical and mechanical concepts of MEMS, Semiconductor devices, Stress and strain analysis, Flexural beam bending, Torsional deflection.

UNIT-II

Sensors and Actuators-I: Electrostatic sensors, Parallel plate capacitors, Applications interdigitated finger capacitor, Comb drive devices, Micro grippers, Micro motors, Thermal sensing and actuation, Thermal expansion, Thermocouples, Thermal resistors, Thermal bimorph, Applications, Magnetic actuators, Micromagnetic components, Case studies of MEMS in magnetic actuators, Actuation using shape memory alloys.

UNIT-III

Sensors and Actuators-II: Piezoresistive sensors, Piezoresistive sensor materials, Stress analysis of mechanical elements, Applications to inertia, Pressure, Tactile and flow sensors, Piezoelectric sensors and actuators, Piezoelectric effects, Piezoelectric materials, Applications to inertia, Acoustic, Tactile and flow sensors.

UNIT-IV

Micromachining: Silicon anisotropic etching, Anisotropic wet etching, Dry etching of silicon, Plasma etching, Deep reaction ion etching (DRIE), Isotropic wet etching, Gas phase etchants, Case studies, Basic surface micro machining processes, Structural and sacrificial materials, Acceleration of sacrificial etch, Striction and antistriction methods, LIGA process, Assembly of 3D MEMS, Foundry process.

UNIT-V

Polymer and Optical MEMS: Polymer in MEMS, Polimide, SU-8, Liquid crystal polymer (LCP), PDMS, PMMA, Parylene, Fluorocarbon, Applications to acceleration, Pressure, Flow and tactile sensors, Optical MEMS, Lenses and mirrors, Actuators for active optical MEMS.

Text/Reference Books:

1. C. Liu, "Foundations of MEMS", Pearson Education Inc., 2012.
2. S. D. Senturia, "Microsystem Design", Springer publication, 2000.
3. T. R. Hsu, "MEMS & Micro Systems Design and Manufacture", Tata McGraw Hill, New Delhi, 2002.
4. N. P. Mahalik, "MEMS", Tata McGraw-Hill Companies, 2011.
5. N. Maluf, " An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
6. M. Gad-el-Hak, editor, "The MEMS Handbook", CRC Press, 2001.
7. J. W. Gardner, V. K. Varadan, and O. O. Awadelkarim, "Micro sensors MEMS and Smart Devices", John Wiley & Sons Ltd., 2002.

Course Outcomes:

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

CO1 Understand the operation of micro devices, micro systems and their applications.

CO2 Design the micro devices, micro systems using the MEMS fabrication process.

CO3 Gain knowledge of basics approaches for various sensor and actuator design.

CO4 Choose micromachining techniques for a specific MEMS fabrication.

CO5 Develop experience on micro/nano systems for polymer and photonics.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	3	3	3			3	1		2	3	1	3
CO2	3	2	3	3	3	3			3	1		2	3	3	3
CO3	3	2	3	1	3	3			3	1		2	3	3	3
CO4	3	1	2	1	3	3			3	1		2	3	3	3
CO5	3	3	3	1	3	3			3	1		2	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

OPEN ELECTIVE-1

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC206TOE01	3	-	-	3 Hours	30	70	100	3

INTRODUCTION TO ELECTRONIC DEVICES & CIRCUITS

Course Objectives:

- To develop basic concept of semiconductor materials and physics.
- To introduce different methods of DC analysis and AC models of semiconductor devices.
- To develop the concept and analysis of transistor characteristics, biasing and thermal stabilization.
- To help students develop various designs of amplifiers and its applications.

UNIT-I

Semiconductor Concept: Atomic structure, Bohr's atom model, Energy band theory of crystals, Energy band structures in metals, Semiconductors and insulators, Forbidden energy gap, Electrical properties of Ge and Si, Conductivity equation, Mobility and conductivity, Electron and holes in intrinsic and extrinsic semiconductors, P type and N type semiconductors– majority and minority carriers, Mass action law, Hall effect, Carrier generation and recombination, Carrier transport: diffusion and drift process, Variation of semiconductor conductivity, Resistance and bandgap with temperature and doping.

UNIT-II

PN Junction Diode: Properties of P-N junction, Open circuited P-N junction, Behaviour of P-N junction under forward and reverse bias, Current component of PN diode, V-I characteristics, Temperature dependence of V-I characteristics, Ideal diode, Breakdown phenomenon: Zener and avalanche breakdown, Diode resistance: Static and dynamic resistance, Diode capacitance: transition and diffusion capacitance, Switching characteristics.

UNIT-III

Special Purpose Diodes: Zener diode, Varactor diode, Tunnel diode, Photodiode, Light emitting diodes- construction, working and characteristics, Applications of diodes: Half-wave diode rectifier, Full-wave rectifier, Clippers and Clampers.

UNIT-IV

Transistors: Definition, Formation of transistor- PNP and NPN, Symbols, Working principle, Regions of operation, Transistor current components, Transistor construction, Common base, Common emitter & Common collector configurations and their characteristics, Early effect, Current gains: α, β, and γ relation between them, Simple problems, Comparison of CB, CE and CC modes, Transistor as a switch, Transistor as an amplifier, Thermal runaway, Thermal stability.

UNIT-V

Field Effect Transistor: JFET construction, Operation, V-I characteristics, Transfer characteristics, Drain characteristics, FET as voltage variable resistor, Metal oxide semiconductor field effect transistor (MOSFET): construction and working of enhancement and depletion modes, Drain and transfer characteristics, Application of MOSFET as a switch, Comparison of JFET & MOSFET.

Text/Reference Books:

1. J. Millman and C. C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill Publishing Limited, New Delhi, 2003.
2. A. Mottershead, "Electronic Devices and Circuits- An Introduction", Prentice Hall of India Private Limited, New Delhi, 2003
3. R. Boylestad and L. Nashelsky, "Electronic Device & Circuit Theory", 11th ed., Pearson, 2013.
4. B. G. Streetman and S. Banerjee, "Solid State Electronic Devices", Pearson Education, 2002 / PHI
5. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd ed., John Wiley & Sons, 2006.
6. T. F. Boghert, "Electronic Devices & Circuits", Pearson Education, 6th ed., 2003.

Course Outcomes:

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

CO1: Illustrate the knowledge of semiconductor physics.

CO2: Understand the characteristics of the PN junction diode, special diodes and its application in electronic circuits.

CO3: Elucidate and analyze the characteristics and performance of transistors.

CO4: Analyze the concept of load line and design biasing circuits of transistor.

CO5: Comprehend the understanding of power electronic devices for industrial application.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1					3	1		2	3		2
CO2	3	3	2	3	3	3			3	1		2	3	2	3
CO3	3	3	2	3	3	3			3	1		2	3	3	3
CO4	3	3	2	3	3	3			3	1		2	3	3	3
CO5	3	3	2	3	3	3			3	1		2	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC207TPE05	3	1	-	4 hours	30	70	100	4

MOBILE COMMUNICATION & NETWORK

Course Objectives:

1. To know the evolution of Mobile communication and cell concept
2. To know the fading mechanism and types of fading and effect of fading on Mobile communication.
3. To know the role of Equalization and diversity techniques in Mobile communication
4. To know the various types of multiple access techniques .
5. To know the higher generation cellular standards

UNIT-I:

Introduction to Mobile Communication

Evolution of mobile communications, Mobile radio around the world, Types of Wireless communication system. Second generation Cellular Networks, GSM, The Cellular Concept-System design Fundamentals: Cellular System, Hexagonal geometry cell and frequency reuse concept, channel assignment strategies, Distance to frequency reuse ratio, channel & Co-channel interference reduction factor, S/I ratio consideration and calculation for minimum Co-channel and adjacent interference, Handoff strategies, Umbrella Cell Concept, Improving Coverage & Capacity in cellular System : splitting, cell sectorization, Repeaters, Micro cell zone concept.

UNIT-II:

Mobile Radio Propagation

Free space propagation model, The three basic propagation Mechanism: reflection, diffraction, scattering, Practical link budget design, Outdoor Propagation models, Indoor propagation models, Small scale Multipath propagation, Impulse response model of a Multipath Channel, Small scale Multipath measurements, parameters of Mobile multipath channels, types of small scale fading, Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading Rayleigh and Ricean Distributions.

UNIT-III:

Receiver Structure

Diversity receivers- selection and MRC receivers, RAKE receiver. Modulation Techniques: Minimum Shift Keying, Gauss ion MSK, M-ary QAM, M-ary FSK, Orthogonal Frequency Division Multiplexing, Performance of Digital Modulation in Slow-Flat Fading Channels and Frequency Selective Mobile Channels. Equalization: Survey of Equalization Techniques, Linear Equalization, Non-linear Equalization, Algorithms for Adaptive Equalization. Diversity Techniques, RAKE receiver. . Performance measures- Probability of Outage, average SNR, average symbol/bit error rate.

UNIT-IV:

Multiple Access Techniques for Wireless Communication

Introduction, FDMA, TDMA, CDMA:DS-SS, FH-SS, Space division multiple access.
Capacity of a cellular systems. Contention-based multiple access schemes (ALOHA and CSMA).

UNIT-V:

Higher Generation Cellular Standards

Evolution of Wireless LANs, Wireless LAN Topologies, IEEE 802.11 Standards, Wireless LAN Applications. Trunking and Grade Of Service(GOS). Enhancements in 3G Standards, Architecture and representative protocols in 4G standard, Introduction to 5G and 6G.

Text/Reference Books:

1. Wireless Communication, Theodore S. Rappaport, Prentice hall
2. Wireless Communications and Networking, Vijay Garg, Elsevier
3. Wireless digital communication, Kamilo Feher, PHI
4. Mobile Communications Engineering, William C. Y. Lee, Mc Graw Hill Publications
5. Wireless Communications, A. J. Goldsmith, Cambridge Univ. Press, 2005

6. Fundamentals of Wireless Communications, D. Tse and P. Vishwanath, ,Cambridge Univ. Press, 2005.
7. Mobile & Personal Communication System, Pandya R., PHI
8. Modern Mobile Wireless Communication, Haykins S & Moher M, Pearson Ed.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Explain basic concepts of the cellular concept and Assess practical handoff considerations, interference and system capacity.

CO2: Compare mobile radio propagation with large-scale path loss and Demonstrate types of Small-Scale Fading

CO3: Analyze the fundamentals of Equalization and diversity in a communication Receiver.

CO4: Demonstrate an ability to explain multiple access techniques for Wireless Communication.

CO5: Explain the architecture, functioning, protocols, capabilities and application of various wireless communication networks.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1			1		2	1	1	1
CO2	3	3	3	3	3	1	1			1		2	2	2	2
CO3	3	3	3	3	3	1	1			1		2	3	2	2
CO4	3	3	3	3	3	1	1			1		2	3	2	2
CO5	3	3	3	3	3	1	1			1		2	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC207TPE06	3	-	-	4 hours	30	70	100	3

DIGITAL IMAGE PROCESSING

Course Objectives:

1. To provide the fundamental knowledge on digital image processing. 2. To develop the ability to understand and implement various digital image processing algorithms. 3. To facilitate the students for analyze and implement various real time digital image processing applications.

UNIT-I: Image Representation and Image Processing Paradigm: Image, Elements of Image perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels. **Image Enhancements:** Point operations, Arithmetic operations, Logical operation, Gray level transformations, histogram equalization, histogram specifications, pixel-domain smoothing filters, pixel-domain sharpening filters, two-dimensional DFT and its inverse, Cosine transform.

UNIT-II: Image Filtering and restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.

UNIT-III: Color Image Processing: Color models, Color transformations, Color image smoothing and sharpening; Color Segmentation. **Wavelets and Multi-resolution image processing:** Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub-band filter banks, wavelet packets.

UNIT-IV: Image Compression: Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression- predictive and transform coding; Still image compression standards – JPEG and JPEG-2000.

UNIT-V: Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding, region-based segmentation, Segmentation Using Morphological Watersheds.

Text/Reference Books:

1. R. C. Gonzalez, R. E. Woods, Digital Image Processing, 3rd Edition, Pearson Education 2010.
2. Anil K Jain, Fundamentals of Digital Image Processing, Prentice Hall of India,2nd ed 2011.
3. William K. Pratt, Digital Image Processing, 4th edition, John Wiley, 2007.
4. John C. Russ, The Image Processing Handbook, 6th edition, CRC Press,2011.
5. Maria M. P. Petrou and Costas Petrou, Image Processing: The Fundamentals, 2nd Ed., John Wiley & Sons, Ltd, 2010.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Acquire the knowledge of basic image processing concept and image enhancement techniques involved.
2. Demonstrate image restoration process and its respective filters required.
3. Illustrate the color image processing and various multi-resolution techniques
4. Interpret the various image compression techniques and their applications.
5. Design the various image segmentation operations for a meaningful partition of objects.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1			1		2	1	1	1
CO2	3	3	3	3	3	1	1			1		2	2	2	2
CO3	3	3	3	3	3	1	1			1		2	3	2	2
CO4	3	3	3	3	3	1	1			1		2	3	2	2
CO5	3	3	3	3	3	1	1			1		2	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC207TPE07	3	-	-	4 hours	30	70	100	3

ANALOG CMOS IC DESIGN

Course Objectives:

1. To demonstrate the ability to analyze and design the basic & advance analog integrated circuit.
2. To gain knowledge of strengths and weaknesses of basic CMOS circuit building blocks and feedback concepts
3. To develop skills in designing CMOS operational amplifier and reference circuits.
4. To study the frequency response of the amplifier.
5. To design analog IC circuits for a given specification.

UNIT-I: Basic MOSFET Physics: General consideration, MOS I/V characteristics, Second order effects and MOS small & large signal models.

UNIT-II: CMOS Amplifier and Current Sources: Single Stage Amplifier: CS stage with resistance load, Diode connected load, Current source load, Triode load, CS stage with source degeneration, Source follower, Common-gate stage, Cascade stage, current sources, Basic current mirrors, Cascode Current Mirrors.

UNIT-III: Operational Amplifiers Design: Basic difference pair, Common mode response, Differential pair with MOS loads, Gilbert cell theory and design, Performance parameters, Design of 2-stage MOS operational amplifier, Gain boosting, Slew rate, Offset effects, PSRR.

UNIT-IV: Frequency Response and Feedback Amplifiers: Miller effect, Frequency response of all single stage amplifiers and cascade stage, General consideration of feedback circuits, Feedback topologies, Effect of loading.

UNIT-V: Voltage References and Noise: Different configurations of voltage references, Major issues, Supply independent biasing, Temperature independent references, Types of noise, Analysis and representation of noise in single stage amplifiers, cascode stage.

Text/Reference Books:

1. Behzad Razavi,"Design of Analog CMOS Integrated Circuits", Tata Mc Graw-Hill, 2001.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", 5th Edition, Wiley, 2009
3. Phillip Allen and Douglas R. Holberg, "CMOS analog Circuit Design", 3rd Edition, Oxford University Press, USA, 2011.
4. T. Carusone, D. Johns, K. Martin, Analog Integrated Circuit Design, 2nd Edition, Wiley, 2011.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1. Realize the concepts of analog IC design including small & large signal models.

CO2. Design different configuration of amplifiers for a given specification & current sources.

CO3. Illustrate the concept of op-amp and its design parameters and application.

CO4. Analyze the characteristics of frequency response of the amplifier and comprehend the feedback topologies.

CO5: Design band gap reference circuits providing constant dc voltage and immune to temperature variations and noise.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1			1		2	1	1	1
CO2	3	3	3	3	3	1	1			1		2	2	2	2
CO3	3	3	3	3	3	1	1			1		2	3	2	2
CO4	3	3	3	3	3	1	1			1		2	3	2	2
CO5	3	3	3	3	3	1	1			1		2	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC207TPE08	3	1	-	4 hours	30	70	100	4

FIBER OPTIC COMMUNICATION

Course Objectives:

1. To introduce the concept of signal propagation through the optical fiber.
2. Discuss the channel impairments like losses and dispersion
3. To learn the various components of optical fiber Communication system.
4. Discuss the concept of optical networking and signal booster devices.
5. To familiar with the concept of advance optical communication system.

UNIT-I:

Introduction to optical communication, principle of light transmission, propagation of light in to fiber, mode theory of a cylindrical waveguide, Ray model.

UNIT-II:

Different types of optical fibers, Modal analysis of a step index fiber.
Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

UNIT-III:

Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsitivity, noise, optical receivers, Optical link design - BER calculation, power penalties.

UNIT-IV:

Optical switches - coupled mode analysis of directional couplers, electro-optics switches. Optical amplifiers - EDFA, Raman amplifier.WDM and DWDM systems. Principles of WDM networks.

UNIT-V:

Nonlinear effects in fiber optic links. Concept of self-phase modulation, group velocity dispersion and solition based communication.

Text/Reference Books:

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
3. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press, 1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed. 1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997
7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

Course Outcome:

At the end of the course, students will demonstrate the ability to:
1. Demonstrate the optical fiber communication system, fiber structure, propagation and transmission properties of an optical fiber.
2. Analyze the losses and propagation characteristics of an optical signal in different types of fibers.
3. Demonstrate the functionality of elements of optical fiber system and analyse the performance of the elements.
4. Estimate the power budget of the system and can understand the designing of the link.
5. Apply different techniques to improve the efficiency of the system.

Course Outcomes and their mapping with Programme Outcomes:

	PO												PSO		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2		1			3			3	3		2
CO2	3	3	2	2		1			3			3	3		2
CO3	3	3	2	2		1			3			3	3		2
CO4	3	3	2	2		1			3			3	3		2
CO5	3	3	2	2		1			3			3	3		2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC207TPE09	3	-	-	4 hours	30	70	100	3

MICROWAVE THEORY & TECHNIQUES

Course Objectives:

1. To understand the concepts of waveguides and modes.
2. To understand the basic concept of various types of Guiding Structure and Passive Components at Microwave.
3. To understand the concepts and working principles of Microwave Active Components.
4. To understand the concepts and working principles of Microwave System Design and Antenna
5. To understand the applications and effect of microwave in various system

UNIT-I:

Introduction to Microwaves-History of Microwaves, Microwave Frequency bands; Applications of Microwaves, Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes in Rectangular and Circular waveguide, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission. Introduction of Microwave Systems.

UNIT-II:

Analysis of RF and Microwave Transmission Lines- Coaxial line, Strip line, Micro strip line. Microwave Network Analysis- Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters. Passive Microwave Devices- Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Resonator.

UNIT-III:

Microwave active components: Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, Travelling Wave Tube Amplifier, Magnetron.

UNIT-IV:

Microwave Design Principles-Impedance transformation, Impedance Matching, Introduction of Microwave Filter Design, Microwave Antennas Antenna parameters, Introduction of Antennas for ground based systems, airborne and satellite systems, Introduction of Planar Antennas for Microwave frequency.

UNIT-V:

Microwave Measurements- Power, Frequency and impedance measurement at microwave frequency, Noise at microwave frequency and measurement of noise figure. Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Modern Trends in Microwaves Engineering, microwave imaging, Effect of Microwaves on human body.

Text/Reference Books:

1. R.E. Collins, Microwave Circuits, McGraw Hill
2. K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house
3. S.Y. Liao, Microwave Devices and circuits, Pearson Education
4. David M. Pozar, Microwave Engineering, John Wiley & Sons
5. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Analyze the need of various microwave system components and their properties.
2. Evaluate the various Guiding structures and passive components along with their properties.
3. Analyze the microwave active systems and different mathematical treatment for comparison of general circuit analysis.
4. Analyze to design the Microwave Devices.
5. Evaluate the Measurement of Microwave Properties and will learn latest development in Microwave Technology.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1		3								3	2	
CO2	3	3	2	2	3								3	2	
CO3	3	3	2										3		
CO4	3	3	3	3	3								3	2	
CO5	3	1	1			1	1						3		3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC207TPE10	3	-	-	4 hours	30	70	100	3

POWER ELECTRONICS

Course Objectives:

- To introduce students to the basic theory of power semiconductor devices and passive components, their practical applications in power electronics.
- To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.
- To provide strong foundation for further study of power electronic circuits and systems.

UNIT-I:

Introduction: Concept & application of power electronics, uncontrolled converters, advantages and disadvantages of power electronics converters, power electronics switches. **Thyristors:** Thyristors, V-I characteristics and applications. Two transistor model of SCR, SCR turn on methods, switching characteristics, gate characteristics, ratings, SCR protection, series and parallel operation, gate triggering circuits, different commutation techniques of SCR.

UNIT-II:

Phase controlled converters: Principle of operation of single phase and three phase half wave, half controlled, full controlled converters with R, R-L and RLE loads, effects of freewheeling diodes and source inductance on the performance of converters. External performance parameters of converters, techniques of power factor improvement, single phase and three phase dual converters.

UNIT-III:

DC-DC converters: Principle of operation, control strategies, step up choppers, types of choppers circuits based on quadrant of operation, performance parameters, multiphase choppers and switching mode regulators.

UNIT-IV:

Inverters: Definition, classification of inverters based on nature of input source, wave shape of output voltage, method of commutation & connections. Principle of operation of single phase and three phase bridge inverter with R and R-L loads, performance parameters of inverters, methods of voltage control and harmonic reduction of inverters. Brief idea of Resonant Pulse inverters.

UNIT-V:

AC controllers: Principle of on-off and phase control, single phase and three phase controllers with R and R-L loads. Principle of operation of cycloconverters, circulating and non-circulating mode of operation, single phase to single phase step up and step down cycloconverters, three phase to single phase Cycloconverters, three phase to three phase Cycloconverter.

Text/Reference Books:

1. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.
2. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India, 3rd ed., 2009.
3. Power Electronics by P.S. Bhibmra, Khanna Publishers.
4. Modern Power Electronics and AC Drives –B. K. Bose-Pearson Publications, 2002.
5. L. Umanand, "Power Electronics Essentials and Applications", Wiley India Ltd., 2009
6. P.C Sen, „Thyristor DC Drives", John wiely and sons, New York, 1981.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Relate basic semiconductor physics and mathematics to Describe basic operation of power semiconductor device and compare performance of various power semiconductor devices, passive components and switching circuits

2. Design and Analyze power converter circuits and learn to select suitable power electronic devices by assessing the requirements of application fields.
3. Formulate and analyze a DC-to-DC converter at the system level and assess the performance.
4. Design and analyse inverter circuits and derive for typical solutions to reduce harmonics to improve its efficiency s.
5. Demonstrate the working of voltage controllers and cyclo-converters and recognize the role of power electronics in domestic and industrial applications.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3		2						1	2	3	1
CO2	3	3	1	3		2						1	2	3	1
CO3	3	3	1	3		2						1	2	3	1
CO4	3	3	1	3		2						1	2	3	1
CO5	3	3	1	3		2						1	2	3	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC207TPE11	3	-	-	4 hours	30	70	100	3

ESTIMATION AND DETECTION THEORY

Course Objectives:

1. To teach students the basics of estimation and detection theory.
2. To introduce the students to estimation bounds.
3. To introduce classical and Bayesian estimators like ML, LS, and MMSE to students.
4. To teach hypothesis testing and a number of detectors of signals in noise. And to introduce the likelihood ratio test and GLRT.
5. Exposing the students to applications of estimation and detection is another important goal.

UNIT-I Introduction: Recap of probability and linear algebra, Introduction of estimation in signal processing, Minimum variance unbiased estimation, Unbiased estimators, Minimum variance criterion, Existence of minimum variance unbiased estimator, Cramer-Rao lower bound (CRLB), scalar parameters, Signal in white Gaussian noise.

UNIT-II Linear model and Estimation: Linear models, General minimum variance unbiased estimation, Sufficient statistic, finding minimum variance unbiased estimators, Best linear unbiased estimators (BLUE), Finding the BLUE, Signal processing example.

UNIT-III Likelihood Estimation: Maximum Likelihood estimators (MLE), finding the MLE, Properties of the MLE, MLE for transformed parameters, Extension to a vector parameter, Introduction to Least Square (LS) Approach, Linear least square estimation, Geometrical interpretations of LS estimation, Some examples.

UNIT-IV Bayesian Estimation: Bayesian estimators, Priors and Posteriors probabilities, Choosing a Prior PDF, General Bayesian estimators, Minimum mean square estimators (MMSE), Maximum A Posteriori (MAP) Estimators, Linear MMSE Estimation.

UNIT-V Detection and Decision: Basics of statistical decision theory, Simple hypothesis testing, Likelihood ratio testing, Neyman-Pearson detectors, Detection of known signals in noise, Composite hypothesis testing, Generalized likelihood ratio tests (GLRTs), Deterministic signals with unknown parameters.

Text/Reference Books:

1. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory, vol. I" Prentice-Hall, 1993 & "vol. II" Prentice-Hall, 1998.
2. H. Vincent Poor, "An Introduction to Signal Detection and Estimation" Springer, 2nd Ed, 1998
3. H. L. Van Trees, "Detection, Estimation, and Modulation Theory, Part I," John Wiley, 1968

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Learn the principle of estimation and detection.

CO2: Learn different estimation and detection techniques like ML, LS, MMSE.

CO3: Solve problems that involve estimation of the signal parameters or detection of the presence of a signals.

CO4: Compare and evaluate the performance of different estimation technique in different setups.

CO5: Apply these skills to solve problems with practical context.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2			1	1	2	3	2	2
CO2	3	3	3	3	3	2	2			1		2	3	2	2
CO3	3	3	3	3	3	2	2			1		2	3	2	2
CO4	3	3	3	3	3	2	2			1		2	3	2	2
CO5	3	3	3	3	3	2	2		1	1	1	2	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC207TPE12	3	-	-	4 hours	30	70	100	3

RADAR & SATELLITE COMMUNICATION

Course Objectives:

1. To know the evolution of Satellite communication and its concept
2. Understand the orbital and functional principles of satellite communication systems.
3. Analyse and evaluate a satellite link and suggest enhancements to improve the link performance.
4. Select an appropriate modulation, multiplexing and multiple access schemes for a given satellite communication link.
5. Understand the basics and functional principles of different types of RADAR.

UNIT-I:

Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

UNIT-II:

Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day. Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

UNIT-III:

Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift. Satellite link budget Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

UNIT-IV:

Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

UNIT-V:

RADAR: Introduction, Radar block diagram and Operation, Radar Frequencies, Simple form of Radar Equation, Prediction of Range Performance, Minimum Detectable Signals, CW Radar, Tracking Radar, MTI Radar.

Text/Reference Books:

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009
3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill,2009

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Visualize the architecture of satellite systems as a means of high speed, high range communication system
2. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3. Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.
4. Explain how satellite is controlled to become stationary w.r.t a point on the earth.
5. Explain how a single satellite is shared by large number of earth stations on the earth.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1									2	3		1
CO2	3	3	1									2	3		1
CO3	3	3	2	2								2	3		1
CO4	3	2	1									2	3		3
CO5	3	2	1									2	2		1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC207TPE13	3	-	-	4 hours	30	70	100	3

PATTERN RECOGNITION & MACHINE LEARNING

Course Objectives:

1- To study the fundamentals of pattern recognition.
2- To study the various parameter based estimation methods.
3- To study some dimensionality reduction methods.
4- To study the fundamentals of artificial neural networks.
5- To be able to choose and apply algorithms for pattern recognition.

UNIT-I:

Introduction to statistical pattern recognition, Bayes Decision Theory: Minimum-error-rate classification. Classifiers, Discriminant functions, Decision surfaces. Discrete features.

UNIT-II:

Parameter Estimation Methods: Maximum-Likelihood estimation, Bayesian estimation, Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical and other methods. Cluster validation.

UNIT-III:

Gaussian mixture models, Expectation-Maximization method for parameter estimation. Hidden Markov Models (HMMs). Discrete HMMs. Continuous HMMs.

UNIT-IV:

Dimensionality reduction: Principal component analysis - relationship to eigen analysis. Fisher discriminant analysis - Generalised eigen analysis.

UNIT-V:

Artificial neural networks: Multilayer perceptron - feedforward neural network. A brief introduction to deep neural networks, convolutional neural networks, recurrent neural networks.

Text Books:

1. J.I. Tou & R C Gonzalez, Pattern Recognition Principles, Addition-Wesley.
2. R Schalkoff, Pattern Recognition- Statistical, Structural and Neural Approaches, John Wiley, 1992.

Reference Books

1. P A Devijer & J Kittler, Pattern Recognition – A statistical Approach, Prentice Hall
2. R O Duda, P E Hart, D G Stork, Pattern Classification, Wiley Publication 2001.
3. D Mckay, Information Theory, Inference and Learning Algorithms, Cambridge University Press 2003.
4. C M Bishop, Pattern Recognition and Machine Learning, Springer, 2006
5. Christopher M Bishop, Pattern Recognition and Machine Learning, Springer, 2006

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Summarize the various techniques involved in pattern recognition
CO2: Ability to analyse the various parameter based estimation methods.
CO3: Illustrate the artificial neural network based pattern recognition
CO4: Discuss the applications of pattern recognition in various applications
CO5: Apply to choose and evaluate suitable algorithm given the application.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	-	-	-	-	-	-	2	3	1	2
CO2	3	3	3	2	1	2	-	-	-	-	-	2	3	2	2
CO3	3	2	2	1	2	2	-	-	-	-	-	2	3	2	2
CO4	3	3	3	2	3	2	-	-	-	-	-	2	3	1	3
CO5	3	2	3	1	2	2	-	-	-	-	-	2	3	1	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC207TOE02	3	-	-	4 hours	30	70	100	3

CMOS DIGITAL VLSI DESIGN (Open Elective 02 for non-ECE branch)

Course Objectives:

1. To introduce the physics of MOSFETs.
2. To understand MOS inverter and switching characteristics.
3. To identify different sources of power dissipation in CMOS logic circuits.
4. To build upon the theoretical, mathematical and physical analysis of digital VLSI circuits, for proper understanding of concept, working, analysis and design.

UNIT-I: Introduction: Basic MOSFET characteristics-Threshold voltage, Substrate bias effect, Current voltage characteristics-Square-law model, MOSFET modeling-Drain-source resistance, MOSFET capacitances, Geometric scaling theory-Full-voltage scaling, Constant-voltage scaling, Challenges of MOSFET scaling.

UNIT-II: MOS Inverter & Switching Characteristics: Introduction, NMOS inverter with different loads, CMOS inverter, Delay-time definitions, Calculation of delay times, inverter design with delay constraints.

UNIT-III: Combinational & Sequential Logic Circuits: CMOS logic circuits, Complex logic circuits, CMOS transmission gates, Behavior of bi-stabile elements, The S-R latch circuit, Clocked latch & flip flop circuits, CMOS D latch.

UNIT-IV: Power Dissipation in CMOS Digital Circuits: Switching power dissipation, Short circuit power dissipation, Glitching power dissipation, Static power dissipation-Reverse leakage current, Subthreshold leakage current.

UNIT-V: VHDL: Introduction and use of VHDL, Entity and architecture declaration, Types of models of architecture, Data objects, Data types, Operators, concurrent and sequential statements, process statements, case, if, when statements, Design of sequential and combinational circuits.

Text/Reference Books:

1. S. Kang and Y. Leblebici, "CMOS Digital Integrated Circuits-Analysis and Design", 3rd ed. Tata McGraw Hill, 2008.

2. N.H.E. Weste and K. Eshraghian, "CMOS VLSI Design: A Circuits and Systems Perspective", 2nd ed. eddision Wesley, 1998.

3. J. M. Rabaey, A.P. Chandrakasen, and B. Nikolic, "Digital Integrated Circuits-A Design Perspective", 2nd ed. Pearson Education, 2007.

4. V. A. Pedroni, "Circuits Design with VHDL", 3rd ed. The MIT Press, 2000.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Comprehend the fundamental of MOS transistor and short channel effects.
CO2: Design a MOS inverter with different loads and analyze switching characteristics.
CO3: Illustrate and design CMOS combinational & sequential Circuits.
CO4: Identify sources of power dissipation in VLSI systems.
CO5: Design an application using VHDL.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1			1	1		3	3	1	2
CO2	3	3	2	1	1	1			1	1		3	3	1	2
CO3	3	3	3	1	1	1			1	1		3	3	3	2
CO4	3	3	3	1	1	1			1	1		3	3	3	2
CO5	3	3	1	1					1	1		3	3	1	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC207PPC11	-	-	2	4 hours	30	20	50	1

DESIGN & SIMULATION LAB

Course Objectives:

- To give the exposure of TCAD tools.
- To develop skills in designing diodes and transistors using TCAD.
- To efficiently understand the various device parameters, working and characteristics.
- To provides an opportunity to design feature low power devices.

List of Experiments:

1. Introduction of VLSI TCAD tools.
2. Design and Simulation of 2D/3D PN Junction Diode.
3. Design and Simulation of 2D/3D NPN & PNP BJT.
4. Design and Simulation of 2D/3D NMOS Channel Length 20nm or higher.
5. Design and Simulation of 2D/3D PMOS Channel Length 20nm or higher.
6. Design and Simulation of 2D/3D CMOS using NMOS and PMOS.
7. Design and Simulation of SOI/Bulk Dual Gate FET & Dual Gate Junction less FET.
8. Design and Simulation of SOI/Bulk FINFET device using GDS2MESH and GENIUS.
9. Design and Simulation of SOI/Bulk 2D/3D Nanowire FET

Course Outcome:

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

CO1. Familiar with sophisticated VLSI TCAD tools.
CO2. Design and implement any diode and transistor using TCAD tools.
CO3. Design and implement SOI based junction/junction less dual gate FET & FINFET using TCAD tools
CO4. Understand the working of all devices and implement advanced device using TCAD tools.
CO5: Learn advanced features in device design & simulation.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3		1		3			3	3	3	3
CO2	3	3	2	3	3		1		3			3	3	3	3
CO3	3	3	2	3	3		1		3			3	3	3	3
CO4	3	3	2	3	3		1		3			3	3	3	3
CO5	3	3	2	3	3		1		3			3	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TPE14	3	1	-	4 hours	30	70	100	3

VLSI FABRICATION METHODOLOGY

Course Objectives:

- To introduce the brief concept of fabrication technology of both BJT & MOS.
- To learn difficulties in single crystal development and wafer design.
- To learn different epitaxial growth techniques and their associated problems.
- To introduce the concept of Si atomic structure, atomic planes and structural defects.

UNIT-I: Introduction to VLSI

Brief overview of processing steps of BJT & MOSFET fabrication; Concept of photolithography; Epitaxy; Self-aligned Technique, Polysilicon & its advantages etc.

UNIT-II: Silicon Crystal Structure

Basics of Crystal structure and its types and different formations, Hard sphere model of Diamond lattice and its Packing densities, Concept of misfit factor and its importance, Details of Crystal plane-Miller"s indices, packing densities, interplane distances and angles between the planes, V-groove etching concept, Direction of line on Si-wafer.

Defects in Crystal structure: Point defects, Line defects, Area dislocation, Volume defects.

UNIT-III: Crystal growth of Si

Carbothermic Reduction process, Bridgemann Technique and its problems, Czochralski technique, its thermodynamics and effect of Pull rate on wafer size. Dopant incorporation in Si crystal: Segregation coefficient, O_2 incorporation and its removal.

UNIT-IV: Crystal refinement & wafer preparation

Zone refining technique and its advantages, Wafer preparation, Gettering process and Metallic contaminant removal. **Epitaxy:** Types, 3 cardinal rules and their importance, Liquid phase epitaxy, Vapour Phase Epitaxy, Reactor configuration.

UNIT-V: Chemical Vapour Deposition for Si epitaxy

Silane route, Doping during epitaxy- auto doping, Molecular Beam epitaxy.

Text/Reference Books:

1. VLSI Technology, S. M. Sze, McGraw Hill Book Co.
2. VLSI Fabrication Principles, S.K.Gandhi, John Wiley and Sons, NY.
3. VLSI Technology, Chen, Wiley, March.
4. Principles of Microelectronics Technology, D. Nagchoudhary, Wheeler (India).
5. Silicon VLSI Technology: Fundamentals, Practice & Modeling, Plummer, Deal , Griffin, PH, 2001.
6. Microchip Fabrication, P. VanZant, MH, 2000.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Explain the concept of fabrication technology.
2. Analyze the challenge of single crystal development and wafer design.
3. Apply the epitaxial growth techniques and their associated problems.
4. Explain the concept of Si atomic structure, atomic planes.
5. Explain the structural defects and their effects on wafer quality.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1								3	3	1	2
CO2	3	3	1	1								3	3	1	2
CO3	3	2	1	1								3	3	1	2
CO4	3	2	1	1								3	3	1	2
CO5	3	2	1	1								3	3	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TPE15	3	-	-	4 hours	30	70	100	3

MILLIMETER WAVE TECHNOLOGY

Course Objectives:

1. To understand the Characteristics of Millimeter Wave Technology
2. To understand the concepts and working principles of various guiding Structures at Millimeter Wave Technology.
3. To design the Antenna for Millimeter Wave Applications.
4. To perform analysis of passive Components at Millimeter Wave
5. To understand the basic concept of Active Devices and Link Design at Millimeter Wave.

UNIT-I:

Introduction to Millimeter wave Technology: Advantages and Challenges of Millimeter Wave Technology, Millimeter Wave Applications, Sources of losses at Millimeter wave; Dielectric Loss, Conduction Loss, Radiation Surface wave losses, Wave propagation, Phase and Group Velocity, Slow and Fast waves.TEM, TE and TM modes.

UNIT-II:

Guiding Structure: Transmission Lines, Surface Wave in Grounded Dielectric Slab, Parallel Plate Guide, Rectangular Wave Guide, Circular Waveguides, Microstrip Lines, High Frequency Limitation of Microstrip Lines, Microstrip Coupled Lines, Conductor Backed CPW, Substrate Integrated Waveguide (SIW), SIW Losses, Design of SIW.

UNIT-III:

Antennas at Millimeter wave Frequency: Antennas Parameters, Printed Millimeter Wave Antennas, Dipole and Slot Antenna, Loop Antennas, Printed Millimeter Wave Array Antennas, Waveguide Slot Arrays, On Chip Antennas: Design and Challenges.

UNIT-IV:

Passive Components: Dielectric Resonators, Dielectric Resonators Antenna and its modes, filters, Different types of couplings, Power divider, Directional Coupler, Hybrid Coupler.

UNIT-V:

Active Components: PIN Diode, Gunn Diode, IMPATT Diode**,** FET, MOSFET, HEMT, Comparison of Solid State Devices **,** Noise and Link Budget, Friss Transmission Equation, Millimeter Wave Systems, Noise Figure for Cascaded System Elements.

Text/Reference Books:

1. S. Rappaport, R.W. Heath, R.C. Daniels and J.N. Murdock,Millimeter Wave Wireless Communication, Prentice Hall
2. NPTEL Lectures by Dr M K Mondal IIT Kharagpur on Millimeter Wave Technology

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Explain the Need of Millimeter Wave Technology for Communication
2. Apply the suitable Guiding Structure at Millimeter Wave Technology
3. Design of Antenna for Millimeter wave Frequency
4. Analyze the various Passive Devices at MM Wave Systems
5. Explain the principle of Active Devices and Design of MM Wave System

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1								2	3		2
CO2	3	3	2	3								2	3		2
CO3	3	2	2	3	3							1	3	2	2
CO4	3	1	2	1	3							1	3	2	2
CO5	3	2	1	1	3							1	3		2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TPE16	3	-	-	4 hours	30	70	100	3

VIDEO PROCESSING

Course Objectives:

- To acquire fundamental knowledge of digital video processing.
- To develop the ability to understand and implement various digital video processing and estimation algorithms.
- To facilitate the students for analyzing and implementing various real-time digital video processing applications.

UNIT-I:

Basic concepts of Video Processing: Video capture and display, Analog video, Digital Video, Time-varying Image Formation models-3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations

UNIT-II:

Video modeling: Camera Model-Pinhole Model, CAHV Model, Camera Motions. Object Model-Shape Model, Motion Model. Scene Model, Two-Dimensional Motion Models.

UNIT-III:

2-D Motion Estimation: Optical flow, general methodologies, pixel-based motion estimation, Block matching algorithm, multi-resolution motion estimation, Application of Motion Estimation in Video Coding.

UNIT-IV:

Video Coding: Waveform-based coding, Block based transform coding-Unitary Transform, Discrete Cosine Transform, Bit Allocation and Transform Coding Gain, DCT-Based Image Coders and the JPEG Standard, predictive coding, Video Coding Using Temporal Prediction and Transform Coding.

UNIT-V:

Video Compression: H.261, H.263, MPEG-1, MPEG-2, and MPEG-4.

Text/Reference Books:

1. The Essential Guide to Video Processing, Al Bovik (Alan C Bovik), Academic Press, Second Edition, 2009
2. Handbook of Image and Video processing, Al Bovik (Alan C Bovik), Academic Press, Second Edition, 2005.
3. Digital Video Processing - A. Murat Tekalp, Prentice Hall, 1995.
4. Yao Wang, Jorn Ostermann, Ya-Qin Zhang, "Video Processing and Communications", First Edition, Prentice Hall, 2002
5. Video Coding for Mobile Communications, David Bull et al, Academic Press.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Identify the fundamental concept of video signals.
2. Explain the various video models.
3. Apply appropriate motion estimation model for the specific application
4. Illustrate the video coding techniques for input video
5. Interpret the various video compression techniques and their applications.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1						3	3	1	2
CO2	3	3	1	1	1	1						3	3	1	2
CO3	3	3	1	1	1	1						3	3	2	3
CO4	3	3	1	1	1	1						3	3	2	3
CO5	3	3	1	1	1	1						3	3	2	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TPE17	3	-	-	4 hours	30	70	100	3

WIRELESS SENSOR NETWORKS

Course Objectives:

- To understand the fundamentals of wireless sensor networks and its application to real time scenarios.
- To study the various protocols at various layers and its differences with traditional protocols.
- To understand the issues pertaining to sensor networks and the challenges involved in managing a sensor network.
- To teach hypothesis testing and a number of detectors of signals in noise. And to introduce the likelihood ratio test and GLRT.
- Exposing the students to applications of estimation and detection is another important goal.

UNIT-I:

OVERVIEW OF WIRELESS SENSOR NETWORKS

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

UNIT-II:

ARCHITECTURES

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 Tiny OS and nesC Internet to WSN Communication.

UNIT-III:

NETWORKING SENSORS

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – SMAC, BMAC 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, EnergyEfficient Routing, Issues in designing a routing protocol,classification of routing protocols,table driven,on-demand,hybrid,flooding,hierarchical and power aware routing protocols.

UNIT-IV:

INFRASTRUCTURE ESTABLISHMENT

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT-V:

SENSOR NETWORK PLATFORMS AND TOOLS

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Nodelevel software platforms, Node level Simulators, Statecentric programming.

Text/Reference Books:

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", John Wiley & Sons Publications, 2011
4. Kazem Sohraby, Daniel Minoli and Taieb Znati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Explain the challenges and technologies for wireless sensor networks

CO2: Explain the architecture and sensors

CO3: Describe the communication, energy efficiency, computing, storage and transmission
CO4: Establishing infrastructure and simulations.
CO5: Explain the concept of programming the in WSN environment.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1								2	2	1	2
CO2	3	2	2	1								2	2	2	2
CO3	3	2	2	1								2	2	2	2
CO4	3	2	2	1								2	2	2	2
CO5	3	2	2	1								2	2	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TPE18	3	-	-	4 hours	30	70	100	3

LOW POWER VLSI DESIGN

Course Objectives:

- To understand the low voltage low power VLSI designs.
- To understand the impact of power on system performances.
- To realize different design approaches.
- To identify suitable techniques to reduce power dissipation in the circuits.

UNIT-I:

Introduction: Need for Low Power VLSI chips, Low power design methodology, Basic principal of low power design, Sources of power dissipation: Dynamic, Short-circuit and leakage power dissipation.

UNIT-II:

Supply Voltage Scaling for Low Power: Introduction, Device feature size scaling, Architectural-level approaches, Multilevel voltage scaling and challenges, Dynamic voltage and frequency scaling.

UNIT-III:

Switching Capacitance Minimization: Dynamic voltage and frequency scaling, Bus encoding, clock gating, Gated-clock FSM, Glitching power minimization, Logic style for low power.

UNIT-IV:

Leakage Power Minimization: Fabrication of multiple threshold voltages, VTCMOS approach, Transistor stacking, MTCMOS approach, Power gating.

UNIT-V:

Special Techniques: Low power clock distribution, Single driver vs distributed buffers, Various clock distribution networks, Power reduction in clock networks, Low power bus, CMOS floating nodes, and Adiabatic logic.

Text/Reference Books:

1. Ajit Paul, "Low Power VLSI Circuits & Systems", Springer, 2015.
2. Kaushik Roy, Sharat Prasad, "Low power CMOS VLSI circuit design", John Wiley sons Inc.,2000.
3. Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998.
4. J. B. Kulo and J. H. Lou, "Low voltage CMOS VLSI Circuits", Wiley, 1999.
5. A. P. Chandrasekaran and R. W. Broadersen, "Low power digital CMOS design", Kluwer, 1995.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Identify sources of power dissipation in VLSI systems.

CO2: Understand how to apply techniques at the device, circuit and architectural level to reduce power dissipation in an electronic design.

CO3: Illustrate and design switching capacitance & leakage power minimization techniques low voltage low power applications.

CO4: Learn and design special techniques for various low voltage low power applications.

CO5: Design and implementation of various structures for low power applications.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1			1	1		2	3	1	2
CO2	3	3	2	1	1	1			1	1		2	3	1	2
CO3	3	3	3	1	1	1			1	1		2	3	3	2
CO4	3	3	3	1	1	1			1	1		2	3	3	2
CO5	3	3	1	1	1	1			1	1		2	3	1	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TPE19	3	-	-	4 hours	30	70	100	3

BIOMEDICAL INSTRUMENTATION

Course Objectives:

- To introduce an fundamentals of transducers as applicable to physiology
- To explore the human body parameter measurements setups
- To measure non electrical parameter of human body.
- To make the students understand medical imaging techniques.
- To make the students understand the devices used in diagnosing the disease.

UNIT-I: Physiology and transducers

Cell and its structure, Resting and Action Potential, Nervous system: Functional organization of the nervous system, Structure of nervous system, neurons, transmitters and neural communication, Cardiovascular system, respiratory system, Basic components of a biomedical system, Transducers, selection criteria, Piezo-electric, ultrasonic transducers, Temperature, measurements.

UNIT-II: Electro – Physiological measurements

Electrodes: Limb electrodes, floating electrodes, Micro, needle and surface electrodes, Amplifiers: Preamplifiers, differential amplifiers, chopper amplifiers, ECG, EEG, EMG, ERG, Lead systems and recording methods, Typical waveforms. Electrical safety in medical environment: leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT-III: Non-electrical parameter measurements

Measurement of blood pressure, Cardiac output, Heart rate, Heart sound Pulmonary function measurements, Blood Gas analyzers : pH of blood, measurement of blood pCO2, finger-tip oximeter, measurements.

UNIT-IV: Medical Imaging

Radiographic and fluoroscopic techniques, X rays, Computer tomography, Mammography, MRI, Ultrasonography, Endoscopy, Different types of biotelemetry systems and patient monitoring.

UNIT-V: Assisting and therapeutic equipments

Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy, Heart Lung machine, Audio meters, Dialyzers.

Text/Reference Books:

1. R.S.Khandpur, „Hand Book of Bio-Medical instrumentation“, Tata McGraw Hill Pub., 2003.
2. Leslie Cromwell, Fred J.Weibell, Erich A.Pfeiffer, „Bio-Medical Instrumentation and Measurements“, II edition, Pearson Education, 2002 / PHI.
3. J.Webster, „Medical Instrumentation“, John Wiley & Sons, 1995.
4. L.A. Geddes, L.E.Baker, „Principles of Applied Bio-Medical Instrumentation“, John Wiley & Sons, 1975

Course Outcome:

At the end of the course, students will demonstrate the ability to:

- Explain the physiology of biomedical system.
- Describe biomedical and physiological information.
- Determine the non electrical parameter of human body.
- Illustrate the devices used in medical imaging and biotelemetry
- Discuss the application of electronics in therapeutic area

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	1							2	3	2	3
CO2	3	3	2	3	1							2	3	3	3
CO3	3	3	2	3	1							2	3	3	3
CO4	3	3	2	3	1							2	3	3	3
CO5	3	3	2	3	1							2	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TPE20	3	-	-	4 hours	30	70	100	3

NEURAL NETWORK & FUZZY LOGIC

Course Objectives:

- To introduce the origin and terminology of the Neural Network.
- To understand the basic structure of the Artificial Neural Network (ANN).
- To understand the single layer Neural Network and concept of perceptrons.
- To introduce the concept of back propagation and deep learning at an elementary level.
- To introduce basic concepts and terminology of Fuzzy logic and systems.

UNIT-I:

Introduction to Neural Networks: Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

UNIT-II:

Essentials of Artificial Neural Networks Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application.

UNIT-III:

Single Layer Feed Forward Neural Networks, Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications.

UNIT-IV:

Multilayer Feed forward Neural Networks Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

Introduction of RBF Neural Network, MLP Network, Self-organizing Feature Map, counter-propagation neural network, recurrent neural network, deep learning(Introductory).

Applications of Neural Networks: Pattern classification/Handwritten character recognition/ Face recognition/Image compression and decompression.

UNIT-V:

Fuzzy Logic & System: Basic Fuzzy logic theory, sets and their properties, Operations on fuzzy sets, Fuzzy relation and operations on fuzzy relations and extension principle, Fuzzy membership functions and linguistic variables, Fuzzy rules and fuzzy reasoning, Fuzzification and defuzzification and their methods, Fuzzy inference systems, Mamdani Fuzzy models, and Fuzzy knowledge based controllers

Basic applications of Fuzzy Logic and Fuzzy Systems: In controllers /Fuzzy pattern recognition/ Fuzzy image processing/popular applications of fuzzy sets, namely fuzzy reasoning and fuzzy clustering.

Text/Reference Books:

1. Neural Networks: A comprehensive foundation, S. Haykin , 2nd Ed., Pearson Education Asia,1999.
2. Neural Networks and Fuzzy Systems: A dynamical systems approach to machine intelligence, .B. Kosko , Prentice Hall India 1994.
3. Fuzzy Logic with Engineering Applications‖, Thimothy J. Ross, Wiley India Publications
4. Fundamentals of Neural Networks‖,Laurence Fausett, Pearson Education
5. Neural Networks, Fuzzy Logic, and Genetic Algorithms‖,S.Rajasekaran andG. A. Vijaylakshmi Pai, PHI
6. Introduction to Neural Network Using MATLAB", S. N. Sivanandam, S. Sumathi, and S. N. Deepa, Tata McGraw-Hill Publications 2006.

7. Neural Networks – James A Freeman and Davis Skapura, Pearson Education, 2002.
8. Fuzzy Sets and Fuzzy Logic,' G.J. Klir and B. Yuan, Prentice Hall India 1997.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Describe artificial neurons and its role in ANN.
2. Explain learning types and elementary structures of ANN.
3. Describe perceptron model and single layer neural networks with application.
4. Identify and apply basic techniques of fuzzy logic and systems
5. Apply neural network and fuzzy based processing in pattern recognition and Image Processing.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1						1	3	3	2
CO2	3	3	3	2	3	2						1	3	3	2
CO3	3	3	3	2	3	2						1	3	3	2
CO4	3	3	3	2	3	1						1	3	3	2
CO5	3	3	3	3	3	2						2	3	3	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TPE21	3	-	-	4 hours	30	70	100	3

NEXT GEN. COMM. TECHNOLOGY

Course Objectives:

1. To learn the new communication technologies such as OFDM and MIMO used in Next Generation communication systems.
2. To understand and apply the fundamental concept of Coherence Time, Coherence Bandwidth.
3. To learn the different fading model and evaluate the SNR.
4. To learn and analyse the performance of a massive MIMO system.
5. To analysis the performance such as capacity/spectral efficiency and energy efficiency of the MIMO and massive MIMO system.

UNIT – I

Introduction and Preliminaries: Introduction to point-to-point Multi-input Multi-output (MIMO), multiuser MIMO, massive MIMO, Coherence Time, Coherence Bandwidth, Coherence Interval. TDD Coherence Interval structure, Coherence Interval in the context of OFDM modulation, Small-scale and Large-scale fading, Normalized signal model, and SNR.

UNIT –II

OFDM: Principle of Orthogonal Frequency Division Multiplexing (OFDM), Multiple access – OFDMA, Implementation of transceivers, Frequency-selective channels, Cyclic Prefix (CP), Performance in the frequency-selective channel, Pilot based channel estimation, Peak-to-average power ratio, Inter-carrier-interference, Parameter adaptation.

UNIT –III

MIMO Systems: Introduction to MIMO systems, Diversity in wireless channel, Introduction to fading distributions, Analytical MIMO channel models, Independent and identically distributed (uncorrelated) MIMO fading model, Fully correlated MIMO channel model, MIMO channel parallel decomposition.

UNIT –IV

MIMO Channel Capacity and Power Allocation: Power allocation in MIMO systems, Uniform power allocation, Adaptive power allocation, MIMO channel capacity, Capacity of i.i.d. Rayleigh fading MIMO channels, Capacity of separately correlated Rayleigh fading MIMO channel.

UNIT –V

Massive MIMO Systems: Definition of Massive MIMO, Correlated Rayleigh fading, Uplink, and downlink system model, Impact of Spatial channel correlation, Channel hardening and favorable propagation, Pilot transmission and channel estimation, Spectral Efficiency (SE), Transmit precoding and Receive decoding, Single-cell uplink and downlink SE expressions, Asymptotic analysis, Energy efficiency.

Suggested Books & References: -

1. D. Tse and P. Vishwanath, "Fundamentals of Wireless Communications," Cambridge Univ. Press, 2005.
2. A. J. Goldsmith, "Wireless Communications," Cambridge Univ. Press, 2005.
3. R. S. Kshetrimayum, "Fundamentals of MIMO Wireless Communications," Cambridge University Press, 2017.
4. T. L. Marzetta, E. G. Larsson, H. Yang, and H. Q. Ngo, "Fundamentals of Massive MIMO," Cambridge Univ. Press, 2016.
5. Emil Björnson, Jakob Hoydis, and Luca Sanguinetti, "Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency," Foundations and Trends® in Signal Processing: Vol. 11: No. 3-4, pp 154-655 (2017).

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Explain the different physical layer wireless communication technologies used in 4G and 5G communication systems.

CO2: Apply the concept of Coherence Bandwidth, Coherence Time, Coherence Interval, Small-

scale and Large-scale fading to analyze the physical layer performance of 4G and 5G communication systems.
CO3: Evaluate the channel capacity of the MIMO and massive MIMO Systems.
CO4: Analyze the communication system performance under OFDMA.
CO5: Evaluate the spectral efficiency and energy efficiency of massive MIMO technology used in 5G.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1							2	3	3	3
CO2	3	3	2	2	2							2	3	3	2
CO3	3	3	2	3	2							2	3	3	1
CO4	3	3	2	3	2							2	3	3	1
CO5	3	3	2	3	2							2	3	3	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TOE03	3	-	-	4 hours	30	70	100	3

INTRODUCTION TO IOT (OPEN ELECTIVE-03)

Course Objectives:

1. To understand the definition and significance of the Internet of Things.
2. To learn the architecture, operation, and business benefits of an IoT solution.
3. To examine the potential Security issues in IoT and explore the relationship between IoT, cloud computing, and big data.
4. Design and program IoT devices, use real IoT protocols for communication, Secure the elements of an IoT device.

UNIT-I:

Introduction to The Internet of Things

IoT Definition, Elements of an IoT ecosystem, IoT applications, trends and implications, sensing components and devices, Wearable sensors and their Applications, operating System for IoT, Industrial IoT: case study: Agriculture, Healthcare, Process Automation & monitoring etc.

UNIT-II:

Internet of Things– Architecture and Communication Protocol

Layered Architecture for IoT, Protocol Architecture of IoT, Infrastructure Protocols: MAC protocols for sensor network, S-MAC, IEEE 802.15.4, Near Field Communication (NFC), RFID, ZigBee, Bluetooth Low Energy (BLE),IPv6 over LowPower Wireless Personal Area Networks (6LoWPAN), Long Term Evolution-Advanced, Z-Wave, Components of ZWave Network, Protocols for IoT Service Discovery: DNS service discovery, multicast domain name system.

UNIT-III:

Internet of Things – Networking Protocol Constrained Application Protocol (CoAP), Message Queue Telemetry Transport (MQTT), Extensible Messaging and Presence Protocol (XMPP), Advanced Message Queuing Protocol (AMQP), Data Distribution Service (DDS), Service Discovery Protocols, Routing Protocol for Low Power and Lossy Networks (RPL), sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, sensor network architecture, data dissemination and gathering protocol.

UNIT-IV:

Platforms for IOT Applications and Analytics

Role of the cloud and fog resources in the delivery of IoT services, The IoT Building Blocks, Connected Devices, IoT or Sensor Data Gateway, The IoT Data Analytics Platforms: IBM Watson IoT Platform, Splunk Software for IoT Data, Amazon Web Service IoT Platform, Azure IoT Hub, The IoT Data Virtualization Platforms, IoT Data Visualization Platform, Security and Privacy in IoT.

UNIT-V:

Design and Development

IoT Platforms, Arduino, Raspberry Pi Board, Other IoT Platforms; Data Analytics for Design Methodology,Embedded computing logic, Microcontroller, System on Chips , IoT system building blocks Arduino, Board details, IDE programming ,Raspberry Pi , Interfaces and Raspberry Pi with Python Programming Case Studies: Agriculture, Healthcare, and Activity Monitoring. Sensor-Cloud, Smart Cities and Smart Homes.

Text/Reference Books:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.
2. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, "Internet of Things: Architectures, Protocols and Standards," Wiley, 2018.
3. Fei Hu, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations," CRC Press, 2016Fundamentals of Wireless Communications, D. Tse and P. Vishwanath, ,Cambridge Univ. Press, 2005.

4. R. Buyya and A.K. Dastjerdi (eds.), "Internet of Things: Principles and Paradigms," Cambridge, MA, USA: Morgan Kaufmann (Elsevier), 2016.
5. Modern Mobile Wireless Communication, Haykins S & Moher M, Pearson Ed.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Explain the concept of IoT.
CO2: Analyze the concept of data communications protocols and convergence of technologies.
CO3: Interpret the protocols to track, monitor and manage IoT devices.
CO4: Apply data analytics and use cloud offerings related to IoT..
CO5: Explain the principles and various research issues related to Internet of Things.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1						2	1	1	1
CO2	3	3	3	3	3	1						2	2	2	2
CO3	3	3	3	3	3	1						2	3	2	2
CO4	3	3	3	3	3	1						2	3	2	2
CO5	3	3	3	3	3	1						2	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATT01	3	-	-	40	60	100	3

LINEAR ALGEBRA

Course Objectives:

The objective of the course are to make the students:

1. Formulate, solve, apply, and interpret systems of linear equations in several variables.
2. Compute with and classify matrices. Master the fundamental concepts of abstract vector spaces.
3. Decompose linear transformations and analyze their spectra (eigenvectors and eigenvalues).
4. Utilize length and orthogonality in each of the above contexts.
5. Apply orthogonal projection to optimization (least-squares) problems.

UNIT-I:

Introduction to Vectors: Vectors and Linear Combinations, Lengths and Dot Products.

Solving linear Equations: Matrices and Linear Equations, Gaussian Elimination, Rules for Matrix Operations, Row-Reduced Echelon Form (RREF), Rank of a Matrix, Solution set of a Linear System, Inverse Matrices, Factorization: A=LUs.

UNIT-II:

Vector Spaces and Subspaces: Properties, Rank, Nullspace, The Complete Solution $Ax = b$, Independence, Basis of a Vector Space, Dimension, Linear Span and Linear Independence, Dimensions of the Four Subspaces, Sums and Direct Sums.

Orthogonality: Orthogonality of the Four Subspaces, Projections and Least Square, Orthogonal Bases and Gram-Schmidt Orthonormalization Process, QR Decomposition, The Fast Fourier Transform.

UNIT-III:

Eigenvalues and Eigenvectors: Introduction to Eigenvalues, The Characteristic Polynomial**,** Eigenvalues of Square Matrices, Invariant Subspaces, Diagonalizing a Matrix, Applications to Differential Equations, Upper-Triangular Matrices, Diagonal Matrices, Invariant Subspaces on Real Vector Space Symmetric Matrices, Spectrum of a Matrix.

Positive Definite Matrices: Tests for Positive Definiteness**,** Similar Matrices, Singular Value Decomposition (SVD).

Operators on Complex Vector Spaces: Complex Numbers, Complex Vectors and Matrices: Hermitian and Unitary Matrices, Generalized Eigenvectors, The Characteristic Polynomial, Decomposition of an Operator, Square Roots, The Minimal Polynomial, Jordan Form**.**

UNIT-IV:

Linear Transformations: The Idea of a Linear Transformation, The Matrix of a Linear Transfonnation/Linear Maps: Definitions and Examples, Null Spaces and Ranges, Rank-Nullity Theorem, The Matrix of a Linear Map, Invertibility, Ordered Bases, Change of Basis, Diagonalization and the Pseudoinverse.

Trace and Determinant: Change of Basis, Trace, Determinant of a Matrix ,The Properties of Determinants, Permutations and Cofactors, Cramer's Rule. Inverses, and Volumes.

UNIT-V:

Inner-Product Spaces: Inner Products, Norms, Orthonormal Bases, Orthogonal Projections, Linear Functionals and Adjoints, The Intersection of Two Vector Spaces, The Sum of Two Vector Spaces, Cauchy-Schwartz Inequality, The Kronecker Product $A \otimes B$ of Two Matrices.

Operators on Inner-Product Spaces: Self-Adjoint and Normal Operators, The Spectral Theorem, Normal Operators on Real Inner-Product Spaces, Positive Operators, Isometries.

Applications: Matrices in Engineering, Graphs and Networks, Markov Matrices, Linear Programming, Fourier Series: Linear Algebra for Functions, Computer Graphics.

Numerical linear Algebra: Gaussian Elimination in Practice, Norms and Condition Numbers, Iterative Methods for Linear Algebra.

Text/Reference Books:

1. Strang, Gilbert,"Introduction to Linear Algebra",4th/5th Edition,Wellesley-Cambridge Press.
2. Axler, Sheldon, "Linear Algebra Done Right", 2nd/3rd edition, Springer.
3. K.Hoffman and R.Kunze, "Linear Algebra", 2nd Edition, Prentice- Hall of India, 2005.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Solve a system of linear equations required for analysing different systems. And apply the different matrix operations.

CO2: Evalute the a linear independence, vector space, subspace, null space and the dimension of a different vector spaces.

CO3: Define norm and orthogonality. And find the orthogonal bases and orthogonal projections; and QR decomposition.

CO4: Apply matrix diagonalization and determine its eigenvalues and eigenvectors, find Singular Value Decomposition and its application in wirless communication.

CO5: Apply linear mapping and least-squares solutions to solve the different engineering problems.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1						2	2	3	2	1
CO2	3	3	2	2	1						2	2	3	2	1
CO3	3	3	2	3	1						2	2	3	3	1
CO4	3	3	2	3	1						2	2	3	3	1
CO5	3	3	2	3	1						2	2	3	3	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATP01	3	-	-	40	60	100	3

WIRELESS COMMUNICATION & NETWORK

Course Objectives:

1. To describe the concepts of wireless Communication and its different types.
2. To Identify recent wireless technologies for wireless communication.
3. To identify different contention free and contention based multiple access techniques.
4. To describe different wireless personal area network , standard and protocols.
5. To describe comprehensive understanding of ad-hoc wireless network.

UNIT-I:

Overview of wireless communication, cellular communication, different generations of Cellular communication system, satellite communication including , wireless local loop ,cordless phone.

UNIT-II:

Recent wireless technologies; multicarrier modulation, OFDM, MIMO system , diversity-multiplexing trade off; MIMO OFDM system; smart antenna; beamforming and MIMO, cognitive radio.

UNIT-III:

Multiple access techniques in wireless communication : contention free multiple access Schemes {FDMA TDMA, CDMA, SDMA and Hybrid}, contention-based multiple access schemes (ALOHA and CSMA).

UNIT-IV:

Wireless personal local area networks{Bluetooth, UWB and ZigBee), wireless local area network,{IEEE 802.11, network architecture, medium access methods, WLAN standards.

UNIT-V:

Ad-Hoc wireless network: Design Challenges in Ad-hoc wireless networks, concept of cross layer design, security in wireless networks MANET and WSN, Wireless system protocols.

Text/Reference Books:

1 Andrea Goldsmith, "Wireless Communications Cambridge University press, 2005.
2. Sanjay Kumar, "wireless communication the fundamental and advanced concepts, River publisher, Denmark ,2015 {Indian reprint}
3. Vijay K Garg , " Wireless communication and Network, Pearson education ,2012
4. Iti Saha Misra," Wireless Communication ,2/e ,MGH,2013.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Visualize the architecture of different types of wireless systems as a means of high speed, high range communication system.
2. Analyze various aspects related to recent wireless technologies.
3. Apply the Multiple access techniques in wireless technologies
4. Analyze various aspects related to wireless personal local area network.
5. Apply various aspects of Ad -hoc wireless network.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3				2			3	3	2	2
CO2	3	3	2	2	3				2			3	3	2	2
CO3	3	3	2	2	3				2			3	3	2	2
CO4	3	3	2	2	3				2			3	3	2	2
CO5	3	3	2	2	3				2			3	2	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATP02	3	-	-	40	60	100	3

INTRODUCTION TO EMBEDDED SYSTEM & IoT

Course Objectives:

1. To introduce the Building Blocks of Embedded System
2. To understand the life cycle and applications of embedded system.
3. To understand the fundamentals about IoT, IoT Access technologies and IoT case studies.
4. To understand the design methodology and different IoT hardware platforms.
5. To study the basics of IoT Data Analytics and supporting services.

UNIT-I: Introduction and functioning: Review of Microcontroller concept. Functional block diagram of 8051 microcontroller. Introduction to Embedded system, characteristic of Embedded system. Functional building blocks of embedded systems, processor and controller.

UNIT-II: Life cycles and Applications: Interfacing of memory between analog and digital blocks, interfacing with external systems, Temperature control, stepper motor and keyboard interface. user interfacing, Embedded Life cycle, Water Fall Model , Spiral Model, RAD Model.

UNIT-III: Introduction to IOT: Definition and characteristics of IoT, Physical design of IoT, Logical design of IoT, IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabling technologies: Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture,Industry, and health and life style.

UNIT-IV: IoT and M2M- Software defined networks, network function virtualization, difference between SDNand NFV for IoT, Basics of IoT System Management with NETCOZF, YANG-NETCONF, YANG, SNMP NETOPEER. Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board details.

UNIT-V: Data Analytics and Supporting Services: Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M, Supporting Services: Computing Using a Cloud Platform for IoT/M2M Applications/Services, Everything as a service and Cloud Service Models.

Text/Reference Books:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton,Jerome Henry,Cisco Press, 2017
2. Internet of Things–A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Univ Press, 2015
3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education.
4. Internet of Things–Key applications and Protocols,O Hersent,D Boswarthick,O Elloumi, Wiley,12

Course Outcome: At the end of the course, students will demonstrate the ability to:

1. Comprehend the basics of Embedded System.
2. Implement the state of the Architecture of an Embedded system.
3. Explain the basics of IoT and Implement the state of the Architecture of an IoT.
4. Analyze the design methodology and hardware platforms involved in IoT.
5. Analyze the acquired data and supporting services related to IoT.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1							3	3		2
CO2	3	2	1	1	2							3	3		2
CO3	3	2	2	1	2							3	3		2
CO4	3	3	2	1	3							3	3		2
CO5	3	3	2	1	3							3	3		2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATP03	3	-	-	40	60	100	3

MICROSTRIP ANTENNA

Course Objectives:

This course will enable student to

1. To introduce the basic concept of Microstrip Antenna
2. To introduce different Microstrip Antenna feeding techniques
3. To learn different parameters of Rectangular Microstrip Antenna
4. To learn the effect of various parameters on performance of Rectangular Microstrip Antenna
5. To develop the concept of antenna design to control different Antenna characteristics

UNIT-I:

Microstrip Antenna- Concept, Various Designs, Advantages, Problems, Applications.

UNIT-II:

Microstrip Antenna feeding techniques- Coaxial feed, Microstrip Line feed, EM Coupled feed, Aperture coupled feed.

UNIT-III:

Rectangular Microstrip Antenna- Resonance Frequency, Characterization, Design Equations, Design Examples.

UNIT-IV:

Effect of various parameters on performance of Rectangular Microstrip Antenna – Feed point location, Effect of width, Effect of thickness, Effect of probe diameter, Effect of Loss tangent, Effect of Dielectric constant.

UNIT-V:

Rectangular Microstrip Antenna : radiation patterns, Dual and circular Polarization, Effect of finite ground plane, Square and Circular Microstrip Antenna characteristics.

Text/Reference Books:

1. Microstrip Antenna Design Handbook, Ramesh Garg, Prakash Bhartia, Inder J. Bahl, A. Ittipiboon
2. Broadband Microstrip Antennas, Girish Kumar, K.P. Ray
3. Microstrip and Printed Antennas: NEW TRENDS, TECHNIQUES AND APPLICATIONS by Debatosh Guha, Yahia M. M. Antar

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Outline the basic concept of Microstrip Antenna
2. Outline the different Microstrip Antenna feeding techniques
3. Apply the Concept of different parameters of Rectangular Microstrip Antenna for its design
4. Apply the Concept of effect of various parameters on performance of Rectangular Microstrip Antenna
5. Apply the Concept of antenna design to control different Antenna characteristics

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1		3								3		2
CO2	3	1	2	2	3								3		2
CO3	3	2	2	1	3								3	2	2
CO4	3	1	1	1	3								3	2	2
CO5	3	1	2	2									3		2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATP04	3	-	-	40	60	100	3

OPTOELECTRONIC DEVICES

Course Objectives:

1. To develop the basic concept of solid state physics and characteristics of light.
2. To develop the concept of luminescence, display devices, laser and their applications.
3. To learn the principle of optical detection mechanism in detection devices.
4. To learn different light modulation techniques and applications of optical switching.
5. To develop the concept of opto electronic integrated circuits in transmitters and receivers.

UNIT-I: WAVE NATURE OF LIGHT AND SOLID STATE PHYSICS:

Wave nature of light, Polarization, Interference, Diffraction, Light Source, Review of Solid State Physics, Review of Semiconductor Physics and Semiconductor Junction Device.

UNIT-II: DISPLAY DEVICES AND LASERS:

Introduction, Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, LED, Plasma Display, Liquid Crystal Displays, Numeric Displays, Laser Emission, Absorption, Radiation, Population Inversion, Optical Feedback, Threshold condition, Laser Modes, Classes of Lasers, Mode Locking, laser applications.

UNIT-III: OPTICAL DETECTION DEVICES:

Optoelectronic detectors: thermal detectors, Photon devices Photo emissive detectors, Photo conductive detectors, Photomultipliers (PMT), Photo diodes PIN & APD, photo transistors, Design of detector arrays, CCD, Solar cells.

UNIT-IV: OPTOELECTRONICS MODULATOR:

Opto Electronic Modulators: Basic principles, Polarization, birefringence. Electro optic effect, EO materials. Kerr modulators, scanning and switching, Magneto Optic Modulators Faraday effect, Accusto Optic Modulators.

UNIT-V: OPTOELECTRONICS INTEGRATED CIRCUITS:

Introduction, hybrid and Monolithic Integration, Application of Opto Electronic Integrated Circuits, Integrated transmitters and Receivers, Guided wave devices.

Text/Reference Books:

1. Opto electronics An introduction J Wilson and J F B Hawkes. (PHI, 1989)
2. Optical fiber communication J M Senior (Pearson, 2nd Ed)
3. Fiber Optics and Optoelectronics – R P Khare, (Oxford University Press, 4th Ed)

REFERENCES:

1. Optical Electronics – Ghattak & Thyagarajan, (Cambridge University Press,1984)
2. Essentials of OptoElectronics – A Rogers, CRC Press, 1st ed,1997
3. Optical fibre communication systems J Gowar (Prentice Hall, 2nd 1995).
4. Semiconductor Optoelectronics – Physics and Technology Jasprit Singh(McGraw Hill, 1995)

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Comprehend the concept of light and solid state physics
2. Analyze the Mechanism of various Display devices and light sources.
3. Distinguish between different detection methods.
4. Analyze various modulators and mechanism.
5. Analyze various type of integrated circuits.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3	1			2			3	3	1	2
CO2	3	3	2	3	3	1			2			3	3	1	2
CO3	3	3	2	3	3	1			2			3	3	1	2
CO4	3	3	2	3	3	1			2			3	3	1	2
CO5	3	3	2	3	3	1			2			3	3	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATP05	3	-	-	40	60	100	3

SOLID STATE DEVICES

Course Objectives:

The objectives of the course are to make the students:

- To develop strong background in semiconductor physics.
- To understand the importance of electrons and holes in semiconductors, the charge density and distribution, the charge transport mechanisms.
- To expose the physics of a p-n junction and semiconductor-metal junctions.
- To identify the internal workings of the most basic solid state electronic devices.

UNIT-I: Introduction: Review of electrons and energy band structures in crystals, density of states, effective density of states, Fermi function, Law of Mass action, Elemental and compound semiconductor, Electron & hole concentration in semiconductor, Temperature dependence of carrier concentration.

UNIT-II: Carrier Transport in Semiconductor: Drift and diffusion currents, Excess carriers in semiconductors-Generation & recombination, Basic equation for semiconductor device operation.

UNIT-III: PN Junctions: Abrupt & linearly graded junctions, V-I characteristics of an ideal diode, a real diode, C-V characteristics of reverse biased p-n junction, Electrical breakdown of a p-n junction in reverse bias- Zener & Avalanche Breakdown, Solar cell.

UNIT-IV: Bipolar Junction Transistor: Structure, Principle of operation, Ideal & real transistor, I-V characteristics, Small signal equivalent circuits, High frequency & switching transistors.

UNIT-V: MOSFETs: Basic operation & fabrication, Ideal MOS capacitor, Threshold voltage, C-V characteristics, I-V characteristics, Short channel MOSFET, Body effect, Subthreshold characteristics, Equivalent circuits, Short Channel effects, GIDL, DIBL.

Text/Reference Books:

1. M. S. Tyagi, Introduction to "Semiconductor Materials and Devices", John Wiley, 2004.
2. B. G. Streetman and S. K. Banerjee, "Solid State Electronic Devices", Prentice Hall India, 2014.
3. D. Neamen, "Semiconductors Physics and Devices", Tata Mc Graw Hill, 2003.
4. N. D. Gupta and A. D. Gupta, "Semiconductor Devices: Modeling and Technology", Prentice Hall, 2007.
5. R. Pierret, "Semiconductor Device Fundamentals", Pearson Education, 2006

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Illustrate energy band structure of crystal and evaluate density of states.

CO2: Analyze carrier transport in semiconductor and basic equation for semiconductor.

CO3: Analyze ideal & real diode and establish I-V & C-V distribution of junction diode.

CO4: Describe the principle and analyze the operation of ideal & real bipolar junction transistor and their characteristics.

CO5: Analyze the operation of MOSFET and evaluate MOSFET performance at scaled gate lengths.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	2				3			3	3		2
CO2	3	3	1	1	2				3			3	3		2
CO3	3	3	1	1	2	1			3		1	3	3		3
CO4	3	3	1	1	2	1			3		1	3	3		3
CO5	3	3	1	1	2	1			3		1	3	3		3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATP06	3	-	-	40	60	100	3

ANTENNA FOR MODERN WIRELESS COMMUNICATION

Course Objectives:

1. To understand the concept of radiation and characterizing parameters of Antenna
2. To get the knowledge of working principles of modern Antennas
3. Design the array of Antenna for modern communication
4. To perform analysis of MIMO key technology of 4G/5G System
5. To get the knowledge and design of Antennas for modern wireless system.

UNIT-I:

Concepts of Radiation and Antenna Fundamentals: Fundamental parameters of antennas, Near and Far Field regions, S Parameters, Antenna Measurements: Radiation pattern, Gain, directivity and polarization measurement.

UNIT-II:

Printed Antenna: Microstrip Antennas & Dielectric Resonator Antenna: Radiation mechanism - parameters and applications - feeding methods.

UNIT-III:

Array of Antennas: Linear and planar array fundamentals, Mutual Coupling in Arrays, Multidimensional Arrays, Phased Arrays, Array Feeding Techniques, Array optimization techniques.

UNIT-IV:

MIIMO System: Concept of Diversity, Introduction of MIMO, Types of MIMO Systems, Design parameters of MIMO system.

UNIT-V:

Antennas for Modern Wireless System: Antennas for space applications, Antennas for 5G System, Reconfigurable Antenna:Reconfigurable methodologies, Design Considerations for Reconfigurable systems, Concept of Smart Antenna.

Text/Reference Books:

1. Jordan E C and Balmain K G, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Pearson Education, 2015.
2. Balanis C A, "Antenna Theory: Analysis and Design", 4th Edition, John Wiley and Sons, NewJersey, 2016.
3. Kraus J D and Marhefka R J, "Antennas for All Applications", 3rd. Edition, Tata McGraw Hill, 2002.
4. Girish Kumar and Ray K P, "Broadband Microstrip Antennas", Artech House, 2003

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Measurement of Antenna's parameters
2. Analyze the suitable antennas for Modern Wireless Communication
3. Evaluate array of Antenna to meet the requirement of Modern Wireless Communication
4. Apply analysis of key technology of 4G/5G wireless system
5. Evaluate antennas for various applications of modern wireless communication

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		3							2	3	2	2
CO2	3	2	2	2	3							2	3	2	2
CO3	3	3	2	1	3							2	3	2	2
CO4	3	2	3	3	3							2	3	2	3
CO5	3	1	2	3								2	3		3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATP07	3	-	-	40	60	100	3

ANALOG CMOS VLSI DESIGN

Course Objectives:

- To demonstrate the ability to analyze and design the basic & advance analog integrated circuit.
- To gain knowledge of strengths and weaknesses of basic CMOS circuit building blocks and feedback concepts
- To develop skills in designing CMOS operational amplifier and reference circuits.
- To study the frequency response of the amplifier.
- To design analog IC circuits for a given specification.

UNIT-I: Basic MOSFET Physics: General consideration, MOS I/V characteristics, second order effects and MOS small & large signal models.

UNIT-II: CMOS Amplifier and Current Sources: Single Stage Amplifier: CS stage with resistance load, Diode connected load, Current source load, Triode load, CS stage with source degeneration, Source follower, Common-gate stage, Cascade stage, current sources, Basic current mirrors, Cascode current Mirrors, Active current Mirrors.

UNIT-III: Operational Amplifiers Design: Basic difference pair, Common mode response, Differential pair with MOS loads, Gilbert cell, Performance parameters, Design of 2-stage MOS operational amplifier, Gain boosting, Slew rate, Offset effects, PSRR, Stability and Frequency compensation.

UNIT-IV: Frequency Response and Feedback Amplifiers: Miller effect, Frequency response of all single stage amplifiers and Cascade stage, General consideration of feedback circuits, Feedback topologies, Effect of loading.

UNIT-V: Voltage References and Noise: Different configurations of voltage references, Major issues, Supply independent biasing, Temperature independent references, Types of noise, Analysis and representation of noise in single stage amplifiers, cascode stage and Noise in differential pairs.

Text/Reference Books:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata Mc Graw-Hill,2001.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", 5th Edition, Wiley, 2009
3. Phillip Allen and Douglas R. Holberg, "CMOS analog Circuit Design", 3rd Edition, Oxford University Press, USA, 2011.
4. T. Carusone, D. Johns, K. Martin, Analog Integrated Circuit Design, 2nd Edition, Wiley, 2011.

Course Outcome: At the end of the course, students will demonstrate the ability to:

CO1. Realize the concepts of analog IC design including small & large signal models.
CO2. Design different configuration of amplifiers for a given specification & current sources.
CO3. Illustrate the concept of op-amp and its design parameters and application.
CO4. Analyze the characteristics of frequency response of the amplifier and comprehend the feedback topologies.
CO5: Design band gap reference circuits providing constant dc voltage and immune to temperature variations and noise.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1			1			2	3	1	1
CO2	3	3	2	1	1	1			1			2	3	2	2
CO3	3	3	2	1	1	1			1			2	3	1	1
CO4	3	3	2	1	1	1			1			2	3	1	1
CO5	3	3	2	1	1	1			1			2	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATP08	3	-	-	40	60	100	3

DIGITAL IMAGE PROCESSING

Course Objectives:

- To provide fundamental knowledge on digital image processing.
- To develop the ability to understand and implement various digital image processing algorithms.
- To facilitate the students for analyze and implementing various real-time digital image processing applications.

UNIT-I: Image Representation and Image Processing Paradigm: Image, Elements of Image perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels

Image Enhancements: Point operations, Arithmetic operations, Logical operation, Gray level transformations, histogram equalization, histogram specifications, pixel-domain smoothing filters, pixel-domain sharpening filters, two-dimensional DFT and its inverse, and Cosine transform.

UNIT-II: Image Filtering and Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.

UNIT-III: Color Image Processing: Color models, Color transformations, Color image smoothing and sharpening; Color Segmentation. **Wavelets and Multi-resolution image processing**- Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub-band filter banks, wavelet packets.

UNIT-IV: Image Compression: Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression- predictive and transform coding; Still image compression standards – JPEG and JPEG-2000.

UNIT-V: Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding, region-based segmentation, Segmentation Using Morphological Watersheds.

Text/Reference Books:

1. Rafael C. Gonzalez, R E. Woods, Digital Image Processing, 3rd Edition, Pearson Ed 2010
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall,2nd ed 2011
3. William K. Pratt, Digital Image Processing, 4th edition, John Wiley, 2007.
4. John C. Russ, The Image Processing Handbook, 6th edition, CRC Press,2011
5. Maria M. P. Petrou, C Petrou, Image Processing: The Fundamentals, 2nd Ed, Wiley 2010

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Acquire the knowledge of basic image processing concepts and image enhancement techniques involved.
2. Demonstrate the image restoration process and its respective filters required.
3. Illustrate the color image processing and various multi-resolution techniques
4. Interpret the various image compression techniques and their applications.
5. Design the various image segmentation operations for a meaningful partition of objects.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1			1		2	1	1	1
CO2	3	3	3	3	3	1	1			1		2	2	2	2
CO3	3	3	3	3	3	1	1			1		2	3	2	2
CO4	3	3	3	3	3	1	1			1		2	3	2	2
CO5	3	3	3	3	3	1	1			1		2	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATP09	3	-	-	40	60	100	3

MODERN DIGITAL COMMUNICATION

Course Objectives:

1. Understand and appreciate the need of various modulation and spread spectrum techniques.
2. To introduce the properties of basic Modulation techniques and apply them to Digital Communication
3. To understand coding techniques to design the optimum receiver for channels with ISI and AWGN.
4. To introduce the different types of modulation techniques, equalizer to improve the performance under fading channels for various applications.
5. To introduce Spread Spectrum Signals for Digital Communication.

UNIT-I:

Baseband Modulation and Transmission: Line coding - types, criterions for choosing a line code, power spectra. Matched filter – maximization of output SNR, properties, RF and baseband design, integrate and dump filter. Signal space representation, Gram-Schmidt orthogonalization, correlation receiver, equivalence of matched filter and correlation receiver. Baseband transmission of digital signal, eye pattern, intersymbol interference, Nyquist criterion for zero ISI. Pulse Shaping - raised cosine filtering. Correlative coding – duobinary coding, modified duobinary coding, generalized partial response signalling.

UNIT-II:

Passband Transmission: Signal space and mathematical representation, transmitter, receiver (coherent and non coherent detection), Carrier modulation – Linear modulation schemes: M-ary ASK, PSK, QAM, FSK etc. Nonlinear Modulation schemes: CPFSK, MSK, GMSK. Non coherent modulations schemes: DPSK Spectral properties of various modulation schemes and their comparison. probability of error for various modulation schemes in AWGN channel. Clock and carrier recovery, synchronization issues.

UNIT-III:

Optimum receivers: channels with ISI and AWGN, linear equalization and decision feedback equalization, adaptive linear and adaptive decision feed back equalizer.

UNIT-IV:

Error Control Codes: Examples of the use of error control codes, basic notions, Characterization of Error control codes performance of error control codes, comparison of uncoded and coded systems. Linear Block Codes, Cyclic Codes. Convolution Coding, Representation, properties of convolution codes, Reed Solomon coding, Interleaving and concatenated codes, Turbo Codes.

UNIT-V:

Spread Spectrum Signals for Digital Communication: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, Frequency hopped spread spectrum signals, CDMA, Time hopping SS, Synchronization of SS systems.

Text/Reference Books:

1. Bernard Sklar, "Digital Communication, Fundamentals and Application", Pearson Education Asia, 2nd Edition, 2001.
2. Simon, Hinedi, Lindsey, "Digital Communication Techniques, Signal Design and Detection", Prentice Hall of India Private Limited, New Delhi - 11, 1999.
3. John .G.Proakis, "Digital Communication", McGraw Hill Inc 2001.
4. Simon Haykin, "Digital Communications", John Wiley and Sons, 1998.
5. B.P.Lathi, "Modern Digital and Analog and communication systems", 3rd Edition Oxford university press 1998.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Represent Line coding and baseband data transmission over AWGN and band-limited channels

2. Apply and explain different digital modulation schemes and Passband data transmission
3. Analyze the performance of optimum receivers for different modulation schemes for AWGN channels
4. Apply different error control coding for secure and error-free communication.
5. Explain the concepts of spread spectrum for digital communication system.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	1							2	3	2	2
CO2	3	3	1	2	3							2	3	2	2
CO3	3	3	1	2	3							2	3	2	2
CO4	3	3	1	2	3							2	3	2	2
CO5	3	2	1	1	1							2	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATP10	3	-	-	40	60	100	3

NETWORK SECURITY & CRYPTOGRAPHY

Course Objectives:

- To provide deeper understanding into cryptography, its application to network security, threats/vulnerabilities to networks and countermeasures.
- To explain various approaches to Encryption techniques, strengths of Traffic Confidentiality, Message Authentication Codes.
- To familiarize Digital Signature Standard and provide solutions for their issues.
- To familiarize with cryptographic techniques for secure communication of two parties over a public channel; verification of the authenticity of the source of a message.
- Understand Intrusions and intrusion detection.
- Generate and distribute a PGP key pair and use the PGP package to send an encrypted email message.
- Discuss Web security and Firewalls

UNIT-I:

INTRODUCTION:

Security trends, The OSI Security Architecture, Security Attacks, Security Services and Security Mechanisms, A model for Network security. CLASSICAL ENCRYPTION TECHNIQUES: Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques, Rotor Machines, Stenography**.** key range and key size, possible types of attacks.

UNIT-II:

BLOCK CIPHER AND DATA ENCRYPTION STANDARDS: Block Cipher Principles, Data Encryption Standards, the Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles.

Analysis, Block Cipher Design Principles.

ADVANCED ENCRYPTION STANDARDS: Evaluation Criteria for AES, the AES Cipher. MORE ON SYMMETRIC CIPHERS: Multiple Encryption, Triple DES, Block Cipher Modes of Operation, Stream Cipher and RC4

UNIT-III:

Introduction to Number Theory Principles of public key cryptosystems, RSA Algorithm, Key management, Diffie-Hellman key exchange algorithm, Elliptic Curve Cryptography (ECC).

AUTHENTICATION AND HASH FUNCTION: Authentication requirements – Authentication functions Message Authentication Codes – Hash Functions – Security of Hash Functions and MACs, MD5 message Digest algorithm, Secure Hash Algorithm, RIPEMD, HMAC Digital Signatures, Authentication Protocols – Digital Signature Standard.

UNIT-IV:

NETWORK AND SYSTEM LEVEL SECURITY:

Authentication Applications: Kerberos – X.509, Authentication Service, Electronic Mail Security – PGP – S/MIME - IP Security – Web Security, Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems, Hardware trojan.

UNIT-V:

WEB SECURITY: Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET), Intruders, Viruses and related threats.

FIREWALL: Firewall Design principles, Trusted Systems.

Text/Reference Books:

1. Cryptography and Network Security: Principles and Practice by William Stallings, Pearson Education.
2. Cryptography: Theory and Practice by D Stinson, Chapman & Hall.
3. Network Security by C. Kaufman, R. Perlman and M. Spenser, Prentice Hall of India.
4. Internet Security and Firewalls by S. Bellovin and W. Chesvick, Addison-Wesley, Reading.
5. Introduction to Cryptography with Coding Theory by Wade Trappe and Lawrence C.

Washington, Prentice-Hall.
6. Cryptography & Network Security by Behrouz A. Forouzan, McGraw Hill Education

Course Outcome:

At the end of the course, students will demonstrate the ability to:
CO1: Apply block cipher and stream cipher algorithms.
CO2: Employ Public key cryptographic techniques .
CO3: Explain the authentication and hash algorithms .
CO4: Analyze the digital signature concepts and applications .
CO5: Apply the Network and System level security measures

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			1	2						3	3	1	1
CO2	3	2			1	2						3	3	2	2
CO3	3	2										3	3	2	2
CO4	3	2	2	2	1							3	3	2	2
CO5	3	2			1	2						3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATP11	3	-	-	40	60	100	3

INTRODUCTION TO SIGNAL PROCESSING

Course Objectives:

The objectives of the course are to make the students:

1. Review of signal and system, Fourier transforms, the Z-transform
2. To impart knowledge of mathematical concept involved in signal processing.
3. To introduce mathematical modeling for Statistical Signals processing.
4. To apply optimization techniques for signal processing applications.

UNIT-I: Discrete and Continuous time signals and systems, LTI systems, Convolution, z-transforms, Fourier transform and its properties.

UNIT-II: Sampling and reconstruction, Review of vector spaces, Eigenvectors and Eigen-values. Hilbert transforms, matched filtering, equalization. Coherent and Non-coherent detection.

UNIT-III: Probability theory review, Random variables, statistical averages, Random processes, Transmission of random process through an LTI system.

UNIT-IV: Statistical Signal Processing: Power Spectrum Estimation Parametric and Maximum Entropy Methods, Wiener, Kalman Filtering, and the Poisson process, Levinson Durbin Algorithms Least Square Method.

UNIT-V: Optimization techniques for linear and nonlinear problems, Applications in various areas of signal processing.

Text/Reference Books:

1. Proakis, John G. - Digital signal processing: principles algorithms and applications, PHI.
2. Oppenheim, Alan V - Discrete-time signal processing, Pearson Education India.
3. Vaidyanathan, Parishwad P - Multirate systems and filter banks, Pearson Education India.
4. Monson H. Hayes, "Statistical Digital Signal Processing And Modeling", 1st Edition, Wiley India Pvt Ltd, 2008.
5. Vaidyanathan, Palghat P- The theory of linear prediction, Morgan and Claypool Publishers.
6. Haykin, Simon S. - Adaptive filter theory, Pearson Education India.
7. Henry Stark and John W. Woods, "Probability and Random Processes with Applications to Signal Processing", Prentice Hall, 3rd Edition 2001
8. Sanjit K. Mitra. " Digital Signal Processing: A computer based approach." McGraw Hill. 1998.
9. Steven M. Kay, "Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory", Prentice Hall, 1993

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Apply the basic concept of frequency domain analysis for signal processing.
2. Utilize the linear analysis concept for signal processing.
3. Describe and apply probability theory concept for random signals.
4. Apply basic statistical signal processing filtering techniques.
5. Design and Demonstrate basic optimization techniques for the applications based on signal processing.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1						3	3	1	2
CO2	3	3	3	2	1	1						3	3	1	2
CO3	3	3	3	2	1	1						3	3	2	2
CO4	3	3	3	2	1	1						3	3	2	2
CO5	3	3	3	2	1	1						3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATP12	3	-	-	40	60	100	3

SATELLITE COMMUNICATION

Course Objectives:

1. recall the basic concepts, frequency allocations and applications of satellite communication system
2. To know the role of different factors affecting satellite and link budget equation.
3. explain satellite sub system .
4. compare various multiple access schemes used in satellite communications.
5. To know the basics and details of Earth station

UNIT-I:

An overview of satellite communication, Satellite orbits, Kepler's law, Orbital Elements, Eclipse effect, Sun transit outage, Placement of a satellite in a geostationary orbit, Station keeping and Stabilization.

UNIT-II:

Satellite Link Design: Basic transmission theory, Friss transmission equation, EIRP, Completion Link design, System noise temperature G/T ratio, Noise figure and Noise temperature.

UNIT-III:

Communication Satellite Subsystems: Space Platform (Bus) and Communication Subsystem (Payload), Satellite Antennas, Frequency reuse Antennas.

UNIT-IV:

Earth Stations: Earth station antennas, Tracking, Equipment for earth stations, Equipment Reliability and Space qualification.

UNIT-V:

Analogue Satellite Communication Vs Digital Satellite Communication, Multiple Access Techniques : FDMA Concept, MCPC & SCPC, TDMA frame efficiency and super frame structure, Frame Acquisition and Synchronisation, CDMA concept, PN system, Spread spectrum, DSSS, DS CDMA, FHSS, FH CDMA.

Text/Reference Books:

"1. "Satellite Communication", T. Pratt & C. W. Bostian.
2. "Digital Satellite communication", Tri T. Ha, McGraw Hill.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget.
3. Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.
4. Explain how satellite is controlled to become stationary w.r.t a point on the earth.
5. Explain how a single satellite is shared by large number of earth stations on the earth by using multiple access schemes

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1									2	3		1
CO2	3	3	1									2	3		1
CO3	3	3	2	2								2	3		1
CO4	3	2	1									2	3		3
CO5	3	2	1									2	2		1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPATC01	2	-	-	-	50	50	2

RESEARCH METHODOLOGY & IPR

Course Objectives:

1. To understand the objectives, motivation, and significance of research.
2. To enable the students to prepare report writing and framing Research proposals.
3. To understand the concept and importance of IPR.

UNIT-I:

Research Methodology: Meaning, objectives, and Motivation of research, types of research, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, identification and definition of the research problem, Research Process, Criteria of Good Research, Research Ethics, Problems Encountered by Researchers in India.

UNIT-II:

Literature Survey and Data Collection: literature survey and its necessity, Sources of information, Effective literature studies approach, Data collection: primary and secondary data, sources of data, collection of primary data through observation, interview, questionnaire, and schedule methods, and Collection of secondary data.

UNIT-III:

Interpretation and Report Writing: Meaning, techniques, and precautions of interpretation, Significance of Report writing, different steps in writing report, the layout of the research report, types of report, mechanics of writing a research report, Precautions for writing research,

UNIT-IV:

Intellectual Property Rights: Introduction to IPRs, Basic concepts and need for Intellectual Property, Patents, Trademarks, and Copyright, Nature of Intellectual Property**,** technological research, innovation, Important examples of IPR**,** International Scenario: International cooperation on Intellectual Property, Role of WIPO and WTO in IPR establishments

UNIT-V:

Patents: objectives and benefits of patent, Benchmarks for patentability of inventions, Process of Patenting and Development: technological research, innovation, patenting, development, procedure for grants of patents, Patenting under PCT.

Text/Reference Books:

1. Research Methodology – Methods and Techniques, C K Kothari, New Age International.
2. Research in education, By J W Best and J V Kahn, Pearson/ Allyn and Bacon.
3. Management Research Methodology: Integration of Principles, Methods and Techniques, K N Krishnaswamy, A I Sivakumar and M Mathiranjan, Pearson Education.
4. Fundamentals of IP for Engineers, K.Bansal & P.Bansal.
5. Intellectual property right- The Law of Trademarks, Copyrights, Patents and Trade Secrets, Deborah, E. BoDcboux, Cengage learning.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Comprehend the basics of research methodology.
2. Prepare a literature review and collect the data for research.
3. prepare report writing and framing Research proposals
4. Identify the need of IPR for economic growth and social benefits
5. Identify the significance of practice and procedure of Patents

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1		2						1		2	3	2	2
CO2	3							3	2	3		2	2		2
CO3	3							3	2	3		2	2		2
CO4	3	2	1									2	2		2
CO5	3	2	1					1	1	2		2	2		2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPALT01	-	-	4	30	20	50	2

ADV SIMULATION LAB

Course Objectives:

1. Apply different parameters to solve for channel capacity.
2. Understand and compare different multiple access techniques.
3. Analyse and plot the results.

List of experiments:

1. Programme to calculate SNR using channel capacity theorem.
2. Programme to calculate Channel capacity for variable SINR and its plot using channel capacity theorem.
3. Programme to show relationship between E_b/N_0 and SINR and its plot.
4. Programme to calculate channel capacity of FDMA system and its plot.
5. Programme to calculate channel capacity of TDMA system and its plot.
6. Programme to calculate channel capacity of CDMA system and its plot.
7. Programme for comparison of channel capacity of FDMA,TDMA and CDMA systems and its plot.
8. Programme to calculate channel capacity of latest mobile communication system and its plot.
9. Programme to calculate spectral efficiency of latest mobile communication system and its plot.
10. Programme to calculate energy efficiency of latest mobile communication system and its plot.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Demonstrate the concept of channel capacity of wireless system.
2. Analyze SINR and other parameters for channel capacity of wireless communication system.
3. Analyze the different multiple access techniques for wireless system.
4. Analyze the spectral efficiency for latest cellular network
5. Analyze the energy efficiency for latest cellular network

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1							3	3	1	3
CO2	3	3	1	1	1							3	3	1	3
CO3	3	3	1	1	1							3	3	1	3
CO4	3	3	1	1	1							3	3	1	3
CO5	3	3	1	1	1							3	3	1	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBTT01	3	-	-	40	60	100	3

ESTIMATION AND DETECTION THEORY

Course Objectives:

- To teach students the basics of estimation and detection theory.
- To introduce the students to estimation bounds.
- To introduce classical and Bayesian estimators like ML, LS, and MMSE to students.
- To teach hypothesis testing and a number of detectors of signals in noise. And to introduce the likelihood ratio test and GLRT.
- Exposing the students to applications of estimation and detection is another important goal.

UNIT-I: Introduction: Recap of probability and linear algebra, Introduction of estimation in signal processing, Minimum variance unbiased estimation, Unbiased estimators, Minimum variance criterion, Existence of minimum variance unbiased estimator, Cramer-Rao lower bound (CRLB), scalar parameters, Signal in white Gaussian noise.

UNIT-II: Linear model and Estimation: Linear models, General minimum variance unbiased estimation, Sufficient statistic, finding minimum variance unbiased estimators, Best linear unbiased estimators (BLUE), Finding the BLUE, Signal processing example.

UNIT-III: Likelihood Estimation: Maximum Likelihood estimators (MLE), finding the MLE, Properties of the MLE, MLE for transformed parameters, Extension to a vector parameter, Introduction to Least Square (LS) Approach, Linear least square estimation, Geometrical interpretations of LS estimation, Some examples.

UNIT-IV: Bayesian Estimation: Bayesian estimators, Priors and Posteriors probabilities, Choosing a Prior PDF, General Bayesian estimators, Minimum mean square estimators (MMSE), Maximum A Posteriori (MAP) Estimators, Linear MMSE Estimation.

UNIT-V: Detection and Decision: Basics of statistical decision theory, Simple hypothesis testing, Likelihood ratio testing, Neyman-Pearson detectors, Detection of known signals in noise, Composite hypothesis testing, Generalized likelihood ratio tests (GLRTs), Deterministic signals with unknown parameters.

Text/Reference Books:

1. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory, vol. I" Prentice-Hall, 1993 & "vol. II" Prentice-Hall, 1998.
2. H. Vincent Poor, "An Introduction to Signal Detection and Estimation" Springer, 2nd Ed, 1998
3. H. L. Van Trees, "Detection, Estimation, and Modulation Theory, Part I," John Wiley, 1968

Course Outcome: At the end of the course, students will demonstrate the ability to:

CO1: Explain the principle of estimation and detection.
CO2: Learn different estimation and detection techniques like ML, LS, MMSE.
CO3: Solve problems that involve estimation of the signal parameters or detection of the presence of a signals.
CO4: Evaluate the performance of different estimation technique in different setups.
CO5: Apply these skills to solve problems with practical context.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2							3	3	2	2
CO2	3	3	3	3	3							3	3	2	2
CO3	3	3	3	3	3							3	3	2	2
CO4	3	3	3	3	3							3	3	2	2
CO5	3	3	3	3	3							3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBTP01	3	-	-	40	60	100	3

LOW POWER VLSI DESIGN

Course Objectives:

- To understand the low power low voltage VLSI design.
- To understand the impact of power on system performances.
- To realize different design approaches.
- To identify suitable techniques to reduce power dissipation in the circuits.

UNIT-I:

Introduction: Need for Low Power VLSI chips, Low power application, Low power design methodology, Basic principal of low power design, Low power figure of merits, Sources of Power dissipation: Dynamic, Short-circuit, Glitching and Leakage power dissipation, The load capacitance.

UNIT-II:

Supply Voltage Scaling for Low Power: Introduction, Device feature size scaling, Architectural-level approaches, Multilevel voltage scaling and challenges, Dynamic voltage and frequency scaling.

UNIT-III:

Switching Capacitance Minimization: Dynamic voltage and frequency scaling, Bus encoding, clock gating, Gated-clock FSM, Glitching power minimization, Logic style for low power, some related techniques for dynamic power reduction.

UNIT-IV:

Leakage Power Minimization: Fabrication of multiple threshold voltages, VTCMOS approach, Transistor stacking, MTCMOS approach, Power gating, DTCMOS, Dynamic V_{th} scaling.

UNIT-V:

Special Techniques: Low power clock distribution, Single driver Vs distributed buffers, Various clock distribution networks, Power reduction in clock networks, Low power bus, CMOS floating nodes, and Adiabatic logic.

Text/Reference Books:

1. Ajit Paul, "Low Power VLSI Circuits & Systems", Springer, 2015.
2. Kaushik Roy, Sharat Prasad, "Low power CMOS VLSI circuit design", John Wiley sons Inc.,2000.
3. Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998.
4. J. B. Kulo and J. H. Lou, "Low voltage CMOS VLSI Circuits", Wiley, 1999.
5. A. P. Chandrasekaran and R. W. Broadersen, "Low power digital CMOS design", Kluwer, 1995.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Identify sources of power dissipation in VLSI systems.

CO2: Understand how to apply techniques at the device, circuit and architectural level to reduce power dissipation in an electronic design.

CO3: Illustrate and design switching capacitance & leakage power minimization techniques low voltage low power applications.

CO4: Learn and design special techniques for various low voltage low power applications.

CO5: Design and implementation of various structures for low power applications.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1			1	1		2	3	1	2
CO2	3	3	2	1	1	1			1	1		2	3	1	2
CO3	3	3	3	1	1	1			1	1		2	3	3	2
CO4	3	3	3	1	1	1			1	1		2	3	3	2
CO5	3	3	1	1	1	1			1	1		2	3	1	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBTP02	3	-	-	40	60	100	3

ADV DIGITAL SIGNAL PROCESSING

Course Objectives:

The objectives of the course are to make the students:

1. To impart knowledge about the sampling/reconstruction of signals and their analysis in the frequency domain
2. To introduce the fundamental concepts for filter designs, and multi-rate processing.
3. To enable the students to understand the efficient algorithms and their use in real-time implementation

UNIT-I:

Multirate Digital Signal Processing: Decimation and Interpolation, Applications of multirate signal processing, Digital filter banks, two-channel quadrature mirror filter banks.

UNIT-II:

Linear prediction and Optimum Linear Filters: Random signals, Stationary Random Process. Forward and Backward Linear Prediction, The Levinson-Durbin Algorithm. Properties of the Linear Prediction-Error Filters.

UNIT-III:

Adaptive filters: Applications of Adaptive Filters-Adaptive Channel Equalization, Adaptive noise cancellation, Linear Predictive coding of Speech Signals, Adaptive direct form filters.

UNIT-IV:

Power Spectrum Estimation:

Parametric and Non parametric Methods for Power Spectrum Estimation, Methods for the AR Model Parameters, ARMA Model for Power Spectrum Estimation.

UNIT-V:

Wavelet Transform: Origin of Wavelets, Wavelets and other reality transforms History and future of wavelets, Short Time Fourier Transform, Continuous Wavelet, and Discrete Wavelet Transform.

Text/Reference Books:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", Pearson, Fourth edition, 2007.
2. S. Haykin, "Adaptive Filter Theory" Prentice Hall, Englewood Cliffs, NJ, 1991.
3. K P Soman, Ramachandran, Resmi, "Insight into Wavelets- from Theory to Practice", PHI, Third Edition, 2010.
4. P.P.Vaidyanathan, "Multi rate systems and filter banks", Prentice Hall, 1993.
5. Mallet,"A Wavelet tour of Signal Processing", Academic Press, 1998

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Apply knowledge of Multi-rate signal processing and the concept of decimators and interpolators.
2. Analyze the signals using prediction-based filtering
3. Design adaptive filters for a given application
4. Implement various estimation algorithms for signal analysis
5. Understand advanced signal processing techniques, including wavelet transform

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1						3	3	2	2
CO2	3	3	3	2	1	1						3	3	2	2
CO3	3	3	3	2	1	1						3	3	2	2
CO4	3	3	3	2	1	1						3	3	2	2
CO5	3	3	3	2	1	1						3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBTP03	3	-	-	40	60	100	3

OPTICAL INSTRUMENTATION

Course Objectives:

- To understand the measuring methods and instruments of electrical quantities.
- To understand the concept of optical instrumentation.
- To get the concept of optical switching and various instruments.
- To get the concept of optical fiber sensors.
- To get the measurement concept of optical instrumentation.

UNIT-I:

Performance characteristics of instruments: Static characteristics, accuracy, resolution, precision, expected value, error and sensitivity. Errors in measurement and dynamic characteristics: speed of response, fidelity, lag and dynamic error.

UNIT-II:

Optical Instruments: basic principles, interferometric configurations, MachZender, Michelson and FabriPerot configurations components and construction, OTDR and applications.

UNIT-III:

Fiber optic components and devices : Direction couplers, beam splitters, switches modulations, connectors, couplers, polarizer, polarization controllers, amplifiers, wavelength filters, polarizing beam splitters, wavelength division multiplexers, fiber optic isolators.

UNIT-IV:

Fibre optic sensors : general features, types of OFS, intrinsic and extrinsic sensors, intensity sensors, shutter based multimode OFS, simple fibre based sensors for displacement, temperature and pressure. Fibre Bragg grating based sensors.

UNIT-V:

Measurements methods in optical fiber : General experimental consideration, measurement of refractive index profile, numerical aperture, attenuation, pulse dispersion and bandwidth, Cut off wavelength, mode field diameter and birefringence of single mode fiber.

Text/Reference Books:

1. B. P. Pal : Fundamentals of Fibre Optics in Telecommunication and Sensor Systems, New Age, New Delhi.
2. A. K. Ghatak and K. Thyagarajan, Introduction to Fiber Optics, Cambridge.
3. S.M. Senior : Optical Fibre Communication: Principles and Practice, PHI, New Delhi.
4. A.K.Ghatak, M.R. Shenoy : Fibre Optics Measurements, Viva, New Delhi.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

- Explain the measuring methods and instruments of electrical quantities.
- Apply the concept of optical instrumentation.
- Analyze the concept of optical switching and various instruments.
- Explain the concept of optical fiber sensors.
- Demonstrate the measurement concept of optical instrumentation.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	3	1							3	2	2	
CO2	2	2	1	3	2							3	2	2	
CO3	3	2	3	3	2							3	2		3
CO4	3	2	1	2	3							3	2		2
CO5	3	2	1	2	3							3	2	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBTP04	3	-	-	40	60	100	3

PATTERN RECOGNITION & MACHINE LEARNING

Course Objectives:

1- To study the fundamentals of pattern recognition.
2- To study the various parameter based estimation methods.
3- To study some dimensionality reduction methods.
4- To study the fundamentals of artificial neural networks.
5- To be able to choose and apply algorithms for pattern recognition.

UNIT-I:

Introduction to statistical pattern recognition, Bayes Decision Theory: Minimum-error-rate classification. Classifiers, Discriminant functions, Decision surfaces. Discrete features.

UNIT-II:

Parameter Estimation Methods: Maximum-Likelihood estimation, Bayesian estimation, Unsupervised learning and clustering - Criterion functions for clustering. Algorithms for clustering: K-Means, Hierarchical and other methods. Cluster validation.

UNIT-III:

Gaussian mixture models, Expectation-Maximization method for parameter estimation. Hidden Markov Models (HMMs). Discrete HMMs. Continuous HMMs.

UNIT-IV:

Dimensionality reduction: Principal component analysis - relationship to eigen analysis. Fisher discriminant analysis - Generalised eigen analysis.

UNIT-V:

Artificial neural networks: Multilayer perceptron - feedforward neural network. A brief introduction to deep neural networks, convolutional neural networks, recurrent neural networks.

Text Books:

1. J.I. Tou & R C Gonzalez, Pattern Recognition Principles, Addition-Wesley.
2. R Schalkoff, Pattern Recognition- Statistical, Structural and Neural Approaches, John Wiley, 1992.

Reference Books

1. P A Devijer & J Kittler, Pattern Recognition – A statistical Approach, Prentice Hall
2. R O Duda, P E Hart, D G Stork, Pattern Classification, Wiley Publication 2001.
3. D Mckay, Information Theory, Inference and Learning Algorithms, Cambridge University Press 2003.
4. C M Bishop, Pattern Recognition and Machine Learning, Springer, 2006
5. Christopher M Bishop, Pattern Recognition and Machine Learning, Springer, 2006

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Summarize the various techniques involved in pattern recognition
CO2: Ability to analyse the various parameter based estimation methods.
CO3: Illustrate the artificial neural network based pattern recognition
CO4: Discuss the applications of pattern recognition in various applications
CO5: Apply to choose and evaluate suitable algorithm given the application.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	-	-	-	-	-	-	2	3	1	2
CO2	3	3	3	2	1	2	-	-	-	-	-	2	3	2	2
CO3	3	2	2	1	2	2	-	-	-	-	-	2	3	2	2
CO4	3	3	3	2	3	2	-	-	-	-	-	2	3	1	3
CO5	3	2	3	1	2	2	-	-	-	-	-	2	3	1	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBTP05	3	-	-	40	60	100	3

OPTICAL COMMUNICATION SYSTEM

Course Objectives:

- To understand the transmission mechanism of optical fiber communication system .
- To understand the working of light source.
- To introduce the concept of optical detector and various parameter associated with it.
- To get the concept of design of system link and its characteristics.
- To introduce the concept of optical fiber cable and working principle of amplifier

UNIT-I: Introduction to Guided optical communication system : Review of Unguided optical communication system, Guided optical communication, Elements of an Optical Fiber Transmission System. Optical Fibres Types, Materials, Fabrication techniques. Signal degradation Attenuation, Signal Distortion.

UNIT-II: Sources for communication: Review of LED – modulation circuits: analog & digital. Laser Diode – Structure, modulation analog & digital circuits. Opto mechanical switches, Photonic & digital switches.

UNIT-III: Detectors for communication: Noise in PIN diode, Noise Sources, Principal Noises thermal noise, dark current noise, quantum noise, receiver noise, noise in APD receiver. Receiver configurations: Receiver noises preamplifiers, Low impedance, High impedance, Trans impedance amplifiers.

UNIT-IV: System design considerations: multiplexing, OTDM, WDM. Digital systems: regenerative repeaters, Point to point Link s Link Power Budget Analysis, Rise Time Budget Analysis. Line coding: NRZ codes, RZ codes, block codes. Analog Systems: Sub carrier multiplexing. Coherent systems homodyne and heterodyne detection.

UNIT-V: Optical fiber cable componenets and amplifier. Optical Fiber Cables, Fiber Connectors, Joints, Splicers, Couplers, , Fiber amplifiers : Types, Semiconductor Laser Amplifier, Erbium doped fiber amplifier, Raman Fiber Amplifier, Brillowin fiber Amplifier, Solitons Communication.

Text/Reference Books:

1. Optical Fiber Communication G Keiser (4th Ed, TMH)
2. Optical Fiber Communications J M Senior (Pearson Publication)
3. Introduction to Optical Fibre Communication Suematsu and Iga, (John Wiley)
4. Fiber Optic Communication – Joseph C Palais, (PHI)
5. Optical Communication Components and Systems – J H Franz, V K Jain (Narosa Pub House)
6. Optical Fiber Communication Systems J Gowar (Prentice Hall India,)
7. Fiber Optic Communication Systems D C Agarwal (S Chand).
8. An Introduction to Fiber Optic Systems – John Powers(McGraw Hill Irwin)
9. Fiber optic Communications Technology – D K Mynbaev & L L Scheiner, (Pearson Edu)

Course Outcome: At the end of the course, students will demonstrate the ability to:

1. Analyze the performance of OFC system.
2. Distinguish between various emission approaches and also light source based on it.
3. Analyze the noise performance of optical detector.
4. Demonstrate the design of system link and performance of the OFC system.
5. Distinguish between the working of electrical and optical amplifier and analyze the performance of optical amplifiers

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2								3	2	2	2
CO2	3	2	1	2								3	2	2	2
CO3	3	2	1	1								3	3	3	3
CO4	3	2	1	1								3	2	2	2
CO5	3	2	2	2								3	2	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBTP06	3	-	-	40	60	100	3

NEXT GEN. COMM. TECHNOLOGY

Course Objectives:

1. To learn the new communication technologies such as OFDM and MIMO used in Next Generation communication systems.
2. To understand and apply the fundamental concept of Coherence Time, Coherence Bandwidth.
3. To learn the different fading model and evaluate the SNR.
4. To learn and analyse the performance of a massive MIMO system.
5. To analysis the performance such as capacity/spectral efficiency and energy efficiency of the MIMO and massive MIMO system.

UNIT – I

Introduction and Preliminaries: Introduction to point-to-point Multi-input Multi-output (MIMO), multiuser MIMO, massive MIMO, Coherence Time, Coherence Bandwidth, Coherence Interval. TDD Coherence Interval structure, Coherence Interval in the context of OFDM modulation, Small-scale and Large-scale fading, Normalized signal model, and SNR.

UNIT –II

OFDM: Principle of Orthogonal Frequency Division Multiplexing (OFDM), Multiple access – OFDMA, Implementation of transceivers, Frequency-selective channels, Cyclic Prefix (CP), Performance in the frequency-selective channel, Pilot based channel estimation, Peak-to-average power ratio, Inter-carrier-interference, Parameter adaptation.

UNIT –III

MIMO Systems: Introduction to MIMO systems, Diversity in wireless channel, Introduction to fading distributions, Analytical MIMO channel models, Independent and identically distributed (uncorrelated) MIMO fading model, Fully correlated MIMO channel model, MIMO channel parallel decomposition.

UNIT –IV

MIMO Channel Capacity and Power Allocation: Power allocation in MIMO systems, Uniform power allocation, Adaptive power allocation, MIMO channel capacity, Capacity of i.i.d. Rayleigh fading MIMO channels, Capacity of separately correlated Rayleigh fading MIMO channel.

UNIT –V

Massive MIMO Systems: Definition of Massive MIMO, Correlated Rayleigh fading, Uplink, and downlink system model, Impact of Spatial channel correlation, Channel hardening and favorable propagation, Pilot transmission and channel estimation, Spectral Efficiency (SE), Transmit precoding and Receive decoding, Single-cell uplink and downlink SE expressions, Asymptotic analysis, Energy efficiency.

Suggested Books & References: -

1. D. Tse and P. Vishwanath, "Fundamentals of Wireless Communications," Cambridge Univ. Press, 2005.
2. A. J. Goldsmith, "Wireless Communications," Cambridge Univ. Press, 2005.
3. R. S. Kshetrimayum, "Fundamentals of MIMO Wireless Communications," Cambridge University Press, 2017.
4. T. L. Marzetta, E. G. Larsson, H. Yang, and H. Q. Ngo, "Fundamentals of Massive MIMO," Cambridge Univ. Press, 2016.
5. Emil Björnson, Jakob Hoydis, and Luca Sanguinetti, "Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency," Foundations and Trends® in Signal Processing: Vol. 11: No. 3-4, pp 154-655 (2017).

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Explain the different physical layer wireless communication technologies used in 4G and 5G communication systems.

CO2: Apply the concept of Coherence Bandwidth, Coherence Time, Coherence Interval, Small-scale and Large-scale fading to analyze the physical layer performance of 4G and 5G

communication systems.
CO3: Evaluate the channel capacity of the MIMO and massive MIMO Systems.
CO4: Analyze the communication system performance under OFDMA.
CO5: Evaluate the spectral efficiency and energy efficiency of massive MIMO technology used in 5G.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1							2	3	3	3
CO2	3	3	2	2	2							2	3	3	2
CO3	3	3	2	3	2							2	3	3	1
CO4	3	3	2	3	2							2	3	3	1
CO5	3	3	2	3	2							2	3	3	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBTP07	3	-	-	40	60	100	3

COMPUTER VISION

Course Objectives:

1) To provide the fundamental concept of Computer Vision.
2) To Comprehend the working of stereo vision.
3) To identify and analyze various features with extraction in an image and video signal.
4) To study basic motion detection and object tracking.
5) To facilitate the ability to develop basic vision based applications.

UNIT-I:

Image Formation Models: Introduction and Goals of Computer Vision, Image Formation and Radiometry, Introduction to Computer Vision and Basic Concepts of Image Formation: Geometric Transformation, Geometric Camera Models, Image Reconstruction from a Series of Projections.

UNIT-II:

Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; basic introduction to Auto-calibration in stereo vision.

UNIT-III:

Image Descriptors and Features: Texture Descriptors, Colour Features, Edge Detection, Object Boundary and Shape Representations, Binary shape analysis, Interest or Corner Point Detectors, Histogram of Oriented Gradients(HOG), Scale Invariant Feature Transform (SIFT), Speeded up Robust Features (SURF).

UNIT-IV:

Motion Detection and Estimation : Regularization theory , Optical computation , Motion estimation, Background Subtraction and Modelling, Optical Flow, Kanade–Lucas–Tomasi (KLT), SpatioTemporal Analysis, Motion Tracking in Video.Mean Shift and Cam shift object Tracking.

UNIT-V:

Introduction to basic Pattern Recognition Concepts: Linear Regression, Basic Concepts of Decision Functions, Gaussian Classifier, Parameter Estimation,Template Matching, Clustering for Knowledge Representation, Dimension Reduction.

Applications of Computer Vision: Machine Learning Algorithms and their Applications in Medical Images, Motion Estimation and Object Tracking,Biometrics, Image Fusion,Document Image Processing.

Text/Reference Books:

1) D. Forsyth and J. Ponce,"Computer Vision - A modern approach", 2nd Edition, Pearson Prentice Hall, 2012
2) Szeliski, Richard, "Computer Vision: Algorithms and Applications", 1st Edition, SpringerVerlag London Limited, 2011.
3) Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2004.
4) K. ,Ll the concept of calibration and stereo vision.

Course Outcome:

At the end of the course, students will demonstrate the ability to:
CO1: Explain Image formation and mathematically analyze the camera model.
CO2: Explain working concept of stereo vision.
CO3: Identify and detect standard features in the image or video frame.
CO4: Apply techniques for motion detection and estimation in video frames.
CO5: identify challenges and develop basic computer vision based application in medical , security and document Image processing

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1						1	3	3	2
CO2	3	3	3	2	3	2						1	3	3	2
CO3	3	3	3	2	3	2						1	3	3	2

CO4	**3**	**3**	**3**	**2**	**3**	1						**1**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	2						**2**	**3**	**3**	**2**

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBTP08	3	-	-	40	60	100	3

DIGITAL COMMUNICATION RECEIVER

Course Objectives:

1. To gain knowledge about basic principles of digital communication techniques and Detection of Binary Signals in Gaussian Noise.
2. To gain knowledge about Coherent and Noncoherent Detection
3. To gain knowledge about receivers for AWGN channel and Fading channels.
4. To gain knowledge about concepts of synchronization and
5. To gain knowledge about concepts of adaptive equalization techniques.

UNIT-I:

Review of Digital Communication Techniques: Base band communication; signal space representation, linear and nonlinear modulation techniques, Error tracking and Spectral characteristics of digital modulation.

Detection of Binary Signal in Gaussian Noise: Detection of Binary signal in Gaussian Noise: Maximum Likelihood Receiver Structure, The Matched Filter, Correlation Realization of Matched Filter, Optimum error performance, Error performance of Binary Signalling.

UNIT-II:

Coherent and Noncoherent Detection: Coherent Detection: Coherent Detection of PSK, Sampled Matched Filter, Coherent Detection of Multiphase Shift Keying, Coherent Detection of FSK. Noncoherent Detection: Detection of Differential PSK, Binary Differential PSK example, Noncoherent Detection of FSK, Required Tone Spacing for Noncoherent Orthogonal FSK.

UNIT-III:

Optimum Receivers for AWGN Channel: Correlation demodulator, matched filter, maximum likelihood sequence detector, optimum receiver for CPM signals, M-ary orthogonal signals, envelope detectors for M-ary and correlated binary signals.

Receivers for Fading Channels: Characterization of fading multiple channels, statistical models, flat and frequency selective fading, diversity technique, Optimal receivers for data detection, coded waveform for fading channel.

UNIT-IV:

Synchronization Techniques: Carrier and signal synchronization, carrier phase estimation-PLL, Decision directed loops, symbol timing estimation, maximum likelihood and non-decision directed timing estimation, joint estimation.

UNIT-V:

Adaptive Equalization: Zero forcing algorithm, LMS algorithm, adaptive decision-feedback equalizer and Equalization of Trellis-coded signals. Kalman algorithm, blind equalizers and stochastic gradient algorithm.

Text/Reference Books:

1. Digital Communications, 2ndEd, Bernard Sklar, Pearson Education, 2001.
2. Digital Communication Microwave Applications By Kamilo Feher, PHI, 1987.
3. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, " Digital communication receivers ", Vol I & Vol II, John Wiley, New York, 1997.
4. H.Meyr & G.Ascheid, Synchronization in Digital Communications, John Wiley, 1990
5. Simon Marvin, "Digital communication over fading channel; An unified approach to performance Analysis ", John Wiley, New York, 2000.
6. U. Mengali & A.N.D"Andrea, Synchronization Techniques for Digital Receivers, Kluwer, 1997

Reference Books:

1. Digital Communication, Prokis, John G. Tata McGraw Hill.
2. Digital Communication Technique, Signal Design & Detection By Simon, Marvin K, Hinedi,Sami M & Lindsey, William C, PHI.
3. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, " Digital communication receivers ", Vol I & Vol II, John Wiley, New York, 1997.

4. H.Meyr & G.Ascheid, Synchronization in Digital Communications, John Wiley, 1990
5. John.G.Proakis, "Digital communication "4th Edition, McGraw-Hill, New York, 2001.
6. R.G. Gallager, "Principles of Digital Communication", New York, Cambridge University Press, 2008

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Analyze the concept of basic modulation technique and detection technique of Binary Signal in Gaussian Noise.
2. Apply the concept of Coherent and Non-Coherent detection techniques.
3. Design the optimum receiver for AWGN channels and Analyse the concept of Receivers for Fading Channels
4. Apply Synchronization Techniques for Receivers and various estimation techniques
5. Design and develop the different types of equalizers

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1							3	3	2	2
CO2	3	3	2	2	2							3	3	2	2
CO3	3	3	2	3	3							3	3	2	2
CO4	3	3	2	3	3							3	3	2	2
CO5	3	3	2	3	3							3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBTP09	3	-	-	40	60	100	3

MILLIMETER WAVE TECHNOLOGY

Course Objectives:

1. To understand the Characteristics of Millimeter Wave Technology
2. To understand the concepts and working principles of various guiding Structures at Millimeter Wave Technology.
3. To design the Antenna for Millimeter Wave Applications.
4. To perform analysis of passive Components at Millimeter Wave
5. To understand the basic concept of Active Devices and Link Design at Millimeter Wave.

UNIT-I:

Introduction to Millimeter wave Technology: Advantages and Challenges of Millimeter Wave Technology, Millimeter Wave Applications, Sources of losses at Millimeter wave; Dielectric Loss, Conduction Loss, Radiation Surface wave losses, Wave propagation, Phase and Group Velocity, Slow and Fast waves.TEM, TE and TM modes.

UNIT-II:

Guiding Structure: Transmission Lines, Surface Wave in Grounded Dielectric Slab, Parallel Plate Guide, Rectangular Wave Guide, Circular Waveguides, Microstrip Lines, High Frequency Limitation of Microstrip Lines, Microstrip Coupled Lines, Conductor Backed CPW, Substrate Integrated Waveguide (SIW), SIW Losses, Design of SIW.

UNIT-III:

Antennas at Millimeter wave Frequency: Antennas Parameters, Printed Millimeter Wave Antennas, Dipole and Slot Antenna, Loop Antennas, Printed Millimeter Wave Array Antennas, Waveguide Slot Arrays, On Chip Antennas: Design and Challenges.

UNIT-IV:

Passive Components: Dielectric Resonators, Dielectric Resonators Antenna and its modes, filters, Different types of couplings, Power divider, Directional Coupler, Hybrid Coupler.

UNIT-V:

Active Components: PIN Diode, Gunn Diode, IMPATT Diode**,** FET, MOSFET, HEMT, Comparison of Solid State Devices **,** Noise and Link Budget, Friss Transmission Equation, Millimeter Wave Systems, Noise Figure for Cascaded System Elements.

Text/Reference Books:

1. S. Rappaport, R.W. Heath, R.C. Daniels and J.N. Murdock,Millimeter Wave Wireless Communication, Prentice Hall
2. NPTEL Lectures by Dr M K Mondal, IIT Kharagpur on Millimeter Wave Technology

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Explain the Need of Millimeter Wave Technology for Communication
2. Apply the suitable Guiding Structure at Millimeter Wave Technology
3. Design of Antenna for Millimeter wave Frequency
4. Analyze the various Passive Devices at MM Wave Systems
5. Explain the principle of Active Devices and Design of MM Wave System

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1								2	3		2
CO2	3	3	2	3								2	3		2
CO3	3	2	2	3	3							1	3	2	2
CO4	3	1	2	1	3							1	3	2	2
CO5	3	2	1	1	3							1	3		2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBLT01	-	-	4	30	20	50	2

SEMICONDUCTOR DEVICE DESIGN AND SIMULATION LAB

Course Objectives:

- To give the exposure of TCAD tools.
- To develop skills in designing diodes and transistors using TCAD.
- To efficiently understand the various device parameters, working and characteristics.
- To provides an opportunity to design feature low power devices.

List of Experiments:

1. Introduction of VLSI TCAD tools.
2. Design and Simulation of 2D/3D NMOS Channel Length 20nm or higher.
3. Design and Simulation of 2D/3D PMOS Channel Length 20nm or higher.
4. Design and Simulation of 2D/3D CMOS using NMOS and PMOS.
5. Design and Simulation of SOI/Bulk Dual Gate FET & Dual Gate Junction less FET.
6. Design and Simulation of SOI/Bulk FINFET device using GDS2MESH and GENIUS.
7. Design and Simulation of SOI/Bulk 2D/3D Nanowire FET.
8. Design and simulation of dopingless FET.
9. Design and implementation of SRAM using CMOS & FINFET Process.
10. Desgn and implemenation of Tunnel Field Effect Transistor.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1. Familiar with sophisticated VLSI TCAD tools.
CO2. Design and implement any diode and transistor using TCAD tools.
CO3. Design and implement SOI based junction/junction less dual gate FET & FINFET using TCAD tools.
CO4. Understand the working of all devices and implement advanced device using TCAD tools.
CO5: Learn advanced features in device design & simulation.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	3	3		1		3			3	3	3	3
CO2	3	3	2	3	3		1		3			3	3	3	3
CO3	3	3	2	3	3		1		3			3	3	3	3
CO4	3	3	2	3	3		1		3			3	3	3	3
CO5	3	3	2	3	3		1		3			3	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBLT02	-	-	4	30	20	50	2

RF & MICROWAVE COMPONENT DESIGN LAB

Course Objectives:

1. To understand the concepts and working principles of the feeding techniques used in RF and Microwave Communication
2. Hands on Experience of High frequency Software
3. To understand the concepts and working principles of the microwave filters
4. To understand the concepts and working principles of the microwave Antennas
5. To analyze the complex system of RF component like antenna

LIST OF EXPERIMENTS:

1. Design and Simulate Rectangular Waveguide at f = _____Ghz
2. Design and Simulate Microstrip feed
3. Design and Simulate CPW feed
4. Design and Simulate SIW feed
5. Design and Simulate power divider at f = _____GHz.
6. Design and Simulate planar band reject filter at frequency of f =_____GHz
7. Design and Simulate planar band pass filter at frequency of f =_____GHz
8. Design and Simulate microstrip patch antenna at resonating frequency of f = ____GHz.
9. Design and Simulate Dielectric Resonator Antenna at resonating frequency of f =GHz
10. Design and Simulate array of Antennas

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Select the suitable feed at microwave component design
2. Design the microwave filter
3. Design the Microwave Antennas
4. Design the Arrays of Antennas
5. Operate high frequency design software tools

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		3								3		
CO2	3	2	2	2	3								3		
CO3	3	3	2	1	3								3		
CO4	3	2	3	3	3								3		
CO5	3	1	2	3									3		

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

OPEN ELECTIVES

Sub Code	L	T	P	IA	ESE	Total	Credits
ECPBTO7	3	-	-	40	60	100	3

INTERNET OF THINGS

Course Objectives:

1. To understand the definition and significance of the Internet of Things.
2. To learn the architecture, operation, and business benefits of an IoT solution.
3. To examine the potential Security issues in IoT and explore the relationship between IoT, cloud computing, and big data.
4. Design and program IoT devices, use real IoT protocols for communication, Secure the elements of an IoT device.

UNIT-I: Introduction to The Internet of Things

IoT Definition, Elements of an IoT ecosystem, IoT applications, trends and implications, sensing components and devices, Wearable sensors and their Applications, operating System for IoT, Industrial IoT: case study: Agriculture, Healthcare, Process Automation & monitoring etc.

UNIT-II: Internet of Things– Architecture and Communication Protocol

Layered Architecture for IoT, Protocol Architecture of IoT, Infrastructure Protocols: MAC protocols for sensor network, S-MAC, IEEE 802.15.4, Near Field Communication (NFC), RFID, ZigBee, Bluetooth Low Energy (BLE),IPv6 over LowPower Wireless Personal Area Networks (6LoWPAN), Long Term Evolution-Advanced, Z-Wave, Components of ZWave Network, Protocols for IoT Service Discovery: DNS service discovery, multicast domain name system.

UNIT-III: Internet of Things – Networking Protocol Constrained Application Protocol (CoAP), Message Queue Telemetry Transport (MQTT), Extensible Messaging and Presence Protocol (XMPP), Advanced Message Queuing Protocol (AMQP), Data Distribution Service (DDS), Service Discovery Protocols, Routing Protocol for Low Power and Lossy Networks (RPL), sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, sensor network architecture, data dissemination and gathering protocol.

UNIT-IV: Platforms for IOT Applications and Analytics

Role of the cloud and fog resources in the delivery of IoT services, The IoT Building Blocks, Connected Devices, IoT or Sensor Data Gateway, The IoT Data Analytics Platforms: IBM Watson IoT Platform, Splunk Software for IoT Data, Amazon Web Service IoT Platform, Azure IoT Hub, The IoT Data Virtualization Platforms, IoT Data Visualization Platform, Security and Privacy in IoT.

UNIT-V: Design and Development

IoT Platforms, Arduino, Raspberry Pi Board, Other IoT Platforms; Data Analytics for Design Methodology,Embedded computing logic, Microcontroller, System on Chips , IoT system building blocks Arduino, Board details, IDE programming ,Raspberry Pi , Interfaces and Raspberry Pi with Python Programming Case Studies: Agriculture, Healthcare, and Activity Monitoring. Sensor-Cloud, Smart Cities and Smart Homes.

Text/Reference Books:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.
2. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, "Internet of Things: Architectures, Protocols and Standards," Wiley, 2018.
3. Fei Hu, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations," CRC Press, 2016Fundamentals of Wireless Communications, D. Tse and P. Vishwanath, ,Cambridge Univ. Press, 2005.
4. R. Buyya and A.K. Dastjerdi (eds.), "Internet of Things: Principles and Paradigms," Cambridge, MA, USA: Morgan Kaufmann (Elsevier), 2016.
5. Modern Mobile Wireless Communication, Haykins S & Moher M, Pearson Ed.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

CO1: Explain the concept of IoT.

CO2: Define and analyze the concept of data communications protocols and convergence of technologies.

CO3: Interpret protocols to track, monitor and manage IoT devices.

CO4: Apply data analytics and use cloud offerings related to IoT.

CO5: Understand the principles and various research issues related to Internet of Things.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	1							3	3	2	2
CO2	3	2	1	1	1							3	3	2	2
CO3	3	2	2	1	1							3	3	2	2
CO4	3	3	2	1	1							3	3	2	2
CO5	3	3	2	1	1							3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

RESEARCH METHODOLOGY IN ENGINEERING

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATT1	03	01	0	4 HRS	100	4

Unit 1: Philosophy and Ethics

Introduction to philosophy: nature and scope, concept, branches. Ethics: Definition, moral philosophy, nature of moral judgments and reactions.

Ethics with respect to science and research. Intellectual honesty and research integrity. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP).Redundant publication duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data.

Unit 2: Errors in Measurements

Types of Errors, Mean Deviation, Standard Deviation and Probable Errors, Propagation of Errors with Summation, Difference, Product and Quotient.

Curve fitting, Method of least square fit, least square fit (straight line) to linear equations and equation reducible to linear equations. Least square fit (parabola) to quadratic equations and equations reducible to quadratic equations.

Unit 3: Data Processing & Analysis

Literature Survey, Defining the equation and formulating hypothesis/hypotheses. Collection of research data, tabulating and cataloging, Sampling and methods of data analysis. Laboratory Safety Measures, Maintenance of equipment's and proper storage and disposal of materials.

Unit 4: Scientific Presentation and Writing Skills

Survey of literature and presentation of data, one seminar paper-preparation in PowerPoint (which include texts, graphs, pictures, tables, references etc.)-Oral in PowerPoint/poster, development of communication skills in presentation of scientific seminars- eye to eye contact, facing the audience, question & answer sessions etc.

Steps to better writing, flow method, organization of material and style, drawing figures, graphs, tables, footnotes, references etc in research paper.

Unit 5: Publication Ethics.

1. Publication ethics: definition, introduction and importance.2. Best practice/standards setting initiatives and guidelines: COPE, WAME, etc. 3. Conflicts of interests 4. Publications misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types 5. Violation of publication ethics, authorship and contributor ship6. Identification of publication misconduct complains and appeals 7. Predatory publishers and journals.

Reference Books

1. D B Resnik, The Ethics of Science: An Introduction, Routledge Publisher, USA (1998).
2. Callahand D & Bok S, Ethics Teaching in Higher Education, Plenum Press, New York, USA (1996).
3. Kanpur J N, Ethical values for excellence in Education and Science, VishwaPrakashan, New Delhi (1996).
4. A. N Tripathi, Human Values, New Age International Publication, New Delhi (2008).
5. A Wilson: Handbook of Science Communication, Institute of Physics publishing, Bristol Philadelphia (1998).
6. Science Communication: Theory and practice; Stocklmayer, Gore MM, Bryant C (Eds), Springer (2002).
7. Laszios P., Communicating Science: A Practical Guide, Springer (2006).
8. C R Kothari, Research Methodology: Methods and Technology, 2nd revised edition, New Age International Publication 2004.
9. K. N. Krishanaswamy, A I Sivakumar, M Mathiranjan, Management Research Methodology: Integration Principles, Methods and Techniques, Pearson Education, New Delhi 2006.
10. C K Sharma, M K Jain; Research Methodology, Shree Publications, New Delhi.

Course Outcome:

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

CO1: Comprehend the ethical basis of the research and intellectual honesty.

CO2: Analyze the different types of errors related to measurement techniques.

CO3: Illustrate the data processing techniques.

CO4: Demonstrate the writing skills and scientific presentations.

CO5: Comprehend the ethics for research publication.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1		1	1		3	1	2		3	3	2	3
CO2	3	1	1		3	1		3	1	2		3	3	2	3
CO3	3	1	2		3	1		3	1	2		3	3	2	3
CO4	3	1	2		3	1		3	1	2		3	3	2	3
CO5	3	1	1		1	1		3	1	2		3	3	2	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

VACUUM TECHNOLOGY

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATP1	03	01	0	4 HRS	100	4

Unit-1: Fundamentals of Vacuum Technology: vacuum nomenclature and definitions, Gas properties, Molecular process and Kinetic theory, Throughput, Pumping speed, Evacuation rate, Out gassing rate, Leak rate, Gas How, Conductance, Flow calculations.

Unit-2: Vacuum generation: Diaphragm pump, Rotary pump, Diffusion pump, Cryogenic pump, Turbo -molecular pump, Sputter-ion pump and Getter pumps.

Unit-3: Vacuum Measurement scale, Gauges and Leak detection: U.H.V. techniques, Mass Spectrometer.

Unit-4: Surface Physics and its Relation to Vacuum Science: Adsorptions, Chemisorptions, Isotherms, Desorption's and Photo-activation.

Unit-5: Materials for Vacuum tubes, Chemical and Thermal Cleaning, Sputtering Techniques, Brazing, Spot, Arc, Electron beam and Laser welding, Vacuum and Protected Atmosphere Furnaces, Jigs and Tools Processing of Electron-Beam Devices.

References Books:

1. Vacuum Science and Technology, V V Rao, T B Ghosh, K L Chopra
2. Vacuum Journal, Science direct, Elsevier Publication
3. Journal of Vacuum Science and Technology A, IEEE Transaction
4. Journal of Vacuum Science and Technology B, IEEE Transaction

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

CO1: Comprehend the basic concepts of the vacuum, its properties and calculations.

CO2: Analyze the vacuum pump principles and architectures.

CO3: Analyze different measurement techniques and its utility in different vacuum levels.

CO4: Comprehend the surface physics and its relation in creating and maintaining the vacuum in a closed chamber.

CO5: Illustrate the effects of the materials used for fabrication, cleaning and maintaining the vacuum.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2				2			3	3	1	1
CO2	3	2	2	2	2				2			3	3	2	2
CO3	3	2	2	2	2				2			3	3	2	2
CO4	3	2	2	3	2				2			3	3	2	2
CO5	3	2	2	2	2				2			3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

ANTENNA FOR MODERN WIRELESS COMMUNICATION

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATP2	03	01	0	4 HRS	100	4

Unit 1: Concepts of Radiation and Antenna Fundamentals

Fundamental parameters of antennas, Near and Far Field regions, S Parameters, Antenna Measurements: Radiation pattern, gain, directivity, phase and polarization measurement

Unit 2: Printed Antenna

Microstrip Antennas & Dielectric Resonator Antenna: Radiation mechanism - parameters and applications - feeding methods.

UNIT 3: Reconfigurable Antenna

Reconfigurable methodologies, Design Considerations for Reconfigurable systems, Reconfigurable Planar/printed antenna configurations, Active reconfigurable systems, Concept of Smart Antenna

Unit 4: Array of Antennas

Linear and planar array fundamentals, Mutual Coupling in Arrays, Multidimensional Arrays, Phased Arrays, Array Feeding Techniques, Array optimization techniques

Unit 5: MIMO System

Concept of MIMO: Types of MIMO Systems, Design Parameters of MIMO system.

Reference Books:

1. Jordan E C and Bahl-lain K G, "Electromagnetic Waves and Radiating Systems", 2nd Edition, PL.:arson Education.
2. BaIanis C A, "Antenna Theory: Analysis and Design". 4th Edition, John Wiley and Sons, New Jersey, 2016.
3. Kraus J D and Viarhefka R J, "Antennas for All Applications", 3rd Edition, Tata McGraw Hill, 2001.
4. Girish Kumar and Ray K P, "Broadband Microstrip Antennas", Artech House, 2003.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Measurement of Antenna's parameters
2. Analyze the suitable antennas for Modern Wireless Communication
3. Evaluate array of Antenna to meet the requirement of Modern Wireless Communication
4. Apply analysis of key technology of 4G/5G wireless system
5. Evaluate antennas for various applications of modern wireless communication

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		3							2	3	2	2
CO2	3	2	2	2	3							2	3	2	2
CO3	3	3	2	1	3							2	3	2	2
CO4	3	2	3	3	3							2	3	2	3
CO5	3	1	2	3								2	3		3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

MICROSTRIP ANTENNA

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATP3	03	01	0	4 HRS	100	4

Course Objective:

This course will enable student to

1. To introduce the basic concept of Rectangular Microstrip Antenna
2. To introduce different Microstrip Antenna feeding techniques
3. To learn different parameters of Rectangular Microstrip Antenna
4. To learn the effect of various parameters on performance of Rectangular Microstrip Antenna
5. To develop the concept of antenna design to control different Antenna characteristics

Unit-1:

Rectangular Microstrip Antenna- Concept, Various Designs, Advantages, Problems, Applications

Unit-2:

Microstrip Antenna feeding techniques- Coaxial feed, Microstrip Line feed, EM Coupled feed, Aperture coupled feed

Unit-3:

Rectangular Microstrip Antenna- Resonance Frequency, Characterization, Design Equations, Design Examples

Unit-4:

Effect of various parameters on performance of Rectangular Microstrip Antenna – Feed point location, Effect of width, Effect of thickness, Effect of probe diameter, Effect of Loss tangent, Effect of Dielectric constant

Unit-5:

Rectangular Microstrip Antenna patterns for different Dielectric constant, Dual Polarization, Effect of finite ground plane, Square and Circular Microstrip Antenna characteristics

Text/Reference Books:

1. Microstrip Antenna Design Handbook, Ramesh Garg, Prakash Bhartia, Inder J. Bahl, A. Ittipiboon
2. Broadband Microstrip Antennas, Girish Kumar, K.P. Ray
3. Microstrip and Printed Antennas: NEW TRENDS, TECHNIQUES AND APPLICATIONS by Debatosh Guha, Yahia M. M. Antar

Course Outcome:

At the end of the semester, the students will be able to

1. Outline the different Microstrip Antenna feeding techniques
2. Outline the basic concept of Smart Antenna
3. Apply the Conceptof different parameters of Rectangular Microstrip Antenna for its design
4. Apply the Conceptof effect of various parameters on performance of Rectangular Microstrip Antenna
5. Apply the Conceptof antenna design to control different Antenna characteristics

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1		3								3		2
CO2	3	1	2	2	3								3		2
CO3	3	2	2	1	3								3	2	2
CO4	3	1	1	1	3								3	2	2
CO5	3	1	2	2									3		2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

WIRELESS COMMUNICATION & NETWORK

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATP4	03	01	0	4 HRS	100	4

Unit 1: Overview of wireless communication, cellular communication, different generations of cellular communication system, satellite Communication including, wireless local loop, cordless phone,

Unit 2: Recent wireless technologies: multicarrier modulation, OFDM, MIMO system, diversity-multiplexing trade-off, MIMO-OPOM system, smart-antenna; beamforming and MIMO, cognitive radio,

Unit 3: Multiple access techniques in wireless communication: contention-free multiple access schemes (FDMA TDMA, CDMA, SDMA and Hybrid), contention-based multiple access schemes (ALOHA and CSMA).

Unit 4: Wireless personal area networks (Bluetooth, UWB and Zig-Bee), wireless local area networks (IEEE 802.11, network architecture, medium access methods, WLAN standards

Unit 5: Ad-hoc wireless networks: Design Challenges in Ad-hoc wireless networks, concept of cross layer design, security in wireless networks MANET and WS.N. Wireless system protocols.

Reference Books:

Textbooks:

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
2. Sanjay Kumar, "Wireless Communication the Fundamental and Advanced Concepts" River Publishers, Denmark, 2015 (Indian reprint).

Reference books:

1. Vijay K Garg, "Wireless Communications and Networks'', Morgan Kaufmann Publishers an Imprint of Elsevier, USA 2009 (Indian reprint)
2. J. Schiller, "Mobile Communication" 2/e, Pearson Education, 2012.
3. Iti Saha vilisra, "Wireless Communication and Networks: 3G and Beyond", 2/e, McGraw Hill (India) Private Ltd, New Delhi, 2013.

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Visualize the architecture of different types of wireless systems as a means of high speed, high range communication system.
2. Analyze various aspects related to recent wireless technologies.
3. Apply the Multiple access techniques in wireless technologies
4. Analyze various aspects related to wireless personal local area network.
5. Apply various aspects of Ad -hoc wireless network.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3				2			3	3	2	2
CO2	3	3	2	2	3				2			3	3	2	2
CO3	3	3	2	2	3				2			3	3	2	2
CO4	3	3	2	2	3				2			3	3	2	2
CO5	3	3	2	2	3				2			3	2	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

TUNNEL FIELD EFFECT TRANSISTOR

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATP8	03	01	0	4 HRS	100	4

Course objective:

- To introduce CMOS scaling and its limitations.
- To demonstrate the fundamental aspect of quantum tunneling.
- To gain the knowledge of principle working , characteristics and current improving techniques of TFET.
- To cognize the role of TFET in low power application.

UNIT-I:

CMOS Scaling: Introduction, Basics of MOSFET and CMOS, MOSFET structure and operation, Operation of MOSFET as a switch, Short-channel effects in a MOSFET, CMOS inverter, Power dissipation in a CMOS circuit, CMOS scaling, Types of CMOS scaling-Constant-field scaling, Constant-voltage scaling, Current trends in CMOS scaling, Challenges in continued CMOS scaling, Emerging research devices.

UNIT-II:

Quantum Tunneling: Quantum mechanics, Quantum mechanical tunneling, Solving the tunneling problems-Analytic Approximation methods, Numerical methods, Junction breakdown due to tunneling, Tunnel diode.

UNIT-III:

Basics of Tunnel Field Effect Transistors: Introduction, Device structure, Operation, Transfer characteristics-OFF state, Subthreshold region, Super-threshold region, Subthreshold swing, Tunneling current, Output characteristics, Threshold voltage, Impact of device parameters, Ambipolar current.

UNIT-IV:

Boosting ON-Current in Tunnel Field Effect Transistor: Introduction, Types of techniques to boost ON current, Gate Engineering, Tunneling junction engineering, Material engineering.

UNIT-V: –

Application of Tunnel Field Effect Transistor: Introduction, Electrical characteristics of TFETs, Digital Circuits, Application in memories, Analog circuits, Future perspective of TFETs in circuits.

Text/Reference Books:

1. S. Saurabh and M. J. Kumar, "Fundamentals of tunnel field effect transistors", CRC Press, Taylor & Francis, 2016.
2. M. J. Kumar, R. Vishnoi and P. Pandey, "Tunnel Field Effect Transistor-Modelling & Simulation" Wiley, 2016.
3. N. Gupta, A. Makosiej, A. Amara, A. Vladimirescu and C. Anghel, "TFET Integrated Circuits", Springer, 2021.

Course Outcomes:

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

CO1: Develop an understanding for the scaling of CMOS and its future limitation.

CO2: Explore the fundamental aspect of quantum tunneling and the physical principle that forms the basis of TFET.

CO3: Comprehend the operating principle of TFET and analyze the characteristics of TFET.

CO4: Discuss & explore various techniques to improve the ON current of TFET device.

CO5: Apply TFET based device in various low power application.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1			2			3	3	1	2
CO2	3	3	2	2	2	1			2			3	3	2	2
CO3	3	3	3	2	2	1			2			3	3	2	2
CO4	3	3	3	2	2	1			2			3	3	2	2
CO5	3	3	3	2	2	1			2			3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

MIMO COMMUNICATION SYSTEM

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATP9	03	01	0	4 HRS	100	4

Course objective:

- To introduce the fundamentals need and limitations of MIMO communication systems.
- To demonstrate the different MIMO channel models.
- To identify the role of diversity and MIMO techniques in combating the effect of fading and maximizing the capacity.
- To cognize the most recent trends in the broad area of wireless communication.

Introduction: MIMO wireless communication, Need for MIMO systems, Multiple antennas in wireless communication systems, MIMO in wireless networks, Diversity-multiplexing trade-off, Transmit diversity schemes, advantages and applications of MIMO systems, MIMO channel and signal model, MIMO in wireless standards, Future challenges.

MIMO Channel Models: Analytical MIMO channel models: Uncorrelated, fully correlated, separately correlated and keyhole MIMO fading models, parallel decompositionof MIMO channel.

Capacity limits of MIMO systems, Introduction, Single-user MIMO, Multi-user MIMO, MIMO Channel models, Capacity and information rates in MIMO channels: Capacity and Information rates in AWGN and fading channels, Capacity of MIMO channels, Capacity for deterministic and random MIMO channels, Capacity of i.i.d., separately correlated and keyhole Rayleigh fading MIMO channels, Single user MIMO Capacity, Single user capacity metrics, Multi-user capacity metrics.

Precoding Design: Channel state information at the transmitter (CSIT), Information-theoretic foundation for exploiting CSIT, A transmitter structure, Precoding design criteria, Linear precoder designs, Precoder performance results and discussion, Applications in practical systems.

Space Time-Coding for Wireless Communications: Principles and applications, Introduction, Space time coding principles, Alamouti space-time codes, SER analysis of Alamouti space-time code over fading channels, Space-time block codes, Space-time trellis codes, Performance analysis of Space-time codes over separately correlated MIMO channel.

Text/Reference Books:

1. E. G. Larsson, P. Stoica, "Space-Time Block Coding for Wireless Communications", Cambridge University Press, 2008.
2. E. Biglieri, R. Calderbank et al "MIMO Wireless Communications" Cambridge Univ Press, 2007.
3. D. Tse, P. Viswanath, "Fundamentals of Wireless Communication", Cambridge Univ Press, 2005.
4. H. Jafarkhani, "Space-Time Coding: Theory and Practice", Cambridge University Press 2005.
5. Paulraj, R. Nabar, and D. Gore, "Introduction to Space-Time Wireless Communications", Cambridge University Press, 2003.

Course Outcomes:

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

CO1: Understand the concept & working principle of MIMO communication systems.
CO2: Learn & design uncorrelated & correlated MIMO channel and its impact on system capacity.
CO3: Analyze the information theoretic capacity of MIMO system under different conditions.
CO4: Illustrate the concept of channel state information at the transmitter side and their impact on channel capacity.
CO5: Comprehend space time coding and design a suitable coding of structure for the improvement of bit error rate.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1			2			3	3	1	2
CO2	3	3	2	2	2	1			2			3	3	2	2
CO3	3	3	3	2	2	1			2			3	3	2	2
CO4	3	3	3	2	2	1			2			3	3	2	2
CO5	3	3	3	2	2	1			2			3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

DEEP LEARNING

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATP10	03	01	0	4 HRS	100	4

Course objectives:

1. To introduce the basic concept of artificial neural network for deep learning.
2. To introduce techniques used for training artificial neural networks.
3. To understand practical aspects of deep neural networks.
4. To understand the Convolutional neural network and optimization algorithms.
5. To carry out design and implementation of deep learning models on signals and images.

UNIT I: Introduction: Introduction to deep learning, Machine learning vs and Deep learning, review of gradient descent; logistic regression; cost function- maximum likelihood based cost, cross entropy, MSE; perceptron learning; activation functions – softmax, logistic sigmoid, tanh, ReLU; types of neural networks – feed forward neural network, recurrent neural network, symmetrically connected network.

UNIT II: Deep Feed Forward Neural Networks: Gradient based learning; hidden units; architecture design; back-propagation; hyperparameters. output units: linear, softmax; hidden units: tanh, RELU; GPU training etc.

UNIT III: Regularization and Practical Aspects of Deep Learning: Regularization and under-constrained problems, dataset augmentation, noise robustness, early stopping, bagging, dropout, normalizing inputs; vanishing/exploding gradients, weight initialization for deep networks; numerical approximation of gradients; gradient checking; hyperparameter tuning; batch normalization.

UNIT IV: Convolutional neural networks , Fundamentals, architectures, pooling, visualization, Deep learning for spatial localization, Convolution operation, Transposed convolution, efficient pooling, object detection, semantic segmentation, Optimization Algorithms: mini-batch gradient descent; gradient descent with momentum; rmsprop, ADAM optimization algorithm.

UNIT V: Recurrent neural networks (RNN), long-short term memory (LSTM), language models, machine translation, image captioning, video processing, visual question answering, video processing, and learning from descriptions. Deep Learning Tools: Use of deep learning tools such as tensor flow, Keras for deep learning applications.

Reference books:

1. Goodfellow, Ian, Yoshua Bengio, Aaron Courville, Deep Learning (Adaptive Computation and Machine Learning Series), MIT Press, 2016.
2. Nielsen, Michael A., Neural Networks and Deep Learning, 2015.
3. Gibson, Adam, and Josh Patterson, Deep Learning: a Practitioner's Approach, O'Reilly Media, Inc 2016.
4. Chollet, Franois. Deep Learning with Python, 2017.
5. Buduma, Nikhil, and Nicholas Locascio, Fundamentals of Deep Learning: Designing Next-generation Machine Intelligence Algorithms, O'Reilly Media, Inc., 2017.
6. Hope, Tom, Yehezkel S Resheff, Itay Lieder, Learning Tensorflow: A Guide to Building Deep Learning Systems, O'Reilly Media, Inc., 2017.
7. Nikhil Ketkar, "Deep Learning with Python: A Hands-on Introduction", Apress, 2017.
8. AurélienGéron, "Hands-On Machine Learning with Scikit- Learn and TensorFlow", O'Reilly, 2017.

Course Outcomes (COs): At the end of the course, the students will be able to:

1. Explain the mathematics behind functioning of artificial neural network for deep learning.
2. Illustrate the basic concepts of Neural Networks based on architectures and learning rules.
3. Comprehend the practical aspects of Deep Neural Networks (DNN) with parameter tuning.
4. Design and implementation of deep learning models for signal/image processing applications
5. Design and deploy simple TensorFlow-based deep learning solutions to classification/ segmentation problems.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	2				2			3	3	1	3
CO2	3	2	2	1	2				2			3	3	1	3
CO3	3	2	2	2	2				2			3	3	2	3

CO4	3	2	2	2	2				2			3	3	2	3
CO5	3	2	2	2	2				2			3	3	2	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

MACHINE LEARNING

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATP11	03	01	0	4 HRS	100	4

Course Objectives:

1. To understand the basic theory underlying machine learning.
2. To understand a range of machine learning algorithms along with their strengths and weaknesses.
3. To understand the working of neural network.
4. To be able to formulate machine learning problems corresponding to different applications.
5. To be able to learn different metrics for error and anomasly detection.

UNIT I

Introduction To Machine Learning: Concept of Machine Learning, Applications of Machine Learning, Key elements of Machine Learning, Supervised vs. Unsupervised Learning, Statistical Learning: Bayesian Method, The Naive Bayes Classifier, Decision Trees.

UNIT II

Linear Regression: Prediction using Linear Regression, Gradient Descent, Linear Regression with one variable, Linear Regression with multiple variables, Polynomial Regression, Feature Scaling/Selection.

Logistic Regression: Classification using Logistic Regression, Logistic Regression vs. Linear Regression, Logistic Regression with one variable and with multiple variables, Optimization, Decision Trees vs Logistic Regression

UNIT III

Neural Networks: Introduction, Model Representation, Gradient Descent vs. Perceptron Training, Stochastic Gradient Descent, Multilayer Perceptrons, Multiclass Representation, Back-propagation Algorithm and related Issues.

UNIT IV

Support Vector Machines:Knowing SVMs, SVM as Large Margin Classifier, Kernels, Using SVMs in Learning complex non-liner functions, Constrained Optimization, SVM utilization.

Introduction to Clustering, K-Means Algorithm, Random Initialization, Choosing the number of Clusters, Mixture Models, Dimensionality Reduction and its application, Principal Component Analysis (PCA).

UNIT V

Error Analysis and Anomaly Detection: Utility of Error Analysis, Precision/Recall, Error Metrics for Skewed Classes, Introduction of Anomaly Detection, Gaussian Distribution, Anomaly Detection vs. Supervised Learning.

Reference books:

1. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, The MIT Press.
2. Simon O. Haykin, "Neural Networks and Learning Machines", Pearson Education, 2016.
3. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2010.
4. Smola and Vishwanathan, "Introduction to Machine Learning", Cambridge University Press, 2010.
5. T.M. Mitchell, "Machine Learning", McGraw Hill Education, 2017.
6. Andrew NG, "Machine Learning Yearning", Amazon.com Services LLC, Kindle Edition, 2019.
7. V.N. Vapnik, “The Nature of Statistical Learning Theory”
8. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, Taylor & Francis

Course Outcomes:

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

1. Comprehend the basic concept of machine learning with its working principle.
2. Comprehend a range of machine learning algorithms along with their strengths and weaknesses.
3. Illustrate the concept and working of neural network.
4. Design various machine learning algorithms for different applications.
5. Illustrate the error analysis and anomaly detection in machine learning algorithms.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3				2			3	3	1	2
CO2	3	2	2	1	3				2			3	3	1	2
CO3	3	2	2	2	3				2			3	3	2	3
CO4	3	2	2	2	3				2			3	3	2	3
CO5	3	2	2	2	3				2			3	3	2	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

INTRODUCTION TO IoT

Sub Code	L	T	P	Duration	ESE	Credits
ECDATP13	3	1	-	4 hours	100	4

Course Objectives:

1. To provide fundamental knowledge on the Internet of Things.
2. To develop the ability to explore the use of various hardware, Protocols, and communication technologies to build IoT devices.
3. To facilitate the students for analyzing and implementing various real time IOT applications.

Unit 1: Introduction to IOT: Definition, History and characteristics of IoT, IOT reference Architecture, Major component of IO, IOT enabling technologies: Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels, and Templates.

Unit 2 M2M & System Management with NETCONF-YANG: M2M, Difference between IOT and M2M, Software-defined networks, Network function virtualization, the difference between SDN and NFV for IoT, Need for IOT Systems Management, Simple Network Management Protocol, Limitations of SNMP, Network Operator Requirements, NETCONF, YANG, IOT Systems Management with NETCONF-YANG.

Unit 3: IOT protocols and Communication Technologies: MQTT, MQTT brokers, QoS levels in MQTT, HTTP, COAP, XMPP and gateway protocols, IOT Communication Pattern, IOT Protocol Architecture, Selection of Wireless technologies. Wireless technologies for IOT: WiFi, Bluetooth, BLE, Zigbee, NFC, 6LoWPAN, LORA.

Unit 4: DATA ANALYTICS AND IOT PLATFORM: Introduction to Data Analytics for IOT, Structured Versus Unstructured Data, Data in Motion Versus Data at Rest, IoT Data Analytics Overview, IoT Data Analytics Challenges, IoT Platform overview: Overview of IoT supported Hardware platforms such as Raspberry pi, Arduino Board details

UNIT-V IoT PHYSICAL SERVERS AND CLOUD OFFERINGS: Introduction to cloud computing, Cloud Service and Deployment Models, Communication APIs, Cloud and WAMP for IOT, Case studies illustrating IoT design – home automation, smart cities, smart environment.

Text/Reference Books:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
2. Internet of Things – A hands-on approach, ArshdeepBahga, Vijay Madisetti, Universities Press,

2015
3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education, 2022.
4. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012.

Course Outcome:

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

1. Comprehend the concepts, components, enabling technologies, and reference architecture of IOT.
2. Evaluate the concept of M2M, SDN/NFV, and system management with NETCONF-YANG
3. Analyze IoT protocols and communication technologies
4. Elaborate the need for data analytics and hardware platforms in IOT.
5. Analyze potential applications of IoT and the cloud.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	3				2			3	3	2	2
CO2	3	2	2	1	3				2			3	3	2	3
CO3	3	2	2	1	3				2			3	3	2	3
CO4	3	2	2	1	3				2			3	3	2	3
CO5	3	2	2	1	3				2			3	3	2	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

SATELLITE COMMUNICATION

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATP14	03	01	0	4 HRS	100	4

Course Objective:

1.To know the evolution of Satellite communication and its concept
2. To know the orbital mechanism and different satellite subsystems.
3. To know the role of different factors affecting satellite and link budget equation.
4. To know the various types of multiple access techniques for satellite communication.
5. To know the basics and details of Earth station.

UNIT-I

An overview of satellite communication, Satellite orbits, Kepler's law, Orbital Elements, Eclipse effect, Sun transit outage, Placement of a satellite in a geostationary orbit, Station keeping and Stabilization.

UNIT-II

Satellite Link Design: Basic transmission theory, Friss transmission equation, EIRP, Completion Link design, System noise temperature G/T ratio, Noise figure and Noise temperature.

UNIT-III

Communication Satellite Subsystems: Space Platform (Bus) and Communication Subsystem (Payload), Satellite Antennas, Frequency reuse Antennas.

UNIT-IV

Earth Stations: Earth station antennas, Tracking, Equipment for earth stations, Equipment Reliability and Space qualification

UNIT-V

Analogue Satellite Communication Vs Digital Satellite Communication, Multiple Access Techniques : FDMA Concept, MCPC & SCPC, TDMA frame efficiency and super frame structure, Frame Acquisition and Synchronisation, CDMA concept, PN system, Spread spectrum, DSSS, DS CDMA, FHSS, FH CDMA.

Text/Reference Books:

1. "Satellite Communication", T. Pratt & C. W. Bostian.
2. "Digital Satellite communication", Tri T. Ha, McGraw Hill.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget.
3. Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.
2. Explain how satellite is controlled to become stationary w.r.t a point on the earth.
3. Explain how a single satellite is shared by large number of earth stations on the earth by using multiple access schemes.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1									2	3		1
CO2	3	3	1									2	3		1
CO3	3	3	2	2								2	3		1
CO4	3	2	1									2	3		3
CO5	3	2	1									2	2		1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

DIGITAL IMAGE PROCESSING

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATP23	03	01	0	4 HRS	100	4

Course Objectives:

- To provide fundamental knowledge on digital image processing.
- To develop the ability to understand and implement various digital image processing algorithms.
- To facilitate the students for analyze and implementing various real-time digital image processing applications.

UNIT-I: Image Representation and Image Processing Paradigm: Image, Elements of Image perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels

Image Enhancements: Point operations, Arithmetic operations, Logical operation, Gray level transformations, histogram equalization, histogram specifications, pixel-domain smoothing filters, pixel-domain sharpening filters, two-dimensional DFT and its inverse, and Cosine transform.

UNIT-II: Image Filtering and Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering.

UNIT-III: Color Image Processing: Color models, Color transformations, Color image smoothing and sharpening; Color Segmentation. **Wavelets and Multi-resolution image**

processing- Uncertainty principles of Fourier Transform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub-band filter banks, wavelet packets.

UNIT-IV: Image Compression: Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression- predictive and transform coding; Still image compression standards – JPEG and JPEG-2000.

UNIT-V: Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding, region-based segmentation, Segmentation Using Morphological Watersheds.

Text/Reference Books:

1. Rafael C. Gonzalez, R E. Woods, Digital Image Processing, 3rd Ed, Pearson Ed 2010
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall,2nd ed 2011
3. William K. Pratt, Digital Image Processing, 4th edition, John Wiley, 2007.
4. John C. Russ, The Image Processing Handbook, 6th edition, CRC Press,2011
5. Maria M. P. Petrou, C Petrou, Image Processing: The Fundamentals, 2nd Ed, Wiley 2010

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Acquire the knowledge of basic image processing concepts and image enhancement techniques involved.
2. Demonstrate the image restoration process and its respective filters required.
3. Illustrate the color image processing and various multi-resolution techniques
4. Interpret the various image compression techniques and their applications.
5. Design the various image segmentation operations for a meaningful partition of objects.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1			1		2	1	1	1
CO2	3	3	3	3	3	1	1			1		2	2	2	2
CO3	3	3	3	3	3	1	1			1		2	3	2	2
CO4	3	3	3	3	3	1	1			1		2	3	2	2
CO5	3	3	3	3	3	1	1			1		2	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

MEDICAL IMAGE PROCESSING

Sub Code	L	T	P	Duration	ESE	Credits
ECDATP24	3	1	-	4 hours	100	4

Course Objectives:

4. To provide fundamental knowledge about images & their processing.
5. To understand & to know how an image model is developed and processed.
6. To develop a capacity to analyze the image through various segmentation techniques.
7. To develop a capacity to apply these processings in medical applications.

UNIT-1 Medical Imaging: fundamentals of medical imaging, Various Modalities of Medical Imaging: X-ray Imaging, Computed Tomography, magnetic resonance imaging, Ultrasound Imaging, Nuclear medicine imaging, Mammographic Imaging. Fundamental steps in Digital Image Processing, Components of Image processing system, Image Formation Model, Image Sampling and Quantization, Basic relationship between pixels, Image sensing, and acquisition.

UNIT-2: Medical Image Enhancement in spatial domain: Background, Point processing-Image negatives, Log transformation, Power law transformations, Contrast stretching, Intensity level slicing, Bit plane slicing, histogram processing-Histogram equalization, Histogram matching, Arithmetic/Logic operations-Image subtraction, Image averaging, Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters.

UNIT-3: Medical Image Enhancement in Frequency Domain: Background, 2D-Discrete Fourier Transform and its Inverse, Basic properties of the 2D-Discrete Fourier Transform, Basics of filtering in the frequency domain. Image smoothing using frequency domain filters-Ideal lowpass filters, Butterworth lowpass filters, Gaussian lowpass filters; Image sharpening using frequency domain filters- Ideal highpass filters, Butterworth highpass filters, Gaussian highpass filters, Homomorphic filtering.

UNIT-4: Medical Image restoration: Image degradation model, Image noise models, filtering techniques. Image Compression: Fundamentals, image compression models, basic compression methods- Huffman coding, Arithmetic coding, LZW coding, Run-length coding.

UNIT-5: Medical Image Segmentation: Fundamentals, Point detection, Line detection, Edge models, Edge detection, Canny edge detector, Thresholding, Region-based segmentation.

Text/Reference Books:

1. Digital Image Processing by Rafael C. Gonzalez & Richard E. Woods, 3rd Ed. Pearson Edu, 2012.
2. Medical Image Processing Concepts and Applications by G.R. Sinha, Bhagwati Charan Patel. PHI Learning, 2014
3. Handbook of Medical Image Processing and Analysis by Isaac Bankman, Academic Press
4. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd ed, 2011.
5. John C. Russ, The Image Processing Handbook, 6th edition, CRC Press,2011

Course Outcome:

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

1. Acquire the knowledge of basic medical imaging and recognize the imaging modality from their visualization
2. Describe fundamental methods of medical image enhancement in the spatial domain.
3. Demonstrate the frequency domain image enhancement process and its respective filters required.
4. Interpret the various medical image restoration and compression techniques.
5. Design the various image segmentation operations for a meaningful partition of objects.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	3				3			3	3	1	2
CO2	3	1	1	1	3				3			3	3	1	2
CO3	3	2	2	1	3				3			3	3	2	3
CO4	3	2	2	2	3				3			3	3	2	3
CO5	3	2	2	2	3				3			3	3	2	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

CONVEX OPTIMIZATION

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATP25	03	01	0	4 HRS	100	4

Course Objective

1- To study the fundamentals of convex optimization.
2- To study the Unconstrained optimization methods.
3- To study Linear programming and its usability.
4- To study the fundamentals of Non-linear constrained optimization.
5- Learn to apply and convert real world problem in to convex optimization framework.

Prerequisites: Linear Algebra, Probability.

Unit I Background on linear algebra, Convex sets and Convex functions: examples of convex problems.

UNIT II Level sets and Gradients. Unconstrained Optimization: Search methods, Gradients Methods, Newton Method, Conjugate Direction Methods, Quasi-Newton Methods.

UNIT III Linear Programming: Standard Form Linear Programs, Simplex method, Duality and Non Simplex Methods, applicability in Communication domain.

UNIT IV Nonlinear Constrained Optimization: Problems with equality constraints, Problems with Inequality Constraints, Convex Optimization Problems.

UNIT V Algorithms for Constrained Optimization: Projected Gradient Methods and Penalty Methods.

References:

• Lieven Vandenberghe and Stephen P. Boyd, Convex Optimization, Cambridge University Press, 2004.
• Dimitris Bertsekas, John N. Tsitsiklis, Introduction to Linear Optimization, Athena Scientific Series, 1997.
• Aharon Ben-Tal and Arkadi Nemirovski, Lectures on Modern Convex Optimization: Analysis,
Algorithms, and Engineering Applications, SIAM, 2001.
• Stephen Boyd and Lieven Vandenberghe, Convex Optimization, Cambridge University Press.
[Online]. http://www.stanford.edu/~boyd/cvxbook/
• Convex Optimization in Signal Processing and Communications, D. P. Palomar, Y. C. Eldar. Cambridge Press, 2010.
• https://ocw.mit.edu/courses/6-079-introduction-to-convex-optimization-fall-2009/pages/readings/
• Dimitri P. Bertsekas, Convex Analysis and Optimization, Athena-Scientific, 2003.

Course Outcome

On the successful completion of this course Student are able to
CO1: Differentiate between non convex and convex functions and sets
CO2: Analyse the various algorithms and their convergence.
CO3: Formulate communication problems in convex optimization framework
CO4: Discuss the applications of convex optimization methods in various applications
CO5: Choose and apply suitable algorithm given the application.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1	1			2			3	3	1	2
CO2	3	2	2	2	1	1			2			3	3	1	2
CO3	3	2	2	2	1	1			2			3	3	1	2
CO4	3	2	3	2	1	1			2			3	3	1	2
CO5	3	2	3	2	1	1			2			3	3	1	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

INTRODUCTION TO SIGNAL PROCESSING

SUB CODE	L	T	P	DURATION	ESE	CREDITS
ECDATP26	03	01	0	4 HRS	100	4

Course Objectives:

The objectives of the course are to make the students:

1. Review of signal and system, Fourier transforms, the Z-transform
2. To impart knowledge of mathematical concept involved in signal processing.
3. To introduce mathematical modeling for Statistical Signals processing.
4. To apply optimization techniques for signal processing applications.

UNIT-I: Discrete and Continuous time signals and systems, LTI systems, Convolution, z-transforms, Fourier transform and its properties.

UNIT-II: Sampling and reconstruction, Review of vector spaces, Eigenvectors and Eigen-values. Hilbert transforms, matched filtering, equalization. Coherent and Non-coherent detection.

UNIT-III: Probability theory review, Random variables, statistical averages, Random processes, Transmission of random process through an LTI system.

UNIT-IV: Statistical Signal Processing: Power Spectrum Estimation Parametric and Maximum Entropy Methods, Wiener, Kalman Filtering, and the Poisson process, Levinson Durbin Algorithms Least Square Method.

UNIT-V: Optimization techniques for linear and nonlinear problems, Applications in various areas of signal processing.

Text/Reference Books:

1. Proakis, John G. Digital signal processing: principles algorithms and applications, PHI.
2. Oppenheim, Alan V - Discrete-time signal processing, Pearson Education India.
3. Vaidyanathan, Parishwad P - Multirate systems and filter banks, Pearson Ed India.
4. M H. Hayes, "Statistical Digital Signal Processing And Modeling", 1st Ed, Wiley, 2008.
5. Vaidyanathan, Palghat P- The theory of linear prediction, Morgan and Claypool Pub.
6. Haykin, Simon S. - Adaptive filter theory, Pearson Education India.
7. Henry Stark and John W. Woods, "Probability and Random Processes with Applications to Signal Processing", Prentice Hall, 3rd Edition 2001
8. Sanjit K. Mitra. "Digital Signal Processing: A computer based approach." McGraw Hill. 1998.
9. Steven M. Kay, "Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory", Prentice Hall, 1993

Course Outcome:

At the end of the course, students will demonstrate the ability to:

1. Apply the basic concept of frequency domain analysis for signal processing.
2. Utilize the linear analysis concept for signal processing.
3. Describe and apply probability theory concept for random signals.
4. Apply basic statistical signal processing filtering techniques.
5. Design and Demonstrate basic optimization techniques for the applications based on signal processing.

Course Outcomes and their mapping with Programme Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	1						3	3	1	2
CO2	3	3	3	2	1	1						3	3	1	2
CO3	3	3	3	2	1	1						3	3	2	2
CO4	3	3	3	2	1	1						3	3	2	2
CO5	3	3	3	2	1	1						3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**