ANNA UNIVERSITY, CHENNAI
NON- AUTONOMOUS AFFILIATED COLLEGES
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM

B. E. ELECTRONICS AND COMMUNICATION ENGINEERING

I. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

1. To provide the students with a strong foundation in the required sciences in order to pursue studies in Electronics and Communication Engineering.
2. To gain adequate knowledge to become good professional in electronic and communication engineering associated industries, higher education and research.
3. To develop attitude in lifelong learning, applying and adapting new ideas and technologies as their field evolves.
4. To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problems identified.
5. To inculcate in the students a professional and ethical attitude and an ability to visualize the engineering issues in a broader social context.

II. PROGRAM OUTCOMES (POs)

1 **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2 **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3 **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4 **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5 **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6 **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities

relevant to the professional engineering practice.

7 **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8 **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9 **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12 **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

III. PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Design, develop and analyze electronic systems through application of relevant electronics, mathematics and engineering principles

PSO2: Design, develop and analyze communication systems through application of fundamentals from communication principles, signal processing, and RF System Design & Electromagnetics.

PSO3: Adapt to emerging electronics and communication technologies and develop innovative solutions for existing and newer problems

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REGULATIONS 2021
B. E. ELECTRONICS AND COMMUNICATION ENGINEERING CHOICE BASED CREDIT SYSTEM
CURRICULA FOR SEMESTERS I TO VIII AND SYLLABI FOR SEMESTERS III AND IV

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IP3151	Induction Programme	-	-	-	-	-	**0**
THEORY								
2.	HS3151	Professional English - I	HSMC	3	0	0	3	3
3.	MA3151	Matrices and Calculus	BSC	3	1	0	4	4
4.	PH3151	Engineering Physics	BSC	3	0	0	3	3
5.	CY3151	Engineering Chemistry	BSC	3	0	0	3	3
6.	GE3151	Problem Solving and Python Programming	ESC	3	0	0	3	3
7.	GE3152	தமிழர் மரபு / Scientific Thoughts in Tamil	HSMC	1	0	0	1	1
PRACTICALS								
8.	GE3171	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
9.	BS3171	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
10.	GE3172	English Laboratory $	EEC	0	0	2	2	1
			TOTAL	**16**	**1**	**10**	**27**	**22**

$ Skill Based Course SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS3251	Professional English - II	HSMC	2	0	0	2	2
2.	MA3251	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3254	Physics for Electronics Engineering	BSC	3	0	0	3	3
4.	BE3254	Electrical and Instrumentation Engineering	ESC	3	0	0	3	3
5.	GE3251	Engineering Graphics	ESC	2	0	4	6	4
6.	EC3251	Circuit Analysis	PCC	3	1	0	4	4
7.	GE3252	தமிழரும் தொழில்நுட்பமும் /Heritage of Tamils	HSMC	1	0	0	1	1
8.		NCC Credit Course Level 1#	-	2	0	0	2	2*
PRACTICALS								
9.	GE3271	Engineering Practices Laboratory	ESC	0	0	4	4	2
10.	EC3271	Circuits Analysis Laboratory	PCC	0	0	2	2	1
11.	GE3272	Communication Laboratory / Foreign Language $	EEC	0	0	4	4	2
			TOTAL	**17**	**1**	**14**	**33**	**26**

 # NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

$ Skill Based Course

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3355	Random Processes and Linear Algebra	BSC	3	1	0	4	4
2.	CS3353	C Programming and Data Structures	ESC	3	0	0	3	3
3.	EC3354	Signals and Systems	PCC	3	1	0	4	4
4.	EC3353	Electronic Devices and Circuits	PCC	3	0	0	3	3
5.	EC3351	Control Systems	PCC	3	0	0	3	3
6.	EC3352	Digital Systems Design	PCC	3	0	2	5	4
PRACTICALS								
7.	EC3361	Electronic Devices and Circuits Laboratory	PCC	0	0	3	3	1.5
8.	CS3362	C Programming and Data Structures Laboratory	PCC	0	0	3	3	1.5
9.	GE3361	Professional Development[$]	EEC	0	0	2	2	1
			TOTAL	**18**	**2**	**10**	**30**	**25**

[$] Skill Based Course

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	EC3452	Electromagnetic Fields	PCC	3	0	0	3	3
2.	EC3401	Networks and Security	PCC	3	0	2	5	4
3.	EC3451	Linear Integrated Circuits	PCC	3	0	0	3	3
4.	EC3492	Digital Signal Processing	PCC	3	0	2	5	4
5.	EC3491	Communication Systems	PCC	3	0	0	3	3
6.	GE3451	Environmental Sciences and Sustainability	BSC	2	0	0	2	2
7.		NCC Credit Course Level 2[#]		3	0	0	3	3[#]
PRACTICALS								
8.	EC3461	Communication Systems Laboratory	PCC	0	0	3	3	1.5
9.	EC3462	Linear Integrated Circuits Laboratory	PCC	0	0	3	3	1.5
			TOTAL	**17**	**0**	**10**	**27**	**22**

[#] NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	EC3501	Wireless Communication	PCC	3	0	2	5	4
2.	EC3552	VLSI and Chip Design	PCC	3	0	0	3	3
3.	EC3551	Transmission lines and RF Systems	PCC	3	0	0	3	3
4.		Professional Elective I	PEC	-	-	-	-	3
5.		Professional Elective II	PEC	-	-	-	-	3
6.		Professional Elective III	PEC	-	-	-	-	3
7.		Mandatory Course-I[&]	MC	3	0	0	3	0
PRACTICALS								
8.	EC3561	VLSI Laboratory	PCC	0	0	4	4	2
			TOTAL	-	-	-	-	**21**

[&] Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under Mandatory Course-I)

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	ET3491	Embedded Systems and IOT Design	PCC	3	0	2	5	4
2.	CS3491	Artificial Intelligence and Machine Learning	ESC	3	0	2	5	4
3.		Open Elective– I*	OEC	3	0	0	3	3
4.		Professional Elective V	PEC	-	-	-	-	3
5.		Professional Elective VI	PEC	-	-	-	-	3
6.		Professional Elective VII	PEC	-	-	-	-	3
7.		Mandatory Course-II [&]	MC	3	0	0	3	0
8.		NCC Credit Course Level 3[#]		3	0	0	3	3 [#]
			TOTAL	-	-	-	-	**20**

***Open Elective – I Shall be chosen from the list of open electives offered by other Programmes**

[&] Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under Mandatory Course-II)

[#] NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA

SEMESTER VII / VIII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	GE3791	Human values and Ethics	HSMC	2	0	0	2	2
2.		Elective - Management#	HSMC	3	0	0	3	3
3.		Open Elective – II**	OEC	3	0	0	3	3
4.		Open Elective – III**	OEC	3	0	0	3	3
5.		Open Elective – IV**	OEC	3	0	0	3	3
PRACTICALS								
6.	EC3711	Summer internship	EEC	0	0	0	0	2
			TOTAL	**14**	**0**	**0**	**14**	**16**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.**

**** Open Elective II - IV (Shall be chosen from the list of open electives offered by other Programmes).**

 # Elective - Management shall be chosen from the Elective Management courses.

SEMESTER VIII /VII*

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	**EC3811**	Project Work / Internship	EEC	0	0	20	20	10
			TOTAL	**0**	**0**	**20**	**20**	**10**

***If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.**

TOTAL CREDITS : 162

ELECTIVE – MANAGEMENT COURSES

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PERWEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	GE3751	Principles of Management	HSMC	3	0	0	3	3
2.	GE3752	Total Quality Management	HSMC	3	0	0	3	3
3.	GE3753	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	GE3754	Human Resource Management	HSMC	3	0	0	3	3
5.	GE3755	Knowledge Management	HSMC	3	0	0	3	3
6.	GE3792	Industrial Management	HSMC	3	0	0	3	3

MANDATORY COURSES I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3081	Introduction to Women and Gender Studies	MC	3	0	0	3	0
2.	MX3082	Elements of Literature	MC	3	0	0	3	0
3.	MX3083	Film Appreciation	MC	3	0	0	3	0
4.	MX3084	Disaster Management	MC	3	0	0	3	0

MANDATORY COURSES II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MX3085	Well Being with traditional practices (Yoga, Ayurveda and Siddha)	MC	3	0	0	3	0
2.	MX3086	History of Science and Technology in India	MC	3	0	0	3	0
3.	MX3087	Political and Economic Thought for a Humane Society	MC	3	0	0	3	0
4.	MX3088	State, Nation Building and Politics in India	MC	3	0	0	3	0
5.	MX3089	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I Semiconductor Chip Design and Testing	**Vertical II Signal Processing**	**Vertical III RF Technologies**	**Vertical IV Bio Medical Technologies**	**Vertical V Underwater Technologies**	**Vertical VI Sensor Technologies and IoT**	**Vertical VII Space Technologies**	**Vertical VIII High Speed Communications**
Wide Bandgap Devices	Advanced Digital Signal Processing	RF Transceivers	Wearable Devices	Underwater Instrumentation System	IoT Processors	Radar Technologies	Optical Communication & Networks
Validation and Testing Technology	Image processing	Signal Integrity	Human Assist Devices	Underwater Imaging Systems and Image Processing	IoT Based System Design	Avionics Systems	Wireless Broad Band Networks
Low Power IC Design	Speech processing	Antenna Design	Therapeutic Equipment	Underwater Communication	Wireless Sensor Network Design	Positioning and Navigation Systems	4G/5G Communication Networks
VLSI Testing and Design For Testability	Software Defined Radio	MICs and RF System Design	Medical Imaging Systems	Ocean Observation Systems	Industrial IoT and Industry 4.0	Satellite Communication	Software Defined Networks
Mixed Signal IC Design Testing	DSP Architecture and Programming	EMI/EMC Pre compliance Testing	Brain Computer Interface and Applications	Underwater Navigation Systems	MEMS Design	Remote Sensing	Massive MIMO Networks
Analog IC Design	Computer Vision	RF ID System Design & Testing	Body Area Networks	Ocean Acoustics	Fundamentals of Nanoelectronics	Rocketry and Space Mechanics	Advanced Wireless Communication Techniques

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V and VI. These courses are listed in groups called verticals that represent a particular area of specialisation / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2021, Clause 4.10.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: SEMICONDUCTOR CHIP DESIGN AND TESTING

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CEC363	Wide Bandgap Devices	PEC	2	0	2	4	3
2.	CEC361	Validation and Testing Technology	PEC	2	0	2	4	3
3.	CEC370	Low Power IC Design	PEC	2	0	2	4	3
4.	CEC362	VLSI Testing and Design For Testability	PEC	2	0	2	4	3
5.	CEC342	Mixed Signal IC Design Testing	PEC	2	0	2	4	3
6.	CEC334	Analog IC Design	PEC	2	0	2	4	3

VERTICAL 2: SIGNAL PROCESSING

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CEC332	Advanced Digital Signal Processing	PEC	2	0	2	4	3
2.	CEC366	Image processing	PEC	2	0	2	4	3
3.	CEC356	Speech Processing	PEC	2	0	2	4	3
4.	CEC355	Software Defined Radio	PEC	2	0	2	4	3
5.	CEC337	DSP Architecture and Programming	PEC	2	0	2	4	3
6.	CCS338	Computer Vision	PEC	2	0	2	4	3

VERTICAL 3: RF TECHNOLOGIES

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CEC350	RF Transceivers	PEC	2	0	2	4	3
2.	CEC353	Signal Integrity	PEC	2	0	2	4	3
3.	CEC335	Antenna Design	PEC	2	0	2	4	3
4.	CEC341	MICs and RF System Design	PEC	2	0	2	4	3
5.	CEC338	EMI/EMC Pre compliance Testing	PEC	2	0	2	4	3
6.	CEC349	RF ID System Design & Testing	PEC	2	0	2	4	3

VERTICAL 4: BIO MEDICAL TECHNOLOGIES

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CBM370	Wearable Devices	PEC	3	0	0	3	3
2.	CBM352	Human Assist Devices	PEC	3	0	0	3	3
3.	CBM368	Therapeutic Equipment	PEC	3	0	0	3	3
4.	CBM355	Medical Imaging Systems	PEC	3	0	0	3	3
5.	CBM342	Brain Computer Interface and Applications	PEC	3	0	0	3	3
6.	CBM341	Body Area Networks	PEC	3	0	0	3	3

VERTICAL 5: UNDERWATER TECHNOLOGIES

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CEC359	Underwater Instrumentation System	PEC	3	0	0	3	3
2.	CEC358	Underwater Imaging Systems and Image Processing	PEC	2	0	2	4	3
3.	CEC357	Underwater Communication	PEC	2	0	2	4	3
4.	CEC344	Ocean Observation Systems	PEC	2	0	2	4	3
5.	CEC360	Underwater Navigation Systems	PEC	3	0	0	3	3
6.	CEC343	Ocean Acoustics	PEC	2	0	2	4	3

VERTICAL 6: SENSOR TECHNOLOGIES AND IOT

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CEC369	IoT Processors	PEC	2	0	2	4	3
2.	CEC368	IoT Based System Design	PEC	3	0	0	3	3
3.	CEC365	Wireless Sensor Network Design	PEC	3	0	0	3	3
4.	CEC367	Industrial IoT and Industry 4.0	PEC	2	0	2	4	3
5.	CEC340	MEMS Design	PEC	2	0	2	4	3
6.	CEC339	Fundamentals of Nanoelectronics	PEC	2	0	2	4	3

VERTICAL 7: SPACE TECHNOLOGIES

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CEC347	Radar Technologies	PEC	3	0	0	3	3
2.	CEC336	Avionics Systems	PEC	3	0	0	3	3
3.	CEC346	Positioning and Navigation Systems	PEC	3	0	0	3	3
4.	CEC352	Satellite Communication	PEC	3	0	0	3	3
5.	CEC348	Remote Sensing	PEC	3	0	0	3	3
6.	CEC351	Rocketry and Space Mechanics	PEC	3	0	0	3	3

VERTICAL 8: HIGH SPEED COMMUNICATIONS

SL. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CEC345	Optical Communication & Networks	PEC	3	0	0	3	3
2.	CEC364	Wireless Broad Band Networks	PEC	3	0	0	3	3
3.	CEC331	4G/5G Communication Networks	PEC	2	0	2	4	3
4.	CEC354	Software Defined Networks	PEC	2	0	2	4	3
5.	CEC371	Massive MIMO Networks	PEC	3	0	0	3	3
6.	CEC333	Advanced Wireless Communication Techniques	PEC	3	0	0	3	3

OPEN ELECTIVES

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

OPEN ELECTIVES – I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OAS351	Space Science	OEC	3	0	0	3	3
2.	OIE351	Introduction to Industrial Engineering	OEC	3	0	0	3	3
3.	OBT351	Climate Change and its Impact	OEC	3	0	0	3	3
4.	OCE351	Environment and Social Impact Assessment	OEC	3	0	0	3	3
5.	OEE351	Renewable Energy System	OEC	3	0	0	3	3
6.	OEI351	Introduction to Industrial Instrumentation and Control	OEC	3	0	0	3	3
7.	OMA351	Graph Theory	OEC	3	0	0	3	3
8.	OCS355	Deep Learning	OEC	3	0	0	3	3
9.	OCS356	Digital Marketing	OEC	3	0	0	3	3

OPEN ELECTIVES – II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OIE352	Resource Management Techniques	OEC	3	0	0	3	3
2.	OMG351	Fintech Regulations	OEC	3	0	0	3	3
3.	OFD351	Holistic Nutrition	OEC	3	0	0	3	3
4.	OCE352	ICT in Agriculture	OEC	3	0	0	3	3
5.	OEI352	Introduction to Control Engineering	OEC	3	0	0	3	3
6.	OPY351	Pharmaceutical Nanotechnology	OEC	3	0	0	3	3
7.	OAE351	Aviation Management	OEC	3	0	0	3	3
8.	OCS357	Dev-ops	OEC	3	0	0	3	3
9.	OCS358	Robotics Process Automation	OEC	3	0	0	3	3

OPEN ELECTIVES – III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS351	English for Competitive Examinations	OEC	3	0	0	3	3
2.	OMG352	NGOs and Sustainable Development	OEC	3	0	0	3	3
3.	OMG353	Democracy and Good Governance	OEC	3	0	0	3	3
4.	OME353	Renewable Energy Technologies	OEC	3	0	0	3	3
5.	OME354	Applied Design Thinking	OEC	2	0	2	4	3
6.	OMF351	Reverse Engineering	OEC	3	0	0	3	3
7.	OMF353	Sustainable Manufacturing	OEC	3	0	0	3	3
8.	OAU351	Electric and Hybrid Vehicle	OEC	3	0	0	3	3
9.	OAS352	Space Engineering	OEC	3	0	0	3	3
10.	OIM351	Industrial Management	OEC	3	0	0	3	3
11.	OIE354	Quality Engineering	OEC	3	0	0	3	3
12.	OSF351	Fire Safety Engineering	OEC	3	0	0	3	3
13.	OML351	Introduction to non-destructive testing	OEC	3	0	0	3	3
14.	OMR351	Mechatronics	OEC	3	0	0	3	3
15.	ORA351	Foundation of Robotics	OEC	3	0	0	3	3
16.	OAE352	Fundamentals of Aeronautical engineering	OEC	3	0	0	3	3
17.	OGI351	Remote Sensing Concepts	OEC	3	0	0	3	3
18.	OAI351	Urban Agriculture	OEC	3	0	0	3	3
19.	OEN351	Drinking Water Supply and Treatment	OEC	3	0	0	3	3
20.	OEE352	Electric Vehicle technology	OEC	3	0	0	3	3
21.	OEI353	Introduction to PLC Programming	OEC	3	0	0	3	3
22.	OCH351	Nano Technology	OEC	3	0	0	3	3
23.	OCH352	Functional Materials	OEC	3	0	0	3	3
24.	OBT352	Biomedical Instrumentation	OEC	3	0	0	3	3
25.	OFD352	Traditional Indian Foods	OEC	3	0	0	3	3
26.	OFD353	Introduction to food processing	OEC	3	0	0	3	3
27.	OPY352	IPR for Pharma Industry	OEC	3	0	0	3	3
28.	OTT351	Basics of Textile Finishing	OEC	3	0	0	3	3
29.	OTT352	Industrial Engineering for Garment Industry	OEC	3	0	0	3	3
30.	OTT353	Basics of Textile Manufacture	OEC	3	0	0	3	3

31.	OPE351	Introduction to Petroleum Refining and Petrochemicals	OEC	3	0	0	3	3
32.	OPE352	Energy Conservation and Management	OEC	3	0	0	3	3
33.	OPT351	Basics of Plastics Processing	OEC	3	0	0	3	3
34.	OBM351	Foundation Skills in integrated product Development	OEC	3	0	0	3	3
35.	OBM352	Assistive Technology	OEC	3	0	0	3	3
36.	OMA352	Operations Research	OEC	3	0	0	3	3
37.	OMA353	Algebra and Number Theory	OEC	3	0	0	3	3
38.	OMA354	Linear Algebra	OEC	3	0	0	3	3
39.	OCE353	Lean Concepts, Tools And Practices	OEC	3	0	0	3	3

OPEN ELECTIVES – IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	OHS352	Project Report Writing	OEC	3	0	0	3	3
2.	OMA355	Advanced Numerical Methods	OEC	3	0	0	3	3
3.	OMA356	Random Processes	OEC	3	0	0	3	3
4.	OMA357	Queuing and Reliability Modelling	OEC	3	0	0	3	3
5.	OMG354	Production and Operations Management for Entrepreneurs	OEC	3	0	0	3	3
6.	OMG355	Multivariate Data Analysis	OEC	3	0	0	3	3
7.	OME352	Additive Manufacturing	OEC	3	0	0	3	3
8.	OME353	New Product Development	OEC	3	0	0	3	3
9.	OME355	Industrial Design & Rapid Prototyping Techniques	OEC	2	0	2	4	3
10.	OMF352	Microand Precision Engineering	OEC	3	0	0	3	3
11.	OMF354	Cost Management of Engineering Projects	OEC	3	0	0	3	3
12.	OAU352	Batteries and Management system	OEC	3	0	0	3	3
13.	OAU353	Sensors and Actuators	OEC	3	0	0	3	3
14.	OAS353	Space Vehicles	OEC	3	0	0	3	3
15.	OIM352	Management Science	OEC	3	0	0	3	3
16.	OIM353	Production Planning and Control	OEC	3	0	0	3	3
17.	OIE353	Operations Management	OEC	3	0	0	3	3
18.	OSF352	Industrial Hygiene	OEC	3	0	0	3	3

19.	OSF353	Chemical Process Safety	OEC	3	0	0	3	3
20.	OML352	Electrical, Electronic and Magnetic materials	OEC	3	0	0	3	3

21.	OML353	Nanomaterials and applications	OEC	3	0	0	3	3
22.	OMR352	Hydraulics and Pneumatics	OEC	3	0	0	3	3
23.	OMR353	Sensors	OEC	3	0	0	3	3
24.	ORA352	Foundation of Automation	OEC	3	0	0	3	3
25.	ORA353	Concepts in Mobile Robotics	OEC	3	0	0	3	3
26.	OMV351	Marine Propulsion	OEC	3	0	0	3	3
27.	OMV352	Marine Merchant Vehicles	OEC	3	0	0	3	3
28.	OMV353	Elements of Marine Engineering	OEC	3	0	0	3	3
29.	OAE353	Drone Technologies	OEC	3	0	0	3	3
30.	OGI352	Geographical Information System	OEC	3	0	0	3	3
31.	OAI352	Agriculture Entrepreneurship Development	OEC	3	0	0	3	3
32.	OEN352	Biodiversity Conservation	OEC	3	0	0	3	3
33.	OEE353	Introduction to control systems	OEC	3	0	0	3	3
34.	OEI354	Introduction to Industrial Automation Systems	OEC	3	0	0	3	3
35.	OCH353	Energy Technology	OEC	3	0	0	3	3
36.	OCH354	Surface Science	OEC	3	0	0	3	3
37.	OBT353	Environment and Agriculture	OEC	3	0	0	3	3
38.	OFD354	Fundamentals of Food Engineering	OEC	3	0	0	3	3
39.	OFD355	Food safety and Quality Regulations	OEC	3	0	0	3	3
40.	OPY353	Nutraceuticals	OEC	3	0	0	3	3
41.	OTT354	Basics of Dyeing and Printing	OEC	3	0	0	3	3
42.	OTT355	Fibre Science	OEC	3	0	0	3	3
43.	OTT356	Garment Manufacturing Technology	OEC	3	0	0	3	3
44.	OPE353	Industrial safety	OEC	3	0	0	3	3
45.	OPE354	Unit Operations in Petro Chemical Industries	OEC	3	0	0	3	3
46.	OPT352	Plastic Materials for Engineers	OEC	3	0	0	3	3
47.	OPT353	Properties and Testing of Plastics	OEC	3	0	0	3	3
48.	OBM353	Wearable devices	OEC	3	0	0	3	3
49.	OBM354	Medical Informatics	OEC	3	0	0	3	3
50.	OCE354	Basics of Integrated Water Resources Management	OEC	3	0	0	3	3

SUMMARY

Name of the Programme: B.E. Electronics and Communication Engineering										
S.No	Subject Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII/VII I	VIII/VI I	
1	HSMC	4	3					5		12
2	BSC	12	7	4	2					25
3	ESC	5	9	3			4			21
4	PCC		5	17	20	12	4			58
5	PEC					9	9			18
6	OEC						3	9		12
7	EEC	1	2	1				2	10	16
8	Non-Credit /(Mandatory)					√	√			
Total		22	26	25	22	21	20	16	10	162

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also.
Complete details are available in clause 4.10 of Regulations 2021.

VERTICALS FOR MINOR DEGREE
(In addition to all the verticals of other programmes)

Vertical I Fintech and Block Chain	**Vertical II Entrepreneurship**	**Vertical III Public Administration**	**Vertical IV Business Data Analytics**	**Vertical V Environmental and Sustainability**
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building & Leadership Management for Business	Constitution of India	Datamining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity & Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Blockchain and its Applications	Principles of Marketing Management For Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis
-	-	-	-	Integrated Energy Planning for Sustainable Development
-	-	-	-	Energy Efficiency for Sustainable Development

(choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

VERTICAL 1: FINTECH AND BLOCK CHAIN

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG331	Financial Management	PEC	3	0	0	3	3
2.	CMG332	Fundamentals of Investment	PEC	3	0	0	3	3
3.	CMG333	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4.	CMG334	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5.	CMG335	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6.	CMG336	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL 2: ENTREPRENEURSHIP

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG337	Foundations of Entrepreneurship	PEC	3	0	0	3	3
2.	CMG338	Team Building & Leadership Management for Business	PEC	3	0	0	3	3
3.	CMG339	Creativity & Innovation in Entrepreneurship	PEC	3	0	0	3	3
4.	CMG340	Principles of Marketing Management For Business	PEC	3	0	0	3	3
5.	CMG341	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6.	CMG342	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL 3: PUBLIC ADMINISTRATION

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG343	Principles of Public Administration	PEC	3	0	0	3	3
2.	CMG344	Constitution of India	PEC	3	0	0	3	3
3.	CMG345	Public Personnel Administration	PEC	3	0	0	3	3
4.	CMG346	Administrative Theories	PEC	3	0	0	3	3
5.	CMG347	Indian Administrative System	PEC	3	0	0	3	3
6.	CMG348	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL 4: BUSINESS DATA ANALYTICS

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CMG349	Statistics for Management	PEC	3	0	0	3	3
2.	CMG350	Datamining for Business Intelligence	PEC	3	0	0	3	3
3.	CMG351	Human Resource Analytics	PEC	3	0	0	3	3
4.	CMG352	Marketing and Social Media Web Analytics	PEC	3	0	0	3	3
5.	CMG353	Operation and Supply Chain Analytics	PEC	3	0	0	3	3
6.	CMG354	Financial Analytics	PEC	3	0	0	3	3

VERTICAL 5: ENVIRONMENTAL AND SUSTAINABILITY

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CES331	Sustainable infrastructure Development	PEC	3	0	0	3	3
2.	CES332	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3.	CES333	Sustainable Bio Materials	PEC	3	0	0	3	3
4.	CES334	Materials for Energy Sustainability	PEC	3	0	0	3	3
5.	CES335	Green Technology	PEC	3	0	0	3	3
6.	CES336	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7.	CES337	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8.	CES338	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3

MA3355 RANDOM PROCESSES AND LINEAR ALGEBRA L T P C
3 1 0 4

COURSE OBJECTIVES :

- To introduce the basic notions of vector spaces which will then be used to solve related problems.
- To understand the concepts of vector space, linear transformations , inner product spaces and orthogonalization..
- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To provide necessary basics in probability that are relevant in applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random
- variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.

UNIT - I PROBABILITY AND RANDOM VARIABLES 9 + 3

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions - Functions of a random variable.

UNIT - II TWO - DIMENSIONAL RANDOM VARIABLES 9 + 3

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT – III RANDOM PROCESSES 9 + 3

Classification – Stationary process – Markov process - Poisson process - Discrete parameter Markov chain – Chapman Kolmogorov equations (Statement only) - Limiting distributions .

UNIT - IV VECTOR SPACES 9 + 3

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

UNIT - V LINEAR TRANSFORMATION AND INNER PRODUCT SPACES 9 + 3

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Inner product - Norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.

TOTAL: 60 PERIODS

COURSE OUTCOMES :

Upon successful completion of the course, students will be able to:

CO1:Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.

CO2:Demonstrate accurate and efficient use of advanced algebraic techniques.

CO3:Apply the concept of random processes in engineering disciplines.

CO4:Understand the fundamental concepts of probability with a thorough knowledge of standard distributions that can describe certain real-life phenomenon.

CO5: Understand the basic concepts of one and two dimensional random variables and apply them to model engineering problems.

TEXTBOOKS :

1. Gross, D., Shortle, J.F, Thompson, J.M and Harris. C.M., "Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014.
2. Ibe, O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier,1st Indian Reprint, 2007.
3. Friedberg. A.H., Insel. A.J. and Spence. L., "Linear Algebra", Prentice Hall of India, New Delhi, 4th Edition, 2004.

REFERENCE BOOKS :

1. Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
2. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
3. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
4. Kolman. B. Hill. D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009.
5. Kumaresan. S., "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.
6. Strang. G., "Linear Algebra and its applications", Thomson (Brooks/Cole), New Delhi, 2005.

CS3353 C PROGRAMMING AND DATA STRUCTURES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

UNIT I C PROGRAMMING FUNDAMENTALS (8+1 SKILL) 9

Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays.

UNIT II C PROGRAMMING - ADVANCED FEATURES (8+1 SKILL) 9

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – File Handling – Preprocessor Directives.

UNIT III LINEAR DATA STRUCTURES (8+1 SKILL) 9

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly- Linked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Priority Queues – Queue Implementation – Applications.

UNIT IV NON-LINEAR DATA STRUCTURES (8+1 SKILL) 9

Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing – Double Hashing – Rehashing.

UNIT V SORTING AND SEARCHING TECHNIQUES (8+1 SKILL) 9

Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.

TOTAL45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc) 5

COURSE OUTCOMES:

CO1:Develop C programs for any real world/technical application.
CO2:Apply advanced features of C in solving problems.
CO3:Write functions to implement linear and non–linear data structure operations.
CO4: Suggest and use appropriate linear/non–linear data structure operations for solving a given problem.
CO5:Appropriately use sort and search algorithms for a given application.
CO6:Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1997.
2. ReemaThareja, "Programming in C", Second Edition, Oxford University Press, 2016.

REFERENCES:

1. Brian W. Kernighan, Rob Pike, "The Practice of Programming", Pearson Education, 1999.
2. Paul J. Deitel, Harvey Deitel, "C How to Program", Seventh Edition, Pearson Education, 2013.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education,1983.
4. Ellis Horowitz, SartajSahni and Susan Anderson, "Fundamentals of Data Structures", Galgotia, 2008.

List of Open Source Software/ Learning website:

https://www.coursera.org/specializations/data-structures-algorithms
https://nptel.ac.in/courses/112107243
https://nptel.ac.in/courses/112105598

EC3354 SIGNALS AND SYSTEMS L T P C

3 1 0 4

COURSE OBJECTIVES :

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 6+6

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids_Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals -Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant& Time-invariant,Causal & Non-causal, Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 6+6

Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 6+6

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 6+6

Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 6+6

Impulse response–Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

TOTAL: 30+30 PERIODS

COURSE OUTCOMES:

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

CO1:determine if a given system is linear/causal/stable
CO2: determine the frequency components present in a deterministic signal
CO3:characterize continuous LTI systems in the time domain and frequency domain
CO4:characterize continuous LTI systems in the time domain and frequency domain
CO5:compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

1. Oppenheim, Willsky and Hamid, "Signals and Systems", 2nd Edition, Pearson Education, New Delhi, 2015.(Units I - V)
2. Simon Haykin, Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley, 2002

REFERENCES :

1. B. P. Lathi, "Principles of Linear Systems and Signals", 2nd Edition, Oxford, 2009.
2. M. J. Roberts, "Signals and Systems Analysis using Transform methods and MATLAB", McGraw- Hill Education, 2018.
3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.

EC3353 ELECTRONIC DEVICES AND CIRCUITS L T P C

3 0 0 3

COURSE OBJECTIVES :

- To give a comprehensive exposure to all types of devices and circuits constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits
- To analyze the frequency response of small signal amplifiers
- To design and analyze single stage and multistage amplifier circuits
- To study about feedback amplifiers and oscillators principles
- To understand the analysis and design of multi vibrators

UNIT I SEMICONDUCTOR DEVICES 9

PN junction diode, Zener diode, BJT, MOSFET, UJT –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier, Zener as regulator

UNIT II AMPLIFIERS 9

Load line, operating point, biasing methods for BJT and MOSFET**,** BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response –MOSFET small signal model– Analysis of CS, CG and Source follower – Gain and frequency response- High frequency analysis.

UNIT III MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – MOSFET input stages – tuned amplifiers – Gain and frequency response – Neutralization methods.

UNIT IV FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – Voltage / Current, Series , Shunt feedback Amplifiers – positive feedback–Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

UNIT V POWER AMPLIFIERS AND DC/DC CONVERTERS 9

Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

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

CO1: Explain the structure and working operation of basic electronic devices.
CO2: Design and analyze amplifiers.
CO3: Analyze frequency response of BJT and MOSFET amplifiers CO4:
Design and analyze feedback amplifiers and oscillator principles. CO5:
Design and analyze power amplifiers and supply circuits

TEXT BOOKS :

1. David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5 th Edition, 2010.
2. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10th Edition, Pearson Education / PHI, 2008.
3. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7 th Edition, 2014.

REFERENCES :

1. Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3 rd Edition, 2010.
2. D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 1989
3. Muhammad H.Rashid, "Power Electronics", Pearson Education / PHI , 2004.

EC3351 **CONTROL SYSTEMS** **L T P C**
3 0 0 3

COURSE OBJECTIVES :

- To introduce the components and their representation of control systems
- To learn various methods for analyzing the time response, frequency response and stability of the systems.
- To learn the various approach for the state variable analysis.

UNIT I SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory- Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system

UNIT II TIME RESPONSE ANALYSIS 9

Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems

UNIT III FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot - Polar Plot- Nyquist plots-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation

UNIT IV CONCEPTS OF STABILITY ANALYSIS 9

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

UNIT V CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS 9

State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models-Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems-Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.

TOTAL:45 PERIODS

COURSE OUTCOMES :

Upon successful completion of the course the student will be able to

CO1: Compute the transfer function of different physical systems.
CO2: Analyse the time domain specification and calculate the steady state error.
CO3: Illustrate the frequency response characteristics of open loop and closed loop system response.
CO4: Analyse the stability using Routh and root locus techniques.
CO5: Illustrate the state space model of a physical system and discuss the concepts of sampled data control system.

TEXT BOOK:

1. M.Gopal,"Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.

REFERENCE:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2007.
2. K.Ogata, "Modern Control Engineering", PHI, 5th Edition, 2012.
3. S.K.Bhattacharya, "Control System Engineering", Pearson, 3rd Edition, 2013.
4. Benjamin.C.Kuo, "Automatic Control Systems", Prentice Hall of India, 7th Edition,1995.

EC3352 DIGITAL SYSTEMS DESIGN L T P C

3 0 2 4

COURSE OBJECTIVES :

- To present the fundamentals of digital circuits and simplification methods
- To practice the design of various combinational digital circuits using logic gates
- To bring out the analysis and design procedures for synchronous and asynchronous Sequential circuits
- To learn integrated circuit families.
- To introduce semiconductor memories and related technology

UNIT I BASIC CONCEPTS 9

Review of number systems-representation-conversions, Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms min term and max term, Simplification of Boolean expressions-Karnaugh map, completely and incompletely specified functions, Implementation of Boolean expressions using universal gates ,Tabulation methods.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux, Case study: Digital trans-receiver / 8 bit Arithmetic and logic unit, Parity Generator/Checker, Seven Segment display decoder

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Latches, Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment,lock - out condition circuit implementation - Counters, Ripple Counters, Ring Counters, Shift registers, Universal Shift Register. Model Development: Designing of rolling display/real time clock

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Fundamental and Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT V LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES 9

Logic families- Propagation Delay, Fan - In and Fan - Out - Noise Margin - RTL ,TTL,ECL, CMOS - Comparison of Logic families - Implementation of combinational logic/sequential logic design using standard ICs, PROM, PLA and PAL, basic memory, static ROM,PROM,EPROM,EEPROM EAPROM.

45 PERIODS

PRACTICAL EXERCISES : 30 PERIODS

1. Design of adders and subtractors & code converters.
2. Design of Multiplexers & Demultiplexers.
3. Design of Encoders and Decoders.
4. Design of Magnitude Comparators
5. Design and implementation of counters using flip-flops
6. Design and implementation of shift registers.

COURSE OUTCOMES :

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

CO1: Use Boolean algebra and simplification procedures relevant to digital logic. CO2: Design various combinational digital circuits using logic gates.
CO3:Analyse and design synchronous sequential circuits. CO4: Analyse and design asynchronous sequential circuits. . CO5: Build logic gates and use programmable devices

TOTAL:75 PERIODS

TEXTBOOKS :

1. M. Morris Mano and Michael D. Ciletti, 'Digital Design', Pearson, 5th Edition, 2013.(Unit - I -V)

REFERENCES :

1. Charles H. Roth, Jr, 'Fundamentals of Logic Design', Jaico Books, 4th Edition, 2002.
2. William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hall of India, 1980.
3. Floyd T.L., "Digital Fundamentals", Charles E. Merril publishing company,1982.
4. John. F. Wakerly, "Digital Design Principles and Practices", Pearson Education, 4 th Edition,2007.

EC3361 ELECTRONIC DEVICES AND CIRCUITS LABORATORY L T P C

0 0 3 1.5

COURSE OBJECTIVES

- To learn the characteristics of PN Junction diode and Zener diode.
- To understand the operation of rectifiers and filters.
- To study the characteristics of amplifier.

LIST OF EXPERIMENTS

1. Characteristics of PN Junction Diode and Zener diode.
2. Full Wave Rectifier with Filters.
3. Design of Zener diode Regulator.
4. Common Emitter input-output Characteristics.
5. MOSFET Drain current and Transfer Characteristics.
6. Frequency response of CE and CS amplifiers.
7. Frequency response of CB and CC amplifiers.
8. Frequency response of Cascode Amplifier
9. CMRR measurement of Differential Amplifier
10. Class A Transformer Coupled Power Amplifier.

COURSE OUTCOMES

At the end of the laboratory course, the student will be able to understand the

CO1: Characteristics of PN Junction Diode and Zener diode.

CO2: Design and Testing of BJT and MOSFET amplifiers.

CO3: Operation of power amplifiers.

TOTAL:45 PERIODS

LAB REQUIREMENTS

1. CRO/DSO (30 MHz) – 15 Nos.
2. Signal Generators / Function Generators (3 MHz) – 15 Nos.
3. Dual Regulated Power Supplies (0-30 v) - 15 Nos.
4. Bread Boards - 15 Nos.
5. BC107, BC547, BF195C, BFW10, IN4001, IN4007 – 25 each
6. SPICE Simulator

REFERENCE :

XYZ of Oscilloscope – Application note: Tektronix USA.

CS3362 C PROGRAMMING AND DATA STRUCTURES LABORATORY L T P C

0 0 3 1.5

COURSE OBJECTIVES:

- To develop applications in C
- To implement linear and non-linear data structures
- To understand the different operations of search trees
- To get familiarized to sorting and searching algorithms

LIST OF EXPERIMENTS

1. Practice of C programming using statements, expressions, decision making and iterative statements
2. Practice of C programming using Functions and Arrays
3. Implement C programs using Pointers and Structures
4. Implement C programs using Files
5. Development of real time C applications
6. Array implementation of List ADT
7. Array implementation of Stack and Queue ADTs
8. Linked list implementation of List, Stack and Queue ADTs
9. Applications of List, Stack and Queue ADTs
10. 10.Implementation of Binary Trees and operations of Binary Trees
11. Implementation of Binary Search Trees
12. Implementation of searching techniques
13. Implementation of Sorting algorithms : Insertion Sort, Quick Sort, Merge Sort
14. Implementation of Hashing – any two collision techniques

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:Use different constructs of C and develop applications

CO2:Write functions to implement linear and non-linear data structure operations

CO3:Suggest and use the appropriate linear / non-linear data structure operations for a given problem
CO4:Apply appropriate hash functions that result in a collision free scenario for data storage and Retrieval
CO5:Implement Sorting and searching algorithms for a given application

EC3452 **ELECTROMAGNETIC FIELDS** **L T P C**
3 0 0 3

COURSE OBJECTIVES :

- To impart knowledge on the basics of static electric field and the associated laws
- To impart knowledge on the basics of static magnetic field and the associated laws
- To give insight into coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To gain the behaviour of the propagation of EM waves
- To study the significance of Time varying fields.

UNIT I INTRODUCTION **9**

Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem, Verify theorems for different path, surface and volume.

UNIT II ELECTROSTATICS **9**

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Electrostatics boundary value problems, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Uniqueness of electrostatic solutions, Current density and Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law

UNIT III MAGNETOSTATICS **9**

Lorentz force equation, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Calculation of magnetic field intensity for various current distributions Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torques

UNIT IV TIME-VARYING FIELDS AND MAXWELL's EQUATIONS **9**

Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields, Observing the Phenomenon of wave propagation with the aid of Maxwell's equations

UNIT V PLANE ELECTROMAGNETIC WAVES **9**

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary

COURSE OUTCOMES :

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

CO1: Relate the fundamentals of vector, coordinate system to electromagnetic concepts
CO2: Analyze the characteristics of Electrostatic field
CO3: Interpret the concepts of Electric field in material space and solve the boundary conditions
CO4: Explain the concepts and characteristics of Magneto Static field in material space and solve boundary conditions.
CO5: Determine the significance of time varying fields

TOTAL:45 PERIODS

TEXT BOOKS

1. D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 2002
2. M.N.O.Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford(Asian Edition), 2015

REFERENCES

1. Edward C. Jordan & Keith G. Balmain,Electromagnetic waves and Radiating Systems, Second Edition, Prentice-Hall Electrical Engineering Series, 2012.
2. W.H. Hayt and J.A. Buck, Engineering electromagnetics, 7th ed., McGraw-Hill (India), 2006
3. B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011

EC3401 NETWORKS AND SECURITY L T P C
3 0 2 4

OBJECTIVES:

- To learn the Network Models and datalink layer functions.
- To understand routing in the Network Layer.
- To explore methods of communication and congestion control by the Transport Layer.
- To study the Network Security Mechanisms.
- To learn various hardware security attacks and their countermeasures**.**

UNIT I NETWORK MODELS AND DATALINK LAYER 9

Overview of Networks and its Attributes – Network Models – OSI, TCP/IP, Addressing – Introduction to Datalink Layer – Error Detection and Correction – Ethernet(802.3)- Wireless LAN – IEEE 802.11, Bluetooth – Flow and Error Control Protocols – HDLC – PPP.

UNIT II NETWORK LAYER PROTOCOLS 9

Network Layer – IPv4 Addressing – Network Layer Protocols(IP,ICMP and Mobile IP) Unicast and Multicast Routing – Intradomain and Interdomain Routing Protocols – IPv6 Addresses – IPv6 – Datagram Format - Transition from IPv4 to IPv6.

UNIT III TRANSPORT AND APPLICATION LAYERS 9

Transport Layer Protocols – UDP and TCP Connection and State Transition Diagram - Congestion Control and Avoidance(DEC bit, RED)- QoS - Application Layer Paradigms – Client – Server Programming – Domain Name System – World Wide Web, HTTP, Electronic Mail.

UNIT IV NETWORK SECURITY 9

OSI Security Architecture – Attacks – Security Services and Mechanisms – Encryption –Advanced Encryption Standard – Public Key Cryptosystems – RSA Algorithm – Hash Functions – Secure Hash Algorithm – Digital Signature Algorithm.

UNIT V HARDWARE SECURITY 9

Introduction to hardware security, Hardware Trojans, Side – Channel Attacks – Physical Attacks and Countermeasures – Design for Security. Introduction to Blockchain Technology.

45 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

Experiments using C

1. Implement the Data Link Layer framing methods,
   i) Bit stuffing, (ii) Character stuffing
2. Implementation of Error Detection / Correction Techniques
   i) LRC, (ii) CRC, (iii) Hamming code
3. Implementation of Stop and Wait, and Sliding Window Protocols
4. Implementation of Go back-N and Selective Repeat Protocols.
5. Implementation of Distance Vector Routing algorithm (Routing Information Protocol) (Bellman-Ford).
6. Implementation of Link State Routing algorithm (Open Shortest Path First) with 5 nodes (Dijkstra's).
7. Data encryption and decryption using Data Encryption Standard algorithm.
8. Data encryption and decryption using RSA (Rivest, Shamir and Adleman) algorithm.
9. Implement Client Server model using FTP protocol.

Experiments using Tool Command Language

1. Implement and realize the Network Topology - Star, Bus and Ring using NS2.
2. Implement and perform the operation of CSMA/CD and CSMA/CA using NS2.

OUTCOMES:

Upon successful completion of the course the student will be able to CO1:

Explain the Network Models, layers and functions.

CO2: Categorize and classify the routing protocols.

CO3: List the functions of the transport and application layer.

CO4: Evaluate and choose the network security mechanisms.

CO5: Discuss the hardware security attacks and countermeasures.

TOTAL:75 PERIODS

TEXTBOOKS

1. Behrouz.A.Forouzan, Data Communication and Networking, Fifth Edition, TMH, 2017.(Unit – I,II,III)
2. William Stallings, Cryptography and Network Security, Seventh Edition, Pearson Education, 2017(Unit- IV)
3. Bhunia Swarup, Hardware Security –A Hands On Approach,Morgan Kaufmann, First edition, 2018.(Unit – V).

REFERENCES

1. James.F.Kurose and Keith.W.Ross, Computer Networking – A Top – Down Approach, Sixth Edition, Pearson, 2017.
2. Doughlas .E.Comer, Computer Networks and Internets with Internet Applications, Fourth Edition, Pearson Education, 2008.

EC3451 **LINEAR INTEGRATED CIRCUITS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the theory and applications of analog multipliers and PLL
- To learn the theory of ADC and DAC
- To introduce the concepts of waveform generation and introduce some special function ICs

UNIT I BASICS OF OPERATIONAL AMPLIFIERS 9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations – MOSFET Operational Amplifiers – LF155 and TL082.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT III ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode *R - 2R* Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters.

UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS 9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto- couplers and fibre optic IC

COURSE OUTCOMES:

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

CO1 : Design linear and nonlinear applications of OP – AMPS
CO2 : Design applications using analog multiplier and PLL

CO3 : Design ADC and DAC using OP – AMPS
CO4 : Generate waveforms using OP – AMP Circuits
CO5 : Analyze special function ICs

TOTAL:45 PERIODS

TEXT BOOK

1. 1.D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018, Fifth Edition. (Unit I – V)
2. 2.Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata Mc Graw-Hill, 2016 (Unit I – V)

REFERENCES

1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015
2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.
3. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH,2nd Edition, 4th Reprint, 2016.

EC3492 DIGITAL SIGNAL PROCESSING L T P C
3 0 2 4

COURSE OBJECTIVES:

- To learn discrete fourier transform, properties of DFT and its application to linear filtering
- To understand the characteristics of digital filters, design digital IIR and FIR filters and apply these filters to filter undesirable signals in various frequency bands
- To understand the effects of finite precision representation on digital filters
- To understand the fundamental concepts of multi rate signal processing and its applications
- **T**o introduce the concepts of adaptive filters and its application to communication engineering

UNIT I DISCRETE FOURIER TRANSFORM 9

Sampling Theorem, concept of frequency in discrete-time signals, summary of analysis & synthesis equations for FT & DTFT, frequency domain sampling, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.

UNIT II INFINITE IMPULSE RESPONSE FILTERS 9

Characteristics of practical frequency selective filters. characteristics of commonly used analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT III FINITE IMPULSE RESPONSE FILTERS 9

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations

UNIT IV FINITE WORD LENGTH EFFECTS 9

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.

UNIT V DSP APPLICATIONS 9

Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor – Adaptive Filters: Introduction, Applications of adaptive filtering to equalization-DSP Architecture- Fixed and Floating point architecture principles

45 PERIODS

PRACTICAL EXERCISES:

30 PERIODS

MATLAB / EQUIVALENT SOFTWARE PACKAGE/ DSP PROCESSOR BASED IMPLEMENTATION

1. Generation of elementary Discrete-Time sequences
2. Linear and Circular convolutions
3. Auto correlation and Cross Correlation
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations
7. Study of architecture of Digital Signal Processor
8. Perform MAC operation using various addressing modes
9. Generation of various signals and random noise
10. Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering
11. Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering
12. Implement an Up-sampling and Down-sampling operation in DSP Processor

COURSE OUTCOMES:

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

CO1: Apply DFT for the analysis of digital signals and systems
CO2: Design IIR and FIR filters
CO3: Characterize the effects of finite precision representation on digital filters
CO4: Design multirate filters
CO5: Apply adaptive filters appropriately in communication systems

TOTAL:75 PERIODS

TEXT BOOKS:

1. 1.John G. Proakis and Dimitris G.Manolakis, Digital Signal Processing – Principles, Algorithms and Applications, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. 2.A. V. Oppenheim, R.W. Schafer and J.R. Buck, ―Discrete-Time Signal Processing‖, 8th Indian Reprint, Pearson, 2004.

REFERENCES

1. Emmanuel C. Ifeachor& Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
2. 2.Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007.
3. 3.Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006.

EC3491 COMMUNICATION SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce Analog Modulation Schemes
- To impart knowledge in random process
- To study various Digital techniques
- To introduce the importance of sampling & quantization
- To impart knowledge in demodulation techniques
- To enhance the class room teaching using smart connectivity instruments

UNIT I AMPLITUDE MODULATION 9

Review of signals and systems, Time and Frequency domain representation of signals, Principles of Amplitude Modulation Systems- DSB, SSB and VSB modulations. Angle Modulation, Representation of FM and PM signals, Spectral characteristics of angle modulated signals. SSB Generation – Filter and Phase Shift Methods, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & complex envelope AM techniques, Superheterodyne Receiver.

UNIT II RANDOM PROCESS & SAMPLING 9

Review of probability and random process. Gaussian and white noise characteristics, Noise in amplitude modulation systems, Noise in Frequency modulation systems. Pre-emphasis and De- emphasis, Threshold effect in angle modulation.

Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Nyquist criterion- Logarithmic Companding –PAM, PPM, PWM, PCM – TDM, FDM

UNIT III DIGITAL TECHNIQUES 9

Pulse modulation Differential pulse code modulation. Delta modulation, Noise considerations in PCM,, Digital Multiplexers, Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder

UNIT IV DIGITAL MODULATION SCHEME 9

Geometric Representation of signals - Generation, detection, IQ representation, PSD & BER of Coherent BPSK, BFSK, & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers Synchronization and Carrier Recovery for Digital modulation, Spectrum Analysis – Occupied bandwidth – Adjacent channel power, EVM, Principle of DPSK

UNIT V DEMODULATION TECHNIQUES 9

Elements of Detection Theory, Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Baseband Pulse Transmission- Inter symbol Interference, Optimum demodulation of digital signals over band-limited channels.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: Gain knowledge in amplitude modulation techniques

CO2: Understand the concepts of Random Process to the design of communication systems

CO3: Gain knowledge in digital techniques

CO4: Gain knowledge in sampling and quantization

CO5: Understand the importance of demodulation techniques

TEXTBOOKS :

1. Simon Haykins," Communication Systems", Wiley, 5th Edition, 2009.(Unit I - V)
2. B.P.Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2011.

REFERENCES :

1. Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education,2008.
2. D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006
3. A.Papoulis, "Probability, Random variables and Stochastic Processes", McGraw Hill, 3rd edition, 1991.
4. B.Sklar, "Digital Communications Fundamentals and Applications", 2nd Edition Pearson Education 2007
5. H P Hsu, Schaum Outline Series - "Analog and Digital Communications" TMH 2006
6. Couch.L., "Modern Communication Systems", Pearson, 2001

GE3451 ENVIRONMENTAL SCIENCES AND SUSTAINABILITY L T P C
2 0 0 2

UNIT I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness.Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts .

UNIT III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT 6

Development , GDP ,Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES 6

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL:30 PERIODS

TEXT BOOKS :

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006.
7. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998.

REFERENCES :

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

EC3461 COMMUNICATION SYSTEMS LABORATORY L T P C

0 0 3 1.5

COURSE OBJECTIVES :

- To study the AM & FM Modulation and Demodulation.
- To learn and realize the effects of sampling and TDM.
- To understand the PCM & Digital Modulation.
- To Simulate Digital Modulation Schemes.
- To Implement Equalization Algorithms and Error Control Coding Schemes.

LIST OF EXPERIMENTS

1. AM- Modulator and Demodulator
2. FM - Modulator and Demodulator
3. Pre-Emphasis and De-Emphasis.
4. Signal sampling and TDM.
5. Pulse Code Modulation and Demodulation.
6. Pulse Amplitude Modulation and Demodulation.
7. Pulse Position Modulation and Demodulation and Pulse Width Modulation and Demodulation.
8. Digital Modulation – ASK, PSK, FSK.
9. Delta Modulation and Demodulation.
10. Simulation of ASK, FSK, and BPSK Generation and Detection Schemes.
11. Simulation of DPSK, QPSK and QAM Generation and Detection Schemes.
12. Simulation of Linear Block and Cyclic Error Control coding Schemes.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

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

1. Design AM, FM & Digital Modulators for specific applications.
2. Compute the sampling frequency for digital modulation**.**
3. Simulate & validate the various functional modules of Communication system.
4. Demonstrate their knowledge in base band signaling schemes through implementation of digital modulation schemes.
5. Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of Communication system.

LAB REQUIREMENTS :

1. Trainer Kits for AM, FM, Signal Sampling, TDM, PCM, PAM, PPM,PWM, DM and Line Coding Schemes.
2. Trainer Kits for ASK, FSK and PSK.
3. CRO/DSO (30 MHz) – 15 Nos.
4. Signal Generators / Function Generators (3 MHz) – 15 Nos.
5. MATLAB or equivalent opensource software package for simulation Experiments.

6.PCs - 15 Nos.

EC3462 LINEAR INTEGRATED CIRCUITS LABORATORY L T P C

0 0 3 1.5

COURSE OBJECTIVES:

- To gain hands on experience in designing electronic circuits
- To learn simulation software used in circuit design

- To learn the fundamental principles of amplifier circuits
- To differentiate feedback amplifiers and oscillators.
- To differentiate the operation of various multivibrators

LIST OF EXPERIMENTS:

DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS

1. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance
2. RC Phase shift oscillator and Wien Bridge Oscillator
3. Hartley Oscillator and Colpitts Oscillator
4. RC Integrator and Differentiator circuits using Op-Amp
5. Clippers and Clampers
6. Instrumentation amplifier
7. Active low-pass, High pass & Band pass filters
8. PLL Characteristics and its use as frequency multiplier, clock synchronization
9. R-2R ladder type D-A converter using Op-Amp

SIMULATION USING SPICE (Using Transistor):

1. Tuned Collector Oscillator
2. Twin -T Oscillator / Wein Bridge Oscillator
3. Double and Stagger tuned Amplifiers
4. Bistable Multivibrator
5. Schmitt Trigger circuit with Predictable hysteresis
6. Analysis of power amplifier

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS:

S.NO	**EQUIPMENTS**
1.70MHz DSO with built in 4 bit pattern generator and 50 MHz AFG	-15 Nos
2.Programmable Triple o/p Power Supplies (0 – 30V/3A)(0-30V/3A)(0-5V/3A)	-15 Nos
3Digital Multimeter	-15 Nos
4Digital LCR Meter	-2 Nos
5. Standalone desktops PC	-15 Nos
6. Transistor/MOSFET (BJT-NPN-PNP and NMOS/PMOS)	-50 Nos
7. IC Tester	-5 Nos

Components and Accessories:

Transistors, Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers. SPICE Circuit Simulation Software: (any public domain or commercial software)

Note: Op-Amps uA741, LM 301, LM311, LM 324, LM317, LM723, 7805, 7812, 2N3524, 2N3525, 2N3391, AD 633, LM 555, LM 565 may be used

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Analyze various types of feedback amplifiers
- Design oscillators, tuned amplifiers, wave-shaping circuits and multivibrators
- Design and simulate feedback amplifiers,oscillators, tuned amplifiers, wave-shaping circuits and multivibrators, filters using SPICE Tool.
- Design amplifiers, oscillators, D-A converters using operational amplifiers.
- Design filters using op-amp and perform an experiment on frequency response