NOORUL ISLAM CENTRE FOR HIGHER EDUCATION

(Deemed to be University Under Section 3 of the UGC Act, 1956)
Kumaracoil, Thuckalay

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM AND SYLLABI

REGULATION 2021

NOORUL ISLAM CENTRE FOR HIGHER EDUCATION, Kumaracoil

Regulation: 2021

Curriculum and Syllabi

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

Vision of the University

To be recognized by the Government and society at large as an institution able to deliver excellence with relevance in the field of higher education and research focusing on the needs of the nation in tune with the technological revolution to cope with the knowledge explosion and global competence.

Mission of the University

To develop the institution as a Centre of Excellence, keeping pace with the advances in the field, so as to provide quality higher education to the students and instill in them high standards of discipline and ethics so that they become enlightened individuals in the service of humanity and to carry out focused research in the frontier areas of science and technology.

Faculty of Electrical and Electronics Engineering

Department of Electronics & Communication Engineering

Vision of the Department

To impart the students of Electronics and Communication Engineering Department, the latest technical knowledge, professional excellence and social responsibility.

Mission of the Department

To attain academic excellence in Electronics and Communication Engineering through commitment in duty, innovation in learning and research.

To establish a suitable environment for the students to develop professionalism and face life challenges with ethical integrity.

To develop the students to understand the societal needs and equip them with technical expertise to provide the necessary solutions

Description of the programme

The Department of Electronics and Communication Engineering was started in the year 1989. It has emerged as a leading department with excellent laboratory facilities, well-qualified and experienced staff. In present era, the field of Electronics & Communication plays an important role in almost every sphere of our life. It mainly deals with the communication technologies along with the basic electronic components, design of circuits and systems. Electronics & Communication Engineering offers scope in the field of Research, Mobile Communication, Microwave Communication, Robotics, Defense, Radio Communication, TV Broadcasting, VLSI Design, DSP, Wireless Communication, Biotechnology, Embedded System, Artificial Intelligence and Image Processing.

Electronics and Communication Engineering programme is designed to prepare students to serve the nation in meeting the challenging requirements of society envisaged in the broad areas of Design, Analysis and Testing related to Electronics Circuits, Embedded System, Wireless Communication, Image Processing, Networking, Artificial intelligence in BSNL, ISRO, DRDO, Alcatel-Lucent, BEL, Nokia, Ericson, Cognizant and Tata Consultancy Services.

Programme Educational Objectives - PEO	
PEO-01	To equip the graduates with knowledge in Mathematics, Engineering fundamentals, Electronics and Communication Engineering and related fields for professional achievement in industry and organizations.
PEO-02	To develop the students to identify, analyze and apply engineering concepts for design of Electronics and Communication Systems and demonstrate multidisciplinary expertise to meet contemporary requirements.
PEO-03	To develop the ability of graduates to communicate orally and in writing in an effective way, and to present their work before peers and/or scientific community
PEO-03	To have an ability to design and evaluate electronic systems or components considering realistic constraints.
PEO-05	To provide students with a solid foundation in mathematical, scientific and electronics and communication engineering fundamentals required to solve engineering problems.
PEO-06	To inculcate a strong flavour of practical knowledge among the students by imparting them with good scientific and engineering depth and breadth of knowledge in hardware and software languages.
PEO-07	To inculcate in students the finest professional attributes, ethics, a positive attitude, effective communication and presentation skills, ownership, responsibility and accountability.

PEO-08	To practice the ethics of their profession, consistent with a sense of social responsibility and develop their engineering design, problem–solving skills in multi-disciplinary teams.
PEO-09	To equip the students by imparting professional development courses and industrial trainings, preparing students to crack various national level competitive examinations like GATE, IES, TOFEL, etc.
PEO-10	To be receptive to new technologies and attain professional competence through lifelong learning such as advanced degrees, professional registration, publications and other professional activities.
PEO-11	To develop the leadership qualities, team spirit, managerial skills, attitude and ethics needed for successful career and entrepreneurship.
PEO-12	To handle and analyse inter-disciplinary projects to engage in effective teamwork with significant social, environmental and economic considerations.

Graduate Attributes-GA	
GA-1	**Innovative Engineering Solutions** Develop creative and innovative solutions to complex engineering problems, incorporating the latest technologies and approaches to address current and future challenges.
GA-2	**Global Perspective in Engineering** Understand and apply engineering solutions in a global context, recognizing the diversity of global issues, standards, and the impact of engineering decisions on different cultures and communities.
GA-3	**Sustainable Development and Green Engineering** Design and implement engineering solutions that prioritize sustainability, resource efficiency, and environmental protection, contributing to a sustainable future.
GA-4	Social Responsibility and Community Engagement Demonstrate a commitment to social responsibility by engaging with and contributing to local communities, understanding societal needs, and addressing social challenges through engineering
GA-5	**Adaptability and Lifelong Learning** Exhibit a proactive approach to continuous learning and adaptability, keeping pace with technological advancements and industry changes, and engaging in professional development activities.
GA-6	**Entrepreneurship and Innovation** Foster an entrepreneurial mindset, identifying opportunities for innovation and creating value through new technologies, products, and processes that meet market needs.

GA-7	**Interdisciplinary Collaboration** Work effectively in interdisciplinary teams, integrating knowledge from various fields to develop comprehensive solutions to complex engineering problems.
GA-8	**Ethical Leadership and Integrity** Lead with integrity and ethical principles, ensuring transparency, fairness, and respect in all professional and personal
GA-9	**Digital and Data Literacy** Utilize advanced digital tools and data analytics techniques to solve engineering problems, optimize processes, and make informed decisions based on data-driven insights.
GA-10	**Safety, Health, and Risk Management** Prioritize safety, health, and risk management in engineering practices, ensuring the well-being of individuals and communities while minimizing potential risks and hazards.
GA-11	**Effective Communication and Negotiation Skills** Communicate ideas, solutions, and technical information effectively to a variety of audiences, and engage in negotiation to resolve conflicts and reach consensus.
GA-12	**Impact Assessment and Policy Making Assess** the impact of engineering projects on society and the environment, and contribute to policy-making processes that promote sustainable and responsible engineering practices.

Programme Outcome – PO	
PO-A	To apply the knowledge of mathematics, science, and engineering fundamentals to solve problems in the domain of Electronics and Communication engineering.
PO-B	To identify, formulate and analyze complex problems in real world using principles of science and engineering.
PO-C	To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health, safety, manufacturability and sustainability
P0-D	To conduct experiments, analyze and interpret experimental results and synthesize information to provide valid conclusion
PO-E	To apply techniques, skills, and modern engineering tools necessary for engineering practice
PO-F	To develop and model complex electronic hardware and software systems for human needs.
PO-G	To comprehend the impact of engineering solutions in a global, economic, environmental, and societal context

PO-H	To apply professional and ethical principles and function with responsibility
PO-I	To identify areas of interest and to function an individual and as a member or leader in multidisciplinary teams
PO-J	To articulate teamwork principles, work with a multi-disciplinary team, and appreciate the role of a leader.
PO-K	To communicate facts successfully with people in engineering domain and effectively design and prepare documents and reports.
PO-L	To acquire knowledge of contemporary issues and recognize the need for lifelong learning
PO-M	To apply knowledge of engineering and management principles in multidisciplinary environment and projects.

Mapping of Graduate Attributes and Programme Educational Objectives(PEO)

GAs / PEOs	GA-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10	GA-11	GA-12
PEO-01	H	H	H	H	H	H	H	A	H	H	Not	H
PEO-02	H	H	H	H	H	H	H	A	H	H	Not	H
PEO-03	H	H	H	H	H	H	H	H	H	Not	H	H
PE0-04	H	H	H	H	H	H	H	A	H	H	Not	H
PEO-05	H	H	H	H	H	H	H	A	H	H	Not	H
PEO-06	H	H	H	H	H	H	H	A	H	H	Not	H
PEO-07	H	H	H	H	H	H	H	H	Not	A	H	H
PEO-08	H	H	H	H	H	H	H	H	H	H	H	H
PEO-09	H	H	H	H	H	H	H	H	H	A	Not	H
PEO-10	H	H	H	H	H	H	H	H	H	H	Not	H
PEO-11	H	H	H	H	H	H	H	H	A	Not	H	H
PEO-12	H	H	H	H	H	H	H	H	H	H	Not	H

H- Highly Associated A- Associated Not – Not Associated

Mapping of Graduate Attributes and Programme Outcomes (PO)

GAs / POs	GA-01	GA-02	GA-03	GA-04	GA-05	GA-06	GA-07	GA-08	GA-09	GA-10	GA-11	GA-12
PO-A	H	H	H	H	H	H	H	A	H	H	A	H
PO-B	H	H	H	H	H	H	H	A	H	H	A	H
PO-C	H	H	H	H	H	H	H	A	H	H	A	H
P0-D	H	H	H	H	H	H	H	A	H	H	A	H
PO-E	H	H	H	H	H	H	H	A	H	H	A	H
PO-F	H	H	H	H	H	H	H	A	H	H	A	H
PO-G	H	H	H	H	H	H	H	A	H	H	H	H
PO-H	A	A	A	A	A	H	H	H	A	H	A	H
PO-I	H	H	H	H	H	H	H	A	H	A	A	H
PO-J	H	H	H	H	H	H	H	H	H	A	H	H
PO-K	H	H	H	A	H	H	H	A	H	Not	H	H
PO-L	H	H	H	H	H	A	H	H	H	A	A	H
PO-M	H	H	H	H	H	H	H	H	H	H	A	H

H- Highly Associated A- Associated Not – Not Associated

Mapping of Programme Educational Objective (PEOs) and Programme Outcomes (POs)

PEO / PO	PEO-01	PEO-02	PEO-03	PEO-04	PEO-05	PEO-06	PEO-07	PEO-08	PEO-09	PEO-10	PEO-11	PEO-12
PO-A	H	H	H	A	Not	A	Not	A	A	A	A	H
PO-B	H	H	H	H	Not	H	Not	Not	A	A	A	H
PO-C	H	H	H	H	H	H	H	A	Not	A	H	H
P0-D	H	H	H	H	H	H	H	H	Not	H	H	H
PO-E	H	H	H	H	H	H	A	H	Not	H	H	H
PO-F	H	H	H	H	H	H	H	H	Not	H	H	H
PO-G	H	H	H	H	H	H	H	H	Not	A	A	H
PO-H	H	H	H	H	H	H	H	H	Not	Not	H	H
PO-I	H	H	H	H	H	H	H	H	Not	H	H	H
PO-J	H	H	H	H	H	H	H	Not	Not	H	H	H
PO-K	H	H	H	H	H	H	H	H	Not	H	H	H
PO-L	H	H	H	H	H	H	H	H	Not	H	H	H
PO-M	H	H	H	H	H	H	H	H	H	H	H	H

H- Highly Associated A- Associated Not – Not Associated

Duration of the programme: 4 Years/ 8 Semesters

Total credit: 162

CURRICULUM & SYLLABI

SEMESTER I

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EG3101	Technical English	3	1	0	4
2.	MA3101	Engineering Mathematics – I	3	1	0	4
3.	BS3101	Engineering Physics	3	0	0	3
4.	BS3102	Engineering Chemistry	3	0	0	3
5.	CS3101	Fundamentals of Computing and Python Programming	3	0	0	3
PRACTICAL						
6.	CS3171	Fundamentals of Computing and Python Programming Laboratory	0	0	4	2
7.	BS3171	Physics and Chemistry Laboratory	0	0	4	2
TOTAL			**15**	**2**	**8**	**21**

SEMESTER II

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EG3102	Communicative English	3	0	0	3
2.	MA3102	Engineering Mathematics – II	3	1	0	4
3.	BE3101	Basic Electrical and Electronics Engineering	3	0	0	3
4.	BE3102	Basic Civil and Mechanical Engineering	3	0	0	3
5.	ME3101	Engineering Graphics	3	0	2	4
PRACTICAL						
6.	BE3171	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1
7.	BE3172	Basic Civil and Mechanical Engineering Laboratory	0	0	2	1
TOTAL			**15**	**1**	**6**	**19**

SEMESTER III

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MA3201	Engineering Mathematics - III	3	1	0	4
2.	EC3201	Electric Circuit Theory	3	0	0	3
3.	EE3210	Electrical Machines	3	0	0	3
4.	EC3202	Electron Devices	3	0	0	3
5.	EC3203	Signals and Systems	3	1	0	4
6.	EC3204	Digital Electronics	3	0	0	3
PRACTICAL						
7.	EC3271	Digital Electronics Laboratory	0	0	2	1
8.	EE3277	Electric Circuits and Machines Laboratory	0	0	2	1
9.	EC3272	Electron Devices Laboratory	0	0	2	1
TOTAL			**18**	**2**	**6**	**23**

SEMESTER IV

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MA3208	Random Process and Queuing theory	2	1	0	3
2.	BS3201	Environmental Studies	3	0	0	2
3.	EC3205	Analog Communication System	3	0	0	3
4.	EC3206	Digital Signal Processing	3	0	0	3
5.	EC3207	Electronic Circuits-I	3	0	0	3
6.	EC3208	Electromagnetic Field Theory	3	0	0	3
PRACTICAL						
7.	EC3273	Analog Communication Laboratory	0	0	2	1
8.	EC3274	Digital Signal Processing Laboratory	0	0	2	1
9.	EC3275	Electronic Circuits-I Laboratory	0	0	2	1
10.	EC32P1	Summer Internship I	0	0	0	2
TOTAL			**16**	**1**	**6**	**22**

SEMESTER V

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MS3201	Professional and Business Ethics	2	0	0	2
2.	EC3209	Computer architecture and Microprocessor	3	0	0	3
3.	EC3210	Control System Engineering	3	0	0	3
4.	EC3211	Linear Integrated Circuits	3	0	0	3
5.	EC3212	Electronic Circuits-II	3	0	0	3
6.	EC32**	Programme Elective –I	3	0	0	3
PRACTICAL						
7.	EC3276	Microprocessor Laboratory	0	0	2	1
8.	EC3277	Linear Integrated Circuits Laboratory	0	0	2	1
9.	EC3278	Electronic Circuits-II Laboratory	0	0	2	1
TOTAL			**17**	**0**	**6**	**20**

SEMESTER VI

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EC3213	Embedded Systems and IoT Applications	3	0	0	3
2.	EC3214	Digital Communication	3	0	0	3
3.	EC3215	Optical Communication	3	0	0	3
4.	EC32**	Programme Elective II	3	0	0	3
5.	EC32**	Programme Elective III	3	0	0	3
6.	XXXXXX	Open Elective I	3	0	0	3
PRACTICAL						
7.	EC3279	Digital Communication Laboratory	0	0	2	1
8.	EC3280	Embedded System and IoT Laboratory	0	0	2	1
9.	EC32P2	Summer Internship II	0	0	0	2
TOTAL			**18**	**0**	**4**	**22**

SEMESTER VII

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MS3202	Principles of Management	2	0	0	2
2.	EC3216	Microwave Engineering	3	0	0	3
3.	EC3217	VLSI Technology	3	0	0	3
4.	EC32**	Programme Elective IV	3	0	0	3
5.	XXXXXX	Open Elective II	3	0	0	3
PRACTICAL						
6.	EC3281	RF Laboratory	0	0	2	1
7	EC3282	VLSI Laboratory	0	0	2	1
8.	EC32P3	Project Work Phase –I	0	0	6	3
TOTAL			**14**	**0**	**10**	**19**

SEMESTER VIII

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EC32**	Program Elective – V	3	0	0	3
2.	EC32**	Program Elective – VI	3	0	0	3
PRACTICAL						
4.	EC32P5	Project Work Phase –II	0	0	24	10
TOTAL			**6**	**0**	**24**	**16**

List of Department Electives (PEC)

SI. NO	Course Code	Course Title	L	T	P	C
1	EC32A1	CMOS Analog Design	3	0	0	3
2	EC32A2	DSP Architecture and Programming.	3	0	0	3
3	EC32A3	Digital System Design with FPGA.	3	0	0	3
4	EC32A4	Real Time System Design.	3	0	0	3
5	EC32A5	IoT and its Components.	3	0	0	3
6	EC32A6	Design of IoT and Industry 4.0.	3	0	0	3

7	EC32A7	ASIC Design.	3	0	0	3
8	EC32A8	ARM based Embedded System Design	3	0	0	3
9	EC32A9	Multicore Architecture and Programming.	3	0	0	3
10	EC32B1	Mobile Communication	3	0	0	3
11	EC32B2	Antenna and Wave Propagation	3	0	0	3
12	EC32B3	Fundamentals of Neural Networks And Deep Learning	3	0	0	3
13	EC32B4	Wireless communication and Networks	3	0	0	3
14	EC32B5	Satellite Communication	3	0	0	3
15	EC32B6	Wireless Adhoc and Sensor Networks	3	0	0	3
16	EC32B7	Nano Electronics	3	0	0	3
17	EC32B8	Digital Image Processing	3	0	0	3
18	EC32B9	Remote Sensing	3	0	0	3
19	EC32C1	Electronic Measurements and Instrumentation	3	0	0	3
20	EC32C2	Robotics Engineering	3	0	0	3
21	EC32C3	Computer Communication	3	0	0	3
22	EC32C4	Medical Electronics	3	0	0	3
23	EC32C5	Mixed Signal IC Design Testing	3	0	0	3
24	EC32C6	Wearable Devices and Systems	3	0	0	3
25	EC32C7	Medical Imaging Systems	3	0	0	3
26	EC32C8	Brain Computer Interface and Applications	3	0	0	3

List of Open Electives (OEC)

SI. NO	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**
1	EC32D1	Fundamentals of Image Processing	3	0	0	3
2	EC32D2	Wireless Communication Techniques	3	0	0	3
3	EC32D3	Embedded System Design With ARM	3	0	0	3

SYLLABUS

SEMESTER I

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EG3101	Technical English	3	1	0	4
2.	MA3101	Engineering Mathematics – I	3	1	0	4
3.	BS3101	Engineering Physics	3	0	0	3
4.	BS3102	Engineering Chemistry	3	0	0	3
5.	CS3101	Fundamentals of Computing and Python Programming	3	0	0	3
PRACTICAL						
6.	CS3171	Fundamentals of Computing and Python Programming Laboratory	0	0	4	2
7.	BS3171	Physics and Chemistry Laboratory	0	0	4	2
TOTAL			**15**	**2**	**8**	**21**

EG3101	**Technical English**	**L**	**T**	**P**	**C**
		3	**1**	**0**	**4**

OBJECTIVES

1. To develop the linguistic, communicative and critical thinking competencies of First Year Engineering students.
2. To enhance the understanding of the complex grammatical structures of the English language to students.
3. To improve the language proficiency of students in English with emphasis on Vocabulary, Grammar, Listening, Speaking, Reading, and Writing skills.
4. To introduce the students to the basic phonetics of English and make them grasp the various sounds of the English language to improve their pronunciation.

Course Outcome		Cognitive Skill
CO-01	The students will be able to improve their vocabulary relating to Engineering and Technology, and use articles and prepositions effectively in sentences.	R
CO-02	The students will be able to learn grammatical items like tense, voice, compound nouns etc. and thereby enhance their linguistic competence.	U
CO-03	The students will be able to learn definitions of technical terms, relative pronouns etc. which will develop their language competence.	A
CO-04	The students will be able to acquire the essentials of writing skills relating to CV, Resume, Formal and Business Letters.	U
CO-05	The students will be able to learn English phonemes such as Vowels, Diphthongs and Consonants, which will be instrumental in improving their pronunciation and speaking skills.	R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	M	S	M	S	M	L	S	S	M	L
CO-02	M	S	M	S	N	L	M	S	M	S	S	S	N
CO-03	S	S	S	M	S	S	M	S	M	S	M	M	S
CO-04	M	S	S	S	S	S	S	M	S	M	M	S	M
CO-05	S	L	S	M	S	M	M	S	M	M	S	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: **9**

Word formation with prefixes and suffixes **–** Articles – Conjunctions **–** Prepositions – Expansion of Abbreviations and Acronyms – Writing Checklists – Writing Instructions.

Unit II: **9**

Tense **–** Voice **–** Punctuation **–** Expansion of Compound Nouns – Writing Recommendations – Paragraph Writing – Types, Structures and Features of a Paragraph – Creating Coherence-– Organizing Principles of Paragraphs in Documents.

Unit III: **9**

Discourse Markers **–** Gerunds and Present Participles – Relative Pronouns – Conditional Clauses – Definitions of Technical Terms – Transcoding: Bar Chart - Flow Chart - Pie Chart - Tree Diagram - Tabular Column.

Unit IV: **9**

Concord – Clauses – Phrases – Numerical Adjectives – CV/Resume Writing – Virtual Communication**:** E-Mail Writing – Essay Writing: Basic Format of an Essay - Types Examples.

Unit V: **9**

Basic Phonetics: Phonemes – Vowels, Diphthongs and Consonants – Classification: Pure Vowels/Monophthongs – Vowel Glides /Diphthongs.

TOTAL: L: 45 + T: 15 = 60 HOURS

TEXT BOOK

1. Khaleel Rahuman A., Deepa P., Sheila J., Mathi Vathani J. , Technical English, R. K. Publishers, 2023.
2. Shiv Khera, You Can Win, Milan, Delhi, 2004.

REFERENCES

1. Nagarajan S., Senthil C. S., Engineering English I & II, Sri Krishna Publications, 2004.
2. Jewelcy Jawahar , Rathna P., English Work Book for First Year B.E./ B.Tech., VRB Publishers, Chennai, 2008.

MA3101	Engineering Mathematics - I	L	T	P	C
		3	1	0	4

OBJECTIVES

The course objective is to develop the required skill of the students in the area of Engineering Mathematics with special emphasis on the characteristic equation of matrices, differential calculus, Beta and Gamma functions.

Course Outcome		Cognitive Skill
CO-01	Understand the characteristic equation and find eigen values and eigen vector of a real matrix. Compute the eigen value and eigen vector using properties. Verify Cayley Hamilton theorem and its applications. Apply orthogonal transformation of a symmetric matrix.	U, A
CO-02	Define the definitions and formula for curvature, radius of curvature, and circle of curvature. Apply the formula and solve problems using the required formulas also find the evolute of the curves.	U, A
CO-03	Know about the differentiation formulae and apply on partial derivatives, total derivatives and Jacobians. Verify the functions be maximum or minimum and Lagrange's multiplier method. Express the Taylor'sexpansion for two variables.	U, A
CO-04	Know the Fundamental concepts of improper integrals, Beta and gamma function and their properties. Develop the skill in the relation between Beta and Gamma Functions. Calculate definite integral values using Beta and Gamma Functions.	U, A
CO-05	Evaluate the double and multiple integrals and can apply these concepts to find areas of regions on a plane or in space. Graph Cartesian and polarequations. Convert Cartesian coordinates into polar coordinates.	U, A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	M	S	M	S	M	L	S	M	M	L
CO-02	M	S	M	S	N	L	M	S	M	S	S	S	M
CO-03	S	S	S	M	S	M	M	S	M	S	M	M	S
CO-04	M	S	S	S	S	S	S	M	S	M	M	S	M
CO-05	S	L	S	M	S	M	M	S	M	M	S	M	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Matrices **9**

Characteristic Equation – Eigen Values and Eigen Vectors of a Real Matrix – Properties of Eigen Values and Eigen Vectors (without proof)– Cayley Hamilton Theorem (statement only), verification and its Applications – Orthogonal and Symmetric Matrices and their properties (excluding proof)- Orthogonal Transformation of a Symmetric Matrix to Diagonal Form.

Unit II: Differential Calculus **9**

Curvature – Cartesian Co-ordinates and Parametric Form -Centre and Radius of Curvature, Circle of Curvature – Evolutes.

Unit III: Functions of Several Variables **9**

Partial Derivatives – Total Derivatives – Jacobians – Properties – Maxima and Minima for Functions of Two Variables–Lagrange Multiplier Method- Taylor's Expansion.

Unit IV: Improper Integrals **9**

Evaluation of Improper Integrals- Beta And Gamma Functions – Properties – Relation Between Beta and Gamma Functions - Evaluation of Integrals Using Beta and Gamma Functions**.**

Unit V: Multiple Integrals **9**

Evaluation of Double and Triple integrals – Area Enclosed by Plane Curves as Double Integral in Cartesian and Polar co-ordinates– Change of Order of Integration- Transformation of Cartesian Coordinates into Polar Coordinates.

TOTAL: L: 45 + T: 15 = 60 HOURS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics"- 40th Edition , Khanna Publishers, Delhi 2007.

REFERENCES

1. M.Immaculate Mary, K.Uma Samundesvari , K.R.Sobha, " Engineering Mathematics – I", First Edition, Anuradha Publications, 2013.
2. Veerarajan T, "Engineering Mathematics (for first year)", Fourth Edition, Tata McGraw- Hill Publishing Company Ltd., New Delhi, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Seventh Edition, Wiley India, 2007.
4. P.Kandasamy , K.Thilagavathy , K.Gunavathy" ,Engineering Mathematics", Vol.1 S.Chand & Company Ltd.2002.
5. B.V. Ramana,"Higher Engineering Mathematics", Second Edition Tata McGraw-Hill, Publishing Company Ltd., New Delhi, 2006.

BS3101	**Engineering Physics**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

The course objective is to provide basic ideas about the principles of physics related to properties of matter, wave optics, heat, quantum concepts and materials, engineering problems.

Course Outcome		**Cognitive Skill**
CO-01	Students will be able to understand and apply knowledge about the properties of materials.	R, U, A
CO-02	Students will be able to understand the types of oscillations and the wave nature of light in interference, diffraction and polarization phenomenon.	R, U, A, E
CO-03	Students will be able to state and explain the various laws of thermodynamics, understand entropy and its application.	R, U, A, An, E
CO-04	Students gain basic knowledge about quantum mechanics and will be able to solve time dependent and time independent Schrodinger equation for simple potentials.	R, U, A, E, S
CO-05	Students will be able to know the different types of crystal structures and also gain basic knowledge about nanomaterials and biomaterials.	R, U, A, E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	S	M	L	S	M	M	L	S
CO-02	S	S	S	M	L	M	S	M	S	S	S	M	S
CO-03	S	S	S	S	M	M	S	M	S	M	M	S	S
CO-04	S	M	S	S	S	S	M	S	M	M	S	M	M
CO-05	S	S	M	M	M	M	S	M	M	S	M	M	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Properties of Matter **9**

Elasticity – Poisson's Ratio – Stress-Strain Diagram – Factors Affecting Elasticity – Bending of Beams – Cantilever Depression – Young's Modulus- Theory and Experiment of Young's Modulus Determination (Uniform and Non-Uniform Bending) –Shear Modulus – Twisting Couple – Hollow Cylinder – Torsion Pendulum – Determination of Rigidity Modulus - Bulk Modulus - Applications of Elastic Behaviours of Materials.

Unit II: Oscillations and Wave optics **9**

Oscillations - Rectilinear Motion - Oscillations or Vibrations - Simple Harmonic Motion - Damped Harmonic Motion - Real Oscillatory System - Forced or Driven Oscillation.Wave Optics -Interference of Light – Photons - Young's Double Slit Experiment - Huygens's Principle - Diffraction - Diffraction Grating - Polarization.

Unit III: Thermal Physics **9**

Transfer of Heat Energy (Conduction, Convection and Radiation) - Thermal Expansion Of Solids And Liquids – Expansion Joints – Bimetallic Strips-Thermal Conductivity- Forbe's and Lee's Disc Methods (Theory And Experiment)- Thermal Insulation In Buildings -Laws Of Thermodynamics- Heat Exchanger -Solar Power- Applications of Solar Power (Solar Water Heater, Photo Voltaic Cell).

Unit IV: Quantum Physics **9**

Matter Waves- De-Broglie Wavelength - Schrodinger's Wave Equation-Time Independent and Time Dependent Equations- Physical Significance of Wave Function- Uncertainty Principle and Its Application- Energy and Momentum Operators-Particle n a One Dimensional Box- Scanning Electron Microscope- Transmission Electron Microscope-Scanning Tunnelling Microscope.

Unit V: Material Physics **9**

Single Crystalline, Polycrystalline and Amorphous Materials- Single Crystals: Unit Cell, Crystal Systems, Bravais Lattices, Directions and Planes in a Crystal, Miller Indices – Inter

Planar Distances. Introduction and Applications of Metallic Glasses, Shape Memory Alloys (SMA), Nanomaterials, Biomaterials.

TOTAL: 45 HOURS

TEXT BOOKS

1. Engineering Physics I by Bindhu B, Sagi Rani C, Meenadevi V N, Ganapathi Raman R, RK Publishers 2015.
2. Engineering Physics II by Bindhu B, Geetha Kumari R, SugirthaSuni N Y, RK Publishers 2016.
3. Engineering Physics by R K Gaur And S L Gupta, DhanpatRai Publications 2011.
4. A Text Book Oscillations, Waves & Acoustics by Dr. M. Gosh, Dr. D. Battacharya, S. Chand, Revised Edition.

REFERENCES:

1. Engineering Physics by Rajendran V, McGraw-Hill, New Delhi, 2013
1. Engineering Physics by Arumugam M, Anuradha Publications, 2014.
2. Principles of Physics by Halliday D, Resnick R and Walker J, Wiley 2015.
3. Physics for scientist and Engineers by Serway R A and Jewett J W, Cengage Learning 2010.
4. Engineering Physics by Bhattacharya D K and Poonam T, Oxford University Press 2015.
5. Engineering Physics by Pandey B K and Chaturvedi, Cengage Learning India 2022.

BS3102	**Engineering Chemistry**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

To make the students conversant with the principles of the following topics: (i) Use of free energy in chemical equilibria (ii) Water chemistry (iii) Periodic properties (iv)Spectroscopic techniques and applications and (v) Organic reactions and synthesis of a drug molecule.

Course Outcome		**Cognitive Skill**
CO-01	Students will be able to access the quality and utility of suitable water for industrial as well as domestic applications.	U&A
CO-02	To develop awareness and usage of conducting polymers as an engineering material.	U&A
CO-03	To understand the uses of various fuels in economic way.	U
CO-04	To identify the electrolytic cell and electrochemical cells with different types of batteries.	An &A
CO-05	To get basic knowledge about thermodynamically aspects and its applications to engineering.	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	M	S	S	S	S	S	S	S
CO-02	S	S	S	S	M	M	S	S	S	S	S	S	S
CO-03	S	S	S	S	S	S	S	S	S	S	S	S	S
CO-04	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-05	S	S	S	S	S	M	S	S	S	M	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Use of Free Energy in Chemical Equilibria 9

Thermodynamic Functions: Energy, Entropy and Free Energy. Estimations of Entropy and Free Energies. Free Energy and EMF. Cell Potentials, The Nernst Equation and Applications. Acid Base, Oxidation Reduction and Solubility Equilibria. Corrosion. Use of Free Energy Considerations in Metallurgy Through Ellingham Diagrams.

Unit II: Water Chemistry 9

Water as a Universal Solvent – Hard and Soft Water – Reasons for Hardness – Disadvantages of Hard Water in Washing and Industrial Purposes - Estimation of Hardness by EDTA Method, Problems; Boiler Feed Water – Characteristics- Softening Methods - External Conditioning – Demineralization (Ion Exchange) Process, Desalination by Reverse Osmosis Method- Internal Conditioning (Phosphate, Calgon and Carbonate Conditioning Methods); Stages in Domestic Water Treatment – Disinfection by Chlorination, Ozone and UV Treatments.

Unit III: Periodic Properties 9

Effective Nuclear Charge, Penetration of Orbitals, Variations of S, P, D And F Orbital Energies of Atoms in the Periodic Table, Electronic Configurations, Atomic and Ionic Sizes, Ionization Energies, Electron Affinity and Electronegativity, Polarizability, Oxidation States, Coordination Numbers and Geometries, Hard Soft Acids and Bases, Molecular Geometries.

Unit IV: Spectroscopic Techniques And Applications 9

Principles of Spectroscopy and Selection Rules. Electronic Spectroscopy. Fluorescence and Its Applications in Medicine. Vibrational and Rotational Spectroscopy of Diatomic Molecules. Applications. Nuclear Magnetic Resonance and Magnetic Resonance Imaging, Surface Characterisation Techniques. Diffraction and Scattering.

.

Unit V: Organic Reactions and Synthesis of A Drug Molecule 9

Introduction to Reactions Involving Substitution, Addition, Elimination, Oxidation, Reduction, Cyclization and Ring Openings. Synthesis of a Commonly used Drug Molecule.

TOTAL: 45 HOURS

TEXT BOOKS

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition.

CS3101	**Fundamentals of Computing and Python Programming**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To know the basics of algorithmic problem solving
- 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.

Course Outcome		**Cognitive Skill**
CO-01	To know the basics of algorithmic problem solving	U & A
CO-02	To read and write simple Python programs	A
CO-03	To develop Python programs with conditionals and loops	U & A
CO-04	To define Python functions and call them	U & A
CO-05	To use Python data structures –- lists, tuples, dictionaries. To do input/output with files in Python	U & A

R-Remember, U-Understand, A-Apply, An-Analyze ,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	M	S	S	M	S	S	S	S	S	S	S
CO-02	S	S	M	S	M	M	S	S	S	S	S	S	S
CO-03	S	S	M	S	S	S	S	S	S	S	S	S	S
CO-04	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-05	S	S	S	S	S	M	S	S	S	M	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Algorithmic Problem Solving **9**

Algorithms, Building Blocks of Algorithms (Statements, State, Control Flow, Functions), Notation (Pseudo Code, Flow Chart, Programming Language), Algorithmic Problem Solving, Simple strategies for Developing Algorithms (Iteration, Recursion). Illustrative Problems: Find Minimum in a List, Insert a Card In a List of Sorted Cards, Guess an Integer Number in a Range, Towers of Hanoi.

Unit II: Data, Expressions, Statements **9**

Python Interpreter and Interactive Mode; Values and Types: Int, Float, Boolean, String, and List; Variables, Expressions, Statements, Tuple Assignment, Precedence of operators, Comments; Modules and Functions, Function Definition and Use, Flow of Execution, Parameters and Arguments; Illustrative Programs: Exchange the Values of Two Variables, Circulate the Values of N Variables, Distance Between Two Points.

Unit III: Control Flow, Functions **9**

Conditionals: Boolean Values and Operators, Conditional (If), Alternative (If-Else), Chained Conditional If-Elif-Else); Iteration: State, While, For, Break, Continue, Pass; Fruitful functions: Return Values, Parameters, Local and Global Scope, Function Composition, Recursion; Strings: String Slices, Immutability, String Functions and Methods, String Module; Lists as Arrays. Illustrative Programs: Square Root, GCD, Exponentiation, Sum an Array of Numbers, Linear Search, Binary Search.

Unit IV: Lists, Tuples, Dictionaries **9**

Lists: List Operations, List Slices, List Methods, List Loop, Mutability, Aliasing, Cloning Lists, List Parameters; Tuples: Tuple Assignment, Tuple as Return value; Dictionaries: Operations and Methods; Advanced List Processing - List Comprehension; Illustrative Programs: Selection Sort, Insertion Sort, Merge sort, Histogram.

Unit V: Files, Modules, Packages **9**

Files and Exception: Text Files, Reading and Writing Files, Format Operator; Command line Arguments, Errors and Exceptions, Handling Exceptions, Modules, Packages; Illustrative Programs: Word Count, Copy file.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, UpdatedforPython3, Shroff/O‘ReillyPublishers,2016.
1. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd.,2011.

REFERENCES:

1. John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revised and Revised and expanded Edition, MIT Press ,2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd.,2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,2015.
4. KennethA.Lambert, ―FundamentalsofPython:FirstPrograms‖,CENGAGELearning, 2012. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition,2013.
5. Paul Gries, Jennifer Campbell and Jason Montojo,Practical Programming:An Introduction to Computer Science using Python 3‖, 2nd Edition,Pragmatic Programmers, LLC,2013.

CS3171	Fundamentals of Computing and Programming Lab	L	T	P	C
		0	0	4	2

OBJECTIVES

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

Course Outcome		Cognitive Skill
CO-01	To write, test, and debug simple Python	U&A
CO-02	To implement Python programs with conditionals and loops.	U&A
CO-03	Use functions for structuring Python programs.	U&A
CO-04	Represent compound data using Python lists, tuples, dictionaries.	U&A
CO-05	Read and write data from/to files in Python	U&A

R-Remember ,U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	M	S	S	M	S	S	S	S	S	S	S
CO-02	S	S	M	S	M	M	S	S	S	S	S	S	S
CO-03	S	S	M	S	S	S	S	S	S	S	S	S	S
CO-04	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-05	S	S	S	S	S	M	S	S	S	M	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

List of Programs:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

TOTAL: 45 HOURS

BS3171	**Physics & Chemistry Laboratory**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

OBJECTIVES

- To teach students, the importance of physics through involvement in experiments and to have knowledge of the world due to constant interplay between observations and hypothesis.
- To develop the interest among the students regarding chemistry and their applications in engineering.

Course Outcome		Cognitive Skill
CO-01	The students will be able to analyse the physical principle involved in various instruments and also relate the principle to new applications.	R,U,A,An,E
CO-02	Various experiments in the areas of optics, properties of matter and ultrasonics will nurture the students in all branches of engineering.	R ,U,A, An,E
CO-03	learn and apply basic techniques used in chemistry laboratory for small/large scale water analyses/purification	R,U,A,An,E
CO-04	Able estimate the ions/metal ions present in domestic/industry waste water.	R,U,A,An,E
CO-05	Utilize the fundamental laboratory techniques for analyses such as titrations, separation/purification and spectroscopy.	R,U,A,An,E

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	S	S	S	S	S	S	S
CO-02	S	S	S	M	S	S	S	S	S	S	S	S	S
CO-03	S	S	S	S	S	S	S	S	S	S	S	S	S
CO-04	S	M	S	S	S	M	S	S	S	M	S	S	S
CO-05	S	S	M	M	S	S	M	S	S	S	M	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

List of experiments: Physics Laboratory (Any Five Experiments)

1. Determination of velocity of ultrasonic waves and compressibility of the given liquid by Ultrasonic interferometer.(Real and Virtual Lab)
2. Determination of rigidity modulus by Torsional pendulum. (Real and Virtual Lab)
3. Determination of coefficient of viscosity by Poiseulli'smethod.
4. Determination of Youngs modulus by non-uniform bending method.(Real and Virtual Lab)
5. Determination of LASER parameters using LASER diode. (Real and Virtual Lab)
6. Determination of band gap of the semi-conductor.(Real and Virtual Lab)

7. Determination of wavelength of mercury spectrum by diffraction grating.(Real and virtual lab)
8. Determination of wavelength of light by Newton's rings.(Real and Virtual Lab)
9. Determination of angle of the prism using spectrometer. (Real and Virtual Lab)

List of Experiments: Chemistry Lab (Any FIVE experiments)

1. Determination of conductance of solutions.
2. Potentiometry - determination of redox potentials and emfs.
3. Synthesis of drug.
4. Determination of Chloride content.
5. Determination of hardness of water sample.
6. Determination of Alkalinity of water sample.
7. Virtual lab experiments.

SEMESTER II

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EG3102	Communicative English	3	0	0	3
2.	MA3102	Engineering Mathematics – II	3	1	0	4
3.	BE3101	Basic Electrical and Electronics Engineering	3	0	0	3
4.	BE3102	Basic Civil and Mechanical Engineering	3	0	0	3
5.	ME3101	Engineering Graphics	3	0	2	4
PRACTICAL						
6.	BE3171	Basic Electrical and Electronics Engineering Laboratory	0	0	2	1
7.	BE3172	Basic Civil and Mechanical Engineering Laboratory	0	0	2	1
TOTAL			**15**	**1**	**6**	**19**

EG3102	Communicative English	L	T	P	C
		3	0	0	3

OBJECTIVES

- To widen and expand students' knowledge of English vocabulary
- To develop skills of students in the areas of vocabulary, grammar, listening, speaking, reading, and writing
- To develop the knowledge, skills and strategies the student must possess to become proficient readers
- To make the students learn the importance and purpose of communication skills and overcome the communication barriers by gaining confidence
- To make the students understand how to apply technical information and knowledge in practical documents

Course Outcome		Cognitive Skill
CO-01	The students will be able to understand the basic vocabulary items, sentence structures and error detection and correction, which, in turn, will expand their knowledge of the English language.	R
CO-02	The students will be able to grasp the LSRW Skills and gain exposure to absorb Comprehension and Note-making.	U
CO-03	The students will get real time practice in speaking through Oral Presentation, Small Talk, Role Play, Debate, and Group Discussion etc.	A
CO-04	The students will be able to improve their writing skills through exposure to Report Writing and Letter Writing.	U
CO-05	The students will be able to learn the Theory of Communication, the Importance of Communication, and be introduced to the various facets of Verbal and Nonverbal Communication.	R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L	PO-M
CO-01	S	S	S	S	M	**S**	S	S	S	S	M	M	M
CO-02	S	S	M	S	S	**S**	S	S	S	M	M	S	S
CO-03	M	S	S	S	M	**S**	S	M	S	S	S	M	S
CO-04	S	S	S	S	S	**S**	S	S	S	S	M	M	S
CO-05	S	S	S	S	S	**S**	S	S	M	S	M	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Vocabulary and Grammar **9**

Parts of Speech – Sentence Structures – Technical Vocabulary – Synonyms – Antonyms – Homonyms – Homophones – Misspelled Words – One word Substitutes – Odd Words Out – Changing words from one form to another – Common Errors in English – Correction of Errors in Sentences.

Unit II: Listening and Reading **9**

Reading Comprehension – Skimming – Scanning – Predicting the Content – Comprehension Questions – Inductive Reading – Close Reading – Note Making – Précis Writing.

Unit III: Speaking **9**

Introducing Oneself **–** Exchanging Personal Information **–** Small Talk: Family, Friends, Studies, Profession **–** Speaking: Greeting, Taking Leave **–** Product Description **–** Completing information **–** Gap Exercises **–** Presentation / Public Speaking Skills – Group Discussion – Debate – Role Play.

Unit IV: Technical Writing **9**

Report Writing – Characteristics of a Report – Categories of Reports – Letter Writing (Formal Letters) **:** Job Application Letter with Resume – Letter Seeking Permission – Letter of Invitation – Letter Declining an Invitation – Letter of Complaint – Letter of Requisition.

Unit V: Technical Communication **9**

The Theory of Communication – Definition and Scope – Nature, Importance and Types – Different Communication Models – Barriers to Communication – Effective Communication (Verbal / Non-verbal).

TOTAL: 45 HOURS

TEXT BOOKS

1. CanField Jack, Chicken Soup for the Soul, Westland, Chennai, 2013
2. Communication Skills. Oxford University Press.
3. Wood, F. T. (2007). Remedial English Grammar. Macmillan.

REFERENCE BOOKS

1. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
2. The Four Skills for Communication – Josh Sreedharan – Foundation Books
3. Communicative English – E. Sureshkumar and P. Sreehari – Orient Blackswan

MA3102	Engineering Mathematics – II	L	T	P	C
		3	1	0	4

OBJECTIVES

- To develop basic knowledge to the students in differential equations and vector calculus.
- The subject is further broadened to the functions of complex variables and complex integration.
- A thorough knowledge about Laplace transforms is also covered to aid the students solve the differential equations.

Course Outcome		Cognitive Skill
CO-01	The students will be able to solve ordinary differential equations	An, E , S
CO-02	The students will be able to solve complex variables	E
CO-03	The students will be able to synthesize complex integration	S
CO-04	The students will be able to solve Vector Calculus	E, S
CO-05	The students will be able to Synthesize Laplace transforms	S

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

CO \ PO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L	PO-M
CO-01	M	S	M	S	S	N	M	M	S	S	M	M	M
CO-02	S	M	L	N	L	M	S	L	L	S	M	M	S
CO-03	S	L	S	S	L	L	S	S	M	M	S	S	M
CO-04	S	L	M	S	N	L	S	S	M	S	S	M	S
CO-05	S	L	M	M	M	L	N	S	M	M	M	S	N

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I : Ordinary Differential Equations **9**

Linear Differential Equations of Second Order with Constant and Variable Coefficients- Cauchy's and Legendre's Linear Equations – Method of Variation of Parameters.

Unit II: Complex Variables **9**

Functions of a Complex Variable – Analytic Function – Necessary Conditions- Cauchy-Riemann Equations in Cartesian and Polar Co-Ordinates - Sufficient Conditions (Excluding Proof) –Properties of Analytic Function – Harmonic and Its Conjugate – Construction of Analytic Function by Milne Thomson Method – Conformal Mappings W = Z + C, CZ , 1/Z and Bilinear Transformation.

Unit III: Complex Integration **9**

Statement and Applications of Cauchy's Integral Theorem and Cauchy's Integral Formula – Laurent's Expansion – Singular Points – Residues – Cauchy's Residue Theorem – Evaluation of Real Definite Integral Using Contour Integration(Excluding Poles on the Real Axis) - $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$ and $\int_{-\infty}^{\infty} \frac{f(x)}{g(x)}dx$

Unit IV: Vector Calculus **9**

Gradient, Divergence and Curl – Directional Derivative – Irrotational and Solenoidal Vector Fields – Vector Integration – Green's Theorem in a Plane, Gauss Divergence Theorem and Stokes' Theorem (Excluding Proofs) – Simple Applications involving Cubes and Rectangular Parallelopipeds.

UNIT V: Laplace Transforms **9**

Laplace Transform –Existence Condition– Transforms of Elementary Functions – Basic Properties – Transforms of Derivatives and Integrals – Transform of Periodic Functions. Inverse Laplace Transform – Convolution, Initial and Final Value Theorems (Statement only) – Solutions of Linear Ordinary Differential Equation of Second Order with Constant Coefficients Using Laplace Transform Techniques.

TOTAL L: 45 + T: 15 = 60 HOURS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics"- 40th Edition, Khanna Publishers, Delhi 2007.

REFERENCES

1. M.Immaculate Mary, K.Uma Samundesvari, "Engineering Mathematics – II" First Edition, Anuradha Publications, 2013.
2. Erwin Kreyszig, "Advanced engineering Mathematics", Seventh Edition, Wiley India, 2007.
3. Veerarajan T, "Engineering Mathematics (for first year)", Tata McGraw- Hill Publishing Company Ltd.,New Delhi,2007.
4. P.Kandasamy , K.Thilagavathy , K.Gunavathy" Engineering Mathematics" S.Chand & Company Ltd. 2002.
5. B.V. Ramana,"Higher Engineering Mathematics" Second Edition Tata McGraw-Hill, Publishing Company Ltd., New Delhi, 2006.

		L	T	P	C
BE3101	**Basic Electrical and Electronics Engineering**	**3**	**0**	**0**	**3**

OBJECTIVES

- To understand the basic solutions of AC and DC circuits.
- To study the basic principle and operation of AC and DC machines.
- To study the fundamental operations of measuring instruments.
- To study the layout of power system.
- To understand the fundamental operation and characteristics of Electron devices.
- To understand the implementation of Boolean expression using logic gates.

Course Outcome		Cognitive Skill
CO-01	To understand the basic solutions of AC and DC circuits and the basic principle and operation of AC and DC machines.	U, R
CO-02	To study the fundamental operations of measuring instruments and the layout of power system.	U, R
CO-03	To understand the fundamental operation and characteristics of Electron devices.	U, E,S
CO-04	To understand the implementation of Boolean expression using logic gates.	U, E,S
CO-05	To become familiar with basic concepts of Communication system.	U, R

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

CO \ PO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L	PO-M
CO-01	M	S	S	S	M	M	S	S	S	L	M	S	S
CO-02	S	S	S	S	M	M	M	S	S	S	M	S	S
CO-03	S	M	S	S	S	M	S	M	S	M	M	S	S
CO-04	S	L	S	S	M	M	S	S	S	M	M	S	M
CO-05	S	L	S	M	S	S	S	S	S	M	M	S	M

S- Strong, M- Medium, L-Low, N- Not Relevant

Unit I: Electrical Circuits **9**

Ohms Law, Kirchhoff's laws, Mesh and Nodal Analysis for DC Circuits.
Introduction to AC Circuits, Faraday's Law of Electromagnetic Induction, Lenz law, Inductor, Capacitor, Power Factor, Waveforms and RMS Value, Average Value, Peak Factor and Form Factor, Single Phase Circuits- Series and Parallel, Three Phase Balanced Circuits. Fundamentals of Wiring and Earthing.

Unit II: Electrical Measurements, Machines And Power System **9**

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeter and Voltmeter), Dynamometer Type Wattmeter and Energy Meter, Errors in Measurements.
Construction, Principle of Operation and Applications of DC Generators, DC Motors, Single Phase Transformers. Structure of Power System.

Unit III: Semiconductor Devices **9**

Introduction to Semiconductors, PN Junction Diode-Zener Diode and its Characteristics-Half Wave and Full Wave Rectifiers-Bipolar Junction Transistor-CB,CE,CC Configuration and Characteristics-JFET and MOSFET Construction, Operation, Characteristics (CS only) and Uses.

Unit IV: Digital Electronics **9**

Number Systems-Binary Arithmetic--Boolean Algebra-Laws and Theorems-Simplification of Boolean Expression- Logic Gates –Implementation of Boolean Expression Using Logic Gates-Standard Forms of Boolean Expression.

Unit V: Communication Systems **9**

Block Diagram of Basic Communication System-Need for Modulation-Types of Modulation- Principles of Amplitude and Frequency Modulation – Pulse Analog and Digital Modulation-AM and FM Transmitter and Receiver (Block Diagram Description Only) – Satellite Communication Radar Systems-Data Transmission and MODEM.

TOTAL: 45 HOURS

TEXT BOOKS

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical,
2. Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, (2006).

REFERENCES

1. V.N. Mittle "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.
2. V.K.Mehta "Principles of Power System", S. Chand & Company Ltd, New Delhi, 2001.
3. R.S.Sedha, "Applied electronics", S. Chand & Co., 2006.

BE3102	**Basic Civil and Mechanical Engineering**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To enable the students to understand the Basic Civil and Mechanical Engineering concepts.

Course Outcome		**Cognitive Skill**
CO-01	To gain the basic knowledge in Surveying and civil Engineering materials.	U&R
CO-02	Students can attain the basic knowledge in basic civil structures and building components.	U&R
CO-03	Can obtain the basic fundamental knowledge of Engineering Mechanics	U&R
CO-04	Students can expand their knowledge in knowing about IC engines and power plants.	U&R
CO-05	Can increase the skill in basic manufacturing processes.	U &A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	S	S	S	M	S	S	S	S	M	S	S
CO-02	S	S	S	S	S	M	M	S	S	S	M	S	S
CO-03	S	M	S	S	S	M	S	M	S	M	M	S	S
CO-04	S	S	S	S	M	M	S	S	S	M	M	S	M
CO-05	S	M	S	M	S	S	S	S	S	M	M	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Surveying and Civil Engineering Materials 9

Surveying: Objects – Types – Classification – Principles – Measurements of Distances – Angles –Leveling–Determination of Areas–Illustrative Examples.

Civil Engineering Materials: Bricks–stones–sand–cement–concrete–steel sections.

Unit II: Building Components and Structures 9

Foundations: Types, Bearing Capacity– Requirement of Good Foundations.

Superstructure: Brick Masonry – Stone Masonry – Beams – Columns – Lintels – Roofing – Flooring –Plastering – Mechanics – Internal and External Forces – Stress – Strain – Elasticity – Types of Bridges and Dams–Basics of Interior Design and Landscaping.

Unit III: Fundamentals Of Engineering Mechanics 9

Statics –Basics Concepts, Fundamental Principles & Concepts: Newton's Laws, Gravitation, Force, Couple, Moment (about Point and about Axis), Varignon's Theorem, Resultant of Concurrent and Non-concurrent Coplanar Forces, Problem Formulation Concept; 2-D Statics, Two and Three Force Members, Alternate Equilibrium Equations, 3-D Statics.

Unit IV: Basic Concepts of Thermal Engineering 9

Introduction to IC Engines, Working Principle of Petrol and Diesel Engines – Four Stroke and Two Stroke Cycles, Working Principle of Steam, Gas, Diesel, Hydro-electric and Nuclear Power Plants, Principle of Vapour Compression and Absorption System.

Unit V: Basic Manufacturing Processes **9**

Foundry-Investment Casting, Die Casting, Centrifugal Casting, Continuous Casting, Stir Casting, Squeeze Casting. Metal Fusion Welding Processes- Oxyfuel Gas Welding – Arc Welding Processes. Additive Manufacturing-3D Printing.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Shanmugam G and Palanichamy MS, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi,(1996).
2. Ramamrutham S., "Basic Civil Engineering", Dhanpat Rai Publishing Co.(P)Ltd. (1999).

REFERENCES:

1. Seetharaman S.,"Basic Civil Engineering", Anuradha Agencies,(2005).
2. Venugopal K. and Prahu Raja V.,"Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam,(2000).
3. ShanthaKumarSRJ., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai,(2000).

ME3101	Engineering Graphics	L	T	P	C
		3	0	2	4

OBJECTIVES

- To develop skills for communication of concepts, ideas and design of Engineering Products.
- To expose them to existing national standards related to technical drawings.

Course Outcome		Cognitive Skill
CO-01	To know and understand the conventions and the methods of engineering drawing.	U,R
CO-02	Interpret Engineering drawings using fundamental technical mathematics	U,R
CO-03	Construct basic and intermediate geometry.	U,A
CO-04	To improve their visualization skills so that they can apply these skills in developing new products.	U,A
CO-05	To improve their technical communication skill in the form of communicative drawings and comprehend the theory of projection.	U,A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	S	S	S	M	S	S	S	M	M	S	S
CO-02	S	S	S	S	S	M	M	S	S	M	M	S	S
CO-03	M	M	S	S	S	M	S	M	S	M	M	S	S
CO-04	S	S	S	S	M	M	S	S	S	M	M	S	M
CO-05	S	M	S	M	S	S	S	S	S	M	M	S	M

S-Strong, M-Medium,L-Low,N-Not relevant

Unit I: Introduction **9**

Concepts and conventions: Use of Drafting Instruments, BIS Conventions and Specifications – Size, Layout and Folding of Drawing Sheets, Lettering and Dimensioning. General Principles of Orthographic Projection, First Angle Projection – Layout of Views. **(Not for examination)**

General Plane Curves

Conic sections including the Rectangular Hyperbola (General method); Cycloid, Epicycloid, Hypocycloid and Involute.

Unit II: Projection of Points, Lines & Planes **9**

Projection of points, Projection of Straight Lines Located in the First Quadrant. Determination of True Lengths and True Inclinations. Projection of Planes- Parallel to any One Reference Plane, Perpendicular to any One Reference Plane, Inclined to any One Reference Plane and Inclined to both Reference Planes.

Unit III: Projection of Solids & Section of Solids **9**

Prisms, Pyramids, Cylinder and Cone, Axis Perpendicular to any One Reference Plane. Axis Parallel to both the Planes. Axis Inclined to any One Reference Plane.

Sectioning of Solids- Prisms, Pyramids, Cylinder and Cone in Simple Vertical Position by Cutting Planes Inclined to One Reference Plane. Obtaining The True Shape of Section

Unit IV: Development of Surfaces & Isometric Projection **9**

Development of Surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone, Isometric view, Isometric scale to Draw Isometric projection, Non-Isometric lines, Construction of Isometric View from Given Orthographic Views and to Construct Isometric View of a Pyramid, Cone, Sphere.

Unit V: Orthographic Projection & Perspective Projection **9**

Fundamental of Projection along with Classification, Projections from the Pictorial view of the Object on the Principal planes for View from Front, Top and Sides using First Angle Projection Method and Third Angle Projection Method, Full Sectional View. Perspective Projection of Solids (Any one Method).

L: 45+P: 15 = TOTAL: 60 HOURS

TEXT BOOKS:

1. Venugopal K and Prabhu Raja V, "Engineering Graphics", New Age International Publishers, 2007.
2. Luzadder W J, "Fundamentals of Engineering Drawing", Prentice Hall Book Co., New York, 1998.
3. Bhat, N.D.& M. Panchal , Engineering Drawing, Charotar Publishing House,2008

REFERENCES:

1. Kumar M S, "Engineering Graphics", Ninth Edition, DD Publications, Chennai, 2007.
2. Bureau of Indian Standards, "Engineering Drawing Practices for Schools and Colleges SP 46-2003", BIS, New Delhi, 2003.
3. Shah, M.B. & B.C. Rana , Engineering Drawing and Computer Graphics, Pearson Education, 2008.

BE3171	Basic Electrical and Electronics Engineering Laboratory	L	T	P	C
		0	0	2	1

OBJECTIVES

- To understand the electric circuit connection.
- To measure the electrical parameters.
- To obtain the characteristics of electron devices and its applications.

Course Outcome		Cognitive Skill
CO-01	Make basic electrical connection	U, A
CO-02	Measure the electrical parameters	U
CO-03	Gain knowledge about the basic Electronic components	U
CO-04	Analyze the characteristics of some basic electronic devices.	U
CO-05	The Students will be able to understand the working principles of logic gates.	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	S	S	M	S	S	S	M	S	L	M	M
CO-02	M	S	S	S	S	M	S	S	S	L	M	L	L
CO-03	S	S	S	S	M	M	M	S	L	M	L	L	M
CO-04	S	S	S	M	S	S	M	S	S	S	M	L	L
CO-05	S	S	S	M	S	S	S	M	S	L	M	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments

I. Electrical Engineering Lab

1 Study of Symbols, Cables and Earthing.
2 Residential house wiring using switches, fuse, indicator, lamp and energy meter.
3 Fluorescent lamp wiring.
4 Stair case wiring / Lamp control from three different places/ Doctor Room control/ Go down control.
5 Measurement of electrical quantities – voltage, current, power & computation of power factor in RLC circuit.

6 Measurement of energy using single phase energy meter.
7 Fan Wiring.

II. Electronics Engineering Lab

1. Study of Electronic components and equipments – Resistor, colour coding,
2. Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
3. Characteristics of PN Junction diode
4. Characteristics of Zener diode
5. Voltage Regulator using Zener diode
6. Measurement of ripple factor of HWR and FWR.
7. Study of logic gates AND, OR, EX-OR and NOT, NAND and NOR.
8. Generation of Clock Signal.
9. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.

TOTAL: 30 HOURS

BE3172	**Basic Civil and Mechanical Engineering Laboratory**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To provide exposure to the students with hands on experience on various basic Engineering practices in Civil & Mechanical Engineering.

Course Outcome		**Cognitive Skill**
CO-01	Able to gain fundamental knowledge about Buildings and pipe line works.	U
CO-02	Able to handle Carpentry and power tools.	U
CO-03	Able to gain knowledge in basic welding and machining process.	U
CO-04	Able to attain the practice of using gyroscope in dynamics.	U
CO-05	Able to understand the fundamental knowledge in foundry, fitting, sheet metal and IC engines.	U

R-Remember, U-Understand ,A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	S	M	S	N	S	S	S	S	S	S	S
CO-02	M	S	S	S	S	N	S	S	S	M	M	S	S
CO-03	L	S	S	S	M	N	M	S	L	M	S	S	S
CO-04	L	S	S	M	S	M	M	S	S	S	M	S	S
CO-05	L	S	S	M	S	M	S	M	S	M	M	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiment

I. Civil Engineering Practice

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in house hold fittings.

(b) Study of pipe connections requirements for pumps and turbines.

(c) Preparation of plumbing line sketches for water supply and sewage works.

(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.

(b) Hands-on-exercise:

Wood work, joints by sawing, planning and cutting.

II Mechanical Engineering Practice

Welding:

Preparation of arc welding of butt joints, lap joints and tee joints.

Basic Machining:

Simple Turning and Taper turning

Dynamics:

Experiment using Gyroscope/Four bar link mechanism.

Demonstration on:

(a) Demonstration on foundry, fitting and sheet metal exercises.

(b) Demonstration on the working principle of two stroke and four stroke I.C. engines.

TOTAL: 30 HOURS

SEMESTER III

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MA3201	Engineering Mathematics – III	3	1	0	4
2.	EC3201	Electric Circuit Theory	3	0	0	3
3.	EE3210	Electrical Machines	3	0	0	3
4.	EC3202	Electron Devices	3	0	0	3
5.	EC3203	Signals and Systems	3	1	0	4
6.	EC3204	Digital Electronics	3	0	0	3
PRACTICAL						
7.	EC3271	Digital Electronics Laboratory	0	0	2	1
8.	EE3277	Electric Circuits and Machines Laboratory	0	0	2	1
9.	EC3272	Electron Devices Laboratory	0	0	2	1
TOTAL			**18**	**2**	**6**	**23**

MA3201	Engineering Mathematics III	L	T	P	C
		3	1	0	4

OBJECTIVES

- To develop the skill of the students in the areas of boundary value problems and Transform techniques. This will be necessary for their effective studies in a large number of Engineering subjects like heat conduction, communication systems, electro- optics and electromagnetic theory. This course will also serve as a prerequisite for post graduate and specialized studies and research.

Course Outcome		Cognitive Skill
CO-01	Recognize a Partial Differential Equation and formulate a Partial Differential Equation from a given equation. Solve linear Partial Differential Equation of both first and second order using various methods.	A &E
CO-02	Derive a Fourier series expansion for a given periodic function by evaluating Fourier coefficient and expand Fourier cosine and Sine series for given function. Also find the Fourier series expansion for a given set of numerical values by applying harmonic analysis.	An &E
CO-03	Classify the second order Partial Differential Equation and solve second order Partial Differential Equations such as wave equation, heat equation and Laplace equation with boundary and initial conditions applying Fourier series expansion.	An &E
CO-04	Know fundamental and mathematical properties of Fourier transform. Calculate the Fourier transform of a given function and inverse Fourier transform of function. Know the applications of Parseval's and convolution theorem.	An &E
CO-05	Understand the characteristics and properties of Z-transform. Compute Z-transform of simple functions and inverse z transform of given functions and apply Z-transform for solving difference equations.	U, An &E

R-Remember ,U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	S	S	S	S	M	S	M	M	L	L
CO-02	S	S	S	S	M	M	M	S	S	M	L	L	M
CO-03	M	S	S	L	M	S	M	S	S	S	L	L	M
CO-04	M	L	S	M	M	M	S	S	M	L	L	L	M
CO-05	S	M	S	M	S	M	S	M	S	L	M	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Partial Differential Equations **9**

Formation of Partial Differential Equations by Elimination of Arbitrary Constants and Arbitrary Functions – Solutions of Clairaut's Equations – Lagrange's Linear Equation – Homogeneous Linear Partial Differential Equations of Second Order with Constant Coefficients.

Unit II: Fourier Series **9**

Dirichlet's Conditions – Fourier Series – Change of Interval - Odd and Even functions – Half range Sine and Cosine series – Parseval's Identity – Harmonic Analysis.

.**Unit III: Boundary Value Problems** **9**

Classification of Second Order Linear Partial Differential Equations – One Dimensional Wave and Heat Equations – Assumptions – Fourier Series Solution – Steady State Solution of Two Dimensional Heat Equation (Insulated Edges Excluded) – Fourier Series Solution in Cartesian Co-ordinates.

Unit IV: Fourier Transforms **9**

Statement and Meaning of Fourier Integral Theorem – Fourier Transform — Properties - Inverse Fourier Transform – Fourier Sine and Cosine transforms – Inverse Sine and Cosine Transforms – Properties -Transforms of Simple Functions – Convolution Theorem – Parseval's Identity.

.

Unit V: Z-Transforms **9**

Z- Transform – Elementary Properties – Convolution Theorem-Inverse Z-Transform – Partial Fraction Method, Inversion Integral Method and Convolution – Initial and Final Value Theorems –Formation of Difference Equations – Solution of Difference Equations using Z-Transform

L: 45+T:15, TOTAL: 60 HOURS

TEXT BOOKS

1. Grewal B.S., "Higher Engineering Mathematics" 40th Edition , Khanna Publishers, Delhi 2011.

REFERENCES:

1. ErwinKreyszig, "Advanced Engineering Mathematics",10th Edition, John Wiley & Sons, Inc., USA, 2011
2. Kandasamy P, Thilagavathy K, and Gunavathy K., "Engineering Mathematics Volume III", First Edition, S.Chand& Company Ltd., New Delhi.
3. Veerarajan T., "Engineering Mathematics(for Semester III), Third Edition, Tata McGraw – Hill Publishing Company Limited, New Delhi 2007.
4. Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Seventh Edition, Lakshmi Publications Pvt. Ltd., New Delhi, 20093.

EC3201	Electric Circuit Theory	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To introduce the phenomenon of resonance in coupled circuits.

- To educate on obtaining the transient response of circuits.
- To introduce Phasor diagrams and analysis of three phase circuits

Course Outcome		Cognitive Skill
CO-01	Able to understand the basic network reduction techniques.	U
CO-02	Able to get the concepts of network theorems.	R
CO-03	Able to analyze the circuit transient response.	An
CO-04	Able to design three phase circuits.	A
CO-05	Able to get the concepts of resonance and coupled circuits.	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO -A	PO -B	PO -C	PO -D	PO -E	PO -F	PO -G	PO -H	PO -I	PO -J	PO -K	PO -L	PO -M
CO -01	S	M	S	S	S	S	S	M	S	M	M	L	L
CO -02	S	S	S	S	M	M	M	S	S	M	L	L	M
CO -03	M	S	S	M	M	M	M	S	S	S	L	L	M
CO -04	M	S	S	M	M	M	S	S	M	L	L	L	M
CO -05	S	M	S	M	S	M	S	S	S	L	M	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Basic Circuits Analysis **9**

Resistors in Series and Parallel - Reduction to Equivalent Resistors - Star-Delta Conversion -Kichofff's Voltage and Current Law -Mesh -Super Mesh -Nodal -Super Nodal Analysis

Unit II: Network Reduction And Theorems For Dc And Ac Circuits **9**

Source Transformation –Thevenins and Norton Theorems – Superposition Theorem – Maximum Power Transfer Theorem – Reciprocity Theorem – Millman's theorem.

Unit III: Transient Response Analysis **9**

Introduction to L and C Passive Elements -Transient Response of RL, RC and RLC Circuits using Laplace transform for DC input.

Unit IV: Three Phase Circuits **9**

A.C. Circuits – Average and RMS Value - Phasor Diagram – Power, Power Factor and Energy.- Analysis of Three Phase 3-Wire and 4-Wire Circuits with Star and Delta Connected Loads, Balanced & Un balanced – Phasor Diagram of Voltages and Currents .

.**Unit V: Resonance and Magnetic Coupled Circuits** **9**

Series and Parallel resonance – their Frequency Response – Quality Factor and Bandwidth - Self and Mutual Inductance – Coefficient of Coupling – Tuned Circuits – Single Tuned Circuits.

TOTAL: 45 HOURS

TEXT BOOKS

1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2013.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.
4. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", McGraw Hill, 2015.

REFERENCES:

1 Chakrabarti A, "Circuits Theory (Analysis and synthesis), DhanpathRai& Sons, New Delhi, 1999.

2. Jegatheesan, R., "Analysis of Electric Circuits," McGraw Hill, 2015.

3. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, McGraw- Hill, New Delhi, 2010.

4. M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 2015.

5. Mahadevan, K., Chitra, C., "Electric Circuits Analysis," Prentice-Hall of India Pvt Ltd., New Delhi, 2015

6. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley & Sons, Inc. 2015.

EE3210	**Electrical Machines**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To expose the students to the concepts of various types of electrical machines.
- To impart knowledge on
- Constructional details, principle of operation, performance, starters and testing of D.C. machines.

- Constructional details, principle of operation and performance of transformers.
- Constructional details, principle of operation and performance of induction motors and synchronous machines.

Course Outcome		Cognitive Skill
CO-01	Remember the construction and working of any electrical DC machines and transformer under load and unload condition.	R
CO-02	Understand the principle of operation and performance of DC machines and transformer.	U
CO-03	Apply various controls and analyse the responses of DC machine and transformer.	A
CO-04	Troubleshoot the operation of DC machine and transformer.	A
CO-05	Calculate load of DC machine and transformer for a given application and select the suitable DC machine.	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	S	S	S	S	M	S	M	M	L	L
CO-02	S	S	M	S	M	M	M	S	S	M	S	L	M
CO-03	M	S	S	M	M	M	M	S	S	S	L	L	M
CO-04	M	S	S	M	L	M	S	S	M	L	S	L	M
CO-05	S	M	S	M	S	M	S	S	S	L	M	M	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: D.C. Generators **9**

Constructional and Working Principle -Methods of Excitation – Separately and Self Excited Generator-Armature Winding: Lap, Wave Winding and their uses. EMF generation – emf equation- Types-Characteristics of DC Generators: Critical resistance, Critical speed - Armature Reaction – Commutation.

Unit-II: D.C. Motors **9**

Constructional and Working Principle - Characteristics of Motors –Power Stage and Efficiency–Starting and Speed Control. Applications. Testing: Brake Test, Swinburne's Test, Hopkinson's Test.

Unit-III: Transformers **9**

Constructional Details – Principle of Operation – emf equation – Transformation Ratio – Transformer on no Load – Parameters Referred to HV/LV Windings – Equivalent Circuit – Transformer on Load – Regulation - Testing – Load test, Open circuit and Short Circuit Tests.

Unit-IV: Asynchronous Machines **9**

Three-Phase Induction Motors-Construction-Working Principle-Classification – Equivalent Circuit - Performance Calculation – Starting and Speed Control – Single-Phase Induction Motors (only Qualitative Treatment).

Unit- V: Synchronous Machines **9**

Synchronous Generator (Alternator)-Construction-Working Principle –Classification-Winding: Types – Induced emf – Voltage Regulation; Synchronous Motor-Types-Construction-Principle of Operation-Methods of Starting.

TOTAL: 45 HOURS

TEXT BOOKS

1. D.P.Kothari and I.J.Nagrath, 'Basic Electrical Engineering', Tata McGraw Hill Publishing company ltd, second edition, 2017.
2. C.L. Wadhwa, 'Electrical Power Systems', Wiley eastern ltd India, 1985.

REFERENCES

1. S.K.Bhattacharya, 'Electrical Machines', Tata McGraw Hill Publishing company Ltd, second edition, 1998.
2. V.K.Mehta and Rohit Mehta, 'Principles of Power System', S.Chand and Company Ltd, third edition, 2003.

C3202	Electron Devices	L	T	P	C
		3	0	0	3

OBJECTIVES

- To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices.

Course Outcome		Cognitive Skill
CO-01	Able to understand the VI characteristics of PN Junction diode.	U
CO-02	Able to understand the equivalent circuit of transistors.	R
CO-03	Able to analyze Field Effect Transistors.	An
CO-04	Able to get the concepts of special semiconductor devices.	A , U
CO-05	Able to apply the concepts of power supplies.	A

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	M	M	S	S	S	S	S	S	M	L	L
CO-02	S	S	S	M	M	M	M	S	S	S	L	L	L
CO-03	M	S	S	S	M	M	M	M	S	S	S	L	L
CO-04	M	S	S	S	M	M	M	M	M	L	S	L	M
CO-05	S	M	S	S	S	L	S	S	S	L	L	L	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Semiconductor Diode **9**

PN Junction Diode- Current Equations- Energy Band Diagram- Diffusion and Drift Current Densities- Forward and Reverse Bias Characteristics- Transition and Diffusion Capacitances- Switching Characteristics- Breakdown in PN Junction Diodes.

Unit II: Bipolar Junction Transistors **9**

NPN and PNP Operations- Early Effect- Current Equations- Input and Output Characteristics of CE, CB, CC, h- Parameter Model- Hybrid π Model- Multi Emitter Transistor.

Unit III: Field Effect Transistors **9**

JFETs – Drain and Transfer Characteristics,-Current Equations-Pinch Off Voltage and its Significance- MOSFET- VI Characteristics of CS and CD - Threshold Voltage -Channel Length Modulation- D- MOSFET- E-MOSFET- CMOS Device Structure.

Unit IV: Special Semiconductor Devices **9**

Metal-Semiconductor Junction- MESFET, FINFET, PINFET, CNTFET, DUAL GATE MOSFET, Schottky Barrier Diode-Zener Diode-Varactor Diode –Tunnel Diode-GaAs/GaN HEMFET-LASER diode-LDR .

Unit V: Power Devices And Display Devices **9**

UJT, SCR, Diac, Triac, Power BJT- IJPT- Power MOSFET- DMOS-VMOS. LED, LCD, Photo Transistor, Opto Coupler, Solar Cell, CCD.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Robert Boylestad and Louis Nashelsky, ―Electron Devices and Circuit Theory‖ Pearson Prentice Hall, 10th edition, July 2008.
2. R.S.Sedha, ― A Text Book of Applied Electronics‖ S.Chand Publications, 2006.
3. Millman and Halkias- Integrated Electronics, Tata McGraw Hill Publication 2001

REFERENCES:

1. Donald A Neaman, ―Semiconductor Physics and Devices‖, Fourth Edition, Tata McGraw Hill Inc. 2012.
2. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, ―Electronic Devices and circuits‖, Third Edition, Tata McGraw- Hill, 2008.
3. Yang, ―Fundamentals of Semiconductor devices, McGraw Hill International Edition, 1978.

EC3203	Signals and Systems	L	T	P	C
		3	1	0	4

OBJECTIVES

- To study the properties and representation of discrete and continuous signals.
- To study the sampling process and analysis of discrete systems using z-transforms.
- To study the analysis and synthesis of discrete time systems.

Course Outcome		Cognitive Skill
CO-01	Understand the various types of signals and systems classify and analyze them and perform various operations on them.	U, An
CO-02	Analyze the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier and Laplace transform.	An
CO-03	Analyze and classify systems based on their properties and determine the response of LTI system using convolution.	An, E
CO-04	Understand the process of sampling and apply Z-transform for analysis of discrete-time signals.	U, A
CO-05	Evaluate the frequency response and can analyze the system properties of a LTI-DT system.	E, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO -A	PO -B	PO -C	PO -D	PO -E	PO -F	PO -G	PO -H	PO -I	PO -J	PO - K	PO -L	PO - M
CO -01	S	S	M	S	S	S	M	M	N	N	M	S	S
CO -02	S	S	M	S	S	S	S	M	N	N	L	S	S
CO -03	S	S	M	S	S	M	M	S	N	L	L	S	S
CO -04	S	S	S	S	S	M	M	S	N	L	S	S	S
CO -05	S	S	S	S	S	M	S	S	N	S	L	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Representation of Signals **9**

Basic Continuous Time Signals (CT Signals) and Discrete Time Signals (DT signals) – Representation - Step, Ramp, Pulse, Impulse, Exponential, Classification of CT and DT Signals - Periodic and Aperiodic, Energy & Power signals, Even and Odd signals, Causal and Noncausal Signals, Deterministic and Random Signals, CT Systems and DT Systems - Classification – Linearity, Time Invariance, Causality and Stability, Basic Operation on Independent Variable of the Signals- Time Shifting, Time Reversal and Time Scaling.

Unit II: Analysis of Continuous Time Signals 9

Analysis of Periodic Signals with Fourier Series (Trigonometric Fourier Series – Exponential Fourier Series). Fourier Transforms of Basic Periodic and Aperiodic Signals. Laplace Transform – Properties - Laplace Transforms of Signals, Convolution Integral, Initial Value and Final Value of the CT Signals.

Unit III: Analysis of Linear Time Invarient-Continuous Time System 9

LTI System Analysis- Characterization of LTI System, Computation of Transfer Function, Impulse Response and Response of the System using Laplace Transform, Pole-Zero Plot, Stability, Frequency Response, Block Diagram Representation-Direct Form I, Direct Form II, Cascade and Parallel Realization

Unit IV: Analysis of Discrete Time Signals 9

Baseband Sampling of CT Signals- Reconstruction of Signal from its Samples, Nyquist Sample, Aliasing, DT signal- Z-transform –Initial Value and Final Value of the DT Signals, Convolution Sum, Inverse Z-Transform using Power Series Method, Partial Fraction Method, Residue Method, DTFT and Properties

Unit V Linear Time Invarient – Discrete Time Systems 9

Difference Equations, System Function, Pole-Zero Plot, Stability -Impulse Response, Response of the System using Z-Transform Analysis, Frequency Response –FIR and IIR System, Block Diagram Representation -Direct Form I, Direct Form II, Cascade and Parallel Realization.

TOTAL:45+15=60 HOURS

TEXT BOOKS

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, ―Signals and Systems, Pearson, Second Edition, Indian Reprint, 2014.
2. Simon Haykin and Barry Van Veen, - Signals and Systems, Wiley India, Second Edition, 2018.

REFERENCES:

1. Ramesh Babu and R.Anandanatarajan―Signals and Systems, SCITECH 2013
2. John Alan Stuller, ―An Introduction to Signals and Systems, Thomson, 2007
3. Simon Haykin and Barry Van Veen,Signals and Systems, John Wiley & Sons, Inc. 1999
2. Video Lectures by, Alan V. Oppenheim:http://ocw.mit.edu/RES-6.007S11

EC3204	Digital Electronics	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the Binary system and methods for simplifying Boolean expressions.
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits.

- To introduce the concept of memories and programmable logic devices.
- To illustrate the concept of synchronous and asynchronous sequential circuits.
- To illustrate the concept of Digital Circuit construction and FPGAs.

Course Outcome		Cognitive Skill
CO-01	Learn the digital systems, number systems, logic gates.	U
CO-02	Familiar with combinational circuits like adders, subtractors, Encoder, decoder, mux, demux, code converters.	U
CO-03	Infer synchronous sequential circuit like different flipflops.	U
CO-04	Learn and design the sequential circuit design like moore, mealy, counters, state diagram, registers.	U, A
CO-05	Familiar with asynchronous circuits and memory devices.	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	S	M	M	L	L	S	S	S	M	M	L
CO-04	S	S	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	S	S	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not Relevant

Unit I: Number Systems and Logic Gates **9**

Number Systems and Number Base Conversions –Boolean ostulates and Laws –De-Morgan's Theorem- Principle of Duality- Boolean expression – Boolean function- Minimization of Boolean Expressions – Sum of Products (SOP) –Product of Sums (POS)- Minterm- Maxterm- Canonical Forms – Conversion between Canonical Forms –Karnaugh Map Minimization – Don't Care Conditions. Quine-McCluskey Method. Logic Gates- AOI - NAND –NOR implementations –Propagation Delay and Critical Path-TTL, CMOS, NMOD and BiCMOS Logic and their Characteristics –Tristate Gates.

Unit II: Combinational Circuits **9**

Adders-Subtractors – Serial Adder/ Subtractor - Parallel Adder/ Subtractor- Carry Look ahead Adder- BCD Adder- Magnitude Comparator- Multiplexer/ Demultiplexer- Encoder / Decoder – Parity Checker – Code Converters- Binary to Gray and vice versa.

Unit III: Synchronous Sequential Circuits **9**

Latches and Flip flops SR, D, JK, T and Master Slave – Characteristic Table and Equation – – Edge Triggering –Level Triggering –Realization of one Flip Flop using other Flip Flops – Asynchronous / Ripple Counters – Synchronous counters–Modulo – n Counter –Ring Counter.

Unit IV: Sequential Circuit Design **9**

Classification of Sequential Circuits – Moore and Mealy -Design of Synchronous Counters: State Diagram- State Table (PSNSO Table) –State Minimization –State Assignment- Registers – Shift Registers- Universal Shift Register – Shift Counters.

.

Unit V: Asynchronous Circuits and Memory Devices **9**

Introduction of Asynchronous circuits – Races –Hazards: Static –Dynamic –Essential – Hazards elimination. Memory Devices-RAM, DYNAMIC RAM, ROM-PROM, EPROM, EEPROM, EAPROM, PLA, PAL, CPLD-FPGA XL 4000.

.

TOTAL: 45 HOURS

TEXT BOOKS

1. M. Morris Mano, Digital Design, 4.ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2006, Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
2. John .M Yarbrough, Digital Logic Applications and Design, Thomson- Vikas Publishing House, New Delhi, 2002.

REFERENCES:

1. Charles H.Roth. “Fundamentals of Logic Design”, Thomson Publication Company, 2003.
2. R.P.Jain, Modern Digital Electronics, 3 ed., Tata McGraw–Hill publishing company, New Delhi, 2003.
3. Thomas L. Floyd, Digital Fundamentals, Pearson Education, Inc, New Delhi, 2003.
4. S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 3 rd Edition., Vikas Publishing House Pvt. Ltd., New Delhi,2006.
5. Anand Kumar A.: Fundamentals of Digital Circuits, PHI, 2009

		L	T	P	C
EC3271	**Digital Electronics Laboratory**	**0**	**0**	**2**	**1**

OBJECTIVES

- To understand the basic truth table of logic gates and combinational circuits
- To construct and verify the truth table of sequential circuits using simulation.
- To design and implement sequential circuits.

Course Outcome		Cognitive Skill
CO-01	Able to verify the truth table of logic gates and combinational circuits using simulation.	U
CO-02	Able to construct and verify the truth table of sequential circuits using simulation.	U,A
CO-03	Able to construct adders and subtractors and verify its truth table.	U, A
CO-04	Able to construct the encoders and decoders, Magnitude comparators and verify its truth table.	U, A
CO-05	Able to implement sequential circuits.	An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	S	S	M	M	M	L	L	L
CO-02	S	S	S	M	M	S	M	S	S	M	L	M	M
CO-03	S	S	S	S	S	S	S	S	S	M	M	L	M
CO-04	S	S	M	S	M	M	S	S	S	L	M	L	L
CO-05	S	M	M	S	S	S	S	M	M	S	M	L	M

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments:

1. Simulation of Logic gates
2. Simulation of Combinational Circuits
3. Simulation of Sequential Circuits
4. Verification of Logic gates and Combinational Circuits.
5. Implementation of Adders and Subtractors
6. Implementation of Encoders and Decoders
7. Implementation of Multiplexers and Demultiplexers
8. Implementation of Code convertors.
9. Verification of Sequential Circuits.
10. Implementation of Shift Registers

11. Implementation of Synchronous Counters.
12. Implementation of Magnitude Comparators

TOTAL: 45 HOURS

EE3277	Electric Circuits and Machines Lab	L	T	P	C
		0	0	2	1

OBJECTIVES

- To understand how voltage and current are divided up when circuit components are combined.
- To expose the students to the operation of D.C. machines and transformers and give
  them experimental skill.

Course Outcome		Cognitive Skill
CO-01	Apply the different kinds of theorems to solve complex circuit problems.	A
CO-02	Evaluate the circuit parameters.	E
CO-03	Analyze the efficiency of DC Machines by different methodologies.	An
CO-04	Apply the different method to control the speed of DC motor.	A
CO-05	Determine the efficiency for transformer and induction motors.	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	M	S	S	S	M	M	S	S	M	M	L
CO-02	S	S	S	S	M	M	M	S	S	M	L	L	M
CO-03	S	M	S	M	M	M	M	S	S	S	L	S	L
CO-04	M	S	M	M	S	S	S	S	M	L	L	M	M
CO-05	S	M	S	S	S	M	S	S	M	L	M	M	L

S-Strong, M-Medium, L-Low, N-Not relevant

LIST OF EXPERIMENTS (any 10)

1. Verification of Thevenin's theorem.
2. Verification of Superposition theorem.
3. Verification of Reciprocity theorem.
4. Verification of Maximum power transfer theorem
5. Load test on D.C.shunt motor.
6. Load test on D.C. series motor.
7. Speed control of D.C. shunt motor.
8. Load test on Single phase transformer.
9. Load test on Single-phase induction motor.
10. Load test on Three phase induction motor.
11. Study of D.C. motor and induction motor starters.

TOTAL: 45 HOURS

EC3272	**Electron Devices Laboratory**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To study experimentally the characteristics of diodes, BJT's and FET's.
- To verify practically the response of various special purpose electron devices.
- To design voltage regulators.

Course Outcome		**Cognitive Skill**
CO-01	An ability to design and conduct experiments, as well as to analyze and interpret data.	U
CO-02	Able to study the characteristics of diodes	R
CO-03	Able to analyze the characteristics of BJT and FET	An
CO-04	Able to study the characteristics of LDR, photo diode and photo transistor	A
CO-05	Able to do simulation using P-Spice.	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

CO \ PO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	M	M	S	M	M	M	M
CO-02	S	S	S	S	M	M	M	S	S	M	L	L	M
CO-03	M	M	S	M	M	M	M	S	S	S	L	M	M
CO-04	M	S	S	M	S	S	S	S	M	L	L	M	M
CO-05	S	M	S	S	S	M	S	M	M	L	M	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments:

1. Characteristics of PN Junction and Zener Diode.
2. Input, Output and Transfer characteristics of CE and CC Amplifier.
3. Characteristics of LDR, Photo-Diode and Photo Transistor.
4. Transfer Characteristics of JFET.
5. Transfer Characteristics of MOSFET (with depletion and enhancement mode)
6. Simulation of VI Characteristics of PN Junction and Zener Diode.
7. Simulation of VI Characteristics of BJT(CB, CE and CC)
8. Simulation of Transfer Characteristics of JFET
9. Simulation of Transfer Characteristics of MOSFET
10. Simulation of Characteristics of Photo-Diode and Photo Transistor

TOTAL: 45 HOURS

SEMESTER IV

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MA3208	Random Process and Queuing theory	2	1	0	3
2.	BS3201	Environmental Studies	2	0	0	2
3.	EC3205	Analog Communication System	3	0	0	3
4.	EC3206	Digital Signal Processing	3	0	0	3
5.	EC3207	Electronic Circuits-I	3	0	0	3
6.	EC3208	Electromagnetic Field Theory	3	0	0	3
PRACTICAL						
7.	EC3273	Analog Communication Laboratory	0	0	2	1
8.	EC3274	Digital Signal Processing Laboratory	0	0	2	1
9.	EC3275	Electronic Circuits-I Laboratory	0	0	2	1
10.	EC32P1	Summer Internship I	0	0	0	2
TOTAL			**16**	**1**	**6**	**22**

MA3208	**Random Processes and Queuing Theory**	**L**	**T**	**P**	**C**
		2	**1**	**0**	**3**

OBJECTIVES

- To have the fundamental knowledge of basic probability concepts, the standard distributions, the classification of processes and spectral density which can describe real life phenomena.

Course Outcome		Cognitive Skill
CO-01	Know the basic concepts of probability and Random Variables. Understand the characteristic of density random variable and continuous random variable. Able to compute mean, variance and generate moment generating functions.	R, U, A
CO-02	Extend one dimensional random variables to two dimensional random variables and analyze. Understand the concept of correlation and regression.	R, U, An
CO-03	Estimate the function of time when the probability measure is associated to random processes.	R, U, E
CO-04	Correlation functions are used to understand the properties of random processes. Analyze Fourier transform applied to random signal in frequency domain.	R, U, A
CO-05	To understand the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.	U, E, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	S	S	M	S	M	S	M	S	M	M	M
CO-02	S	M	M	S	S	S	S	S	S	M	M	S	S
CO-03	M	M	S	M	M	S	M	M	S	S	S	M	S
CO-04	S	S	S	M	S	S	M	S	M	S	M	S	S
CO-05	S	M	S	M	S	S	M	S	S	S	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Random Variable And Distributions **6**

Random Variable - Probability Mass Functions - Probability Density Functions- Distribution Functions- Properties – Expectation –Moment Generating Function- Binomial, Poisson, Uniform, Exponential, and Normal Distributions and their Properties (problems only).

Unit II: Two Dimensional Random Variables **6**

Joint Distributions - Marginal and Conditional distributions –Expectation- Independence-

Covariance - Correlation and Regression.

Unit III: Random Process **6**

Definition and Examples - First Order, Second Order, Strictly Stationary, Wide –Sense stationary and Ergodic process - Markov process - Binomial, Sine Wave Process and Gaussian Processes.

Unit IV: Correlation And Spectral Densities **6**

Auto Correlation - Cross Correlation - Properties – Power Spectral Density- Cross Spectral Density - Properties – Relationship Between Cross Power Spectrum and cross correlation function – Fundamental Theorem of Power Spectral Density.

Unit V: Queuing Theory **6**

Birth and Death process - Markovian Queuing Models – Little's formulae –M/M/1, M/M/C , Finite And Infinite Capacity (steady state solutions only).

TOTAL:30+15=45 HOURS

TEXT BOOKS

1. Veerarajan. T., "Probabilitiy, Statistics and Random Processes", Second Edition, Tata McGraw-Hill Publications, New Delhi, 2007.

REFERENCES:

2. Ross, S., "A First Course in Probability", 6th Edition, Pearson Education, Delhi, 2007 (Chapters 2 to 8)
3. Peebles Jr.P.Z., "Probability Random Variables and Random Signal Principles", Fourth Edition, Tata McGraw-Hill Publishers, New Delhi, 2002 (Chapters 6, 7 and 8).
4. Henry Stark and John W. Woods "Probability and Random Processes with Applications to Signal Processing", Third Edition, Pearson Education, Delhi, 2012.
5. Medhi J., "Stochastic Models in Queuing Theory", Academic Press, Second Edition, 2003.
6. Medhi J., "Stochastic Processes", New Age Publishers, Second Edition, New Delhi, 2006.

BS3201	Environmental Studies	L	T	P	C
		3	0	0	2

OBJECTIVES

- To understand the basic concepts in environmental science
- To gain the knowledge about structure and natural cycles of environment.
- To get an idea about control methods of pollution.
- To know the information about conservation methods of forest and wild life.

Course Outcome		Cognitive Skill
CO-01	Student will be able to demonstrate a general understanding of interdisciplinary nature of environmental uses and able to characterize natural resources.	U, A, An
CO-02	Students will be able to explain the effects of air, water, soil, noise and thermal pollution environment and suggest ways to reduce them.	R, E ,A
CO-03	Students will be able to explain the effects of air, water, soil, noise and thermal pollution environment and suggest ways to reduce them.	R, U, A
CO-04	Students will be able to understand the effects of human population and know about the awareness programme.	R, A, E
CO-05	Students apply systems concept and methodologies to analyse and understand interaction between social and environmental process.	R, A, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	M	M	S	S	S	M	S	S	M	S
CO-02	M	M	S	M	S	S	S	S	M	S	S	M	M
CO-03	M	M	S	M	S	S	S	S	M	S	S	M	M
CO-04	M	M	S	S	M	S	S	S	M	S	S	M	L
CO-05	M	M	S	S	L	S	M	S	M	S	S	L	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Nature of Environment Studies and Natural Resources 9

Environment Studies- Definition – Scope and Importance- Need for Public Awareness- Methods To Create Environmental Awareness- Natural Resources- Forest Resources- Energy Resources- Food Resources- Water Resources – Land Resources - Mineral Resources.

Unit II: Eco Systems and Bio-Diversity 9

Concept and Component of Eco Systems- Producer, Consumer, Decomposer- Structure and Function of Eco System- Food Chain and Food Web- Energy Flow Model- Aquatic Eco System Forest Eco System- Desert Eco System- Pyramid of Biomass- Ocean Eco

System- Grass Land Eco System- Bio Diversity in India- Value of Bio diversity- Biodiversity Threatens- Biodiversity Protection- In-situ and Ex-situ Conservation.

Unit III: Environmental Pollution **9**

Meaning of Environmental Pollution- Air Pollution- Acid Rain – Global Warming- Water Pollution- Water Pollution Control- Soil Pollution- Urban Waste and Soil Pollution- Marine Pollution- Noise Pollution- Thermal Pollution- Solid and Hazardous Waste Management- Waste Disposal Methods- Solid Waste and India- Natural Disaster And Disaster Management.

Unit IV: Human Population and Environment **9**

Population Growth- Distribution of Population- Factors Affecting Variation in Population Theories of Population- Future of Human Population- Family Welfare Programme - HIV and AIDS- Environment and Human Health- Human Rights- Value Education- Women and Child Welfare.

Unit V: Social Issues and the Environment **9**

Unsustainable to Sustainable Development- Sustainable Development in India- Water Conservation, Watershed Management and Water Harvesting- Environmental Ethics- Role of Engineer in Environmental Protection.

TOTAL: 45 HOURS

TEXT BOOKS

. 1. Cunnigham & saigo: 'Environmental science :A global concern' 4th Ed. W.c. Brown Publishers. USA. 1997 2.Chauhan A.S, 'Environmental studies' 2nd revised ed.2004, Jain Brother publishers, New Delhi

REFERENCES:

1. Benny Joseph : 'Environmental Science and Engineering', 2006, Tata McGraw-Hill Publication.
2. Siddique K.A. : Elements of Ecology and Environmental Pollution, 1st Ed. 2002, Kushal Publication, Varanasi.

EC3205	Analog Communication System	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concepts of various analog modulations and their spectral characteristics.
- To know the effect of noise on communication systems.
- To understand the Transmitters and receivers and Multiplexing techniques.

Course Outcome		Cognitive Skill
CO-01	Learn about the basic concepts, generation and demodulation of AM wave	U and R
CO-02	Understand the basic concepts, generation and demodulation of FM wave and PM wave.	U and R
CO-03	Construct different pulse modulation system like PAM,PDM and PPM	U and R
CO-04	Understand tramsmitters, receivers and multiplexing technique.	An and E
CO-05	Analyze AM and FM systems to find out the Figure of Merit.	A and An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	S	M	M	M	M	M	S
CO-02	S	S	S	S	S	S	S	M	M	M	M	M	S
CO-03	S	S	S	S	S	S	S	M	M	M	M	M	S
CO-04	S	S	S	S	S	S	S	M	M	M	S	S	S
CO-05	S	S	S	S	S	S	S	M	M	M	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction and Amplitude Modulation **9**

Introduction to Communication System-Electromagnetic Spectrum Used in Communication. Need for Modulation. -AM - Modulation Index, Frequency Spectrum and Bandwidth, AM Generation-Collector Modulator and Square Law Modulator, AM Demodulation- Envelope Detector, DSB-SC- Generation of DSB-SC - Balanced Modulator, Ring Modulator, SSB - Generation of SSB – Filter Method, Phase Shift Method and Weaver's Method, Demodulation of DSB-SC And SSB -Synchronous Detector, Costas Loop, VSB Signals, Comparison of Amplitude Modulation Systems.

Unit II: Angle Modulation **9**

Phase and Frequency Modulation-Narrowband and Wideband FM - Spectrum – Transmission Bandwidth.- FM Modulation -Direct FM, Indirect FM and Demodulation –

Balanced Slope Detector, Foster Seely Discriminator, Ratio Detector, PLL as FM Demodulator.

Unit III: Pulse Modulation **9**

Pulse Modulation- Introduction, Pulse Amplitude Modulation (PAM), PAM Modulator Circuit, Demodulation of PAM Signals, Pulse Width Modulation (PWM), PWM Demodulation , Pulse Position Modulation (PPM), PPM Demodulator, Applications of PAM, PDM And PPM.

Unit IV: Transmitters, Receivers and Multiplexing **9**

AM Transmitters, Receiver – Characteristics, AM Receiver- Superhetrodyne :Receiver, FM Transmitters – Direct and Indirect FM Receiver, Multiplexing-Frequency Division Multiplexing, Time Division Multiplexing.

Unit IV: Noise Characterization

9

Noise Sources and Types – Noise Figure and Noise Temperature – Noise in Cascaded Systems. Narrow Band Noise – PSD of In-Phase and Quadrature Noise –Noise Performance in AM with Carrier – Noise Performance in DSB-SC-AM, Noise Performance in SSB-SC Systems, Noise Performance in FM Systems – Pre-Emphasis and De-Emphasis – Capture Effect, Threshold Effect.

.

TOTAL: 45 HOURS

TEXT BOOKS

1. Simon Haykin, " Communication Systems", 5th edition, Wiley Publishers,2010
2. John G. Proakis, MasoudSalehi,"Communication Systems Engineering"2nd edition, Prentice Hall, 2002

REFERENCES:

1. George Kennedy, "Electronic Communication System", 4th edition, McGraw-Hill,2000.
2. Wayne Tomasi, " Electronics Communication systems", 5th edition, Pearson Publishers, 2004.
3. Herbert Taub& Donald L Schilling, "Principles of Communication Systems", 3rd Edition, Tata McGraw Hill, 2008.

EC3206	**Digital Signal Processing**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To study DFT and its computation
- To study the design techniques for digital filters.
- To study the multirate digital filters.

Course Outcome		Cognitive Skill
CO-01	Able to compute DFT and FFT of sequence	U and An
CO-02	Able to design IIR Filters	U and An
CO-03	Able to design FIR Filters	U and An
CO-04	Able to analyze finite word length effects in digital filters	An and E
CO-05	Able to analyze multirate digital filters	A and An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	S	M	M	L	L	S	S	S	M	M	M
CO-04	S	M	M	M	M	L	M	M	M	S	S	S	L
CO-05	S	S	S	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Discrete Fourier Transform **9**

DFT and its properties, Relation between DTFT and DFT, FFT Computations Using Decimation In Time and Decimation in Frequency Algorithms, Convolution and Correlation in Digital Signal Sequence.

Unit II: Infinite Impulse Response Digital Filters **9**

Review of Design of Analog Butterworth and Chebyshev Filters, Frequency Transformation in Analog Domain - Design of IIR Digital Filters using Impulse Invariance Technique - Design of Digital filters using Bilinear Transform - pre warping - Realization using Direct, Cascade and Parallel forms.

Unit III: Finite Impulse Response Digital Filters **9**

Symmetric and Anti symmetric FIR filters - Linear Phase FIR filters - Design using Hamming, Hanning and Blackmann Windows - Frequency Sampling Method - Realization of FIR filters - Transversal, Linear Phase and Polyphase Structures.

Unit IV: Finite Word Length Effects in Digital Filters **9**

Fixed Point and floating Point Number Representations - Comparison - Truncation and Rounding Errors - Quantization Noise - Derivation for Quantization Noise Power - Coefficient Quantization Error - Product Quantization Error - Overflow Error - Round Off Noise Power And Signal Scaling.

Unit V: Multirate Signal Processing **9**

Introduction to Multirate Signal Processing-Decimation-Interpolation-Multistage Implementation of Sampling Rate Conversion- Design of Narrow Band Filters - Applications of Multirate Signal Processing-Sub Band Coding.

TOTAL: 45 HOURS

TEXT BOOKS

1. John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson, Fourth Edition, 2007.
2. S.Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital Signal Processing" , TMH/McGraw Hill International, 2007.

REFERENCES:

1. E.C. Ifeachor and B.W. Jervis, "Digital signal processing - A practical approach", Second edition, Pearson, 2002.
2. S.K. Mitra, "Digital Signal Processing, A Computer Based approach", Tata McGrawHill, 1998.
3. P.P.Vaidyanathan, "Multirate Systems & Filter Banks" , Prentice Hall, Englewood cliffs, NJ, 1993.
4. Johny R. Johnson, "Introduction to Digital Signal Processing" , PHI, 2006. B.Venkataramani&M.Bhaskar, "Digital Signal Processor Architecture, Programming and Application" , TMH 2002.

EC3207	Electronic Circuits- I	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the methods of biasing transistors
- To design and Analyze BJT Amplifier
- To analyze the FET,MOSFET Amplifier
- To Illustrate Frequency Response of Amplifiers
- To design power supplies.

Course Outcome		Cognitive Skill
CO-01	Able to Understand Biasing of BJT, JFET and MOSFET Transistors.	R,U
CO-02	Students can Understand to Analyze BJT Amplifier.	U
CO-03	Able to Analyze FET, MOSFET Amplifier.	U,An
CO-04	Able to Illustrate Frequency Response of Amplifiers.	U,An
CO-05	Able to Design Various Power Supply.	R,A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	M	L	L	S	S	M	L	S	S
CO-02	M	M	M	S	S	S	S	M	M	L	M	L	L
CO-03	S	S	M	S	M	S	M	S	S	S	S	M	M
CO-04	S	S	L	M	S	S	M	S	S	L	M	S	S
CO-05	S	S	L	M	L	S	L	S	M	L	M	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Biasing of Discrete BJT, JFET and MOSFET **9**

BJT– Need for Biasing – DC Load Line and Bias Point – DC Analysis of Transistor Circuits – Various Biasing Methods of BJT – Bias Circuit Design – Thermal Stability – Stability Factors – Bias Compensation Techniques using Diode, Thermistor and Sensistor – Biasing BJT Switching Circuits JFET – DC Load Line and Bias Point – Various Biasing Methods of JFET – JFET Bias Circuit Design – MOSFET Biasing – Biasing FET Switching Circuits.

Unit II: BJT Amplifiers **9**

Analysis of CE, CC and CB Amplifiers using Hybrid π Equivalent Circuits – AC Load Line Analysis- Darlington Amplifier – Cascade, Cascode Amplifiers – BJT Differential Amplifier and CMRR.

Unit III: Single Stage FET, MOSFET Amplifiers **9**

Analysis of CS, CD and CG Amplifiers using Hybrid π Equivalent Circuits – Basic FET Differential Amplifier and CMRR- BiCMOS Circuits.

Unit IV: Frequency Response of Amplifiers **9**

Amplifier Frequency Response – Frequency Response of Transistor Amplifiers with Circuit Capacitors – BJT Frequency Response – Short Circuit Current Gain – Cut Off Frequency – Gain Bandwidth Product – Miller Effect – Frequency Response of FET and MOSFET Amplifier – Transistor Switching Times.

Unit V: Power Supplies **9**

Linear Mode Power Supply -Rectifiers – Filters – Half-Wave Rectifier Power Supply – Full-Wave Rectifier Power Supply – Voltage Regulators: Series and Shunt Regulator-Voltage Regulation – Line and Load Regulation -BJT and MOSFET – Switched Mode Power Supply (SMPS) – Design of Regulated DC Power Supply.

TOTAL: 45 HOURS

TEXT BOOKS

1. Donald .A. Neamen, "Electronic Circuit Analysis and Design", 3 rd Edition, Tata McGraw Hill, 2010.
2. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", 7th Edition, Oxford University Press, 2014

REFERENCES:

1. David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5th Edition, 2010.
2. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill 2007.
3. Paul Gray, Hurst, Lewis, Meyer, "Analysis and Design of Analog Integrated Circuits", John Willey & Sons, 4 th Edition, 2005.
4. Millman .J. and Halkias C.C, "Integrated Electronics", McGraw Hill, 2001.
5. D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 1989.

EC3208	Electromagnetic Field Theory	L	T	P	C
		3	0	0	3

OBJECTIVES

- To analyze field potentials due to static changes.
- To evaluate static magnetic fields.
- To understand how materials affect electric and magnetic fields.
- To understand the relation between the fields under time varying situations.
- To understand principles of propagation of uniform plane waves.

Course Outcome		Cognitive Skill
CO-01	Understand the basic laws and evaluate electric field and potential due to static charges.	U and E
CO-02	Evaluate the static magnetic field and understand the concept of magnetic material.	U and E
CO-03	Understand the concept of inductance and capacitance and derive them for different geometric structures.	U and E
CO-04	Understand the relation between fields under time varying situations.	U
CO-05	Understand the principles of propagation of uniform plane waves and Wave polarization.	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	S	S	M	L	S	S	M	M	S
CO-02	S	S	S	M	S	S	M	L	S	S	M	M	S
CO-03	S	S	S	M	S	S	M	L	S	S	M	M	S
CO-04	S	S	S	M	S	S	M	L	S	S	M	M	S
CO-05	S	S	S	S	S	S	M	L	S	S	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Static Electric Fields 9

Introduction, Curl, Divergence and Gradient–Strokes' Theorem and Divergence Theorem, Coulomb's Law and Electric Field Intensity- Principle of Superposition–Electric Field due to Discrete Charges- Field due to Charges Distributed Uniformly on an Infinite and Finite Line–Electric Field on the Axis of a Uniformly Charged Circular Disc. Field of a Sheet of Charge, Electric Scalar Potential–Relationship between Potential and Electric Field-Potential due to Infinite Uniformly Charged Line–Potential due to Electrical Dipole-Electric Flux Density–Gauss Law .

Unit II: Static Magnetic Field and Magnetic Materials **9**

The Biot-Savart Law in Vector Form–Magnetic Field Intensity due to a Finite and Infinite Wire Carrying a Current I–Ampere's Circuital Law and Simple Applications, Magnetic Flux Density–The Lorentz Force Equation for a Moving Charge and Applications–Force

on a Wire Carrying a Current I Placed in a Magnetic Field–Torque on a Loop Carrying a Current I–Magnetic Moment–Magnetic Vector Potential, Nature of Magnetic Materials, Magnetization. and Permeability.

Unit III: Electric and Magnetic Fields in Materials 9

Electric Current–Current Density–Point Form of Ohm's Law–Continuity Equation for Current, Metallic Conductors- Conductor Properties and Boundary Conditions, The Nature of Dielectric Materials, Boundary Conditions for Perfect Dielectric Materials, Poisson's and Laplace's Equation- Capacitance–Capacitance of Various Geometries Using Laplace's Equation–Electrostatic Energy and Energy Density– Definition of Inductance and Mutual Inductance–Inductance of Loops and Solenoids, Energy Density in Magnetic Fields .

Unit IV: Time Varying Electric and Magnetic Fields 9

Faraday's law-Transformer and Motional EMF-Displacement Current–Maxwell's Four Equations in Integral Form and Differential Form- Maxwell's Equations for Harmonically Varying Fields, Poynting Vector and the Flow of Power.

Unit V: Uniform Plane Waves 9

Derivation of Wave Equation–Uniform Plane Waves—Wave Equation in PhasorForm–Wave Propagation in Lossy Dielectrics- Plane Waves in Lossless Dielectrics- Plane Wave in Free Space- Plane Waves in Good Conductors- Wave Polarisation- Reflection of a Plane Wave at Normal Incidence- Reflection of a Plane Wave at Oblique Incidence.

TOTAL: 45 HOURS

TEXT BOOKS

1. William H. Hayt : "Engineering Electromagnetics", TATA Mc Graw-Hill, 2007 .
2. Sadiku MH, "Principles of Electromagnetics", Oxford University Press Inc, New Delhi, 2009.

REFERENCES:

1. Ramo, Whinnery and Van Duzer: "Fields and Waves in Communications Electronics", John Wiley & Sons (3rd edition 2003).
2. E.C. Jordan & K.G. Balmain "Electromagnetic Waves and Radiating Systems". Prentice Hall of India 2nd edition 2003. McGraw-Hill. David K.Cherp: "Field and Wave Electromagnetics",-Second Edition-Pearson Edition.
3. Karl E Longman and Sava V Savov, "Fundamentals of Electromagnetics", Prentice Hall of India, New Delhi, 2006.

EC3273	Analog Communications Laboratory	L	T	P	C
		0	0	2	1

OBJECTIVES

To construct electronic circuits like modulators and demodulators.

Course Outcome		Cognitive Skill
CO-01	To understand the generation of continuous time signal and plotting their spectrum.	U
CO-02	To simulate and implement AM and FM modulator and Demodulator	U, A
CO-03	To generate and demodulate PAM, PAM and PPM	U, A
CO-04	To construct and test Pre-emphasis and De-emphasis circuit	U, A
CO-05	To generate and demodulate TDM-PAM wave	U, A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	M	M	S	S	S	M	S
CO-02	S	S	S	S	S	S	M	M	S	S	S	M	S
CO-03	S	S	S	S	S	S	M	M	S	S	S	M	S
CO-04	S	S	S	S	S	S	M	M	S	S	S	M	S
CO-05	S	S	S	S	S	S	M	M	S	S	S	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments

1. Generation of Basic Continuous Time Signals Using Matlab.
2. Plotting of Spectrum of Various CT Signals.
3. Simulation of AM Modulator and Demodulator
4. Simulation of FM Modulator and Demodulator
5. Generation and Detection of AM
6. Generation of FM
7. PAM Generation and Demodulation
8. PWM Generation and Demodulation
9. PPM Generation and Demodulation
10. Pre-Emphasis and De-Emphasis.
11. TDM-PAM Generation and Demodulation

TOTAL: 45 HOURS

EC3274	Digital Signal Processing Laboratory	L	T	P	C
		0	0	2	1

OBJECTIVES

- To generate various discrete sequences using MATLAB To implement the IIR filter, FIR filter and multirate filter using MATLAB.

Course Outcome		Cognitive Skill
CO-01	Ability to generate discrete time signals using MATLAB.	R
CO-02	Able to perform the basic operations on Signals.	An
CO-03	Able to Analyze Magnitude and phase characteristics of digital FIR filters .	E
CO-04	Able to of computing DFT and FFT of a sequence.	A
CO-05	Able to design and simulate Multirate filters.	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	M	S	M	S	S	M	S	M	L	L	L
CO-02	M	S	S	M	M	S	M	S	S	M	M	M	L
CO-03	S	S	M	M	S	S	M	S	S	M	M	L	M
CO-04	M	S	M	S	M	M	S	S	S	L	L	L	M
CO-05	S	S	M	S	M	S	S	M	S	S	L	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments:

1. Generation of Signals -Unit impulse, unit step, ramp, exponential and sinusoidal
2. sequences
3. Operation on signals-Addition, Subtraction, multiplication , Shifting and folding
4. Performing Linear and circular convolution of two sequences
5. Auto correlation and cross correlation
6. Sampling and analysis of aliasing
7. Computation of DFT and IDFT of a sequence
8. Implementation of FFT of a sequence
9. Design of FIR filters using windows
10. Design of IIR filters
11. Design of Multirate filters-Decimator and interpolator

TOTAL: 45 HOURS

EC3275	**Electronic Circuits-I Laboratory**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

The student should be made to:

- Perform simulation of Electronic Circuits.
- Study the Frequency response of CE, CB and CC Amplifier.
- Learn the frequency response of CS Amplifiers.
- Study the Transfer characteristics of differential amplifier.
- Perform experiment to obtain the bandwidth of single stage and multistage amplifiers.

Course Outcome		**Cognitive Skill**
CO-01	Able to Study the Analysis of CE, CB and CC Amplifier	R, U
CO-02	Able to Learn the frequency response of JFET Amplifiers	U
CO-03	Able to Analyze Cascode and Cascade amplifiers	U, An
CO-04	Able to know Frequency Response of CE, CB, CC and CS amplifiers	U, An
CO-05	Able to Design Differential Amplifiers	R, A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	L	L	S	S	M	S	S	S	L	L	M
CO-02	M	M	L	M	S	S	L	M	M	M	N	M	S
CO-03	S	M	S	M	M	L	S	S	S	L	L	M	S
CO-04	S	M	M	L	S	S	L	M	S	S	M	M	S
CO-05	S	M	L	M	L	L	L	S	M	M	L	M	M

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments:

1. Analysis of BJT with Fixed bias and Voltage divider bias using simulation software.
2. Analysis of FET, MOSFET with fixed bias, self-bias and voltage divider bias using simulation software.
3. Analysis of Cascode and Cascade amplifiers using simulation software.
4. Analysis of Frequency Response of BJT and FET using simulation software.
5. Design of Regulated Power supplies.
6. Frequency Response of CE, CB, CC and CS amplifiers.
7. Darlington Amplifier.
8. Differential Amplifiers – Transfer characteristics, CMRR Measurement.
9. Cascode and Cascade amplifiers.
10. Determination of bandwidth of single stage and multistage amplifiers.

TOTAL: 45 HOURS

EC32P1	**Summer Internship I**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**2**

OBJECTIVES

- To understand the scope of Electronics and communication.
- To provide hands-on experience at site where Electronic hardware and communication equipment are manufactured or utilized.
- To familiarize the Embedded system and recent advancement in wireless technologies.
- To know the need of Electronics and Communication engineers in research and development.

Course Outcome		Cognitive Skill
CO-01	To learn the application of knowledge in real world problems.	U, A
CO-02	To get exposure to team-work and leadership quality.	An, A
CO-03	To deal with industry-professionals and ethical issues in the work environment	U, E
CO-04	Integrate theory and practice.	E, An
CO-05	Build a record of work experience	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	S	S	M	S	S	M	S	M	M	S
CO-02	S	M	S	S	S	M	S	S	M	S	M	M	S
CO-03	S	M	S	S	S	M	S	S	M	S	M	M	S
CO-04	S	M	S	S	S	M	S	S	M	S	M	M	S
CO-05	S	M	S	S	S	M	S	S	M	S	M	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

DESCRIPTION

Students have to undergo two weeks practical training in All India Radio, Doordharshan Kendra, BSNL, Electronic equipment manufacturing companies etc. At the end of the training student will submit a report as per the prescribed format to the department.

SEMESTER V

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MS3201	Professional and Business Ethics	2	0	0	2
2.	EC3209	Computer architecture and Microprocessor	3	0	0	3
3.	EC3210	Control System Engineering	3	0	0	3
4.	EC3211	Linear Integrated Circuits	3	0	0	3
5.	EC3212	Electronic Circuits-II	3	0	0	3

6.	EC32**	Programme Elective –I	3	0	0	3
PRACTICAL						
7.	EC3276	Microprocessor Laboratory	0	0	2	1
8.	EC3277	Linear Integrated Circuits Laboratory	0	0	2	1
9.	EC3278	Electronic Circuits-II Laboratory	0	0	2	1
TOTAL			**17**	**0**	**6**	**20**

MS3201	**Professional and Business Ethics**	L	T	P	C
		2	0	0	2

OBJECTIVES

To Recognize legal and ethical issues in business decision-making.

- To Understand and apply ethical rules and constraints.
- To Enhance analytical problem-solving skills and ethical decision-making abilities.

Course Outcome		**Cognitive Skill**
CO-01	Ability to understand the relationship between ethics, morals and values in the workplace.	U
CO-02	Ability to help the students to recognize legal and ethical issues when making business decisions	U
CO-03	Ability to improve analytical problem solving and ethical decision making skills.	U &R
CO-04	Ability to gain an enhanced understanding of following ethical rules and safety constraints.	U &R
CO-05	Ability to formulate ethical philosophy to deal with the global issues faced by multinational corporations	U &R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	L	S	S	L	S	M	L	S	S	L
CO-02	S	S	S	L	S	S	L	S	S	L	S	S	L
CO-03	S	S	S	S	S	S	S	S	S	S	S	S	L
CO-04	S	S	S	M	S	M	M	S	S	M	S	S	L
CO-05	S	S	S	S	S	S	S	S	S	S	S	S	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Human Values **6**

Morals, Values, and Ethics - Integrity and Work Ethic - Caring, Sharing, and Honesty - Commitment, Empathy, and Self-Confidence.

Unit II: Engineering Ethics **6**

Senses of 'Engineering Ethics' and Moral Issues -Moral Autonomy and Ethical Theories – Models of Professional Roles.

Unit III: Engineering As Social Experimentation **6**

Engineering as Experimentation - Engineers as Responsible Experimenters - Codes of Ethics and Legal Perspectives.

Unit IV: Safety, Responsibilities, And Rights **6**

Safety, Risk, and Risk Assessment - Collegiality, Loyalty, and Respect for Authority - Professional and
Employee Rights.

Unit V: Global Issues **6**

Multinational Corporations and Environmental Ethics - Engineers as Managers, Consultants, and Expert Witnesses.

TOTAL: 30 HOURS

TEXT BOOKS:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering," McGraw-Hill, New York, Latest edition: 4th edition, 2022.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics," Prentice Hall of India, New Delhi, Latest edition: 2nd edition , 2021

REFERENCES:

1. Charles D. Fleddermann, "Engineering Ethics," Pearson Education/Prentice Hall, New Jersey, Latest edition: 4th edition 2022.
2. Charles E Harris, Michael S. Protchard, and Michael J Rabins, "Engineering Ethics – Concepts and Cases," Wadsworth Thompson Learning, United States, Latest edition: 2nd edition 2023.
3. John R Boatright, "Ethics and the Conduct of Business," Pearson Education, New Delhi,
   Latest edition: 8th edition, 2021.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers," Oxford University Press, Oxford, Latest edition: 2nd edition, 2022.

EC3209	**Computer Architecture and Microprocessor**	**L**	**T**	**P**	**C**
		3	0	0	**3**

OBJECTIVES:

- To study the addressing modes & instruction set of 8085 & 8051.
- To develop skills in simple program writing in assembly languages.
- To introduce commonly used peripheral/interfacing ICs.
- To study and understand typical applications of micro-processors.
- To study and understand the typical applications of micro-controllers.

Course Outcome		**Cognitive Skill**
CO-01	Understand the basic structure of Computer system and its memory.	R, U
CO-02	Understand the CPU organization and Register organization of a computer system.	U
CO-03	Able to write assembly language program for 8085 microprocessor.	A
CO-04	Able to write assembly language program for 8086 microprocessor.	A
CO-05	Able to design and implement interfacing of peripheral with microprocessor.	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	S	S	S	M	S
CO-03	S	M	S	M	M	L	L	S	M	S	S	M	S
CO-04	S	S	M	M	M	L	M	S	S	M	M	S	M
CO-05	S	S	M	M	M	L	S	S	S	M	M	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Basic Structure of Computer System **9**

Computer Components – Functions – Computer Memory System – Cache Memory Principles – Overview of Internal and External Memory – I/O Modules – Programmed I/O – Interrupt Driven I/O – Operating System Overview – Memory Management.

Unit II: Central Processing Unit **9**

Machine Instruction Characteristics – Types of Operands – Types of Operations – Addressing Modes – Instruction Formats – Assembly Language – Processor Organization – Register Organization – Instruction Cycle – Instruction Pipelining.

Unit III: Introduction To 8085 Architecture 9

Functional block diagram –Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming.

Unit IV: The 8086 Microprocessor **9**

Introduction to 8086 - Microprocessor architecture - Addressing modes - Instruction set and assembler directives - Assembly language programming - Modular Programming - Linking and Relocation - Stacks - Procedures - Macros - Interrupts and interrupt service routines - Byte and String Manipulation.

Unit V I/O Interfacing **9**

Memory Interfacing and I/O interfacing - Parallel communication interface - Serial Communication interface - D/A and A/D Interface - Timer - Keyboard /display controller - Interrupt controller - DMA controller - Programming and applications.

TOTAL: 45 HOURS

TEXT BOOKS

1. William Stallings, 'Computer Organization and Architecture Designing for Performance' Pearson Education Limited, London, 10th Edition, 2016.

2. Ramesh S. Gaonkar, 'Microprocessor Architecture Programming and Application', Pen ram International (P) Ltd., Mumbai, 6th Education, 2013.
3. Douglas V. Hall, "Micro-processors & Interfacing", Tata McGraw Hill 3rd Edition, 2017.

REFERENCES:

1. Morris Mano, "Computer System Architecture", Pearson Education, Third Edition, 2016.
2. Ramesh Goankar, "Microprocessor Architecture, Programming and Applications with the 8085", PENRAM.

EC3210	Control System Engineering	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the open loop and closed loop (feedback) systems.
- To understand time domain and frequency domain analysis of control systems required for stability analysis.
- To understand the compensation technique that can be used to stabilize control systems.

Course Outcome		Cognitive Skill
CO-01	Students will be able to understand the concept of open loop and closed loop system an derive the transfer function for them.	U and A
CO-02	Students will be able to find out the response of first order and second order system and understand the concept of controllers	U and A
CO-03	Students will become familiar with frequency response plot and understand the concept of compensator.	A and An
CO-04	Students will be able to analyze the stability of the system.	An
CO-05	Students will be familiar with state-space representation and sample-data control system	U and A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	S	S	M	L	S	M	M	M	S
CO-02	S	S	S	M	S	S	M	L	S	M	M	M	S
CO-03	S	S	S	M	S	S	M	L	S	M	M	M	S
CO-04	S	S	S	M	S	S	M	L	S	M	M	M	S
CO-05	S	S	S	S	S	S	M	L	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Control System Modeling **9**

Basic Elements of Control System - Open loop and Closed loop systems - Differential equation - Transfer function, Modeling of Electric systems, Translational and Rotational Mechanical Systems - Block Diagram Reduction Techniques - Signal flow Graph.

Unit II: Time Response Analysis **9**

Time response analysis - First Order Systems - Impulse and Step Response Analysis of Second Order Systems – Steady State Errors - P, PI, PD and PID Controllers.

Unit III: Frequency Response Analysis **9**

Frequency Response - Bode Plot, Polar Plot, Nyquist Plot - Frequency Domain specifications from the plots - Constant M and N Circles - Nichol's Chart - Use of Nichol's Chart in Control System Analysis. Series, Parallel, series-parallel Compensators - Lead, Lag, and Lead Lag Compensators. Design of compensators using Bode plots.

Unit IV: Stability Analysis **9**

Stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram - Nyquist Stability Criterion - Relative Stability**.**

Unit V: State Variable Analysis & Digital Control Systems **9**

State Variable Model, and Solution of State Equation of LTI System- State Description of Digital Processor - State Equations - Solutions of the State Difference Equations - Concepts of Controllability and Observability – Multivariable System-Sampled Data Control System .

TOTAL: 45 HOURS

TEXT BOOKS:

1. J. Nagrath and M.Gopal," Control System Engineering", New Age International

Publishers, 5th Edition, 2007.
2. M. Gopal, "Control System - Principles and Design", Tata McGraw Hill, 2nd Edition, 2002.

REFERENCES:

1. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition,1995.
2. M.Gopal, Digital Control and State Variable Methods, 2nd Edition, TMH, 2007.
3. Schaum's Outline Series,'Feedback and Control Systems' Tata McGraw- Hill, 2007.
4. John J.D'azzo & Constantine H.Houpis, 'Linear control system analysis and design', Tata McGrow-Hill, Inc., 1995.
5. Richard C. Dorf & Robert H. Bishop, "Modern Control Systems", Addison - Wesley, 1999.

EC3211	**Linear Integrated Circuits**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To introduce the basic building blocks of linear integrated circuits.
- To teach the linear and non-linear applications of operational amplifiers.
- To introduce the theory and applications of analog multipliers and PLL.
- To teach the theory of ADC and DAC

Course Outcome		**Cognitive Skill**
CO-01	Infer the DC and AC characteristics of OPAMP and its effect on output and their compensation techniques	U
CO-02	Analyze and design of basic OPAMP circuits, particularly various linear and non- linear circuits	A
CO-03	Learn about the various techniques used to develop AD and DA converters	U
CO-04	Analysis of multipliers, PLL and their applications	A
CO-05	Working of multivibrators using special function, 555 and their applications	R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	S	M	M	L	L	S	S	S	M	M	L
CO-04	S	S	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	S	S	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Fabrication and Ideal Opamp Characteristics 9

Manufacturing process of monolithic ICs – Construction of monolithic bipolar transistor – Monolithic diodes – Integrated Resistors – Monolithic Capacitors – Inductors. OPAMP - Differential gain – CMRR – DC and AC Performance Characteristics – slew rate, Compensation techniques.

Unit II: Applications of Operational Amplifiers 9

Operational amplifier.– Open and closed loop configurations- Sign Changer, Inverter – Scale Changer – Voltage Follower – Adder – Subtractor – Instrumentation amplifier – Integrator – Differentiator –Comparators – Schmitt trigger – Astable and Monostable Multivibrators – Precision rectifier – V to I and I to V converters.

Unit III: Voltage Regulators and PLL 9

IC Voltage Regulators – 78xx and 79xx Three terminal Fixed and Adjustable voltage regulators – IC 723 general purpose regulator– Switching Regulators, Operation of the basic PLL – Closed loop analysis – Voltage Controlled Oscillator — Application of PLL for AM detection – FM Detection – Frequency Synthesizing

Unit IV: Analog to Digital and Digital to Analog Converters 9

Analog and Digital Data Conversions – specifications – D/A converter: Weighted resistor type, R–2R Ladder type – Sample and Hold circuits – A/D Converters– Flash type – Counter type-Successive Approximation type –Dual Slope.

Unit V: Active Filters, Analog Multiplier and Timers 9

Active Filters, Low pass, High pass and Band pass Butterworth filters, Analog Multiplier Variable Transconductance Amplifier –Timer IC 555 –Monostable and Astable Multivibrator .

TOTAL: 45 HOURS

TEXT BOOKS:

1. D. Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Ag International Pvt. Ltd., 2015.
2. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", 2nd Edition,TMH, 2015.

REFERENCES:

1. Ramakant A. Gayakwad, "OP–AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2001.
2. Sergio Franco, "Design with operational amplifiers and analog integrated circuits", 3rd Edition, Tata McGraw– Hill, 2007.

EC3212	**Electronic Circuits - II**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To give a comprehensive exposure to all types of amplifiers and oscillators constructed with discrete components.
- To develop a strong basis for building linear and digital integrated circuit.
- To study and design feedback amplifiers and oscillatorss.
- To study about turned amplifier.
- To understand the analysis and design of LC and RC oscillators, amplifiers, multi-vibrators, power amplifiers and DC convertor.

Course Outcome		**Cognitive Skill**
CO-01	To study feedback amplifiers and oscillators stability	R, U
CO-02	To analyze the design of oscillators.	U
CO-03	To analyze the design of turned amplifier	U, An
CO-04	To understand the analysis and design of wave shaping circuits and UJT oscillators	U, An
CO-05	To study and analyze power amplifiers and DC convertors.	U, An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	M	L	L	S	S	M	L	S	S
CO-02	M	M	M	S	S	S	S	M	M	L	M	L	L
CO-03	S	S	M	S	M	S	M	S	S	S	S	M	M
CO-04	S	S	L	M	S	S	M	S	S	L	M	S	S
CO-05	S	S	L	M	L	S	L	S	M	L	M	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Feedback Amplifiers and Stability **9**

Feedback Concepts – Gain with Feedback – Effect of Feedback on Gain Stability, Distortion, Bandwidth, Input and Output Impedances; Topologies of Feedback Amplifiers – Analysis of Series-Series, Shunt-Shunt And Shunt-Series Feedback Amplifiers-Stability Problem-Gain and Phase-Margins-Frequency Compensation.

.

Unit II: Oscillators **9**

Barkhausen Criterion for Oscillation – Phase Shift, Wien Bridge – Hartley & Colpitt‘s Oscillators – Clapp scillator-Ring Oscillators and Crystal Oscillators – scillator Amplitude Stabilization.

Unit III: Tuned Amplifiers **9**

Coil Losses, Unloaded and Loaded Q of Tank Circuits, Small Signal Tuned Amplifiers – Analysis of Capacitor Coupled Single Tuned Amplifier – Double Tuned Amplifier – Effect of Cascading Single Tuned and Double Tuned Amplifiers on Bandwidth – Stagger Tuned Amplifiers – Stability of Tuned Amplifiers – Neutralization – Hazeltine Neutralization Method.

Unit IV: Wave Shaping and Multivibrator Circuits **9**

Pulse Circuits – Attenuators – RC Integrator and Differentiator Circuits – Diode Clampers and Clippers –Multivibrators – Schmitt Trigger- UJT Oscillator.

Unit V: Power Amplifiers and 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 HOURS

TEXT BOOKS

1. Sedra and Smith, ―Micro Electronic Circuits‖; Sixth Edition, Oxford University Press, 2011. (UNIT I, III,IV,V)
2. Jacob Millman, _Microelectronics', McGraw Hill, 2nd Edition, Reprinted, 2009. (UNIT I,II,IV,V)

REFERENCES:

1. Robert L. Boylestad and Louis Nasheresky, ―Electronic Devices and Circuit Theory‖, 10th Edition, Pearson Education / PHI, 2008
2. David A. Bell, ―Electronic Devices and Circuits‖, Fifth Edition, Oxford University Press, 2008.
3. Millman J. and Taub H., ―Pulse Digital and Switching Waveforms‖, TMH, 2000.
4. Millman and Halkias. C., Integrated Electronics, TMH, 2007.

EC3276	Microprocessor Laboratory	L	T	P	C
		0	0	2	1

OBJECTIVES

- The students should be made to:
- Introduce ALP concepts and features.
- Write ALP for arithmetic and logical operation in 8086.
- Difference serial and parallel interface.
- Interface different I/Os with microprocessors

Course Outcome		Cognitive Skill
CO-01	Understand ALP concepts and features.	U
CO-02	Perform ALP for arithmetic and logical operation in 8086.	An
CO-03	Able to implement Difference serial interface.	A
CO-04	Able to implement Difference parallel interface	R
CO-05	Able to Interface different I/Os with microprocessors.	An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcom

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	M	M	S	S	S	M	S
CO-02	S	S	S	S	S	S	M	M	S	S	S	M	S
CO-03	S	S	S	S	S	S	M	M	S	S	S	M	S
CO-04	S	S	S	S	S	S	M	M	S	S	S	M	S
CO-05	S	S	S	S	S	S	M	M	S	S	S	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments

1. Single Precision Arithmetic Programming in 8085.
2. Single Precision Logical Programming in 8085
3. Assembly Language Programming of 8086.
4. Searching and sorting of numbers in 8086
5. String Manipulation using 8086.
6. Interfacing ADC and DAC.
7. Interfacing and Programming 8279.
8. Serial Communication between two Microprocessor Kits using 8251.
9. Interfacing and Programming of Stepper Motor Speed control.
10. Parallel Communication between two Microprocessor Kits using Mode 1 and Mode 2 of 8255.
11. Programming using Arithmetic, Logical and Bit Manipulation, instructions of 8051 microcontroller, Interfacing - DAC and ADC

.

TOTAL: 45 HOURS.

EC3277	**Linear Integrated Circuits Laboratory**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

- To impart knowledge on Ac and dc characteristics of Opamp 741.
- To understand the characteristics of IC555.
- To practice and familiarize the different applications of IC 741/TL082.

Course Outcome		Cognitive Skill
CO-01	Infer the DC and AC characteristics of operational amplifiers and its effects on output and their compensation techniques.	U &R
CO-02	Elucidate and design the linear and non-linear applications of op-amp and special application ICs.	A
CO-03	Design and compare the working of multivibrators using special application IC555 and general purpose op-amp.	A & An
CO-04	Design filters for required bandwidth using op-amp.	A & An
CO-05	Illustrate and design the function of application specific ICs such as voltage regulators, PLL and its application in communication.	A & An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	M	M	S	S	S	M	S
CO-02	S	S	S	S	S	S	M	M	S	S	S	M	S
CO-03	S	S	S	S	S	S	M	M	S	S	S	M	S
CO-04	S	S	S	S	S	S	M	M	S	S	S	M	S
CO-05	S	S	S	S	S	S	M	M	S	S	S	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments

1. Design of Inverting and Non Inverting amplifier.
2. Design of Integrator and Differentiator.
3. Study of Comparator.
4. Study of Schmitt Trigger.
5. Design of First Order Filter and Second Order Filters.
6. Design of Band Pass Filters.
7. Design of Astable Multivibrator using 741.
8. Design of Monostable Multivibrator using 741.

9. Design of Triangular Wave Generator using 741.
10. Design of Wein Bridge Oscillator.
11. Design of RC Phase Shift Oscillator.
12. Design of Voltage Regulator using ICs.
13. Design of Astable Multivibrator using 555.

TOTAL: 45 HOURS

EC3278	**Electronic Circuits II Laboratory**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

OBJECTIVES

The student able to:

- Design electronic circuits like amplifiers, oscillators and multivibrators.
- Simulate electronic circuits like amplifiers, oscillators and multivibrators using SPICE.

Course Outcome		**Cognitive Skill**
CO-01	Able to design and construct the feedback amplifiers	U & A
CO-02	Able to design and construct oscillators	U & A
CO-03	Able to design and construct wave shaping circuits	U & A
CO-04	Able to simulate oscillators	A
CO-05	Able to simulate wave shaping circuits	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthes

Mapping of Course Outcome with Programme Outcome

PO / **CO**	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	M	L	L	S	S	M	L	S	S
CO-02	M	M	M	S	S	S	S	M	M	L	M	L	L
CO-03	S	S	M	S	M	S	M	S	S	S	S	M	M
CO-04	S	S	L	M	S	S	M	S	S	L	M	S	S
CO-05	S	S	L	M	L	S	L	S	M	L	M	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments

1. Series feedback amplifier.
2. Shunt feedback amplifier.
3. RC phase shift Oscillator.
4. Hartley Oscillator.
5. Colpitts Oscillator.
6. Astable Multivibrator.
7. Monostable Multivibrator.
8. Bistable Multivibrator

Simulation

9. RC phase shift Oscillator.
10. Hartley Oscillator.
11. Colpitts Oscillator.
12. Astable Multivibrator.
13. Monostable Multivibrator.
14. Bistable Multivibrator

TOTAL: 45 HOURS

SEMESTER VI

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EC3213	Embedded Systems and IoT Applications	3	0	0	3
2.	EC3214	Digital Communication	3	0	0	3
3.	EC3215	Optical Communication	3	0	0	3
4.	EC32**	Programme Elective II	3	0	0	3
5.	EC32**	Programme Elective III	3	0	0	3
6.	XXXXXX	Open Elective I	3	0	0	3
PRACTICAL						
7.	EC3279	Digital Communication Laboratory	0	0	2	1
8.	EC3280	Embedded System and IoT Laboratory	0	0	2	1
9.	EC32P2	Summer Internship II	0	0	0	2
TOTAL			**18**	**0**	**4**	**22**

EC3213	Embedded System and IoT Applications	L	T	P	C
		3	0	0	3

OBJECTIVES

- Learn the architecture of embedded processors.
- To learn embedded C programs and to design simple embedded applications.
- To design IoT applications using Arduino/Raspberry Pi /open platform.

Course Outcome		Cognitive Skill
CO-01	Understand the concept of 8051 and its architectural features.	R, U
CO-02	Understand the concept of ARM processor and programming.	U
CO-03	Develop embedded software using Embedded C.	A
CO-04	Gain basic knowledge on the basics of IoT and its design.	U
CO-05	Design IoT applications using Arduino/Raspberry Pi /open platform.	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	S	S	S	M	S
CO-03	S	M	S	M	M	L	L	S	M	S	S	M	S
CO-04	S	S	M	M	M	L	M	S	S	M	M	S	M
CO-05	S	S	M	M	M	L	S	S	S	M	M	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: 8-Bit Embedded Microcontroller **9**

8-Bit Microcontroller – Architecture of 8051 - Special Function Registers (SFRs) - I/O Pins Ports and Circuits - Memory Organization- Instruction set - Addressing modes - Assembly language programming - GPIO Programming - Keyboard Interfacing - Stepper Motor and Waveform generation.

Unit II: ARM Processor **9**

Introduction to the ARM Instruction set: Introduction, Data processing instructions, Load – Store instruction, Software interrupt instructions, Program status register instructions - Introduction to the THUMB instruction set

Unit III: Embedded C Programming **9**

Introduction to 'C' Programming – Storage Classes – Data types – Controlling Program Flow –Functions– Arrays and Pointers – Constant – Structures and Unions – Importance of While Loop.

Unit IV: IoT Layers and APIs **9**

IoT Definition and Characteristics – IoT Devices Versus Computers – IoT Protocols – Frame Works and Layers – APIs – Types of APIs - MQTT – REST API - SOAP API – Sensors – Think speak.

Unit V: IoT Programming and Applications **9**

Introduction to Arduino – Types of Arduino– Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches– Integration of Sensors and Actuators with Arduino - Development of IoT Applications – Home Automation -Smart Agriculture – Smart Cities.

TOTAL: 45 HOURS

TEXT BOOKS

1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014.
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
3. Kirk Zurell, 'C-Programming for Embedded Systems', CRC Press, First Edition, 2000.

REFERENCES:

1. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
2. Han-Way Huang, "Embedded system Design using C8051", Cengage Learning,2009.
3. Rajib Mall "Real-Time systems Theory and Practice", Pearson Education, 2007.
4. Shibu.K.V, "Introduction to Embedded Systems", TataMcgraw Hill, 2009.

EC3214	Digital Communication	L	T	P	C
		3	0	0	3

OBJECTIVES

- To Introduce The Relevance Of This Course To The Existing Technology Through Demonstrations, Case Studies, Simulations, Contributions Of Scientist, National/International Policies With A Futuristic Vision Along With Socio-Economic Impact And Issues.
- To Demonstrate The Concept Of Information And Types Of Channels.

- To Understand The Various Source Coding Theorems And The Fundamental Limit Of Transmission Over The Channel.
- To Understand The Various Baseband And Band Pass Processing Techniques.
- To Understand The Various Spread Spectrum Techniques.

Course Outcome		Cognitive Skill
CO-01	Familiar with the blocks used in design of digital communication system and types of sampling	U&R
CO-02	Discussion of various line codes used in digital communication techniques	A
CO-03	Design of different digital modulation techniques used in digital communication	An &E
CO-04	Design and development of different error correction and detection codes	A
CO-05	Familiar with the design of PN Sequences used in Digital communication	U& A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	S	M	M	L	L	S	S	S	M	M	L
CO-04	S	S	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	S	S	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I Waveform Coding Techniques **9**

Digital Communication System- Introduction, Sampling theorem, Quantization- PCM-Types - Differential Pulse Coded Modulation-Delta Modulation- Adaptive Delta Modulation - LPC- Time Division Multiplexing

Unit II: Baseband Transmission **9**

Line Codes - Types- Unipolar/Polar RZ & NRZ - Biplar NRZ- Manchester – Inter Symbol Interference - Nyquist criterion for Distortionless transmission - Pulse shaping - Correlative

Coding, Duobinary, Modified Duobinary Schemes - M-ary schemes - Eye pattern - Equalization.

Unit III: Bandpass Transmission **9**

Optimum Filter and matched filter detection, ML Criterion - Coherent Receivers - Generation and Detection of BPSK, BFSK, QPSK, MSK - Bit Error Rate, Non-Coherent Receivers - Generation and Detection of DPSK - Carrier Synchronization.

Unit IV: Error Control Coding Techniques **9**

Channel coding theorem - Linear block codes - Hamming codes - Cyclic codes - Burst Error Correction Codes- Convolutional codes -Types of representation of Convolutional Codes- Polynomial, State Diagram, Code Tree, Trellis Diagram, Viterbi Decoding-

.

Unit V: Spread Spectrum Techniques **9**

Spread Spectrum - PN Sequences- Properties, Direct Sequence and Frequency Hopping Spread Spectrum Systems- Types, Processing gain and Jamming Margin, Application of Spread spectrum in Cellular Systems - CDMA- OFDM.

TOTAL: 45 HOURS

TEXT BOOKS

1. S. Haykin, Digital Communications, John Wiley, 2015.
2. J.G Proakis, - Digital Communication, 5/e, Tata Mc Graw Hill Company, 2008.

REFERENCES:

1. B. Sklar, - Digital Communication Fundamentals and Applications, 2nd edition, Pearson Education, 2009.
2. H P Hsu, Schaum Outline Series-Analog and Digital Communications, TMH 2006.
3. B. P. Lathi, - Modern digital and Analog Communication Systems, 3rd edition, Oxford University Press 2007.

EC3215	**Optical Communication**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To study about the various optical fiber modes, configuration and transmission characteristics of optical fibers.
- To learn about the various optical sources, detectors and transmission techniques.
- To explore various idea about optical fiber measurements and various coupling techniques.
- To enrich the knowledge about optical communication systems and networks.

Course Outcome		Cognitive Skill
CO-01	Realize basic elements in optical fibers, different modes and configurations.	U
CO-02	Analyze the transmission characteristics associated with dispersion and polarization techniques.	An
CO-03	Design optical sources and detectors with their use in optical communication system.	A
CO-04	Construct fiber optic receiver systems, measurements and coupling techniques.	A
CO-05	Design optical communication systems and its networks.	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	S	L	S	S	S	S	S	M	S
CO-03	S	M	S	M	S	L	L	S	M	S	S	M	S
CO-04	S	S	M	M	S	L	M	S	S	M	M	S	M
CO-05	S	S	M	M	M	L	S	S	S	M	M	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction to Optical Fibers **9**

Introduction-General Optical Fiber Communication System- Basic Optical Laws and Definitions- Optical Modes and Configurations -Mode Analysis for Optical Propagation Through Fibers- Modes in Planar Wave Guide-Modes in Cylindrical Optical Fiber-Transverse Electric and Transverse Magnetic Modes- Fiber Materials-Fiber Fabrication Techniques-Fiber Optic Cables- Classification of Optical Fiber-Single Mode Fiber-Graded Index Fiber.

Unit II Optical Fiber **9**

Attenuation-Absorption --Scattering Losses-Bending Losses-Core and Cladding Losses-Signal Dispersion –Inter Symbol Interference and Bandwidth-Intra Model Dispersion-Material Dispersion- Waveguide Dispersion- Polarization Mode Dispersion-Intermodal

Dispersion- Dispersion Optimization Of Single Mode Fiber-Characteristics of Single Mode Fiber-R-I Profile- Cutoff Wave Length-Dispersion Calculation-Mode Field Diameter.

Unit III: Optical Sources and Detectors **9**

Sources: Intrinsic and Extrinsic Material-Direct and Indirect Band Gaps-LED-LED structures- Surface Emitting LED-Edge emitting LED-Quantum Efficiency and LED Power-Light Source Materials-Modulation of LED-LASER Diodes-Modes and Threshold Conditions-Rate Equations-External Quantum Efficiency-Resonant Frequencies-Structures and Radiation Patterns-Single Mode Laser-External Modulation-Temperature Effort. Detectors: PIN Photo Detector-Avalanche Photo Diodes-Photo Detector Noise-Noise Sources-SNR-Detector Response Time-Avalanche Multiplication Noise-Temperature Effects- Comparisons of Photo Detectors.

.

Unit IV: Optical Receiver, Measurements and Coupling **9**

Fundamental Receiver Operation-Preamplifiers-Digital Signal Transmission-Error Sources-Front End Amplifiers-Digital Receiver Performance-Probability of Error-Receiver Sensitivity-Quantum Limit. Optical Power Measurement-Attenuation Measurement-Dispersion Measurement- Fiber Numerical Aperture Measurements- Fiber Cut- Off Wave Length Measurements- Fiber Diameter Measurements-Source to Fiber Power Launching-Lensing Schemes for Coupling Management-Fiber to Fiber Joints-LED Coupling to Single Mode Fibers-Fiber Splicing- Optical Fiber Connectors.

Unit V: Optical Communication Systems and Networks **9**

System Design Consideration Point – to –Point link design –Link Power Budget –Rise Time Budget, WDM –Passive DWDM Components-Elements of Optical Networks-SONET/SDH-Optical Interfaces-SONET/SDH Rings and Networks-High Speed Light Wave Links-OADM Configuration-Optical ETHERNET-Soliton.

TOTAL: 45 HOURS

TEXT BOOKS:

1. P Chakrabarti, "Optical Fiber Communication‖, McGraw Hill Education (India) Private Limited, 2016 (UNIT I, II, III).
2. Gred Keiser,"Optical Fiber Communication‖, McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013. (UNIT I, IV, V).

REFERENCES:

1. John M.Senior, ― Optical fiber communication‖, Pearson Education, second edition.2007.
2. Rajiv Ramaswami, ― Optical Networks ― , Second Edition, Elsevier , 2004.
3. J.Gower, ―Optical Communication System‖, Prentice Hall of India, 2001.
4. Govind P. Agrawal, ―Fiber-optic communication systems‖, third edition, John Wiley & sons, 2004.

EC3279	Digital Communication Laboratory	L	T	P	C
		0	0	2	1

OBJECTIVES

- To give hands on training to the students in understanding digital communication systems.
- To improve the understanding and simulation capability of the various systems used in digital communication

Course Outcome		Cognitive Skill
CO-01	Familiar with the blocks used in design of digital communication system and types of sampling.	U
CO-02	Discussion of various line codes used in digital communication techniques.	A
CO-03	Design of different digital modulation techniques used in digital communication.	An
CO-04	Design and development of different error correction and detection codes.	A
CO-05	Familiar with the design of PN Sequences used in Digital Communication	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	S	M	M	L	L	S	S	S	M	M	L
CO-04	S	S	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	S	S	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments

1. Generation of Amplitude Shift Keying
2. Generation of Frequency Shift Keying
3. Generation of Phase Shift Keying
4. Pseudo Random sequence Generation.
5. Time Division Multiplexing.
6. Generation of Line codes

7. Sampling theorem and Reconstruction
8. Pulse Coded Modulation
9. Delta modulation
10. Adaptive Delta modulation
11. Error Correcting Codes
12. Simulation of Correlative Coding

TOTAL: 45 HOURS

EC3280	**Embedded System and IoT Laboratory**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To give hands on training to the students to work with 8051 microcontrollers and interface ARM processor with devices.

Course Outcome		**Cognitive Skill**
CO-01	Able to work with 8051 microcontrollers.	A
CO-02	Able to perform tasks with embedded-C.	A
CO-03	Able to interface ARM processor with devices.	A
CO-04	Able to work with Arduino.	A
CO-05	Able to develop real time applications using Arduino.	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / **CO**	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	S	S	S	M	S
CO-03	S	M	S	M	M	L	L	S	M	S	S	M	S
CO-04	S	S	M	M	M	L	M	S	S	M	M	S	M
CO-05	S	S	M	M	M	L	S	S	S	M	M	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

List of Experiments

1. Arithmetic and Logic operations using 8051.
2. 8051- Delay Routing and Delay Validation.
3. 8051 – UART.
4. Simple programs using Embedded C.
5. Interfacing ADC and DAC with ARM in C code.
6. Accessing LED with ARM in C code.
7. Accessing keyboard and LCD in C code.
8. Interfacing stepper motor with ARM in C code.
9. Introduction to Arduino platform.
10. Simple programs with Arduino platform.

TOTAL: 45 HOURS

EC32P2	**Summer Internship II**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**2**

OBJECTIVES

- To understand the scope of Electronics and communication.
- To provide hands-on experience at site where Electronic hardware and communication equipment are manufactured or utilized.
- To familiarize the Embedded system and recent advancement in wireless technologies.
- To know the need of Electronics and Communication engineers in research and development.

Course Outcome		**Cognitive Skill**
CO-01	To learn the application of knowledge in real world problems.	U, A
CO-02	To get exposure to team-work and leadership quality.	An, A
CO-03	To deal with industry-professionals and ethical issues in the work environment	U, E
CO-04	Integrate theory and practice.	E, An
CO-05	Build a record of work experience	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	S	S	M	S	S	M	S	M	M	S
CO-02	S	M	S	S	S	M	S	S	M	S	M	M	S
CO-03	S	M	S	S	S	M	S	S	M	S	M	M	S
CO-04	S	M	S	S	S	M	S	S	M	S	M	M	S
CO-05	S	M	S	S	S	M	S	S	M	S	M	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

DESCRIPTION

Students have to undergo two weeks practical training in All India Radio, Doordharshan Kendra, BSNL, Electronic equipment manufacturing companies etc. At the end of the training student will submit a report as per the prescribed format to the department.

TOTAL: 30 HOURS

SEMESTER VII

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	MS3202	Principles of Management	2	0	0	2
2.	EC3216	Microwave Engineering	3	0	0	3
3.	EC3217	VLSI Technology	3	0	0	3
4.	EC32**	Programme Elective IV	3	0	0	3
5.	XXXXXX	Open Elective II	3	0	0	3
PRACTICAL						
6.	EC3281	RF Laboratory	0	0	2	1
7	EC3282	VLSI Laboratory	0	0	2	1
8.	EC32P3	Project Work Phase –I	0	0	6	3
TOTAL			**14**	**0**	**8**	**19**

MS3202	Principles of Management	L	T	P	C
		2	0	0	2

OBJECTIVES

- To introduce students to the basic concepts and functions of management.
- To understand the role and responsibilities of managers in various organizational settings.
- To develop an understanding of the planning, organizing, leading, and controlling functions of management.
- To examine the impact of management theories and practices on organizational performance.
- To equip students with the skills necessary to manage people and processes effectively in a technical environment.

Course Outcome		Cognitive Skill
CO-01	Define and explain the key concepts and functions of management.	U
CO-02	Analyze the roles and responsibilities of managers in different organizational contexts.	An
CO-03	Apply planning, organizing, leading, and controlling principles to real-world scenarios.	A
CO-04	Evaluate the effectiveness of different management theories and practices.	E
CO-05	Demonstrate management skills necessary for leading teams and projects in a technical environment.	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	M	S	M	M	S	M	S
CO-02	S	S	S	S	S	S	M	M	M	M	S	M	M
CO-03	S	S	S	S	S	S	M	M	S	M	S	M	S
CO-04	S	S	S	S	S	S	M	M	M	M	S	M	M
CO-05	S	S	M	S	S	S	S	M	M	M	S	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction to Management **7**

Definition, nature, and importance of management - Functions of management: Planning, Organizing, Leading, Controlling - Roles and skills of managers - Evolution of management thought: Classical, Behavioral, and Modern theories - Scientific Management (Taylor) - Administrative Theory (Fayol) - Human Relations Movement (Mayo) - Contemporary approaches (Systems Theory, Contingency Theory)

Unit II: Planning **5**

Nature and purpose of planning - Types of plans: Strategic, Tactical, Operational - Planning process and techniques - SWOT Analysis, SMART Goals, Scenario Planning - Decision making: Process, types, and tools- Rational Decision-Making Model - Bounded Rationality - Group Decision-Making Techniques (Brainstorming, Delphi Technique)

Unit III: Organizing **5**

Organizational structure and design - Types of organizational structures: Functional, Divisional, Matrix, Network - Authority, responsibility, and delegation - Coordination and communication within organizations - Formal and Informal Communication Channels - Role of Technology in Organizational Communication (Emails, Video Conferencing, Collaborative Tools)

Unit IV: Leading **7**

Leadership theories and styles - Trait Theory - Behavioral Theories (Ohio State Studies, Michigan Studies) - Contingency Theories (Fiedler's Model, Path-Goal Theory) - Transformational vs. Transactional Leadership - Motivation theories and practices, Maslow's Hierarchy of Needs, Herzberg's Two-Factor Theory, McClelland's Theory of Needs, Modern Approaches (Self-Determination Theory) -Group dynamics and team management - Stages of Team Development (Forming, Storming, Norming, Performing) - Managing Virtual Teams

Unit V: Controlling **6**

Nature and purpose of control - Control process and techniques, Establishing Standards, Measuring Performance, Correcting Deviations - Types of control: Feed forward, Concurrent, Feedback - Quality control and management, Total Quality Management (TQM), Six Sigma, Lean Management, Use of Data Analytics in Quality Control.

TOTAL: 30 HOURS

TEXT BOOKS

1. Robbins, S. P., Coulter, M., & DeCenzo, D. A. (2020). Fundamentals of Management (11th ed.). Pearson.
2. Griffin, R. W. (2022). Management: Principles and Practices (12th ed.). Cengage Learning.

3. Jones, G. R., & George, J. M. (2021). Essentials of Contemporary Management (9th ed.). McGraw-Hill Education.

REFERENCES

1. Daft, R. L. (2021). Management (14th ed.). Cengage Learning.
2. Bateman, T. S., & Snell, S. A. (2020). Management: Leading & Collaborating in a Competitive World (14th ed.). McGraw-Hill Education.
3. Schermerhorn, J. R. (2021). Management (14th ed.). Wiley.
4. Hill, C. W. L., Schilling, M. A., & Jones, G. R. (2020). Strategic Management: Theory & Cases (13th ed.). Cengage Learning.
5. Kinicki, A., & Williams, B. K. (2021). Management: A Practical Introduction (10th ed.). McGraw-Hill Education.

EC3216	Microwave Engineering	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study passive microwave components and their S- Parameters.
- To study Microwave semiconductor devices & applications.
- To study Microwave sources and amplifiers

Course Outcome		Cognitive Skill
CO-01	Able to derive S- Parameters of passive microwave components.	An
CO-02	Understand the operating principles of Microwave O-Type Tubes.	U
CO-03	Understand the operating principles of Microwave M-Type Tubes and Slow Wave Devices	U
CO-04	Understand the operating principles of Microwave Solid State Devices	U
CO-05	Able to Measure Microwave parameters	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	M	M	M	M	S	M	M
CO-02	S	S	S	S	S	S	M	M	M	M	S	M	M
CO-03	S	S	S	S	S	S	M	M	M	M	S	M	M
CO-04	S	S	S	S	S	S	M	M	M	M	S	M	M
CO-05	S	S	S	S	S	S	M	M	M	M	S	M	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Microwave Components **9**

Introduction to Microwaves engineering: History of Microwaves, Microwave Frequency bands. Introduction to S parameters, Z & ABCD Parameters, Construction and operation of E-plane, H-plane, MagicTee and Directional couplers S Matrix calculation for Waveguide Tees, Magic Tees (Hybrid Trees), Waveguide Corners, Bends and Twists, Directional Couplers, Circulators and Isolators

Unit II: Microwave O-Type Tubes **9**

Limitations of conventional tubes, O and M type classification of microwave tubes, reentrant cavity, velocity modulation.

O type tubes

Two cavity Klystron: Construction and principle of operation, velocity modulation and bunching process Applegate diagram.

Reflex Klystron: Construction and principle of operation, velocity modulation and bunching process, Applegate diagram, Oscillating modes, o/p characteristics, efficiency, electronic& mechanical tuning.

Unit III: Microwave M-Type Tubes and Slow Wave Devices **9**

Magnetron: Construction and Principle of operation of 8cavity cylindrical travelling wave magnetron, hull cut off condition, modes of resonance, PI mode operation, o/p characteristics, Applications.

Slow wave devices

Advantages of slow wave devices, Helix TWT: Construction and principle of operation, Applications

Unit IV: Microwave Solid State Devices **9**

Microwave bipolar transistor, FET, MESFET, Varactor Diode, PIN Diode, Shottky Barrier Diode, Tunnel Diode, TEDs, Gunn Diodes, IMPATT diode and TRAPATT diode. Structural details, Principle of operation, various modes, specifications, and applications of all these devices.

Unit V: Microwave Measurements **9**

Measurement devices: Slotted line, Tunable detector, VSWR meter, Power Meter, S-parameter measurement, frequency measurements ,Power measurement, Attenuation measurement, Phase shift measurement, VSWR measurement, Impedance measurement, Q of cavity resonator measurement

TEXT BOOKS:

1. Samuel Y.Liao,"Microwave Devices and Circuits",3rd edition,Pearson
2. David M.Pozar,"Microwave Engineering",Fourth edition,Wiley.

REFERENCES:

1. M.Kulkarni,"Microwave and Radar engineering",3rdedition, Umesh Publications
2. M L Sisodia & G S Raghuvamshi, "Microwave Circuits and Passive Devices"Wiley,1987
3. M L Sisodia &G S Raghuvanshi, "Basic Microwave Techniques and Laboratory Manual",New Age International(P) Limited, Publishers

		L	T	P	C
EC3217	**VLSI Technology**	**3**	**0**	**0**	**3**

OBJECTIVES:

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational digital circuits using Verilog HDL
- Learn the design and realization of sequential digital circuits using Verilog HDL.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

Course Outcome		Cognitive Skill
CO-01	To Study the fundamentals of CMOS circuits and its characteristics.	R,U
CO-02	To Learn the design and realization of combinational digital circuits using Verilog HDL	U, A
CO-03	To Learn the design and realization of sequential digital circuits using Verilog HDL.	U, A
CO-04	To Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed	R,U
CO-05	To Learn the different FPGA architectures and testability of VLSI circuits	R,U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	M	L	L	S	S	M	L	S	S
CO-02	M	M	M	S	S	S	S	M	M	L	M	L	L
CO-03	S	S	M	S	M	S	M	S	S	S	S	M	M
CO-04	S	S	L	M	S	S	M	S	S	L	M	S	S
CO-05	S	S	L	M	L	S	L	S	M	L	M	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: CMOS Devices and Circuits **9**

Basic CMOS Technology: n Well, P Well, Twin Tub and SOI process. Design Hierarchies Physical Design of Logic Gates: Inverter, NAND, NOR, Logic Design with CMOS: MOSFETS as Switches, Basic Logic Gates in CMOS and Complex Logic Gates. Transmission Gates: Muxes and Latches.

Unit II: Design of Combinational Circuits Using Verilog HDL **9**

Hardware Description Language: Basic Concepts, Language Features, Module Declaration, Gate Delays, Boolean Expressions , User-Defined Primitives, Combinational Circuits: Design Procedure, Example: Code Conversion, Decoders, Encoders, Combinational Logic

Implementation , Boolean Function Implementation, HDL Models of Combinational Circuits

Unit III: Design of Sequential Circuits Using VERILOG HDL 9

Synchronous Sequential Logic, Storage Elements :Latches, Flip Flop, Synthesizable HDL Models of Sequential Circuits , Structural Description of Clocked Sequential Circuits, Design Procedures, Shift Registers, HDL for Registers and Counters, Memory Description in HDL, , Register Transfer Level Notation in HDL

Unit IV: Design of Arithmetic Building Blocks and Subsystem 9

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, Power And Speed Tradeoffs, Case Study: Design as a Tradeoff. Designing Memory and Array Structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

.

Unit V: Implementation Strategies and Testing 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

.

TOTAL: 45 HOURS

TEXT BOOKS

1. Neil H.E. Weste, David Money Harris CMOS VLSI Design: A Circuits and Systems Perspective, 4th Edition, Pearson , 2017. (Unit I,II,V)
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, Digital Integrated Circuits:A Design perspective, Second Edition , Pearson , 2016.(Unit III,IV)

REFERENCES:

1. M.J. Smith, Application Specific Integrated Circuits, Addisson Wesley, 1997.
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim CMOS Digital Integrated Circuits:Analysis and Design,4th edition McGraw Hill Education, 2013.
3. Wayne Wolf, Modern VLSI Design: System On Chip, Pearson Education, 2007.
4. R.Jacob Baker, Harry W.LI., David E.Boyee, CMOS Circuit Design, Layout and Simulation, Prentice Hall of India 2005.

EC3281	RF Laboratory	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study and analyze microwave components by measuring various parameters.
- To verify the characteristics of optical sources.
- To measure attenuation and distortions in optical fiber link.
- To analyze radiation pattern of horn antenna.

Course Outcome		Cognitive Skill
CO-01	Able to identify and demonstrate the working of various microwave and optical components.	An
CO-02	Able to analyze Microwave Active and Passive Devices by conducting experiments and measuring various parameters	U
CO-03	Able to test the characteristics of microwave components.	U
CO-04	Able to analyze the characteristics of optical fiber by conducting experiments and measuring various parameters.	U
CO-05	Able to analyze the radiation pattern of antenna and measure antenna gain	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-02	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-03	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-04	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-05	M	M	S	S	S	S	M	S	S	L	L	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Optical Experiments

1. Measurement of connector and bending losses.
2. Fiber optic Analog and Digital Link – frequency response (analog) and eye diagram (digital).
3. Numerical Aperture determination for Fibers.
4. Attenuation Measurement in Fibers.

Microwave Experiments

1. Understanding of Active and Passive Microwave Components and their specifications.
2. Measurement of S - parameter for the following Microwave Components (Isolator, Circulator, E plane Tee, H plane Tee, Magic Tee).
3. Mode Characteristics of Reflex klystron.

4. VI Characteristics of GUNN Diode.
5. Measurement of basic Microwave Parameters such as VSWR, Impedance and Frequency.
6. Measurement of Directional Coupler Parameters.
7. Measurement of Radiation Pattern of Horn Antenna.

EC3282	VLSI Laboratory	L	T	P	C
		0	0	2	1

OBJECTIVE:

The student should be made:

- To learn techniques of chip design using programmable devices.
- To learn the concepts of design tools.
- To learn the fundamental principles of VLSI circuit design in digital domain
- To provide hands on design experience with professional design (EDA) platforms

Course Outcome - COs		Cognitive Skill
CO-01	Write Verilog HDL code for basic as well as advanced digital integrated circuit	U
CO-02	Import the logic modules into FPGA Boards	An
CO-03	Get idea on synthesis tools.	An
CO-04	Synthesize Place and Route the digital Ips	E
CO-05	Design, Simulate and Extract the layouts of Digital IC Blocks.	E

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L	PO-M
CO-01	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-02	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-03	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-04	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-05	M	M	S	S	S	S	M	S	S	L	L	M	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Experiments

1. Development of Boolean expressions with various modeling schemes.
2. Develop test bench for simulation of adder/subtractor circuitry.
3. Development of combinational circuit for 8 bit addition.
4. Develop a 4X4 multiplier using verilog code.
5. Develop and implement flipflop sequential circuit.
6. Develop a shift register sequential circuit using verilog.
7. Construct and test a counter sequential circuit using verilog.
8. Develop a memory sequential circuit using verilog.
9. Testing the traffic controller on FPGA board.
10. Design a Realtime clock and demonstrate its working on the FPGA board.

EC32P3	**Project Work Phase I**	**L**	**T**	**P**	**C**
		0	**0**	**6**	**3**

OBJECTIVE:

- To do the literature survey in the thrust area.
- To implement and test/ simulate the project either in hardware or software.
- To demonstrate the project and prepare report.

Course Outcome - COs		**Cognitive Skill**
CO-01	Able to identify thrust areas to do the project.	U
CO-02	Able to do the literature survey in the thrust area.	U and An
CO-03	Able to implement and test/ simulate the project either in hardware or software	A and An
CO-04	Able to demonstrate the project.	A and R
CO-05	Able to prepare the report of the project.	U, R and An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / **CO**	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-k	PO-L	PO-M
CO-01	S	S	S	S	S	S	S	S	S	S	L	S	S
CO-02	S	S	S	S	S	S	M	S	S	L	L	S	S
CO-03	S	S	S	S	S	S	S	S	S	S	L	S	S
CO-04	S	M	S	S	S	S	M	S	S	S	M	M	S
CO-05	S	S	S	S	S	S	M	S	S	M	M	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

SEMESTER VIII

Sl. No	Course Code	Course Title	L	T	P	C
THEORY						
1.	EC32**	Program Elective – V	3	0	0	3
2.	EC32**	Program Elective – VI	3	0	0	3
PRACTICAL						
4.	EC32P5	Project Work Phase –II	0	0	24	10
TOTAL			**9**	**0**	**24**	**16**

EC32P5	Project Work Phase –II	**L**	**T**	**P**	**C**
		0	**0**	**24**	**10**

OBJECTIVE:

To do the literature survey in the thrust area.

- To implement and test/ simulate the project either in hardware or software.
- To demonstrate the project and prepare report.

Course Outcome – Cos		**Cognitive Skill**
CO-01	Able to identify thrust areas to do the project	U
CO-02	Able to do the literature survey in the thrust area.	U and An
CO-03	Able to implement and test/ simulate the project either in hardware or software	A and An
CO-04	Able to demonstrate the project.	A and R
CO-05	Able to prepare the report of the project.	U, R and An

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO - I	PO-J	PO-k	PO -L	PO-M
CO-01	S	S	S	S	S	S	S	S	S	S	L	S	S
CO-02	S	S	S	S	S	S	M	S	S	L	L	S	S
CO-03	S	S	S	S	S	S	S	S	S	S	L	S	S
CO-04	S	M	S	S	S	S	M	S	S	S	M	M	S
CO-05	S	S	S	S	S	S	M	S	S	M	M	S	S

S- Strong, M- Medium, L-Low, N- Not Relevant

Department Electives (PEC)

Sl. NO	Course Code	Course Title	L	T	P	C
1	EC32A1	CMOS Analog Design	3	0	0	3
2	EC32A2	DSP Architecture and Programming.	3	0	0	3
3	EC32A3	Digital System Design with FPGA.	3	0	0	3
4	EC32A4	Real Time System Design.	3	0	0	3
5	EC32A5	IoT and its Components.	3	0	0	3
6	EC32A6	Design of IoT and Industry 4.0.	3	0	0	3
7	EC32A7	ASIC Design.	3	0	0	3
8	EC32A8	ARM based Embedded System Design	3	0	0	3
9	EC32A9	Multicore Architecture and Programming.	3	0	0	3
10	EC32B1	Mobile Communication	3	0	0	3
11	EC32B2	Antenna and Wave Propagation	3	0	0	3
12	EC32B3	Fundamentals of Neural Networks and Deep Learning	3	0	0	3
13	EC32B4	Wireless communication and Networks	3	0	0	3
14	EC32B5	Satellite Communication	3	0	0	3
15	EC32B6	Wireless Adhoc and Sensor Networks	3	0	0	3
16	EC32B7	Nano Electronics	3	0	0	3
17	EC32B8	Digital Image Processing	3	0	0	3
18	EC32B9	Remote Sensing	3	0	0	3

19	EC32C1	Electronic Measurements and Instrumentation	3	0	0	3
20	EC32C2	Robotics Engineering	3	0	0	3
21	EC32C3	Computer Communication	3	0	0	3
22	EC32C4	Medical Electronics	3	0	0	3
23	EC32C5	Mixed Signal IC Design Testing	3	0	0	3
24	EC32C6	Wearable Devices and Systems	3	0	0	3
25	EC32C7	Medical Imaging Systems	3	0	0	3
26	EC32C8	Brain Computer Interface and Applications	3	0	0	3

EC32A1	**CMOS Analog Design**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To study designs with better precision in data conversion
- To study various ADC and DAC circuit architectures

Course Outcome		**Cognitive Skill**
CO-01	Familiarize with MOS properties and architecture	U
CO-02	Understand the concept of CMOS and BiMoS	U
CO-03	Familiarize with precision techniques and calibration	An
CO-04	Design and analyse the ADC	An
CO-05	Understand the concept of modulators and DACs	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / **CO**	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-02	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-03	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-04	M	M	S	S	S	S	M	S	S	L	L	M	S
CO-05	M	M	S	S	S	S	M	S	S	L	L	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Sample and Hold **9**

Properties of MOS switches, Multiplexed Input Architectures, Recycling Architecture, Open and Closed Loop Sampling Architectures, Switched Capacitor and Current Mode Architectures.

Unit II: Building Block of Data Conversion Circuits **9**

Amplifiers, Open Loop and Closed Loop Amplifiers, Gain Boosting, Common Mode Feedback, Bipolar , CMOS and BICMOS Comparators.

Unit III: Precision Techniques 9

Comparator Cancellation, Input and Output Offset Storage Principles, Comparators using Offset Cancelled Latches, Opamp Offset Cancellation, ADC and DAC Calibration Techniques.

Unit IV: ADC/DAC Architectures **9**

DAC Performance Metrics, Reference Multiplication and Division, Switching and Logical Functions of DACs, Current Steering Architectures, DAC Performance Metrics, Flash ADC Architecture, Gray Encoding**,** Thermometer Encoding And Metastability.

Unit V: Over Sampling Converters **9**

Delta Sigma Modulators, Alternative Modulator Architectures, Quantization and Noise Shaping, Decimation Filtering, Implementation of Delta Sigma Modulators, Delta Sigma DACs.

TOTAL: 45 HOURS

TEXT BOOKS:

1. Razavi "Data Conversion System Design" ,IEEE Press and John Wiley, 1995.

REFERENCES:

1. Phillip Allen and Douglas Holmberg "CMOS Analog Circuit Design" Second Edition, Oxford University Press, 2004.

EC32A2	**DSP Architecture and Programming**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To learn the architecture of different DSP series processor and instruction sets.
- To introduce various techniques of digital signal processing that are fundamental to various industrial applications.

Course Outcome		Cognitive Skill
CO-01	Acquire knowledge of DSP computational building blocks and addressing modes	U, A
CO-02	Able to study the architecture of programmable Digital Signal Processors	R, U
CO-03	Acquire the knowledge of DSP Programming.	E, A
CO-04	Able to implement various DSP Algorithms.	U, An
CO-05	Able to implement FFT algorithms using DSPs.	E, A

R-Remember, U-Understand, A-Apply, An-Analyze ,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	S	M	M	L	S	S	S	S	S	L
CO-02	S	S	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	S	S	M	L	S	S	S	S	M	M	M
CO-04	S	M	M	M	M	L	M	S	M	S	S	S	L
CO-05	S	S	S	S	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction To Programmable Digital Signal Processer **9**

Introduction, Multiplier and Multiplier Accumulator (MAC) - Modified Bus Structures and Memory Access Schemes in P-DSPs - Multiple Access Memory - Multiported Memory - VLIW Architecture - pipelining - Special Addressing Modes in P - DSPs - On-Chip Peripherals - Programmability and Program Execution - Features for External Interfacing.

Unit II: Architecture for Programmable Digital Signal Processors **9**

Introduction - Basic Architectural Features - DSP Computational Building Blocks - Bus Architecture and Memory - Data Addressing Capabilities - Address Generation Unit.

Unit III: Programmable Digital Signal Processors **9**

Introduction - Commercial Digital Signal Processing Devices - Data Addressing Modes of TMS32OC54xx - Memory Space of TMS32OC54xx Processors - Program Control - Instructions and Programming of TMS32OC54xx Processor.

Unit IV: Implementation of Basic DSP Algorithms **9**

Introduction - Q-notation - FIR filter - IIR filters - Interpolation and Decimation Filters, PID controllers, Adaptive Filters, 2-D Signal Processing

Unit V: Implementation of FFT Algorithms **9**

Introduction - An FFT Algorithm for DFT Computation, Overflow and Scaling - Bit Reversed Index Generation and Implementation on the TMS32OC54xx

TOTAL: 45 HOURS

TEXT BOOKS

1. Aatar Singh and S. Srinivasan, ”Digital Signal Processing”, Thomson Learning, 2004.
2. Ifeachor E.C and Jervis B.W, ”Digital Signal Procesing: A practical approach”, Pearson Education, PHI, 2002

REFERENCES:

1. B. Venkatramani and M. Bhaskar, ”Digital Signal Processors” , TMH, 2002
2. Peter Pirsch, ”Architecture for Digital Signal Processing” , John Wiley, 2007

EC32A3	**Digital System Design with FPGA**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To design and optimize complex combinational and sequential digital circuits.
- To model combinational and sequential digital circuits by Verilog HDL.
- To design and model digital circuits with Verilog HDL at behavioral, structural, and RTL Levels.
- To develop test benches to simulate combinational and sequential circuits.
- To understand the FPGA Architecture.

Course Outcome		**Cognitive Skill**
CO-01	Able to understand the basics of Digital Systems.	R, U
CO-02	Able to understand and learn the relation of digital system with Boolean algebra	U, An
CO-03	Able to understand the basic HDL programming syntax	U, An, E
CO-04	Able to understand and analyze the different HDL modeling.	U, An
CO-05	Able to understand the FPGA Architecture	U, R

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	L	S	S	S	S	L	S	S	S	M	S
CO-02	S	S	L	M	S	S	S	L	S	S	L	M	M
CO-03	S	S	L	M	S	S	S	M	S	S	L	S	L
CO-04	S	M	L	S	S	S	S	L	S	S	S	M	M
CO-05	S	S	L	M	S	S	S	L	S	S	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction **9**

Introduction to Boolean Algebra - Canonical Forms- Gate minimization- Digital Design of Combinational Circuits- Implementation of expressions using PLA.PAL, ROM.

Unit II: Verilog HDL Coding Style **9**

Lexical Conventions - Ports and Modules - Operators - Gate Level Modeling - System Tasks & Compiler Directives - Test Bench - Data Flow Modeling - Behavioral Level Modeling - Tasks & Functions.

Unit III: Circuits Verilog Modeling of Combinational & Sequential **9**

Behavioral, Data Flow and Structural Realization - Adders - Multipliers- Comparators - Flip Flops - Realization of Shift Register - Realization of a Counter- Synchronous and Asynchronous FIFO -Single port and Dual port RAM - Pseudo Random LFSR - Cyclic Redundancy Check.

Unit IV: Synchronous Sequential Circuit **9**

State Diagram-State Table -State Assignment-Choice of Flip-Flops - Timing Diagram -One Hot Encoding- Mealy and Moore State Machines - Design of Serial Adder Using Mealy and Moore State Machines - State Minimization - Sequence Detection- Design of Vending Machine Using One Hot Controller.

Unit V: FPGA and Its Architecture **9**

Types of Programmable Logic Devices- PLA & PAL- FPGA Generic Architecture. ALTERA Cyclone II Architecture - Timing Analysis and Power Analysis Using Quartus-II-SOPC Builder-NIOS-II Soft-core Processor- System Design Examples using ALTERA FPGAs - Traffic light Controller, Real Time Clock - Interfacing using FPGA: VGA, Keyboard, LCD.

TOTAL: 45 HOURS

TEXT BOOKS

1. Samir Palnitkar, ”Verilog HDL: A Guide to Digital Design and synthesis” Prentice Hall, Second Edition, 2003.

REFERENCES:

1. R.Padmanabhan, B.Bala Tripura Sundari, ”Design through Verilog HDL” Wiley Interscience, 2004.
2. S. Ramachandran, ”Digital VLSI Systems Design: A Design Manual for Implementation of Projects on FPGAs and ASICs Using Verilog”, 2007th Edition.
3. Wayne Wolf , ”FPGA Based System Design”, Prentices Hall Modern Semiconductor Design Series.
4. Stephen Brown &ZvonkoVranesic, ”Digital Logic Design with VerilogHDL” TATA McGraw Hill Ltd. 2nd Edition 2007.

EC32A4	Real Time System Design	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the basic of tasks and scheduling
- To understand uni and multi processor scheduling
- To analyze real time communication
- To analyze evaluation techniques and reliability models for hardware Redundancy

Course Outcome		Cognitive Skill
CO-01	Able to describe the basic of tasks and scheduling	R,U
CO-02	Able to understand uni and multi processor scheduling	U
CO-03	Able to analyze real time communication	U,An,E
CO-04	Able to analyze evaluation techniques and reliability models for Hardware Redundancy	U,An
CO-05	Able to apply in real world problems.	U,R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	S	L	S	S	S	M	S
CO-02	S	S	S	M	S	S	S	L	S	S	L	M	M
CO-03	S	S	S	M	S	S	S	M	S	S	L	S	L
CO-04	S	M	S	S	S	S	S	L	S	S	S	M	M
CO-05	S	S	S	M	S	S	S	L	S	S	S	S	S

S-Strong, M-Medium ,L-Low, N-Not relevant

Unit I: Introduction to Task Scheduling **9**

Introduction -Issues in Real Time Computing, Structure of a Real Time System, Task classes, Performance Measures for Real time Systems, Task Assignment and Scheduling - Classical Uniprocessor Scheduling Algorithms, RM Algorithm with Different Cases-Priority Ceiling-Precedence Constraints-Using of Primary and Alternative Tasks.

Unit II: Uni and Multi Processor Scheduling **9**

Uniprocessor Scheduling of IRIS Tasks, Task Assignment, Utilization Balancing -Next Fit-Bin Packing-Myopic Off-Line -Focused Addressing and Bidding-Buddy Strategy-Fault Tolerant Scheduling.- Aperiodic Scheduling -Spring Algorithm, Horn Algorithm- Bratley. - Sporadic Scheduling.

Unit III: Real Time Communication **9**

Introduction -VTCSMA -PB CSMA-Deterministic Collision Resolution Protocol-DCR for Multi Packet Messages-Dynamic Planning Based-Communication with Periodic and Aperiodic Messages.

.

Unit IV: Real Time Databases **9**

Basic Definition, Real Time Vs General Purpose Databases, Main Memory Databases, Transaction to Improve Predictability, Maintaining Serialization Consistency, Databases for Hard Real Time System.

Unit V: Real-Time Modeling and Case Studies **9**

Petrinets and Applications in Real-Time Modeling, Air Traffic Controller System - Distributed Air Defense System.

TOTAL: 45 HOURS

TEXT BOOKS

1. C.M. Krishna, Kang G. Shin, ”Real Time Systems”, Tata McGraw -Hil, 2010.

REFERENCES:

1. Giorgio C. Buttazzo , ”Hard real-time computing systems: predictable scheduling algorithms and applications”, Springer, 2008.
2. Rajib Mall, ”Real-Time Systems: Theory and Practice,” Pearson, 2008.
3. C. Siva Ram Murthy, G. Manimaran, ”Resource management in real-time systems and networks”, PHI, 2009.
4. Alan C. Shaw, ”Real-Time Systems and Software”, Wiley, 2001.

EC32A5	IoT and Its Components	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understanding the design architecture of IoT.
- Choice of protocols and deployment in solutions
- Overview and Design Perspective of IOT based products /services.
- Ensuring IOT with Security and Privacy as applicable.

Course Outcome		Cognitive Skill
CO-01	Able to define the terms IoT	R
CO-02	Able to understand the importance of IoT devices	A
CO-03	Able to understand the application areas of IoT	U
CO-04	Able to learn the different protocols used in IoT	An
CO-05	Able to design a IoT system	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	S	M	M	S	S	S	M	M	L	L	L
CO-02	S	S	S	M	S	S	M	S	M	S	L	M	M
CO-03	S	S	M	S	S	S	S	S	M	M	M	L	L
CO-04	M	S	M	M	M	M	S	S	S	L	M	L	L
CO-05	M	S	S	M	S	M	S	M	M	M	M	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction **9**

Introduction to Internet of Things: Overview of Internet of Things- the Edge, Cloud and the Application Development, Anatomy of the Thing, Industrial Internet of Things (MOT - Industry 4.0), Quality Assurance, Predictive Maintenance, Real Time Diagnostics, Design and Development for IOT, Understanding System Design for IOT, Design Model for IOT.

Unit II: System Design Fundamentals **9**

System Design of Connected Devices : Embedded Devices, Embedded Hardware, Connected Sensors and Actuators, Controllers, Battery Life Conservation and Designing with Energy Efficient Devices, SoCs, Single Chip Controllers with Integrated Processing and Network Core with Hardware Crypto Engines.

Unit III: Protocols **9**

Understanding Internet Protocols: Simplified OSI Model, Network Topologies, Standards, Types of Internet Networking - Ethernet, WiFi, Local Networking, Bluetooth, Bluetooth Low Energy (BLE), Zigbee,6LoWPAN, Sub 1 GHz, RFID,NFC, Proprietary Protocols, Simplicity, Networking Design - Push, Pull and Polling, Network APIs.

Unit IV: Design Concept **9**

Advances Design Concepts for IOT - Software UX Design Considerations, Machine Learning and Predictive Analysis, Interactions, Inter-usability and Inter-operability considerations, Understanding Security in IOT Design, Design Requirements of IOT Security Issues and Challenges, Privacy, Overview of Social Engineering.

.

Unit V: Domain Specific IoT and Their Challenges **9**

Illustrated Domains-Home Automation, Smart Cities, Environment, Energy, Retail, Logistics, Health and Life Style. Case Study of Rapid Internet Connectivity with Cloud Service Providers with CC3200 Controller.

TOTAL: 45 HOURS

TEXT BOOKS

1. Foundational Elements of an IOT Solution - The Edge, Cloud and Application Development, Joe Biron & Jonathan Follett, Oreilly, First Edition, March 2016

REFERENCES:

1. Designing Connected Products, 1st Edition, Elizabeth Goodman, Alfred Lui, Martin Charlier, Ann Light, Claire Rowland
2. The Internet of Things (A Look at Real World Use Cases and Concerns), Kindle Edition, 2016, Lucas Darnell.

EC32A6	**Design of IoT and Industry 4.0**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- Understand the Architectural Overview of IoT.
- To Understand the IoT Reference Architecture and Real-World Design Constraints
- To Understand the various IoT Protocols (Datalink, Network, Transport, Session, Service).

Course Outcome		**Cognitive Skill**
CO-01	Able to understand the architecture of IoT	R
CO-02	Able to understand the reference architecture	A
CO-03	Able to understand concepts of IoT	U
CO-04	Able to apply IoT in different applications	An
CO-05	Able to make real world design constraints	E

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	M	S	S	M	S	S	S	S	M	S	L	L	L
CO-02	S	S	S	S	S	S	M	S	M	M	L	M	L
CO-03	S	S	M	M	S	S	S	S	S	M	M	M	L
CO-04	M	S	M	M	M	M	S	S	S	M	M	L	L
CO-05	S	S	S	M	S	M	S	M	L	S	M	M	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Overview of IoT **9**

An Architectural Overview-Building an Architecture, Main Design Principles and Needed Capabilities, An IoT Architecture Outline, Standards Considerations. M2M and IoT Technology Fundamentals-Devices and Gateways, Local and Wide area networking, Data Management, Business Processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics.

Unit II: Reference Architecture **9**

IoT Architecture-State of the Art -Introduction, State of the art, Reference Model and architecture, IoT reference Model -IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Real-World Design.
Constraints-Introduction, Technical Design Constraints- Data Representation and visualization, Interaction and Remote Control.

.

Unit III: Data Link Layer & Network Layer Protocols **9**

PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART,Z-Wave,Bluetooth Low Energy, Zigbee Smart Energy, DASH7 -Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP.

Unit IV: Transport & Session Layer Protocols **9**

Transport Layer(TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) -Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT

Unit V: Service Layer Protocols & Security **9**

Service Layer –one M2M, ETSI M2M, OMA, BBF -Security in IoT Protocols -MAC 802.15.4 , 6LoWPAN, RPL, Application Layer

TOTAL: 45 HOURS

TEXT BOOKS

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, 2. David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014

REFERENCES:

1. Peter Waher, "Learning Internet of Things", PACKT publishing, Birmingham – Mumbai
2. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
4. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", First Edition, VPT, 2014. http://www.cse.wustl.edu/ jain/cse570-15/ftp/iot˙prot/index.html

EC32A7	ASIC DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To focus on the semi custom IC Design and introduce the principles of design logic cells, I/O cells and interconnect architecture, with equal importance given to FPGA and ASIC styles.
- To deal the entire FPGA and ASIC design flow.

Course Outcome		Cognitive Skill
CO-01	Familiar with the basics of ASIC and CMOS design.	U
CO-02	Understand the concepts of programmable ASIC Cells.	R,U
CO-03	Familiar with the Design tools and software for ASIC Design	E,A
CO-04	Understand the synthesis, simulation and testing of ASIC.	U, An
CO-05	Able to implement Familiar with the ASIC construction and Floor Planning	E,A

R-Remember, U-Understand ,A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	M	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	M	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	S	S	M	S	S	S	S	S	S	M	M
CO-04	S	M	M	M	M	L	M	s	M	S	S	S	L
CO-05	S	S	S	S	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction To ASICS, CMOS Logic and ASIC Library Design 9

Types of ASICs - Design Flow - CMOS Transistors - Combinational Logic Cell - Sequential Logic Cell - Data Path Logic Cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical Effort.

.

Unit II: Programmable ASICS, Programmable ASIC Logic Cells a Programmable ASIC I/O Cells 9

Anti fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA - Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.

Unit III: Programmable ASIC Interconnect, Programmable ASIC Design Software And Low Level Design Entry 9

Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX - Design Systems - Logic Synthesis - Half gate ASIC -Schematic Entry - Low Level Design Language - PLA tools - EDIF- CFI Design Representation.

Unit IV: LOGIC SYNTHESIS, SIMULATION AND TESTING 9

Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test - fault simulation - automatic test pattern generation

Unit V: ASIC Construction, Floor Planning, Placement and Routing 9

System Partition - FPGA partitioning - partitioning methods - floor planning - placement - physical design flow - global routing - detailed routing - special routing - circuit extraction - DRC.

TOTAL: 45 HOURS

TEXT BOOKS

1. M. J. S. Smith, ”Application - Specific Integrated Circuits”, Pearson, 2003,Book 2.

REFERENCES:

1. Roger Woods, John McAllister, Dr. Ying Yi, Gaye Lightbod, ”FPGA-based Implementation of Signal Processing Systems”, Wiley, 2008.
2. Mohammed Ismail and Terri Fiez, ”Analog VLSI Signal and Information Processing”, Mc Graw Hill, 1994.
3. Jose E. France, Yannis Tsividis, ”Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing”, Prentice Hall, 1994.

EC32A8	ARM Based Embedded System Design	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the advanced controllers used for embedded system design
- To study about current technologies, integration methods and hardware and software design concepts associated with processor in Embedded Systems.
- To study about a simple low power microcontrollers and their applications
- To get detail knowledge regarding testing and hardware software co- design issues pertaining to design of an Embedded System using low power microcontrollers.

Course Outcome		Cognitive Skill
CO-01	To Understand the advanced controllers used for embedded system design	R,U
CO-02	To study about current technologies, integration methods and hardware and software design concepts associated with processor in Embedded Systems.	R,U
CO-03	To study about a ARM Programming	U, An
CO-04	To get detail knowledge regarding testing and hardware software co-design issues pertaining to design of an Embedded System using low power microcontrollers	R,U
CO-05	To Understand the Interfacing of controllers used for embedded system design	R,U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	M	L	L	S	S	M	L	S	S
CO-02	M	M	M	S	S	S	S	M	M	L	M	L	L
CO-03	S	S	M	S	M	S	M	S	S	S	S	M	M
CO-04	S	S	L	M	S	S	M	S	S	L	M	S	S
CO-05	S	S	L	M	L	S	L	S	M	L	M	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: ARM Embedded Systems **9**

An Embedded System-Definition, Embedded System Design and Development, Life Cycle, Embedded system Architecture, Embedded Systems classification, The RISC Design Philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software, ARM processor Families, Core extensions, Architecture Revisions.

Unit II: ARM Processor Fundamental **9**

Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts and Interrupt Vector Table, ARM Instruction set, Thumb instruction set, single register and multiple register load / store instructions. Stack, software interrupt instructions.

Unit III: ARM Programming Using C and Assembly 9

Simple C Programs using Function Calls, Pointers, Structures, Integer and Floating Point Arithmetic, Assembly Code using Instruction Scheduling, Register Allocation, Conditional Execution and Loops.

Unit IV: Architecture of MSP430 Processor 9

Central Processing Unit, registers, Instruction formats, Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Resets, Clock System, Memory Organization, Interrupts and interrupt vector table,, Low-Power Modes, Parallel Ports, Digital Inputs, Switch Debounce, Digital Outputs, Pull up / down resistors, Timers - Watchdog Timer, Timer_A, Timer_A Modes, Timer_B, Timer_B Modes, Real-Time Clock.

Unit V: MSP430 Communication: 9

Communication Peripherals in the MSP430, Serial Peripheral Interface, SPI with the USI, SPI with the USCI, A Thermometer Using SPI Modes, Inter-integrated Circuit Bus(I^2C) and its operations, State Machines for I^2C Communication, A Thermometer Using I^2C,

Asynchronous Serial Communication, Asynchronous Communication with the USCI_A, A Software UART Using Timer_A, programming examples with MSP 430

TOTAL: 45 HOURS

TEXT BOOKS

1. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM Systems Developer's Guide- Designing & Optimizing System Software", 2008, Elsevier
2. John H. Davies "MSP430 Microcontroller Basics", Elsevier Ltd Publications, Copyright 2008.

REFERENCES:

1. Tammy Noergaard "Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers", Elsevier(Singapore) Pvt.Ltd. Publications, 2005.
2. Frank Vahid, Tony D. Givargis, "Embedded system Design: A Unified Hardware/Software Introduction", John Wily & Sons Inc.2002.
3. Peter Marwedel, "Embedded System Design", Science Publishers, 2007.
4. Arnold S Burger, "Embedded System Design", CMP Books, 2002.
5. Rajkamal, "Embedded Systems: Architecture, Programming and Design", TMH Publications, Second Edition, 2008.
6. Manuel Jiménez Rogelio, PalomeraIsidoro Couvertier "Introduction to Embedded Systems Using Microcontrollers and the MSP430" Springer Publications, 2014.

EC32A9	Multicore Architecture and Programming	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the need for multi-core processors, and their architecture.
- To understand the challenges in parallel and multi-threaded programming.
- To develop multicore programs and design parallel solutions

Course Outcome		Cognitive Skill
CO-01	To understand the need for multi-core processors, and their architecture.	U& R
CO-02	To understand the challenges in parallel and multi-threaded programming.	U &R
CO-03	To develop multicore programs and design parallel solutions.	A
CO-04	To learn the distributed memory programming concepts	U
CO-05	To develop the usage of parallel programming development	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	M	S	M	M	S	M	L	L	L
CO-02	S	M	S	S	M	S	M	S	S	S	L	L	M
CO-03	S	M	M	S	S	S	S	S	M	M	M	L	L
CO-04	M	S	M	S	M	S	S	S	S	M	M	M	L
CO-05	M	S	S	M	S	S	M	M	M	S	M	M	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Multi-Core Processors **9**

Single Core to Multi-Core Architectures - SIMD And MIMD Systems - Interconnection Networks Symmetric and Distributed Shared Memory Architectures - Cache Coherence - Performance Issues - Parallel Program Design.

Unit II: Parallel Program Challenges **9**

Performance - Scalability - Synchronization and Data Sharing - Data Races - Synchronization primitives (mutexes, locks, semaphores, barriers) - Deadlocks and Livelocks - Communication between Threads (Condition Variables, Signals, Message Queues And Pipes).

Unit III: Shared Memory Programming With Open MP **9**

Open MP Execution Model - Memory Model – Open MP Directives - Work-sharing Constructs - Library functions - Handling Data and Functional Parallelism - Handling Loops - Performance Considerations.

Unit IV: Distributed Memory Programming with MPI **9**

MPI Program Execution - MPI Constructs - Libraries - MPI Send and Receive - Point-to-point and Collective Communication - MPI Derived Data types - Performance evaluation

..

Unit V: Parallel Program Development **9**

Case Studies - n-Body Solvers - Tree Search – Open MP and MPI Implementations and Comparison.

.

TOTAL: 45 HOURS

TEXT BOOKS

1. Peter S. Pacheco, An Introduction to Parallel Programming, Morgan Kauffman/ Elsevier, 2011.
2. Darryl Gove, Multicore Application Programming for Windows, Linux, and Oracle Solaris, Pearson, 2011

REFERENCES:

1. Michael J Quinn, Parallel programming in C with MPI and OpenMP, Tata McGraw Hill,2003.
2. Victor Alessandrini, Shared Memory Application Programming, 1st Edition, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, 2015.
3. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, 2015.

EC32B1	Mobile Communication	L	T	P	C
		3	0	0	3

OBJECTIVES:

- It deals with the fundamental cellular radio concepts such as frequency reuse and handoff and coverage of mobile system.
- It presents different types of radio propagation models and small scale propagation effects such as fading, time delay spread and Doppler spread and Multipath measurements.
- It provides idea about analog and digital modulation techniques used in wireless communication.
- It also deals with the different types of equalization techniques and diversity concepts.
- It provides an introduction to speech coding principles and linear, non-linear predictive coding techniques and also describes the various multiple access techniques.
- It deals with 1G, 2G, 3G, 4G, 5G wireless systems and standards.

Course Outcome		Cognitive Skill
CO-01	To understand the concepts of cellular system design fundamentals.	R,U
CO-02	To know the mobile radio propagation.	R,U,
CO-03	To understand the modulation techniques for mobile radio.	R,U
CO-04	To understand the various coding and multiple access techniques.	R,U
CO-05	To familiarise the various wireless systems and standards	R,U,A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	L	S	S	S	S	L	S	S	S	S	M
CO-02	S	S	L	M	S	S	S	L	S	S	L	M	S
CO-03	S	S	L	M	S	S	S	M	S	S	L	S	M
CO-04	S	S	L	S	L	S	S	L	S	S	S	M	S
CO-05	S	S	L	M	S	S	S	L	S	S	S	L	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Cellular Concept and System Design Fundamentals 9

Introduction to Wireless Communication: Evolution of Mobile Communications, Mobile Radio Systems- Examples, Trends in Cellular Radio and Personal Communications. Cellular Concept: Frequency Reuse, Channel Assignment, Hand Off, Interference and System Capacity, Tracking and Grade of Service, Improving Coverage and Capacity in Cellular Systems.

Unit II: Mobile Radio Propagation 9

Free Space Propagation Model, Reflection, Diffraction, Scattering- Link Budget Design- Outdoor Propagation Models, Indoor Propagation Models- Small Scale Multipath Propagation, Impulse Model, Small Scale Multipath Measurements, Types of Small Scale Fading, Rayleigh and Rician Distributions.

Unit III: Modulation Techniques for Mobile Radio 9

Overview of Linear Modulation Techniques: QPSK, MSK, QAM – GMSK- OFDM and its Principle, Transceiver Implementation, Cyclic Prefix, Inter Carrier Interference, Windowing, PAPR and its Reduction Techniques. RAKE Receiver.

Unit IV: Coding and Multiple Access Techniques 9

Coding: Vo-coders, Linear Predictive Coders, Selection of Speech Coders for Mobile Communication, GSM Codec. Multiple Access Techniques: FDMA, TDMA, FHMA, CDMA, Hybrid Spread Spectrum Techniques, SDMA.

Unit V: Wireless Systems and Standards 9

1G, 2G, 3G ,4G & 5G Wireless systems and Standards - AMPS, GSM, IS-95 and DECT - Blue tooth, Zig-bee ,WLL, IEEE Standards on Wi-Fi, Wi-Max, WLAN.

TOTAL: 45 HOURS

TEXT BOOKS

1.T.S.Rappaport, "Wireless Communications: Principles and Practice, Second Edition, Pearson Education/ Prentice Hall of India, Third Indian Reprint 2003.

REFERENCES:

1. R. Blake, "Wireless Communication Technology", Thomson Delmar, 2003.
2. W.C.Y.Lee, "Mobile Communications Engineering: Theory and applications, Second Edition, McGraw-Hill International, 1998.
3. Stephen G. Wilson, "Digital Modulation and Coding", Pearson Education, 2003.

EC32B2	**Antenna and Wave Propagation**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To give insight of the radiation phenomena.
- To give a thorough understanding of the radiation characteristics of different types of Antennas.
- To create awareness about the different types of propagation of radio waves at different frequencies.

Course Outcome		**Cognitive Skill**
CO-01	Understanding the fundamental parameters of antenna	R, U
CO-02	Design of antenna arrays and plot its radiation pattern	U, An
CO-03	Understand the construction and operation of various antenna	A,An
CO-04	Understand the construction and operation of various antenna for different applications and measurement of the parameters of antenna	A, S
CO-05	Understand the different wave propagation modes	U, R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesi

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	L	S	S	S	S	L	S	S	S	M	S
CO-02	S	S	L	M	S	S	S	L	S	S	L	S	S
CO-03	S	L	L	S	M	S	M	L	S	S	S	M	S
CO-04	S	L	L	S	M	S	M	L	S	S	S	M	S
CO-05	S	S	L	M	S	S	S	L	S	S	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Fundamentals of Radiation **9**

Definition of Antenna Parameters - Gain, Directivity, Effective Aperture, Radiation Resistance, Bandwidth, Beamwidth, Antenna Impedance, Reciprocity Principle, Radiation from Oscillating Dipole, Half Wave Dipole.

Unit II: Antenna Arrays 9

N Element Linear Array, Broadside and End Fire Array, Pattern Multiplication, Concept of Phased Arrays, Adaptive Array, Yagi-Uda Array-Binomial array

Unit III: Aperture and Slot Antenna **9**

Radiation from Rectangular Apertures, Uniform and Tapered Aperture, Horn Antenna, Reflector Antenna , Feeding structures, Slot Antennas, Lens Antenna, Microstrip Antennas - Radiation Mechanism – Application.

Unit IV: Special Antennas And Antenna Measurements **9**

Loop antenna, Long Wire antennas-V Antenna, Rhombic Antenna, Beverage Antenna, Biconical Antenna, Helical Antenna, Spiral Antenna, Principle of Frequency Independent Antennas- Log Periodic Antennas-YUCOLP Array, Sleeve Antenna, Turnstile Antenna, Reconfigurable Antenna, Active Antenna,

.

Unit V Propagation of Radio Waves 9

Modes of Propagation, Structure of Atmosphere, Ground Wave Propagation, Tropospheric Propagation , Duct Propagation, Tropo scatter Propagation, Flat Earth and Curved Earth Concept, Sky Wave Propagation - Virtual Height, Critical Frequency, Maximum Usable Frequency - Skip Distance, Fading , Multi Hop Propagation

TOTAL: 45 HOURS

TEXT BOOKS

1. John D Kraus," Antennas for all Applications", 3rd Edition, Mc Graw Hill, 2005

REFERENCES:

1. Edward C. Jordan and Keith G. Balmain" Electromagnetic Waves and Radiating Systems" Prentice Hall of India, 2006
2. R. E. Collin," Antennas and Radio wave Propagation", Mc Graw Hill 1985.
3. Constantine. A. Balanis" Antenna Theory Analysis and Design", Wiley Student
4. Edition, 2006
5. Rajeswari Chatterjee," Antenna Theory and Practice" Revised Second Edition New Age International Publishers, 2006.
6. S. Drabowitch," Modern Antennas" Second Edition, Springer Publications, 2007.
7. Robert S. Elliott" Antenna Theory and Design" Wiley Student Edition, 2006.
8. H. Sizun" Radio Wave Propagation for Telecommunication Applications", First India Reprint, Springer Publications, 2007.

EC32B3	**Fundamentals of Neural Networks and Deep Learning**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To understand the basics in neural networks
- To understand the basics of associative memory and unsupervised learning networks
- To understand CNN architectures
- To analyze the key computations underlying deep learning, then use them to build and train deep neural networks for various tasks.
- To apply auto encoders and generative models for suitable applications.

Course Outcome		**Cognitive Skill**
CO-01	Understand the basics in neural networks.	U
CO-02	Understand the basics of associative memory and unsupervised learning networks.	U
CO-03	Apply CNN and its variants for suitable applications.	A
CO-04	Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.	An and A
CO-05	Understand RNN and Apply autoencoders and generative models for suitable applications.	U and A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	S	M	S	M	S	M	S
CO-02	S	S	S	S	S	S	S	M	S	M	S	M	S
CO-03	S	S	S	S	S	S	S	M	S	M	S	M	S
CO-04	S	S	S	S	S	S	S	M	S	M	S	M	S
CO-05	S	S	S	S	S	S	S	M	S	M	S	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction to Neural Networks and Back Propagation Networks 9

Basic concepts of Neural Networks, Model of Artificial Neuron, Neural Network Architectures, Characteristics of Neural Networks, Learning Methods, Early Neural network architectures, Back Propagation Network (BPN), Back Propagation Learning, Applications of BPN, Variations of Back Propagation Algorithms-Supervised Learning Network

Unit II: Associative Memory and Unsupervised Learning Networks 9

Training Algorithms for Pattern Association-Auto associative Memory Network-Hetero associative Memory Network-Bidirectional Associative Memory (BAM)-Hopfield Networks-Iterative Auto associative Memory Networks-Temporal Associative Memory Network-Fixed Weight Competitive Nets-Kohonen Self-Organizing Feature Maps-Learning Vector Quantization-Counter propagation Networks-Adaptive Resonance Theory Network..

Unit III: Convolutional Neural Networks 9

Introduction The Basic Structure of a Convolutional Network - Padding – Strides-The ReLU Layer -Pooling - Fully Connected Layers-The Interleaving between Layers -Training a Convolutional Network -Backpropagating Through Convolutions, Backpropagation as Convolution with Inverted/Transposed Filter- Convolution/Backpropagation as Matrix Multiplications Data Augmentation Case Studies of Convolutional Architectures –AlexNet, ZFNet , VGG, GoogLeNet ,ResNet, Squeeze-and-Excitation Networks (SENets)

Unit IV: Deep Feed forward Networks 9

Deep Learning Neural Networks- History of Deep Learning- A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation - Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets.

Unit V: **Recurrent Neural Networks** 9

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks, LSTM Networks- Bi Directional LSTM, Applications: Image Generation, Image Compression, Natural Language Processing. Complete Auto encoder, Regularized Autoencoder, Stochastic Encoders and Decoders, Contractive Encoders. Gated Recurrent Unit(GRU-EEG Net, Bi GRU.

TOTAL: 45 HOURS

TEXT BOOKS

1. Charu C. Aggarwal, "Neural Networks and Deep Learning: A Textbook", Springer International Publishing, 1st Edition, 2018.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

REFERENCES:

1. AurélienGéron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", Oreilly, 2018.
2. Josh Patterson, Adam Gibson, "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017.
3. Francois Chollet, "Deep Learning with Python", Second Edition, Manning Publications, 2021.
4. Learn Keras for Deep Neural Networks, JojoMoolayil, Apress, 2018.
5. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020.
6. Deep Learning with Python, François Chollet, Manning Shelter Island, 2017.
7. S Rajasekaran, G A VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications", PHI Learning, 2017.
8. Pro Deep Learning with TensorFlow, SantanuPattanayak, Apress, 2017.
9. James A Freeman, David M S Kapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Addison Wesley, 2003. https://nptel.ac.in/courses/11710508
10. Charu CAggarwal, Linear Algebra and Optimization for Machine Learning, Springer Nature Switzerland AG 2020.

EC32B4	Wireless Communication and Networks	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study about multiple access technique for wireless communication.
- To study about OFDM and multi antenna system.
- To know about wireless PAN and LAN.
- To study about WAN.
- To study about mobility management.

Course Outcome		Cognitive Skill
CO-01	Able to understand the concepts of multiple access technique for wireless communication.	R, U
CO-02	Capable of discussing OFDM and Multiantenna system.	R, U,
CO-03	Understand the concepts of wireless PAN and LAN.	R, U
CO-04	Able to learn wireless WAN	R, U
CO-05	Able to know the mobility management in wireless networks	R, U, A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	M	M	M	L	L	S	S	S	M	M	L
CO-04	S	M	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	S	S	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Multiple Access Technique for Wireless Communication 9

Introduction, Review of Multiple Access techniques: FDMA, TDMA, CDMA, SDMA, Hybrid techniques, Packet radio: Packet radio protocols-ALOHA and SALOHA, CSMA, Reservation protocols-Reservation ALOHA and PRMA, Capture effects in Packet radio

Unit II: Orthogonal Frequency Division Multiplexing and Multiantenna System 9

OFDM -Introduction– principle, Implementation of transceivers, Multiple Access OFDMA, Multicarrier code division multiple access, Multiantenna System: Smart antennas, MIMO system- spatial multiplexing, system model, channel state information, capacity in nonfading channels, layered space-time structures, Multiuser MIMO system- Scheduling, Linear precoding.

Unit III: Wireless PAN and LAN 9

Introduction to Bluetooth, Protocol Stack, Network Connection Establishment, Bluetooth applications, Zigbee technology. Introduction to Wireless LANs, WLAN Equipment, Topologies, and Technologies. IEEE 802.16, WiMAX.

Unit IV: Wireless Wide Area Networks **9**

GSM: Evolution for Data, UMTS-Network Reference Architecture, Channel Structure, Spreading and Scrambling, Bearer Service and QoS. CDMA: CDMA 2000- Layering Structure, Forward Link Features, Reverse Link Physical Channels, Evolution of IS 95 to CDMA 2000, WCDMA, IMT 2000, HSPA, HSPA+, LTE and LTE Advanced.

.

Unit V: Mobility Management In Wireless Networks **9**

Introduction- Mobility Management Functions-Mobile Location Management-Mobile Registration-QoS Management.

TOTAL: 45 HOURS

TEXT BOOKS

1. Andreas. F. Molisch, "Wireless Communications", John Wiley – India, 2006.
2. Vijay K Garg, Wireless Communication and Networking, Morgan Kauffmann Publishers, 2010

REFERENCES:

1. Simon Haykin& Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.
2. Rappaport. T.S., "Wireless communications", Pearson Education, 2003
3. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
4. Harry R. Anderson, "Fixed Broadband Wireless System Design" John Wiley – India, 2003
5. Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd.,2001
6. Upena Dalal, "Wireless Communication "Oxford Higher Education 2009

EC32B5	**Satellite Communication**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- Overview of satellite systems in relation to other terrestrial systems.
- Study of satellite orbits and launching.
- Study of earth segment and space segment components
- Study of satellite access by various users.
- Study of DTH and compression standards.

Course Outcome		**Cognitive Skill**
CO-01	Able to understand satellite systems in relation to other terrestrial systems.	R,U

CO-02	Able to explain the space segment components.	R,U,
CO-03	Able to explain earth segment.	R,U
CO-04	Able to understand satellite access by various users.	R,U
CO-05	Able to describe DTH and compression standards	R,U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	S
CO-02	S	S	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	M	M	M	L	L	S	S	S	M	M	S
CO-04	S	M	M	M	M	L	M	M	M	S	S	L	S
CO-05	S	S	S	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Overview of Satellite Systems, Orbits and Launching methods 9

Introduction – Frequency Allocations for Satellite Services – Intelsat – U.S. Domsats – Polar Orbiting Satellites – Problems – Kepler's First Law – Kepler's Second Law – Kepler's Third Law – Definitions of Terms for Earth-orbiting Satellites – Orbital Elements – Apogee and Perigee Heights – Orbital Perturbations – Effects of a Nonspherical Earth – Atmospheric Drag – Inclined Orbits – Calendars – Universal Time – Julian Dates – Sidereal Time – The Orbital Plane – The Geocentric-Equatorial Coordinate System – Earth Station Referred to the IJK Frame – The Topocentric-Horizon Co-ordinate System – The Sub-satellite Point – Predicting Satellite Position, Sun- synchronous orbit .

Unit II: Geostationary Orbit & Space Segment 9

Introduction – Antenna Look Angels – The Polar Mount Antenna – Limits of Visibility – Near Geostationary Orbits – Earth Eclipse of Satellite – Sun Transit Outage – Launching Orbits – Problems – Power Supply – Attitude Control – Spinning Satellite Stabilization – Momentum Wheel Stabilization – Station Keeping – Thermal Control – TT&C Subsystem – Transponders – Wideband Receiver – Input Demultiplexer – Power Amplifier – Antenna Subsystem – Morelos – Anik-E – Advanced Tiros-N Spacecraft.

Unit III: Earth Segment & Space Link 9

Introduction – Receive-Only Home TV Systems – Outdoor Unit – Indoor Unit for Analog (FM) TV – Master Antenna TV System – Community Antenna TV System – Transmit-Receive Earth Stations – Problems – Equivalent Isotropic Radiated Power – Transmission Losses – Free-Space Transmission – Feeder Losses – Antenna Misalignment Losses – Fixed

Atmospheric and Ionospheric Losses – Link Power Budget Equation – System Noise – Antenna Noise – Amplifier Noise Temperature – Amplifiers in Cascade – Noise Factor – Noise Temperature of Absorptive Networks – Overall System Noise Temperature – Carrier-to-Noise Ratio – Uplink – Saturation Flux Density – Input Back Off – The Earth Station HPA – Downlink – Output Back off – Satellite TWTA Output – Effects of Rain – Uplink rain-fade margin – Downlink rain-fade margin – Combined Uplink and Downlink C/N Ratio – Intermodulation Noise.

Unit IV: Satellite Access **9**

Single Access – Preassigned FDMA, Demand-Assigned FDMA, SPADE System. Bandwidth-limited and Power-limited TWT amplifier operation, FDMA downlink analysis. TDMA : Reference Burst; Preamble and Postamble, Carrier recovery, Network synchronization, unique word detection, Traffic Data, Frame Efficiency and Channel capacity, preassigned TDMA, Demand assigned TDMA, Speech Interpolation and Prediction, Downlink analysis for Digital transmission. Comparison of uplink Power requirements for FDMA & TDMA. On-board signal Processing for TDMA / FDMA operation, Satellite switched TDMA. Code-Division Multiple Access – Direct-Sequence spread spectrum – code signal c(t) – autocorrelation function for c(t) – Acquisition and tracking – Spectrum spreading and dispreading – CDMA throughput – Problems – Network Layers – TCP Link – Satellite Links and TCP – Enhancing TCP Over Satellite Channels Using Standard Mechanisms (RFC-2488) – Requests for comments – Split TCP connections – Asymmetric Channels – Proposed Systems.

Unit V: Direct Broadcast Satellite Services 9

Introduction – Orbital Spacings – Power Rating and Number of Transponders – Frequencies and Polarization – Transponder Capacity – Bit Rates for Digital Television – MPEG Compression Standards – Forward Error Correction – Home Receiver Outdoor Unit (ODU) – Home Receiver Indoor Unit (IDU) – Downlink Analysis – Uplink - Problems - Satellite Mobile Services – VSATs – Radarsat – Global Positioning Satellite System – Orbcomm.

TOTAL: 45 HOURS

TEXT BOOKS

1. Dennis Roddy, Satellite Communications, McGraw-Hill Publication Third edition 2001

REFERENCES:

1. Timothy Pratt – Charles Bostian & Jeremy Allmuti, Satellite Communications, John Willy & Sons (Asia) Pvt. Ltd. 2004
2. Wilbur L. Pritchars Henri G.Suyder Hond Robert A.Nelson, Satellite Communication Systems Engineering, Pearson Education Ltd., Second edition 2003.
3. M.Richharia : Satellite Communication Systems (Design Principles Macmillan Press Ltd. Second Edition 2003.

EC32B6	Wireless Ad-Hoc and Sensor Networks	L	T	P	C
		3	0	0	3

OBJECTIVES

- To analyze the significances of an ad-hoc and sensor network mechanisms.
- To realize the issues related with various wideband wireless communication Techniques.
- To gain knowledge about the design techniques of advanced wireless communication Systems.

Course Outcome		Cognitive Skill
CO-01	Able to understand the basics of ad-hoc and sensor networks	R, U
CO-02	Apply the MAC and routing protocols to develop projects for an ad-hoc network	R,A
CO-03	Able to understand Security issues in adhoc and sensor networks	R, U
CO-04	Evaluate the MAC and routing protocols to develop projects for sensor networks	E
CO-05	Analyze how an ad-hoc network can be integrated with other networks	R, A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	S
CO-02	S	S	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	M	M	M	L	L	S	S	S	M	M	S
CO-04	S	M	M	M	M	L	M	M	M	S	S	L	S
CO-05	S	S	S	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Ad-Hoc and Sensor Networks **9**

Advantages, Characteristics Features, Applications, Constraints and Challenges, Required Mechanisms, Difference Between Ad-Hoc and Sensor Networks, Enabling Technologies, Characteristics f Wireless Channel, Adhoc Mobility Models: - Entity and Group Models.

Unit II: Medium Access and Routing Protocols **9**

Ad-hoc MAC Protocols: Design Issues, Goals and Classification. Contention Based Protocols, Reservation Based Protocols, Scheduling Algorithms, Protocols using Directional Antennas. Routing Protocols - Issues in Designing Routing Protocols, Classification of Routing Protocols, Routing Protocols of Ad-Hoc Networks.

Unit III: End -To - End Delivery and Security 9

Transport layer: Issues in Designing- Transport Layer Classification, Adhoc Transport Protocols. Security Issues in Adhoc and Sensor Networks: Challenges, Network Security Attacks, Secure Routing Protocols.

Unit IV: Networking of Sensors 9

Single-Node Architecture - Hardware Components, Network Architecture - Sensor Network Scenarios, Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols of Sensor Networks.

Unit V: Infrastructure Establishment and Integration of Ad-Hoc For 4G **9**

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. Co- operative Networks - Architecture, Methods of Co-operation, Co-operative Antennas, Integration of Ad hoc Network with Other Wired and Wireless Networks.

TOTAL: 45 HOURS

REFERENCES:

1. Carlos de Morais Cordeiro and Dharma Prakash Agrawal, “Ad Hoc and Sensor Networks : Theory and Applications”, World Scientific Publishers, Second Edition, 2011.
2. Prasant Mohapatra and Sriramamurthy, “Ad Hoc Networks: Technologies and Protocols”, Springer-Verlag, First Edition, Reprint 2005.
3. Kazem Sohraby and Daniel Minoli, TaiebZnati, “Wireless Sensor Networks: Technology, Protocols and Applications”, Wiley India, FirstEdition, 2010.
4. Holger Karl A Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks", Wiley India, student edition 2012.

EC32B7	**Nano Electronics**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To introduce the basics of nano electronics and to differentiate it from the conventional electronics theories
- To gain knowledge about the new theories which support nano electronics
- To learn about the fundamental nano electronic components and devices

Course Outcome		Cognitive Skill
CO-01	Learn the fundamentals of Nano technology	U
CO-02	Analyze the different methods to synthesize different nano materials	U &AN
CO-03	Understand the use of nanotechnology in Electronics	U &R
CO-04	Understand the concepts of Single Electron devices	U &R
CO-05	Learn the application of Nanoelectronics	U &R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L
CO-01	S	M	M	M	M	S	L	N	N	L	L	L
CO-02	S	S	S	M	M	M	L	N	N	M	L	M
CO-03	S	S	S	M	S	M	L	N	N	M	M	M
CO-04	S	S	S	M	S	M	L	N	N	M	M	M
CO-05	S	S	S	S	S	S	N	S	S	M	L	L

S-Strong, M-Medium ,L-Low, N-Not relevant

Unit I: Introduction to Nanotechnology **9**

Background to Nanotechnology: Types of Nanotechnology and Nanomachines - Periodic Table -Atomic Structure - Molecules and Phases - Energy - Molecular and Atomic Size - Surface and Dimensional Space - Top Down and ; Molecular Nanotechnology: Electron Microscope Scanning Electron Microscope - Atomic Force Microscope - Scanning Tunnelling Microscope Nanomanipulator - Nanotweezers - Atom Manipulation - Nanodots - Self Assembly - Dip Pen Nanolithography. Nanomaterials: Preparation - Plasma Arcing - Chemical Vapor Deposition - Sol-Gels - Electrodeposition - Ball Milling - Applications of Nanomaterials.

Unit II: Fundamentals of Nanoelectronics **9**

Fundamentals of Logic Devices:- Requirements - Dynamic Properties - Threshold Gates; Physical Limits to Computations; Concepts - Coulomb Blockade Devices - Spintronics – Generation of Spin Polarization Theories of Spin Injection, Spin Relaxation and Spin Dephasing, Spintronic Devices and Applications, Spin Filters, Spin Diodes, Spin

Transistors. Quantum Cellular Automata - Quantum Computing - DNA Computer; Performance of Information Processing Systems;- Basic Binary Operations, Measure of Performance Processing Capability of Biological Neurons - Performance Estimation for the Human Brain. Ultimate Computation:- Power Dissipation Limit - Dissipation in Reversible Computation - The Ultimate Computer.

Unit III: Silicon MOSFETs & Quantum Transport Devices 9

Silicon MOSFETS - Novel Materials and Alternate Concepts:- Fundamentals of MOSFET Devices- Scaling Rules - Silicon-Dioxide Based Gate Dielectrics - Metal Gates - Junctions & Contacts - Advanced MOSFET Concepts. Quantum Transport Devices based on Resonant Tunneling:-Electron Tunneling - Resonant Tunneling Diodes - Resonant Tunneling Devices; Single Electron Devices for Logic Applications:- Single Electron Devices - Applications of Single Electron Devices to Logic Circuits.

Unit IV: Carbon Nanotubes 9

Carbon Nanotube: Fullerenes - Types of Nanotubes - Formation of Nanotubes - Assemblies - Purification of Carbon Nanotubes - Electronic Properties - Synthesis of Carbon Nanotubes - Carbon Nanotube Interconnects - Carbon Nanotube FETs - Nanotube for Memory Applications - Prospects of an all Carbon Nanotube Nanoelectronics.

Unit V Molecular Electronics 9

Electrodes & Contacts - Functions - Molecular Electronic Devices - First Test Systems - Simulation and Circuit Design - Fabrication; Future Applications: MEMS - Robots - Memory Devices and Sensors – Nano Ferroelectrics – Ferroelectric Random Access Memory –Fe-RAM Circuit Design –Ferroelectric Thin Film Properties and Integration – Calorimetric -Sensors – Electrochemical Cells – Surface and Bulk Acoustic Devices – Gas Sensitive FETs – Resistive Semiconductor Gas Sensors –Electronic Noses – Identification of Hazardous Solvents And Gases – Semiconductor Sensor Array

TOTAL: 45 HOURS

TEXT BOOKS

1. Nanoelectronics & Nanosystems: From Transistor to Molecular & Quantum Devices: Karl Goser, JanDienstuhl and others.

REFERENCES:

1. Sadamichi Maekawa. Concepts in Spintronics.
2. David Awschalom ,Spin Electronics .
3. Raguse, Nanotechnology: Basic Science and Emerging Technologies, Chapman & Hall / CRC, 2002.
4. T.Pradeep, NANO.: The Essentials - Understanding Nanoscience Nanotechnology, TMH, 2007.
5. Rainer Waser (Ed.), Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices, Wiley-VCH, 2003.

EC32B8	Digital Image Processing	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn digital image fundamentals.
- Be exposed to simple image processing techniques.
- Be familiar with image compression and segmentation techniques.
- To learn to represent image in terms of features.

Course Outcome		Cognitive Skill
CO-01	Familiar with the basics of Digital Image Processing system and the basic preliminaries	U & R
CO-02	Idea about the various image preprocessing operation used and noise models	U
CO-03	Knowledge about of 2 D Image Degradation model	A
CO-04	Discussion about the various segmentation techniques	A
CO-05	Design of various Image compression Techniques	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	M	M
CO-02	S	S	S	M	M	L	S	S	S	M	M	L	S
CO-03	S	M	S	M	M	L	L	S	M	S	M	M	L
CO-04	S	S	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	S	M	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Digital Image Fundamentals **9**

Elements of digital image processing systems, Vidicon and Digital Camera working principles, Elements of visual perception, Brightness, Contrast, Hue, Saturation, Mach Band

Effect, Color Image Fundamentals RGB, HIS Models, Image Sampling, Quantization, Dither, Two-Dimensional Mathematical Preliminaries.

Unit II: Image Enhancement **9**

Point Processing, Histograms, Histogram Equalization and Specification Techniques, Noise Distributions, Spatial Averaging, Directional Smoothing, Median, Geometric Mean, Harmonic Mean, Contra Harmonic Mean Filters, Homomorphic Filtering, Color Image Enhancement.

Unit III: Image Restoration & Transforms **9**

Image Restoration Degradation Model, Unconstrained and Constrained restoration, Inverse Filtering, Wiener Filtering, Geometric Transformations-Spatial Transformations, 2D Transforms -DFT, DCT. Walsh Transforms, Hadamard Transforms, Discrete Wavelet Transform

Unit IV: Image Segmentation **9**

Edge Detection, Edge Linking via Hough Transform–Thresholding -Region Based Segmentation– Region Growing–Region Splitting and Merging–Segmentation by Morphological Watersheds.

Unit V: Image Compression & CNN **9**

Need for Data Compression, Huffman, Shannon Fano Coding, Run Length Encoding, Shift Codes, Arithmetic Coding, Vector Quantization, Transform Coding, JPEG Standard, MPEG. Convolutional Neural Networks (CNNs) - Introduction to CNN Architecture and its Advantages for Image Processing-Convolutional Layers, Pooling Layers, and Padding.

TOTAL: 45 HOURS

TEXT BOOKS

1. Rafael C.Gonzalez, Richard E.Woods, Digital Image Processing', Pearson Education, Inc., Second Edition, 2004.
2. Anil K.Jain, Fundamentals of Digital Image Processing', Pearson Education, Inc.,2002.

REFERENCES:

1. William K. Pratt, - Digital Image Processing, John Wiley, NewYork, 2002.
2. Milan Sonka et. al, - Image Processing, Analysis and Machine vision, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999
3. S. Sridhar, - Digital Image processing, Oxford University Press, Edition 2011.

EC32B9	Remote Sensing	L	T	P	C
		3	0	0	3

OBJECTIVES

- To familiarize about the basic principles of remote sensing.
- To acquire knowledge about the motion of remote sensing satellites in the space.
- To expose the various types of sensors used for remote sensing.
- To gain knowledge about the generation of satellite data products.
- To extract useful information from satellite images.

Course Outcome		Cognitive Skill
CO-01	Understand the concepts and laws related to remote sensing .	R, U
CO-02	Acquire knowledge about various remote sensing platforms.	R, U,
CO-03	Understand the characteristics of different types of remote sensors.	R, U
CO-04	Gain knowledge about reception, product generation, storage and ordering of satellite data.	R, U
CO-05	Understand the concept of different image processing techniques and interpretation of satellite data.	R, U, A

R-Remember, U-Understand ,A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	S	M	M	L	L	S	S	S	M	M	L
CO-04	S	S	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	M	S	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Physics of Remote Sensing **9**

Remote Sensing - Definition - Components - Electro Magnetic Spectrum – Basic Wave Theory – Particle Theory – Stefan Boltzman law - Wiens-Displacement Law - Radiometric Quantities - Effects of Atmosphere- Scattering – Different Types –Absorption-Atmospheric

Window- Energy Interaction with Surface Features – Spectral Reflectance of Vegetation, Soil and Water .

Unit II: Platforms **9**

Orbit Elements – Types of Orbits – Motions of Planets and Satellites – Launch of Space Vehicle – Orbit Perturbations and Maneuvers – Escape Velocity - Types and Characteristics of Different Remote Sensing Platforms – Sun Synchronous and Geo Synchronous Satellites.

Unit III: Sensors **9**

Classification of Remote Sensors – Selection of Sensor Parameters - Resolution Concept - Spectral, Radiometric and Temporal Resolution – Quality of Images – Imaging Mode – Photographic Camera – Opto-Mechanical Scanners – Pushbroom and Whiskbroom Cameras – Panchromatic, Multi Spectral , Thermal, Hyperspectral Scanners and Microwave Sensors – Geometric Characteristics Of Scanner Imagery – Operational Earth Resource Satellites - Landsat, SPOT, IRS, Worldview, Hyperion And Hysis, ERS, ENVISAT, Sentinel.

Unit IV: Data Reception and Data Products **9**

Ground Segment Organization – Data Product Generation – Sources of Errors in Received Data – Referencing Scheme – Data Product Output Medium – Digital Products – Super Structure, Fast, Geotiff, Hierarchical and HDF Formats – Indian and International Satellite Data Products – Ordering of Data.

.**Unit V: Data Analysis** **9**

Data Products and their Characteristics – Elements of Visual Interpretation – Interpretation Keys – Digital Image Processing – Preprocessing – Image Rectification – Image Enhancement Techniques– Image Classification – Supervised and Unsupervised Classification.

TOTAL: 45 HOURS

TEXT BOOKS

1. Anji Reddy, " Remote Sensing and Geographical Information Systems", Third Edition,BS Publications, Reprint 2011.
2. Lillesand T.M., and Kiefer,R.W. Remote Sensing and Image interpretation, VI edition of John Wiley & Sons-2015.

REFERENCES:

1. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 4th Edition, 2015.
2. John A.Richards, Springer – Verlag, Remate Sensing Digital Image Analysis 5th edition, 2013.
3. Paul Curran P.J. Principles of Remote Sensing, ELBS; 1985.
4. George Joseph, Fundamentals of Remote Sensing, Third Edition, Universities Press (India) Pvt Ltd, Hyderabad, 2018.

EC32BC1	Electronic Measurements and Instrumentation	L	T	P	C
		3	0	0	3

OBJECTIVES

To learn the

- Basic measurement concepts.
- Concepts of electronic measurements.
- Importance of signal generators and signal analysers in measurements.
- Relevance of digital instruments in measurements.
- The need for data acquisition systems.

Course Outcome		Cognitive Skill
CO-01	Understand and explain the concepts and definitions in electronic measurements	U & R
CO-02	Able to measure various electrical parameters with accuracy, precision and resolution.	U & R
CO-03	Acquire knowledge about electronic components, measuring instruments, breadboard assembling etc.	U & R
CO-04	Describe different terminology related to measurements	U & R
CO-05	Understand the principles of various types of transducers and sensors.	U & R

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	S	M	M	M	M	L	L	L
CO-02	S	M	M	S	M	S	M	S	M	S	L	L	M
CO-03	S	M	S	S	S	S	S	S	M	S	M	L	L
CO-04	M	S	S	M	M	S	S	S	S	M	S	M	L
CO-05	M	S	M	M	S	S	M	M	S	M	M	M	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Science of Measurement **9**

Measurement System - Instrumentation - Characteristics of Measurement Systems – Definitions of Static and Dynamic characteristics - Errors in Measurements - Calibration and Standards- their Types.

Unit II: Transducers **9**

Classification of Transducers - Variable Resistive Transducers - Strain Gauges, Thermistor, RTD-Variable Inductive Transducers- LVDT, RVDT, - Variable Capacitive Transducers - Capacitor Microphone- Photo Electric Transducers - Piezo Electric Transducers - Thermocouple

Unit III: Signal Conditioning and Signal Analyzers **9**

DC and AC bridges - Wheatstone, Kelvin, Maxwell, Hay and Schering. Pre - amplifier - Isolation amplifier - Filters - Data acquisition Systems. Spectrum Analyzers - Wave Analyzers - Logic Analyzers.

Unit IV: Digital Instruments **9**

Digital Voltmeters – Types - Servo Tracking, Successive Approximation, Dual Slope ADC, Millimeters - Automation in Voltmeter - Accuracy and Resolution in DVM - Guarding Techniques - Frequency Counter- Data Loggers.

Unit V: Data Display and Recording Systems **9**

Dual Trace CRO - Digital Storage and Analog Storage Oscilloscope. Analog and Digital Recorders and Printers. Virtual Instrumentation - Block Diagram and Architecture - Applications in Various Fields.

TOTAL: 45 HOURS

TEXT BOOKS

1. Albert D.Helfrick and William D. Cooper, ”Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 2007.
2. Ernest Doebelin and dhanesh N manik, ”Measurement systems” ,5th edition, McGraw-Hill, 2007.

REFERENCES:

1. John P. Bentley, ”Principles of Measurement Systems”, Fourth edition, pearson Education Limited, 2005.
2. A.K.Sawhney, ”Course in Electrical and Electronic Measurement and Instrumentation”, Dhanpat Rai Publisher, 2000.
3. Bouwens,A.J, ”Digital Instrumentation”, Tata Mc-Graw Hill, 1986.
4. David A.Bell, ”Electronic Instrumentation and Measurements”, Second edition, Prentice Hall of India, 2007.

EC32C2	Robotics Engineering	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the basics of robotics
- To study the various kinematics and inverse kinematics of robots.
- To understand the principle of end effectors in robots applications.
- To analyze the applications of sensors in robotics.
- To understand the applications of robots.

Course Outcome		Cognitive Skill
CO-01	Able to explain the basic principle of working of a robot	R,U
CO-02	Able to understand the kinematics and dynamics in a robot.	R,U,
CO-03	Able to suggest the suitable hardware requirements for a robot	R,U
CO-04	Able to analyze the applications of sensors in robotics	U,An
CO-05	Able to select the type of robot to be used for a specific application	R,U,A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	S	M	M	M	M	M	M	M
CO-02	S	M	S	S	M	S	M	S	M	S	M	M	M
CO-03	S	M	S	S	S	S	S	S	M	S	M	M	M
CO-04	M	S	S	M	M	S	S	S	S	M	S	M	M
CO-05	M	S	S	M	S	S	M	M	S	M	M	M	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Robot Types and Configurations **9**

Definitions- Robots, Robotics; Types of Robots- Manipulators, Mobile Robots-Wheeled & Legged Robots, Aerial Robots; Anatomy of a Robotic Manipulator-Links, Joints, Actuators, Sensors, Controller; Open Kinematic Vs Closed Kinematic Chain; Degrees of Freedom; Robot Configurations-PPP, RPP, RRP, RRR; Features of SCARA, PUMA Robots; Classification of Robots Based on Motion Control Methods and Drive Technologies; 3R Concurrent Wrist; Classification of End Effectors - Mechanical Grippers, Special Tools,

Magnetic Grippers, Vacuum Grippers, Adhesive Grippers, Active and Passive Grippers, Selection and Design Considerations of Grippers in Robot.

Unit II: Robot Kinematics **9**

Direct Kinematics- Rotations-Fundamental and Composite Rotations, Homogeneous Co-Ordinates, Translations and Rotations, Composite Homogeneous Transformations, Screw Transformations, Kinematic Parameters, The Denavit-Hartenberg (D-H) Representation, The Arm Equation, Direct Kinematics Problems (Upto 3DOF), Inverse Kinematics- General Properties of Solutions, Problems (Upto 3DOF) Inverse Kinematics Of 3DOF Manipulator with Concurrent Wrist (Demo/Assignment only) Tool Configuration Jacobian, Relation between Joint and End Effector Velocities.

Unit III: Trajectory Planning and Manipulator Dynamics **9**

Tasks, Path Planning, Trajectory Planning. Joint Space Trajectory Planning- Cubic Polynomial, Linear Trajectory with Parabolic Blends, Trajectory Planning with Via Points; Cartesian Space Planning, Point to Point Vs Continuous Path Planning. Obstacle Avoidance Methods- Artificial Potential Field, A*Algorithms.

Manipulator Dynamics

Lagrange's Formulation – Kinetic Energy Expression, Velocity Jacobian and Potential Energy Expression, Generalised Force, Euler-Lagrange Equation, Dynamic Model of Planar and Spatial Serial Robots upto 2 DOF, Modelling including Motor and Gearbox. Robot Control The Control Problem, Single Axis PID Control-Its Disadvantages, PD Gravity Control, Computed Torque Control. Simulation of Simple Robot-Control System- Matlab Programming for Control of Robots.

Unit IV: Sensors for Mobile Robots **9**

Sensors for Mobile Robots, Sensor Classification, Characterizing Sensor Performance, Representing Uncertainty, Wheel/Motor Sensors, Heading Sensors, Accelerometers, Inertial Measurement Unit (IMU), Ground Beacons, Active Ranging, Motion/Speed Sensors, Vision Sensors.

Unit V: Robot Applications **9**

Industrial Applications-Material Handling, Welding, Spray Painting, Machining. Case Study- For Robotic Applications including Robot Selection Considerations for a Typical Industrial Application- Number of Axes, Work Volume, Capacity & Speed, Stroke &Reach, Repeatability, Precision and Accuracy, Operating Environment. For Eg – The Robotic Configuration for Pick and Place Robot, Spot Welding Robot In a Car Manufacturing Industry, Pegin Hole Assembly. Applications In the Medical, Mining, Space, Defence, Security, Domestic, Entertainment. Field Robotics Locomotion, Key Issues For Locomotion, Legged Mobile Robots, Wheeled Mobile Robots. Aerial Mobile Robots. Mobile Robot Kinematics (Differential Drive Robot), Simple Examples: Robot Kinematic Models and Constraints, Mobile Robot Workspace- Degrees of Freedom, Holonomic and Nonholonomic Robots Motion Control (Kinematic Control),Open Loop Control (Trajectory-Following), Feedback Control.

TOTAL: 45 HOURS

TEXT BOOKS

1. Robert. J. Schilling , "Fundamentals of robotics – Analysis and control", Prentice Hall of India 1996.
2. Introduction to Robotics (Mechanics and control), John. J. Craig, Pearson Education Asia 2002.
3. Introduction to Robotics by S K Saha, Mc Graw Hill Education
4. R K Mittal and I J Nagrath, "Robotics and Control", Tata McGraw Hill, N.Delhi,2003.
5. AshitavaGhosal, "Robotics-Fundamental concepts and analysis", Oxford University press.
6. Robotics Technology and Flexible Automation, Second Edition, S. R. Deb.
7. Introduction to Autonomous Mobile Robots, Siegwart, Roland, Cambridge, Mass.: MIT Press, 2nd ed.

REFERENCES:

1. Sicilliano, Khatib , "Handbook of Robotics", Springer
2. John J. Craig, Introduction to Robotics – Mechanics and Control
3. Kevin M. Lynch, Frank C. Park, Modern Robotics Mechanics, Planning and Control
4. Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo Robotics Modelling, Planning and Control, Springer.

EC32C3	**Computer Communication**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To understand the division of network functionalities into layers.
- To be familiar with the components required building different types of networks.
- To learn the flow control and congestion control algorithms and its protocols.

Course Outcome		Cognitive Skill
CO-01	Independently understand basic computer network terminology and explain the functions of each layer in ISO/OSI model.	R,U
CO-02	Understand and analyze data communication system and its components.	R,U,
CO-03	Identify different types of topologies and routing protocols.	R,U
CO-04	Enumerate and explain the functions of transport layer in ISO/OSI model.	R,U
CO-05	Enumerate and explain the functions of application layer in ISO/OSI model and understand the different applications and their functions within a network.	R,U,A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	L	S	S	S	S	L	S	S	S	S	S
CO-02	S	S	L	M	S	S	S	L	S	S	L	S	S
CO-03	S	S	L	M	S	S	S	L	S	S	L	S	S
CO-04	S	S	L	S	S	S	S	L	S	S	S	M	S
CO-05	S	S	L	M	S	S	S	L	S	S	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Fundamentals & Link Layer **9**

Building a network - Requirements, Network Topology, Types of Network, Transmission Mode - Categories of Network - ISO/OSI model - Link Layer Services - Types of Errors - Error Detection - Error Correction.

Unit II: Data Link Control & Internetworking **9**

Flow Control - Error Control - Ethernet IEEE (802.3) - IEEE 802.4 - IEEE 802.5 - Wireless LANs - IEEE 802.11 - Bluetooth – Basic Internetworking Protocols (IP, CIDR, ARP, DHCP, ICMP).

Unit III: Message Routing Technologies **9**

Internetworks - Packet Switching - Datagram Approach - Routing: Distance Vector Routing, Link State Routing - Autonomous System - Routing Protocols: Types - RIP, OSPF, BGP, IPv6,DVMRP, PIM.

Unit IV: End-End Protocols and Security **9**

Overview of Transport layer - UDP - Reliable byte stream (TCP) - TCP Congestion control - Congestion avoidance (DECbit, RED) - QoS - Electronic Mail (SMTP, POP3, IMAP, MIME) - HTTP - Web Services - DNS – SNMP.

Unit V: Digital Switching **9**

Switching functions, Space Division Switch, Time Division Switch, STS switching, TST switching, No 4 ESS Toll switch, digital cross connect systems, Recent advances in Switching Approaches, Introduction to Software Defined Networking.

TOTAL: 45 HOURS

TEXT BOOKS

1. William Stallings, ”Data and Computer Communication”, Pearson, 10th Edition, 2013.
2. A. Foruzan, ”Digital Communication and Networking”, TMH Publication, Fourth Edition, 2011

REFERENCES:

1. Behrouz A. Foruzan, ”Digital Communication and Networking”. TMH Publication, Second Edition, 2004.
2. Larry L. Peterson, Bruce S. Davie, ”Computer Networks: A Systems Approach”, Morgan Kaufmann Publishers, Fifth Edition, 2011.
3. James F. Kurose, Keith W. Ross, ”Computer Networking - A Top-Down Approach Featuring the Internet”, Pearson Education, Fifth Edition, 2009.
4. Nader. F. Mir,”Computer and Communication Networks”, Pearson Prentice Hall Publishers, 2010.

EC32C4	Medical Electronics	L	T	P	C
		3	0	0	3

OBJECTIVES

- To gain knowledge about the various physiological parameters and the methods of recording and measuring these parameters.
- To gain knowledge about the various chemical and non electrical physiological parameters.
- To study about the various assist devices used in the hospitals.
- To Gain knowledge on various imaging system used for diagnosis.
- To gain knowledge about equipments used for various diagnostic and therapeutic techniques

Course Outcome		Cognitive Skill
CO-01	Familiar with physiological parameters in bio medical system.	U
CO-02	Analyze the measurement of various bio chemical and non electrical parameters in human body.	An
CO-03	Understand the working of assist devices and Telemetry system..	U
CO-04	Gain knowledge on various imagining system used for diagnosis.	A
CO-05	Gain knowledge about various diagnostic and therapeutic techniques	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	M	L	L	S	S	S	S	M	M
CO-02	S	S	L	M	S	M	S	S	S	S	S	M	L
CO-03	S	M	S	M	S	L	L	S	M	S	S	M	S
CO-04	S	S	M	S	S	L	M	S	L	M	M	S	L
CO-05	S	S	S	M	M	L	S	L	S	M	S	S	M

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Electro-Physiology and Bio-Potential Recording **9**

The Origin of Bio-potentials, Biopotential Electrodes, Biological Amplifiers, ECG, EEG, EMG, PCG, EOG, VAG Lead Systems and Recording Methods, Typical Waveforms and Signal Characteristics.

Unit II: Measurement of Bio-Chemical and Non Electrical Parameters **9**

PH, PO2, PCO2, PHCO3, Electrophoresis, Colorimeter, Photometer, Auto Analyzer, Blood Flow Meter, Cardiac Output, Respiratory Measurement, Blood Pressure, Temperature, Pulse, Blood Cell Counters.

Unit III: Assistive Devices and Bio-Telemetry System **9**

Cardiac Pacemakers, Defibrillators, Bio Telemetry Principles, Elements of Bio Telemetry System, Radio Telemetry, Single and Multi-channel Telemetry System, Implantable Biotelemetry Units, Telemedicine and Telesurgery

Unit IV: Medical Imaging System **9**

X-ray Instruments and Digital Radiography, Diagnostic x-ray Equipment's and Techniques, CT Imaging System, MRI, Ultrasonic Imaging System, Nuclear Imaging System and Thermal Imaging system.

.

Unit V: Special Equipments **9**

Endoscopy – Laparoscopy - Laser Applications in Biomedical Field . Haemodialysis Machines, Anaesthesia Machine, Ventilators , Radiotherapy Equipment . Automated Drug Delivery Systems.

TOTAL: 45 HOURS

REFERENCES

1. Leislie Cromwell, "Biomedical instrumentation and measurement", Prentice Hall of India, New Delhi, 2002.
2. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TATA McGraw-Hill, NewDelhi, 2nd edition 2003.
3. Joseph J.Carr and John M.Brown, "Introduction to Biomedical equipment Technology", John Wiley and Sons, New York, 1997.
4. R. Anand Natarajan - Biomedical Instrumentation and Measurements- PHI Learning, New Delhi,2nd edition, 2015.
5. Geddes LA and Baker L.E, Principles of Applied Biomedical Instrumentation, 3rd Edition, John Wiley and sons, New york 1991

EC32C5	Mixed Signal IC Design Testing	L	T	P	C
		3	0	0	3

OBJECTIVES

- To know about mixed-signal devices and the need for testing these devices.
- To study the various techniques for testing.
- To learn about ADC and DAC based testing.
- To understand the Clock signal and Clock jitter.

Course Outcome		Cognitive Skill
CO-01	Learn the fundamentals of mixed signal circuits.	U
CO-02	Define the various measurement terminologies.	U
CO-03	Understand the Static and Dynamic Characteristics of ADC and DAC	U
CO-04	Acquire knowledge of Analog to Digital Converters	U
CO-05	Learn testing of Analog to Digital Converters	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	S	M	S	M	S	M	S
CO-02	S	S	S	S	S	S	S	M	S	M	S	M	S
CO-03	S	S	S	S	S	S	S	M	S	M	S	M	S
CO-04	S	S	S	S	S	S	S	M	S	M	S	M	S
CO-05	S	S	S	S	S	S	S	M	S	M	S	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Mixed – Signal Testing 9

Common Types of Analog and Mixed- Signal Circuits – Applications of Mixed-Signal Circuits – Post Silicon Production Flow - Test and Packing – Characterization versus Production Testing - Test and Diagnostic Equipment - Automated Test Equipments – Wafer Probers – Handlers – E-Beam Probers – Focused Ion Beam Equipments – Forced – Temperature.

Unit II: Yield, Measurement Accuracy, And Test Time **9**

Yield - Measurement Terminology - Repeatability, Bias, and Accuracy - Calibrations and Checkers - Tester Specifications - Reducing Measurement Error with Greater Measurement Time – Guard bands - Effects of Measurement Variability on Test Yield - Effects of Reproducibilty and Process Variation on Yield - Statistical Process Control .

Unit III: Characteristics of ADC and DAC **9**

Static and Dynamic Characteristics of ADC and DAC - Resolution, Linearity, Accuracy, Monotonocity, Settling Time and Stability Clock Signal -Time-Domain Attributes of a Clock Signal - Frequency-Domain Attributes of a Clock Signal Jitter –metrics, Types.

Unit IV: DAC Testing 9

Basics of Data Converters -Principles of DAC and ADC Conversion, Data Formats, Comparison of DACs and ADCs, DAC Failure Mechanisms - Basic DC Tests - Transfer Curve Tests - Dynamic DAC Tests - Tests for Common DAC Applications

Unit V: ADC Testing 9

ADC Testing Versus DAC Testing - ADC Code Edge Measurements - Edge Code Testing Versus Center Code Testing, Step Search and Binary Search Methods, Servo Method, Linear Ramp Histogram Method, Histograms to Code Edge Transfer Curves, Rising Ramps Versus Falling Ramps, Sinusoidal Histogram Method - DC Tests and Transfer Curve Tests - Dynamic ADC Tests - Tests for Common ADC Applications

TOTAL: 45 HOURS

TEXT BOOKS

1. Gordon W. Roberts, Friedrich Taenzler, Mark Burns, "An Introduction to Mixed-signal IC Test and Measurement" Oxford University Press, Inc.2012 (Unit I - V)
2. M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2002. (Unit - III)

REFERENCES:

1. Bapiraju Vinnakota, "Analog and mixed-signal test", Prentice Hall, 1998.
2. Digital and Analogue Instrumentation: Testing and Measurement by NihalKularatna

EC32C6	**Wearable Devices and Systems**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To know the hardware requirement of wearable systems.
- To understand the communication and security aspects in the wearable devices.
- To know the applications of wearable devices in the field of medicine.

Course Outcome		**Cognitive Skill**
CO-01	Describe the concepts of wearable system.	U
CO-02	Explain the energy harvestings in wearable device	U
CO-03	Use the concepts of BAN in health care	A
CO-04	Illustrate the concept of smart textile	U
CO-05	Compare the various wearable devices in healthcare system	U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	S	M	S	M	S	S	S
CO-02	S	S	S	S	S	S	S	M	S	M	S	S	S
CO-03	S	S	S	S	S	S	S	M	S	M	S	S	S
CO-04	S	S	S	S	S	S	S	M	S	M	S	S	S
CO-05	S	S	S	S	S	S	S	M	S	M	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction to Wearable Systems and Sensors 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.

Unit II: Signal Processing And Energy Harvesting For Wearable Devices 9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

Unit III: Wireless Health Systems **9**

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication Techniques.

Unit IV: Smart Textile 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study smart fabric for monitoring biological parameters - ECG, respiration.

Unit V:Applications of Wearable Systems 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine, Assistive System

TOTAL: 45 HOURS

TEXT BOOKS

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011.
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013 .

REFERENCES:

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014 .
4. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology, Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012.

EC32C7	**Medical Imaging Systems**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES

- To understand the generation of X-ray and its uses in Medical imaging
- To describe the principle of Computed Tomography and Ultrasonic imaging.
- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging.
- To discuss the radiation therapy techniques and radiation safety.

Course Outcome		**Cognitive Skill**
CO-01	Describe the working principle of the X-ray machine and its application.	U
CO-02	Illustrate the principle computed tomography and Ultrasonic imaging	U
CO-03	Interpret the technique used for visualizing various sections of the body using Magnetic Resonance Imaging.	U
CO-04	Demonstrate the applications of radionuclide imaging.	A
CO-05	Analyze different imaging techniques and choose appropriate imaging equipment for better diagnosis and outline the methods of radiation safety	An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-02	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-03	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-04	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-05	S	S	S	S	S	S	S	S	S	M	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: X **Rays** 9

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment (Block Diagram) – X-Ray Tube, the collimator, Bucky Grid, power supply, Digital Radiography - discrete digital detectors, storage phosphor and film scanning, X-ray Image Intensifier tubes – Fluoroscopy – Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.

Unit II: Computed Tomography and Ultrasonic Imaging 9

Principles of tomography, CT Generations, X- Ray sources- collimation- X- Ray detectors – Viewing systems – spiral CT scanning – Ultra fast CT scanners. Image reconstruction techniques – back projection and iterative method.

Ultrasonic Imaging Ultrasound Imaging methods – Resolution of Ultrasound Imaging Systems – Ultrasound Imaging Modalities, Modes of Ultrasound Image Representation- Artifacts-3D Ultrasound image Reconstruction

Unit III: Magnetic Resonance Imaging 9

Fundamentals of magnetic resonance- properties of electromagnetic waves : speed , amplitude, phase, orientation and waves in matter - Interaction of Nuclei with static magnetic field and Radio frequency wave- rotation and precession – Induction of magnetic resonance signals – bulk magnetization – Relaxation processes T1 and T2. Block Diagram approach of MRI system – system magnet (Permanent, Electromagnet and Superconductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, Electronic components, fMRI.

Unit IV: Nuclear Imaging 9

Radioisotopes- alpha, beta, and gamma radiations. Radio Pharmaceuticals. Radiation detectors – gas filled, ionization chambers, proportional counter, GM counter and scintillation Detectors, Gamma camera – Principle of operation, collimator, photomultiplier tube, X-Y positioning circuit, pulse height analyzer. Principles of SPECT and PET

Unit V: Radiation Therapy and Radiation Safety 9

Radiation therapy – linear accelerator, Telegamma Machine. SRS – SRT – Recent Techniques in radiation therapy – 3D CRT – IMRT – IGRT and Cyber knife – radiation measuring instruments Dosimeter, film badges, Thermo Luminescent dosimeters – electronic dosimeter – Radiation protection in medicine – radiation protection principles Optical Imaging System-Optical Microscopy

TOTAL: 45 HOURS

TEXT BOOKS

1. Isaac Bankman, I. N. Bankman , Handbook Of Medical Imaging: Processing and Analysis (Biomedical Engineering),Academic Press,2000
2. Jacob Beutel (Editor), M. Sonka (Editor), Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis , SPIE Press 2000 .

REFERENCES:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw – Hill, New Delhi, 2003.
2. Dougherty, Geoff (Ed.), "Medical Image Processing - Techniques and Applications ", Springer-Verlag New York, 2011.
3. Khin Wee Lai, Dyah Ekashanti Octorina Dewi "Medical Imaging Technology", Springer Singapore, 2015.

EC32C8	Brain Computer Interface and Applications	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the basic concepts of brain computer interface.
- To study the various signal acquisition methods.
- To study the signal processing methods used in BCI.

Course Outcome		Cognitive Skill
CO-01	Describe BCI system and its potential applications.	U
CO-02	Analyze event related potentials and sensory motor rhythms.	An
CO-03	Compute features suitable for BCI.	E
CO-04	Design classifier for a BCI system.	An
CO-05	Implement BCI for various applications	A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-02	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-03	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-04	S	S	S	S	S	S	S	S	S	M	S	S	S
CO-05	S	S	S	S	S	S	S	S	S	M	S	S	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Introduction TO BCI **9**

Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.

Unit II: Electrophysiological Sources **9**

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuromechanisms.

.

Unit III: Feature Extraction Methods **9**

Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR,MA, ARMA models – PCA – Linear and Non-Linear Features

Unit IV Feature Translation Methods **9**

Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modeling – Hidden Markov Modeling – Neural Networks.

Unit V: Applications of BCI 9

Functional restoration using Neuro prosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot, BCI based disease Screening.

TOTAL: 45 HOURS

TEXT BOOKS

1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction”, Springer, 2010.

REFERENCES:

1. R. Spehlmann, "EEG Primer", Elsevier Biomedical Press, 1981.
2. ArnonKohen, "Biomedical Signal Processing", Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.
3. Bishop C.M., "Neural Networks for Pattern Recognition", Oxford, Clarendon Press, 1995.

Open Electives (OEC)

SI. NO	Course Code	Course Title	L	T	P	C
1	EC32D1	Fundamentals of Image Processing	3	0	0	3
2	EC32D2	Wireless Communication Techniques	3	0	0	3
3	EC32D3	Embedded System Design With ARM	3	0	0	3

EC32D1	Fundamentals of Digital Image Processing	L	T	P	C
		3	0	0	3

OBJECTIVES

- To learn digital image fundamentals.
- Be exposed to simple image processing techniques.
- Be familiar with image compression and segmentation techniques.
- To learn the basic image processing transformations.

Course Outcome		Cognitive Skill
CO-01	Familiar with the basics of Digital Image Processing system	U
CO-02	Idea about the various image preprocessing transformations	U
CO-03	Knowledge about of 2 D Image Degradation models and transforms	U
CO-04	Discussion about the various segmentation techniques	U & A
CO-05	Design of various Image compression Techniques	U & An

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	M	M
CO-02	S	S	S	M	M	L	S	S	S	M	M	L	S
CO-03	S	M	S	M	M	L	L	S	M	S	M	M	L
CO-04	S	S	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	S	M	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Digital Image Fundamentals **9**

Digital Image Processing Systems- Block Diagram Representation, Elements of Visual Perception, Brightness, Contrast, Hue, Saturation, Mach Band Effect, Image Sampling and Quantization, Two-Dimensional Mathematical Preliminaries.

UnitII:Basic Transformations **9**

Domain- Ideal and Butterworth Low Pass and High Pass filters, Histogram Processing, Homomorphic Filtering

Unit III: Image Restoration & Transforms **9**

Image Restoration Degradation Models, Unconstrained and Constrained restoration, 2D Transforms - Separable Transforms, DFT, Walsh Transforms, Hadamard Transforms, Discrete Wavelet Transform.

Unit IV: Image Segmentation **9**

Point, Line and Edge detection, Thresholding - Region based Segmentation – Region growing–Region Splitting and Merging – Segmentation by Morphological Watersheds.

Unit V: Image Compression **9**

Need for Data Compression, Huffman, Shannon Fano Coding, Run Length Encoding, Shift Codes, Arithmetic Coding, Vector Quantization, Transform Coding, JPEG, MPEG.

TOTAL: 45 HOURS

TEXT BOOKS

1.Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing', Pearson Education, Inc., Second Edition, 2004.

2. Anil K. Jain, Fundamentals of Digital Image Processing', Pearson Education, Inc., 2002.

REFERENCES:

1. William K. Pratt, - Digital Image Processing, John Wiley, NewYork, 2002.
2. Milan Sonka et. al, - Image Processing, Analysis and Machine vision, Brookes/Cole, Vikas Publishing House, 2nd edition, 1999
3. S. Sridhar, - Digital Image processing, Oxford University Press, Edition 2011.

EC32D2	Wireless Communication Techniques	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the cellular concept
- To study about multiple access technique for wireless communication.
- To know about wireless PAN and LAN.
- To study about WAN.
- To be familiar with new wireless technologies.

Course Outcome		Cognitive Skill
CO-01	Able to understand the concepts of multiple access technique for wireless communication.	R,U
CO-02	Able to understand the concepts of multiple access technique for wireless communication.	R,U,
CO-03	Understand the concepts of wireless PAN and LAN.	R,U
CO-04	Able to learn wireless WAN	R,U
CO-05	Capable of discussing OFDM and new wireless technologies	R,U,A

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	S	M	M	L	S	S	S	S	S	M
CO-02	S	S	S	M	M	L	S	S	S	M	M	M	S
CO-03	S	S	M	M	M	L	L	S	S	S	M	M	L
CO-04	S	M	M	M	M	L	M	M	M	S	S	L	L
CO-05	S	S	S	M	M	L	S	S	S	M	M	M	S

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Cellular Concept and System Design Fundamentals 9

Introduction to Wireless Communication: Evolution of Mobile Communications, Mobile Radio Systems- Cellular Concept: Frequency Reuse, Channel Assignment, Hand Off, Interference and System Capacity, Tracking and Grade of Service, Improving Coverage and Capacity in Cellular Systems.

Unit II: Multiple Access Technique For Wireless Communication 9

Introduction: FDMA, TDMA, CDMA, SDMA, Hybrid Techniques, Packet Radio: Packet Radio Protocols-ALOHA and SALOHA, CSMA, Reservation Protocols-Reservation ALOHA and PRMA, Capture Effects in Packet Radio.

Unit III: Wireless PAN and LAN 9

Introduction to Bluetooth, Protocol Stack, Network Connection Establishment, Network Topology in Bluetooth, Bluetooth applications, Zigbee technology. Introduction to Wireless LANs, WLAN Equipment, Topologies, and Technologies. IEEE 802.16, WiMAX.

Unit IV: Wireless Wide Area Networks 9

WWAN Architecture - CDMA 2000- Layering Structure, Forward Link Features, Reverse Link Physical Channels, Evolution of IS 95 to CDMA 2000, WCDMA, IMT 2000, HSPA, HSPA+, LTE and LTE Advanced

Unit V: New Wireless Technologies 9

Introduction-4G Features And Challenges- Applications of 4G, 5G System.

4G technologies- Multicarrier Modulation, Smart Antenna Techniques- OFDM-MIMO Systems, Blast System- Software Defined Radio- Cognitive Radio

TOTAL: 45 HOURS

TEXT BOOKS

1. Vijay K Garg, Wireless Communication and Networking, Morgan Kauffmann Publishers, 2010

REFERENCES:

1. Simon Haykin& Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.
2. Rappaport. T.S., “Wireless communications”, Pearson Education, 2003
3. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.
4. Harry R. Anderson, “Fixed Broadband Wireless System Design” John Wiley – India, 2003
5. Gordon L. Stuber, “Principles of Mobile Communication”, Springer International Ltd.,2001
6. Upena Dalal, “Wireless Communication “ Oxford Higher Education 2009.
7. Andreas. F. Molisch, “Wireless Communications”, John Wiley – India, 2006

EC32D3	Embedded System Design With ARM	L	T	P	C
		3	0	0	3

OBJECTIVES

- Understand the advanced controllers used for embedded system design
- To study about current technologies, integration methods and hardware and software design concepts associated with processor in Embedded Systems.
- To study about a simple low power microcontrollers and their applications
- To get detail knowledge regarding testing and hardware software co- design issues pertaining to design of an Embedded System using low power microcontrollers

Course Outcome		Cognitive Skill
CO-01	To Understand the Fundamentals of Embedded Systems design process	R,U
CO-02	To study about integration methods and testing of Embedded Systems hardware and software design	R,U
CO-03	To study about networks for embedded system and distributed embedded architecture	U, An
CO-04	To know ARM Processor Fundamentals and Architecture	R,U
CO-05	To get detail knowledge regarding ARM programming using C	R,U

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

Mapping of Course Outcome with Programme Outcome

PO / CO	PO-A	PO-B	PO-C	PO-D	PO-E	PO-F	PO-G	PO-H	PO-I	PO-J	PO-K	PO-L	PO-M
CO-01	S	S	S	M	M	L	L	S	S	M	L	S	S
CO-02	M	M	M	S	S	S	S	M	M	L	M	L	L
CO-03	S	S	M	S	M	S	M	S	S	S	S	M	M
CO-04	S	S	L	M	S	S	M	S	S	L	M	S	S
CO-05	S	S	L	M	L	S	L	S	M	L	M	L	L

S-Strong, M-Medium, L-Low, N-Not relevant

Unit I: Fundamentals of Embedded Systems **9**

Complex Systems and Microprocessors- Embedded System Design Process . Specifications- Architecture Design of Embedded System Design of Hardware and Software Components- Structural and Behavioural Description.

Unit II: Fundamentals Of Embedded Systems **9**

Complex Systems and Microprocessors- Embedded System Design Process . Specifications- Architecture Design of Embedded System Design of Hardware and Software Components- Structural and Behavioural Description.

Unit III: Networks – Distributed Embedded Architectures **9**

Networks for embedded systems, Network based design, Internet enabled systems. Embedded Product Development Life Cycle – Description – Objectives -Phases – Approaches1. Recent Trends in Embedded Computing.

Unit IV: ARM Processor Fundamentals **9**

ARM Architecture, Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts and Interrupt Vector Table, ARM Instruction set, Thumb Instruction Set, Single Register and Multiple Register Load / Store Instructions. Stack, Software Interrupt Instructions

Unit V: ARM Programming Using C **9**

Programming using C and Assembly ,Simple C Programs using Function Calls, Pointers, Structures, Integer and Floating Point Arithmetic, Assembly Code using Instruction Scheduling, Register Allocation, Conditional Execution and Loops.

TOTAL: 45 HOURS

TEXT BOOKS

1. Raj Kamal, Embedded Systems: Architecture, Programming and Design, Third Edition, McGraw Hill Education (India), 2014.
2. Shibu K.V., Introduction to Embedded Systems, McGraw Hill Education (India), 2009.
3. Steave Heath, Embedded System Design, Second Edition, Elsevier.
4. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM Systems Developer's Guide- Designing & Optimizing System Software", 2008, Elsevier.

REFERENCES:

1. Tammy Noergaard "Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers", Elsevier(Singapore) Pvt. Ltd. Publications, 2005.
2. Frank Vahid, Tony D. Givargis, "Embedded system Design: A Unified Hardware/ Software Introduction", John Wiley & Sons Inc.2002.
3. Peter Marwedel, "Embedded System Design", Science Publishers, 2007.
4. Arnold S Burger, "Embedded System Design", CMP Books, 2002.
5. Rajkamal, "Embedded Systems: Architecture, Programming and Design", TMH Publications, Second Edition, 2008.
6. Manuel Jiménez Rogelio, Palomera Isidoro Couvertier "Introduction to Embedded Systems Using Microcontrollers and the MSP430" , Springer Publications, 2014.