B.Tech in
Electronics and Communication Engineering

Faculty of Engineering

Revised in June 2015

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Vision of the Institute

To be a global leader in the delivery of engineering education, transforming individuals to become

creative, innovative, and socially responsible contributors in their professions.

Mission of the Institute:

- To provide best-in-class infrastructure and resources to achieve excellence in technical education,
- To promote knowledge development in thematic research areas that have a positive impact on society, both nationally and globally,
- To design and maintain the highest quality education through active engagement with all stakeholders –students, faculty, industry, alumni and reputed academic institutions,
- To contribute to the quality enhancement of the local and global education ecosystem,
- To promote a culture of collaboration that allows creativity, innovation, and entrepreneurship to flourish, and
- To practice and promote high standards of professional ethics, transparency, and accountability

Vision of the Department:

To provide a value-based learning environment for producing engineers with a blend of technical skills, moral values and leadership qualities in the field of Electronics, Communication and Computing channelized towards technological advancement to cater to the needs of the industry and the society.

Mission of the Department:

M1: Achieving excellence in teaching and learning with an emphasis on fundamental knowledge and hands-on exposure to match the state-of-the-art in technology.

M2: Providing an environment for core competency development and enhancing quality research in emerging areas.

M3: Facilitating professional growth to the students for higher education and career in industry and

academia.

M4: Imbibing the essence of human values, ethics and professional skills to sustain socio-economic

development.

Program Educational Objectives (PEOs)

PEO1: To integrate fundamental knowledge of basic science, mathematics and engineering to work on complex problems in the field of electronics and communication engineering.

PEO2: To promote independent research and continuous learning by providing hands-on exposure in electronics, signal processing and communication domains.

PEO3: To provide a platform to explore and pursue interests in diversified fields for a successful career.

PEO4: To nurture team spirit and leadership qualities with a sense of social responsibility and produce engineers with an ability to integrate engineering and society.

PROGRAM SPECIFIC OUTCOMES (PSO)

- PSO1: Able to design, develop and analyze systems in signal processing, electronics, communication and computing.
- PSO2: Able to demonstrate competency in research and innovations.

PROGRAM OUTCOMES (PO)

Engineering Graduates will be able to:

- PO1: **Engineering knowledge**: Apply the knowledge of mathematics, science and engineering fundamentals to the solution of complex engineering problems in the field of electronics and communication.
- PO2: **Problem analysis**: Identify, formulate, review research literature, and analyze problems in electronics and communication, reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
- PO3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- PO4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in the field of electronics and communication. PO5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, modeling and simulation tools applicable to the field of electronics and communication engineering.
- PO6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
- PO7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- PO8: **Ethics:** Apply ethical principles and commit to professional ethics, responsibilities and norms pertaining to the field of electronics and communication.
- PO9: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

- PO10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

- PO11: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and a leader in a team, to manage projects and in multidisciplinary environments.

- PO12: **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Evaluation Pattern

50:50 (Internal: External) (All Theory Courses)

Assessment	Internal	External
Periodical 1 (P1)	15	
Periodical 2 (P2)	15	
*Continuous Assessment (CA)	20	
End Semester		50

80:20 (Internal: External) (Lab courses and Lab based Courses having 1 Theory hour)

Assessment	Internal	External
*Continuous Assessment (CA)	80	
End Semester		20

70:30(Internal: External) (Lab based courses having 2 Theory hours/ Theory and Tutorial)

Theory- 60 Marks; Lab- 40 Marks

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	10	
Continuous Assessment (Lab) (CAL)	40	
End Semester		30

65:35 (Internal: External) (Lab based courses having 3 Theory hours/ Theory and Tutorial)

Theory- 70 Marks; Lab- 30 Marks

Assessment	Internal	External
Periodical 1	10	
Periodical 2	10	
*Continuous Assessment (Theory) (CAT)	15	
Continuous Assessment (Lab) (CAL)	30	
End Semester		35

*CA – Can be Quizzes, Assignment, Projects, and Reports.

Letter Grade	**Grade Point**	**Grade Description**
O	10.00	Outstanding
A+	9.50	Excellent
A	9.00	Very Good
B+	8.00	Good
B	7.00	Above Average
C	6.00	Average
P	5.00	Pass
F	0.00	Fail

Grades O to P indicate successful completion of the course

$$CGPA = \frac{\sum (C_i x Gr_i)}{\sum C_i}$$

Where

C_i = Credit for the i^{th} course in any semester

Gr_i= Grade point for the i^{th} course

Cr. = Credits for the Course

Gr. = Grade Obtained

Program Articulation Matrix

Si. No.	Sub. Code	Sub.Name	Cr	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
	Semester 1																
1	15ENG 111	Communicative English	**3**														
2	15MAT 111	Calculus, Matrix Algebra	**3**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
3	15CSE 100	Computational Thinking and Problem Solving	**4**	**2**	**1**	**3**	**-**	**3**	**-**	**-**	**3**	**3**	**3**	**-**	**-**	**-**	**-**
4	15PHY 100	Physics	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
5	15PHY 181	Physics Lab	**1**	**-**	**2**	**1**	**2**	**1**	**-**	**1**	**-**	**1**	**2**	**1**	**-**	**-**	**-**
6	15MEC 180	Workshop A	**1**	**2**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**2**	**1**	**-**	**1**	**-**	**-**
7	15MEC 100	Engineering Drawing-CAD	**3**	**3**	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**3**	**-**	**3**	**-**	**-**
8	15CUL 101	Cultural Education I	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**2**	**-**	**3**	**-**	**-**
	Semester 2																
9	15MAT 121	Vector Calculus and Ordinary Differential Equations	**4**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
10	15CHY 100	Chemistry	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
11	15CSE 102	Computer Programming	**3**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
12	15ECE 111	Solid State Devices	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
13	15ECE 112	Fundamentals of Electrical Technology	**4**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
14	15CHY 181	Chemistry Lab	**1**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
15	15EEE 180	Workshop B	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**1**	**-**	**-**
16	15CSE 180	Computer Programming Lab	**1**	**1**	**2**	**2**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**
17	15CUL 111	Cultural Education II	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**2**	**-**	**3**	**-**	**-**

	Semester 3																
18	15ECE 201	Applied Electromagnetics	**4**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**2**
19	15ECE 202	Digital Circuits and Systems	**4**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**2**	**-**
20	15ECE 203	Network Theory	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**
21	15ECE 204	Signals Processing I	**4**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**
22	15MAT 202	Linear Algebra	**3**	**3**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
23	15TAM 101	Tamil	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**
24	15MAL 101	Malayalam	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**
25	15HIN 101	Hindi	**2**														
26	15ECE 281	Digital Circuits and Systems Lab.	**1**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**2**	**2**
27	15ECE 282	Signals Processing I Lab.	**1**	**3**	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**3**	**2**
28	15AVP 201	Amrita Values Program I	**1**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**	**3**	**3**	**-**	**3**	**-**	**-**
	Semester 4																
29	15ECE 211	Electronic Circuits	**4**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**
30	15ECE 212	Signal Processing II	**4**	**3**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
31	15ECE 213	Transmission Lines and Waveguides	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**
32	15MAT 213	Probability and Random Processes	**4**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**
33	15ENG 233	Technical Communication	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**
34	15ECE 285	Digital Signal Processing Lab.	**1**	**3**	**2**	**3**	**-**	**3**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**2**
35	15ECE 286	Electronic Circuits Lab.	**1**	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**-**
36	15SSK 211	Soft Skills I	**2**	**-**	**3**	**-**	**2**	**-**	**-**	**-**	**2**	**3**	**3**	**-**	**3**	**-**	**-**
37	15AVP 211	Amrita Values Program II	**1**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**	**2**	**2**	**-**	**3**	**-**	**-**

	Semester 5																
38	15ECE 301	Communication Theory	**4**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**-**
39	15ECE 302	Control Systems Engineering	**4**	**3**	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**2**	**2**	**2**	**2**	**3**	**2**
40	15ECE 303	Linear Integrated Circuits	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**-**
41	15ECE 304	Microprocessor and Microcontroller	**4**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**
42	15MAT 303	Optimization Techniques	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**
43	15ECE 381	Circuits and Communication Lab.	**1**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**3**	**-**
44	15ECE 382	Microcontroller Lab.	**1**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**2**
45	15SSK 301	Soft Skills II	**2**		**3**		**2**					**3**	**3**	**2**	**3**		
46	15LIL3 90	[Live-in –Lab]**	**3**	**2**	**3**	**2**	**1**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**		
	Sesmter 6																
47	15ECE 311	Data Communication and Networks	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**3**	**3**	**-**
48	15ECE 312	Digital Communication	**4**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**
49	15ECE 313	VLSI Design	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**2**
50	15ECE 314	Computer System Architecture	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
51	15ECE 367	E I -Hardware Security and Trust (Elective)	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**2**
52	15ECE 356	E I- Satellite Communication (Elective)	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**
53	15ECE 344	E I - Antenna Systems and Design (Elective)	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**3**
54	15ECE 339	E I - Application of Linear Integrated Circuits (Elective)	**3**	**3**	**2**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**
55	15ECE 385	Digital Communication Lab.	**1**	**3**	**3**	**2**	**-**	**2**	**-**	**-**	**-**	**2**	**2**	**-**	**2**	**3**	**-**
56	15ECE 386	VLSI Design Lab.	**1**	**3**	**2**	**-**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**

57	15ECE 387	Open Lab.	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**
58	15SSK 311	Soft Skills III	**2**	-	**3**	-	**2**	-	-	-	**2**	**3**	**3**	-	**3**	-	-
	Semester 7																
60	15ECE 401	Information Theory and Coding Techniques	**4**	**3**	**3**	**3**	-	-	-	-	-	-	-	-	**2**	**3**	**2**
61	15ECE 402	Radio Frequency Engineering	**4**	**3**	**2**	**2**	-	-	-	-	-	-	-	-	-	**3**	**2**
62	15ENV 300	Environmental Science and Sustainability	**3**	**1**	**1**	**1**	**1**	-	**2**	**3**	**3**	**1**	**2**	-	**1**	-	-
63	15ECE 345	E II - Cellular and mobile communication system (Elective)	**3**	**3**	**2**	**2**	-	**2**	**3**	-	-	**3**	**3**	**3**	**2**	**3**	-
64	15ECE 359	E II - Wireless communication	**3**	**3**	**3**	**3**	-	-	-	-	-	-	-	-	**2**	**3**	**3**
65	15MEC 333	E II - Financial management	**3**	-	-	-	-	-	**2**	-	**2**	-	**3**	**2**	**2**	-	-
66	15ECE 331	E III - Pattern recognition techniques and algorithms (Elective)	**3**	**3**	**3**	**2**	**2**	**3**	-	-	-	-	-	-	**3**	**3**	**2**
67	15ECE 366	E III - Embedded systems	**3**	**3**	**2**	**2**	**2**	**2**	**2**	-	-	**3**	**2**	-	-	**3**	**3**
68	15ECE 368	E III - Introduction to soft computing	**3**	**3**	**2**	**3**	**2**	-	-	-	-	-	-	-	**2**	**3**	**3**
69	15ECE 481	Microwave Engineering Lab.	**1**	**3**	**3**	**2**	**2**	**2**	-	-	-	-	**2**	-	**2**	**3**	-
70	15ECE 495	Project Phase I	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**
71	15LIL490	[Live-in –Lab]**	**3**	**2**	**3**	**2**	**1**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**		
	Semester 8																
72	15ECE 380	E IV - Telecommunication Management	**3**	**3**	**2**	-	**2**	**3**	-	-	-	**2**	**2**	**2**	-	**2**	-
73	15ECE 347	E IV - Introduction to Radar Systems	**3**	**3**	**3**	-	**2**	-	-	-	-	-	**2**	-	**2**	**3**	**3**
74	15MEC 411	E IV - Operation Research	**3**	**3**	**2**	**2**	-	-	-	-	-	-	**1**	**2**	**3**	**3**	**1**
75	15ECE 369	E V - Principles of VLSI Testing	**3**	**3**	**3**	**2**	-	-	-	-	-	-	-	-	**2**	**2**	-
76	15ECE 371	E V - VLSI Fabrication	**3**	**3**	**3**	**3**	-	-	-	-	-	-	-	-	**2**	**3**	-

		Technology															
77	15ECE 374	E V - Automotive Embedded Systems	**3**	**3**	**2**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**
78	15ECE 499	Project Phase II	**10**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**

15ENG111 COMMUNICATIVE ENGLISH 2 0 2 3

OBJECTIVES:

To make the students communicate their thoughts, opinions, and ideas freely and naturally; to make them understand the different styles in communication; to make the students understand the aesthetics of reading and writing; to bring in a spirit of enquiry; to motivate critical thinking and analysis; to help them ruminate on human values.

Unit 1

Reading: Different styles of communication – Reading Comprehension - critical thinking and analysis – Note-making – Any two pieces from the text.

Unit 2

Writing: Prewriting techniques - Kinds of paragraphs - basics of continuous writing.

Grammar & Usage: Parts of Speech, Tenses, Concord, Phrasal Verbs, Modal Auxiliaries, Modifiers (Workbook) - Any two pieces from the text.

Unit 3

Practical sessions (Listening & Speaking): Introduction to English pronunciation including minimal pairs and word stress – differences between British and American English – Listening comprehension and Note-taking - Any two pieces from the text.

Activities: Short speeches, seminars, quizzes, language games, debates, and discussions, Book Reviews, etc.

Text: *Language through Reading: Compilation by Amrita University for internal circulation*

Poems:

i. The Poplar Field by William Cowper
ii. Telephone Conversation by Wole Soyinka Prose:

i. Higher Mathematics by R. K. Narayan
ii. Wings of Fire by Abdul Kalam (Part III.11)

Short Stories:

i. Best Investment I Ever Made by A. J. Cronin
ii. Death of an Indian by Krishna CharanDas

Language through Practice: Compilation by Amrita University for internal circulation

Outcomes:

CO 1: Demonstrate competency in all the four linguistic skills viz, listening, speaking, reading and writing.

CO 2: Apply different styles of communication in professional context.

CO 3: Take part in different planned & extempore communicative activities.

CO 4: Interpret and Discuss facts and information in a given context.

CO 5: Develop an appreciation for human values.

CO –PO Mapping:

	PO6	PO7	PO8	PO9	PO10	PO12
CO1					3	2
CO2				2	3	2
CO3					3	
CO4					3	
CO5			2			

15MAT111 CALCULUS AND MATRIX ALGEBRA 2 1 0 3

Unit 1

Calculus

Graphs: Functions and their Graphs. Shifting and Scaling of Graphs.

Limit and Continuity: Limit (One-Sided and Two-Sided) of Functions. Continuous Functions,

Discontinuities, Monotonic Functions, Infinite Limits and Limit at Infinity.

Unit 2

Differentiation and its Applications: Derivative of a function, non- differentiability, Intermediate Value Property, Mean Value Theorem, Extreme Values of Functions, Monotonic Functions, Concavity and Curve Sketching, Integration: Definite Integrals, The Mean Value Theorem for definite integrals, Fundamental Theorem of Calculus, Integration Techniques.

Unit 3

Matrix Algebra

Review: System of linear Equations, linear independence

Eigen values and Eigen vectors: Definitions and Properties, Positive definite, Negative Definite and Indefinite Matrices, Diagonalization and Orthogonal Diagonalization, Quadratic form, Transformation of Quadratic Form to Principal axes, Symmetric and Skew Symmetric Matrices, Hermitian and Skew Hermitian Matrices and Orthogonal Matrices Iterative Methods for the Solution of Linear Systems, Power Method for Eigen Values and Eigen Vectors.

Outcomes:

CO1: Understand the basic concepts of functions, limits, continuity, derivatives and analyze them.

CO2: Apply the concept of differentiability to find the extreme values of the given function and analyze the derivatives to sketch the graph of the given function.

CO3: Recall the terms, facts and basic concepts of definite integrals and the techniques of obtaining antiderivatives.

CO4: Understand the notion of eigenvalues and eigenvectors, analyze the possibility of diagonalization and hence compute a diagonal matrix, if possible.

CO5: Apply the knowledge of diagonalization to transform the given quadratic form into the principal axes form and analyze the given conic section.

CO6: Understand the advantages of the iterative techniques and apply it to solve the system of equations and finding eigenvectors.

CO –PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	-	-	-	1	-	-
CO2	1	3	1	-	-	-	-	-	-	-	-	0	-	-
CO3	3	0	0	-	-	-	-	-	-	-	-	1	-	-
CO4	3	2	0	-	-	-	-	-	-	-	-	0	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-	0	-	-
CO6	3	0	0	-	-	-	-	-	-	-	-	0	-	-

TEXTBOOKS:

1. *'Calculus', G. B. Thomas Pearson Education, 2009, Eleventh Edition.*
2. *'Advanced Engineering Mathematics', Erwin Kreyszig, John Wiley and Sons, 2015, Tenth Edition.*

REFERENCE BOOKS:

1. *'Calculus', Monty J. Strauss, Gerald J. Bradley and Karl J. Smith, 3rd Edition, 2002.*
2. *'Advanced Engineering Mathematics', by Dennis G. Zill and Michael R. Cullen, second edition, CBS Publishers, 2012.*

15CSE100 COMPUTATIONAL THINKING AND PROBLEM SOLVING 3 0 2 4

Unit 1

Basics: Introduction, Information and data, Data encoding. Logic: Boolean logic, Applications of propositional logic.

Unit 2

Problem Solving and Algorithmic Thinking: Problem definition, Logical reasoning, Problem decomposition, Abstraction. Flowcharting, Name binding, Selection, Repetition, Modularization. Data organization: List and Arrays. Simple algorithms, comparison of performance of algorithms.

Unit 3

Problem Solving Techniques: Factoring and Recursion Techniques, Search and Sort techniques, Text processing and Pattern matching.

Outcomes:

CO1: Apply computational thinking principles and algorithmic building blocks to understand, define, and solve problems
CO2: Design algorithms and implement solutions for problems
CO3: Represent, organize, manipulate and interpret data
CO4: Trace computational states and analyse techniques/ strategies for given solutions

CO-PO Mapping:

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

TEXTBOOKS:

1. *David Riley and Kenny Hunt, Computational Thinking for Modern Solver, Chapman & Hall / CRC, 2014*
2. *R. G. Dromey, "How to solve it by Computer", PHI, 2008*

15CHY100 CHEMISTRY 3 0 0 3

Unit 1

Chemical Bonding

Review of orbital concept and electronic configuration, electrovalency and ionic bond formation, ionic compounds and their properties, lattice energy, solvation enthalpy and solubility of ionic compounds, covalent bond, covalency, orbital theory of covalency - sigma and pi bonds - formation of covalent compounds and their properties. Hybridization and geometry of covalent molecules - VSEPR theory - polar and non-polar covalent bonds, polarization of covalent bond - polarizing

power, polarisability of ions and Fajan's rule, dipole moment, percentage ionic character from dipole moment, dipole moment and structure of molecules - co- ordinate covalent compounds and their characteristics, molecular orbital theory for H2, N2, O2 and CO, metallic bond - free electron, valence bond and band theories, weak chemical bonds – inter and intra molecular hydrogen bond - van der Waals forces.

Unit 2

Thermodynamic Parameters

Stoichiometry - mole concept, significance of balanced chemical equation - simple calculations - Conditions for occurrence of chemical reactions - enthalpy, entropy and free changes - spontaneity – Thermochemistry - heats of reactions - (formation, combustion, neutralization) - specific heats - variation of enthalpy change with temperature - Kirchhoff' relation (integrated form) - bond enthalpy and bond order - Problems based on the above.

Kinetics

Review of molecularity and order of a reaction, rate law expression and rate constant - first, second, third and zero order reactions, pseudo-first order reactions (pseudo-unimolecular reactions) - complex reactions - equilibrium and steady state approximations - mechanism of these reactions - effect of temperature on reaction rates - Arrhenius equation and its significance, Michaelis Menden kinetics-enzyme catalysis.

Unit 3

Electrochemistry

Electrolytes - strong and weak, dilution law, Debye-Huckel theory, faraday's laws, origin of potential, single electrode potential, electrochemical series, electrochemical cells, Nernst equation and its application, reference electrodes - SHE, Ag/AgCl, Calomel.

Photochemistry

Photochemistry, laws of photochemistry - Stark-Einstein law, Beer-Lamberts law, quantum efficiency-determination, photochemical processes - Jablonsky diagram, internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo sensitization, photo polymerization.

Outcomes:

CO 1: Understand the fundamental concepts of chemistry to predict the structure and properties of engineering materials
CO 2: Develop analytical skills to evaluate the cause, feasibility and course of chemical reactions
CO 3:Design and apply the idea of cutting edge area of chemistry to solve engineering related problems

CO –PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	1	-	-	-	-	-	-	-	-

REFERENCE BOOKS

Physical chemistry, Puri and Sharma Inorganic chemistry, Puri and Sharma

15PHY100 PHYSICS 3 0 0 3

Unit 1

Review of Classical Physics and dual nature of Waves /particle Review of Kinematics, Force, Newton's Laws, Linear Momentum, Work, Energy, Power, Angular Motion - Kinematics and Mechanics, Angular momentum Torque, Conservation laws (linear and angular).

Particle properties of waves: Photoelectric effect, quantum theory of light, X-ray diffraction, Compton effect, pair production. Wave properties of particles: Waves, De Broglie waves, Group velocity and phase velocity, uncertainty principle.

Unit 2

Atomic Structure and Quantum Mechanics

Atomic Structure: Various models of atom, Atomic Spectra, Energy Levels, Correspondence Principle, Nuclear Motion, Atomic Excitation, and Rutherford Scattering.

Quantum Mechanics: Introduction - wave equation - Schrodinger's equation (time dependent and

independent) - expectation values, operators, Eigen value (momentum and energy) – 1D potential box (finite and infinite) - tunnel effect - harmonic oscillator.

Unit 3

Statistical Mechanics and Solid State Physics

Statistical Mechanics: Classical Distribution - Maxwell's Boltzmann-Molecular energies of an ideal gas - most probable speed. Quantum Statistics - Bose-Einstein and
Fermi-Dirac. Applications - Black Body Radiation, Specific heat of solids, free electrons in metals, Electron energy.

Solid State Physics: Types of solids, Crystallography, Bonds- Ionics, Covalent, and Van der Waals, Band Theory and energies, Semiconductor Devices, and Superconductivity.

Outcomes:

CO1: Understand, Comprehend and acquaint with concepts of Modern Physics
CO2: Analyze and solve (idealized and quasi practical) physics problems pertaining to various concepts of Modern Physics
CO3: Apply concepts of Modern Physics to solve engineering problems that needs ideas from Modern Physics

CO –PO Mapping:

CO/ PO	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PO13	PSO 1	PSO 2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TEXTBOOK:

"Concept of Modern Physics", Arthur Beiser, Tata-McGraw Hill, edition.

REFERENCE BOOK:

"Principles of Physics" by Halliday, Resnick and Walker, 9th edition

15CHY181 CHEMISTRY LAB. 0 0 2 1

1. Acid base titration (double titration)
2. Complexometric titration (double titration)
3. Redox (permanganimetry) titration (double titration)
4. Conductometric titration
5. Potentiometric titration
6. Ester hydrolysis

Outcomes:

CO1:Develop analytical skills for the determination of water quality parameter

CO2:Understand the electrochemical principles of conductance and electrode potentials and its application in analytical science

CO3:Develop analytical skills in the determination of rates of chemical reactions and its application

CO4:Learn the basics of redox reaction and applying it for quantitative determination.

CO5:Create skills to convert basic chemical reactions to analytical application.

CO –PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12
CO1	3	3	1	-	-	-	-	-	-	-	-	-
CO2	3	3	1	-	-	-	-	-	-	-	-	-
CO 3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	3	1	-	-	-	-	-	-	-	-	-

15PHY181 **PHYSICS LAB.** **0 0 2 1**

Young's Modulus – Non Uniform Bending Newton's Rings
Laser - Determination of Wavelength and Particle Size Determination Spectrometer Carey Foster's Bridge

Rigidity Modulus - Tensional Pendulum Viscosity of Liquid by Stokes's method Ultrasonic Interferometer
Hysteresis – B H curve

Outcomes:

CO1: Prepare for the lab experiment and perform individually a wide spectrum of experiments.

CO2: Present experimental data in various appropriate forms like tabulation, and plots.

CO3: Analyze, Interpret and Summarize experimental results.

CO4: Communicate clearly understanding of various experimental principles, instruments/setup, and procedure.

CO –PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PSO1	PSO2	PSO3
CO1	-	1	-	-	1	-	-	-	2	1	-	-	-	-	-	-
CO2	-	2	-	2	-	-	-	-	-	-	1	-	-	-	-	-
CO3	-	3	1	-	-	-	-	-	1	1	-	-	-	-	-	-
CO4	-	-	-	-	1	-	1	-	1	3	-	-	-	-	-	-

15MEC180 **WORKSHOP A** **0 0 2 1**

1. Product Detailing Workshop

Disassemble the product of sub assembly - Measure various dimensions using measuring instruments - Free hand rough sketch of the assembly and components - Name of the components and indicate the various materials used - Study the functioning of the assembly and parts - Study the assembly and components design for compactness, processing, ease of assembly and disassembly - Assemble the product or subassembly.

2. Pneumatics and PLC Workshop

Study of pneumatic elements - Design and assembly of simple circuits using basic pneumaticelements – Design and Assembly of simple circuits using Electro-pneumatics. Study of PLC and its applications – Simple programming using ladder diagrams.

3. Sheet Metal Workshop

Study of tools and equipments - Draw development drawing of simple objects on sheet metal (cone, cylinder, pyramid, prism, tray etc.) Fabrication of components using small shearing and bending machines - Riveting and painting practice.

4.(a) Welding Workshop

Study of tools and equipments - Study of various welding methods - Arc welding practice and demonstration of gas welding and cutting.

(b) Demo and practice Workshop

Fitting: Study of tools, practice in chipping, filing and making joints. Carpentry: Study of tools, planning practice and making joints

Outcomes:

CO1: Dismantle and assemble various products.

CO2: Design and simulate pneumatic and electro-pneumatic circuits.

CO3: Fabricate sheet metal objects.

CO4: Perform arc welding and soldering.

CO-PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	2	1	-	-	-	-	-	-	2	1	-	1
CO 2	2	2	1	-	1	-	-	-	2	1	-	1
CO 3	2	2	-	-	-	-	-	-	2	1	-	1
CO 4	2	1	-	-	-	-	-	-	2	1	-	1

REFERENCE:

Concerned Workshop Manual

15EEE180 WORKSHOP B 0 0 2 1

Part A - Electronics

Identification of electronic components (Passive and Active)

Study of measuring instruments (Voltmeter, Ammeter and Multimeter) Measurement and theoretical Verification of series and parallel combination of resistors and capacitors Calibration of CRO and measurements of signal parameters (RMS, maximum value, peak value, time and frequency) Calibration of function generator using CRO Soldering practice

Part B – Electrical

1. Study on power supply and protective devices
2. Study on tools and electrical accessories
3. Study on sources of light
4. Study on energy efficiency
5. Study on water pump
6. Study on house hold appliances:

a. Iron box

b. Fan

c. Refrigerator

d. Air conditioner

7. House wiring I – Glow an incandescent lamp using SPST switch

8. House wiring II – Glow a fluorescent lamp using SPST switch

9. House wiring III – Operate a fan and an incandescent lamp using two independent SPST switch

10. House wiring IV – Operate a fluorescent lamp and a 3 pin socket using two independent SPST switch

11. House wiring V – Staircase wiring

12. House wiring VI – Godown wiring

Outcomes:

CO1: Understand electrical safety measures and identify electrical tools, electroniccomponents and their symbols.

CO2: Understand electric laws using simulation studies and detect failures in electrical and electronic circuits.

CO3: Build/Solder and test, residential wiring/Electronic circuits and measure electrical parameters.

CO4: Estimate the materials required for wiring a building.

CO –PO Mapping:

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

15MEC100 **Engineering Drawing CAD I** **2 0 2 3**

(Pre-Requisite: Nil)

Objectives:

1. To develop drawings using Bureau of Indian Standards (BIS)
2. To communicate effectively through drawings
3. To enhance visualization skills, which will facilitate the understanding of engineering systems.

Keywords:

Coordinate system**,** Orthographic projections, Isometric projections

Contents:

Introduction, Drawing Instruments and their uses, Layout of the Software, standard tool bar/menus, navigational tools. Co-ordinate system and reference planes. Creation of 2 dimensional environment. Selection of drawing size and scale. Commands and Dimensioning.

Orthographic Projections: Introduction, Planes of projection, reference line. Projection of points in all the four quadrants. Projection of straight lines, Projection of Plane Surfaces, and Projection of Solids in first angle projection system.

Outcomes:

CO1: Understand the fundamental principles of first angle and third angle projections.

CO2: Dimension and label the drawings as per standards.

CO3: Construct the drawings by choosing appropriate line type.

CO4: Visualize and construct projections of line and lamina when inclined to one reference plane and

both reference planes.

CO5: Visualize and construct solid entities in its simple position and when inclined to one reference plane.

CO6: Construct the drawings using computer aided design and drafting software package

CO –PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	-	2	-	-	-	3	-	3	2	2	2
CO2	3	3	2	2	-	2	-	-	-	3	-	3	2	2	2
CO3	3	3	3	2	-	2	-	-	-	3	-	3	2	2	2
CO4	3	3	3	3	-	2	-	-	-	3	-	3	2	2	2
CO5	3	3	3	3	-	2	-	-	-	3	-	3	2	2	2
CO6	3	3	3	3	-	2	-	-	-	3	-	3	2	2	2

TEXTBOOK:

Bhat N. D. and Panchal V. M, "Engineering Drawing Plane and Solid Geometry" , 42e, Charoatar Publishing House, 2010

REFERENCES:

1. *James D. Bethune, "Engineering Graphics with AutoCAD", Pearson Education, 2014*
2. *K. R. Gopalakrishna, "Engineering Drawing", 2014, Subhas Publications*
3. *Narayan K. L. and Kannaiah P, Engineering Drawing, SciTech Publications, 2003*

15CUL101 CULTURAL EDUCATION I 2 0 0 2

Unit 1

Introduction to Indian Culture; Introduction to Amma's Life and Teachings; Symbols of Indian Culture.

Unit 2

Science and Technology in ancient India; Education in Ancient India; Goals of Life - Purusharthas; Introduction to Vendanta and Bhagavat Gita.

Unit 3

Introduction to Yoga; Nature and Indian Culture; Values from Indian History; Life and work of Great Seers of India.

Outcomes:

CO1: Be introduced to the foundational concepts of Indian culture and heritage, will be able to understand the cultural ethos of Amrita Vishwa Vidyapeetham, and Amma‟s life a

CO2: Understand the foundational concepts of Indian civilization like purusharthas, law of karma, etc, which contributes towards personality growth.

CO3: Gain a positive appreciation of Indian culture, traditions, customs and practices

CO4: Imbibe spirit of living in harmony with nature, and principles and practices of Yoga

CO5: Get guidelines for healthy and happy living from the great spiritual masters

CO-PO Mapping:

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

TEXTBOOKS:

1. *The Glory of India (in–house publication)*
2. *The Mother of Sweet Bliss (Amma's Life & Teachings)*

15MAT121 VECTOR CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS 3 1 0 4

Unit 1

Vector Differentiation: Vector and Scalar Functions, Derivatives, Curves, Tangents, Arc Length, Curves in Mechanics, Velocity and Acceleration, Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field. (Sections: 9.4, 9.5, 9.6, 9.9, 9.10, 9.11)

Vector Integration: Line Integral, Line Integrals Independent of Path. Green's Theorem in the Plane (Sections: 10.1, 10.2, 10.3, 10.4).

Unit 2

Surface Integral: Surfaces for Surface Integrals, Surface Integrals, Triple Integrals – Gauss Divergence Theorem, Stoke's Theorem. (Sections: 10.5, 10.6, 10.7, 10.9)

First Order Differential Equations: First Order ODE, Exact Differential Equations and Integrating Factors (Sections 1.1and 1.4).

Unit 3

Second Order Differential Equations: Homogeneous and non-homogeneous linear differential equations of second order (Review), Modelling: Free Oscillations, Euler-Cauchy Equations, Solution by Undetermined Coefficients, Solution by the Method of Variation of Parameters (Sections 2.1, 2.2, 2.4, 2.5, 2.6, 2.7, 2.10).

System of Order Differential Equations: Basic Concepts and Theory, Constant Coefficient systems – Phase Plane method, Criteria for Critical Points, Stability. (Sections 4.1 – 4.4).

Outcomes:

CO 1: Able to understand, and interpret the concepts.

CO 2: Able to apply the concept and understand them

CO 3: Able to understand and implement the concepts in application oriented problems.

CO 4: Able to understand and analyze the and apply the knowledge of diagonalization of matrices to transform the given quadratic form.

CO5: Able to understand the basic concepts and apply them in modeling the first order ODEs.

CO6: Able to understand and apply methods of undetermined coefficients and variation of parameters to solve second order ODEs.

CO –PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	-	-	-	-	-	-	1
CO2	1	3	1	-	-	-	-	-	-	-	-	1
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-	-

TEXTBOOK:

'Advanced Engineering Mathematics', Erwin Kreyszig, John Wiley and Sons, Tenth Edition, 2015.

REFERENCE BOOKS:

1. *'Advanced Engineering Mathematics', Dennis G. Zill and Michael R. Cullen, second edition, CBS Publishers, 2012.*
2. *'Calculus', G. B. Thomas Pearson Education, 2009, Eleventh Edition.*
3. *'Calculus', Monty J. Strauss, Gerald J. Bradley and Karl J. Smith, 3rd Edition, 2002.*

15CSE102 Computer Programming 3 0 0 3

Objectives:

- The course intends to familiarize the students with the structured programming paradigm.
- The course aims to provide necessary skills to students to apply the structured programming principles to solve problems

Keywords:

Contents:

Introduction to C language: Structure of a C program, comments, Data types, variables, constants, data input and output statements, input assertions; expressions and evaluation. Functions: inter function communication, standard functions, scope. Selection: two way selection, multi-way selection. Repetition: concept of loop, loop invariant, pretest and posttest loops, initialization and updating, event and counter controlled loops. Recursion: recursive definition, recurivse solution, designing recursive functions, limitations of recursion.

Files and streams, file input output, Arrays –1D numeric, searching and sorting, 2D numeric arrays, problems with matrices. Pointers: introduction, compatibility, arrays and pointers, Dynamic memory allocation, arrays of pointers, pointer arithmetic.

Strings: fixed length and variable length strings, strings and characters, string input, output, array of strings, string manipulation functions, sorting of strings. Enumerated types, Structres: structure vs array comparison, complex structures, structures and functions, Union, binary input output, command line arguments.

Outcomes:

CO1: Understand the structured programming constructs: data types (primitive and compound), control and recursion thereby to understand a given program

CO2: Understand and analyze a given program by tracing, identify coding errors and debug them

CO3: Apply structural programming constructs appropriately for given problem scenarios

CO4: Develop computer programs that implement suitable algorithms for problem scenarios and applications

CO-PO Mapping:

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

TEXTBOOK/ REFERENCES:

1. Behrouz A. Forouzan and Richard*Computer*F*Science*.Filberg,*AStructuredProgramming*" *Approach Using*

   C",Third Edition, Cengage Learning, 2006.

2. Brian W. Kernighan *The*and*CProgramming*Dennis*Language*M.",RitSe**c**hie,ond Edition,"

   1988.
3. Eric S. Roberts, *"Art and Science,*AddisonWesley,*of*1995.*C"*

   Jeri Hanly and Elliot Koffman, *"Problem Solving and,*Fifth*Program*Edition,Addison Wesley*Design i* (Pearson), 2007.

15ECE111 **SOLID STATE DEVICES** **3 0 0 3**

(Pre Requisites Nil)

Objectives:

- To enable understanding and application of physics that govern semiconductors
- To provide fundamental knowledge on electron transport and working principles of PN junctions
- To prepare the students towards higher learning of solid state electronic devices

Keywords:

Semiconductor materials, Charge carriers, Diffusion, Diode, MOSFET

Contents:

Introduction to Semiconductor materials, Crystal Structure of Silicon and GaAs –Planes –directions - planes and planar atomic densities - Unit cell characteristics - Review of Quantum Mechanics –Dual Nature of Light and Electrons - Bohr model of atom, Uncertainty Principle - Time dependant and Time independent Schrodinger Wave equation - Infinite Potential well problem - Step Potential Function - Tunneling.

Molecular Orbital theory and formation of energy bands in semiconductors - Direct and Indirect band gap semiconductors - Charge carriers - Effective mass - Extrinsic and intrinsic semiconductors - Fermi Dirac Statistics and Fermi Level - Boltzman Statistics - Density of states - Equilibrium Carrier concentrations - Drift velocity and mobility - Temperature dependence of carrier concentration – mobility - and conductivity - Hall effect - Excess Carriers and photoconductivity - Diffusion of Carriers - Built in fields.

Direct and indirect recombination - excess carrier lifetime - Steady State Carrier generation - Quasi Fermi levels - Continuity Equation - Haynes Shockley experiment - Equilibrium PN junctions - Band diagram - built in potential and electric field in space charge region - depletion width - Forward and Reverse Biased PN junction - Ideal Diode equation - Reverse bias breakdown - PN Junction diodes - MOSFET Physics - Threshold voltage - Fundamentals of BJT physics.

Outcomes:

CO1: Able to understand the fundamentals of solid state physics and quantum mechanics
CO2: Able to understand the basics and the nature of semiconducting materials

CO3: Able to apply the physics to comprehend the manifestation of charge carriers in a semiconductor
CO4: Able to describe the flow of charge in p-type and n-type semiconductors

CO5: Able to acquire and analyze the knowledge on the working principles of PN Junction-based devices

CO-PO Mapping:

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

TEXT BOOKS/
REFERENCES:

1. Ben G. Streetman and Sanjay Kumar Banerjee, *"Solid State Electronic Devices"*, PrenticeHallIndia, Sixth Edition, 2009.
2. Donald A. Neamen, *"Semiconductor Physics and Devices:* McGraw-Hill International, Third Edition, 2003.
3. S. M. Sze and Kwok K. NG, *"Physics of Semiconductor Devices"* JohnWileyandSons,Inc., ThirdEdition,2007.
4. S. O. Kasap, *"Principles of Electronic Materials and Devices"* TataMcGraw Hill, ThirdEdition,2007.

15ECE112 FUNDAMENTALS OF ELECTRICAL TECHNOLOGY 3 1 0 4

Objectives:

- To enable review of fundamental laws of electricity

- To introduce basic laws of circuit theory to do DC, transient and AC analysis
- To impart knowledge about the working of machines and instruments

Keywords:

Mesh analysis, nodal analysis, network, phase, magnetic induction

Contents:

Introduction to Electrical Power System - Ideal Independent Current and Voltage Sources - Reference Directions and Symbols –Resistance - Inductance - Capacitance - Ohm‟s law,‟s Kirchhoff-lawEnergyandPower - Series parallel combination of R,L and C Components - DC Series - Parallel Circuits - Voltage Divider and Current Divider Rules - Superposition Theorem - Network Analysis - Mesh and Node methods - Generation of sinusoidal voltage –Instantaneous - Average and effective values of periodic functions - Phasor representation.

Reactance and Impedance - Response in RLC circuits to sinusoidal voltage - Real and Reactive Power - Power factor - Complex Power and Power Triangle: Introduction to Three Phase Systems - Balanced 3-Phase STAR and DELTA connections of Load - Three phase power.

Measuring Instruments for AC and DC quantities: Instruments to measure Voltage –Current - Power and Energy - Electromagnetic Induction - Magnetic Circuit Elements - Self and Mutual Inductances - Classification and Applications of Electrical Machines –Torque - Output Power and Efficiency. 3-Phase Induction Motor: Principle of operation –Slip – Torque - Speed relation. Single Phase and Three Phase Transformers - Principle of Operation - Turns ratio and connections.

Outcomes:

CO1: Able to formulate equations of circuit and its components based on fundamental laws

CO2: Able to understand the circuit parameters in steady state and transient conditions

CO3: Able to analyse the behaviour and evaluate the circuit parameters in single-phase and three phase systems

CO4: Able to comprehend three-phase induction motor and transformer

CO5: Able to analyse the characteristics of measuring instruments

CO –PO Mapping:

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

TEXTBOOK/ REFERENCES:

1. Edward Hughes, Electrical Technology, Pearson Education Asia, Seventh Edition 2011.
2. A. P. Malvino, “Electronic Principles”, Tata McGraw Hill, Seventh Edition, 2007.
3. S K Bhattcharya, “Basic Electrical and Electronics Engineering, Pearson, 2012.
4. Vincent Del Toro, “Electrical Engineering Fundamentals”, Prentice Hall of India Private Limited, Second Edition, 2003.
5. David A Bell, “Electronic Devices and Circuits”, Oxford University Press, Fifth Edition, 2008.
6. Michael Tooley B.A, “Electronic Circuits: Fundamentals and Applications”, Elsevier Ltd, Third Edition, 2006.

15CSE180 Computer Programming Laboratory 0 0 2 1

Objectives:

- The laboratory intends to provide hands-on experience on the structured programming paradigm.
- This laboratory facilitates students to apply the structured programming principles to solve problems

Keywords:

Contents:

Solving simple problems with operators, programs on conditional control constructs, programs on loops (while, do-while and for), programs using user-defined functions and library functions, programs on files, arrays (single and multi-dimensional), programs using DMA, programs on strings, structures.

Outcomes:

CO1: Develop solutions for problems systematically using structured logic approach.

CO2: Develop computer programs for a given problem scenario.

CO3: Make use of the programming constructs effectively while developing computer programs.

CO4: Develop modular solutions for a given scenario.

CO-PO Mapping:

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

TEXT BOOKS/REFERENCES:

Behrouz A. ForouzanComputerand ScienceRichardAStructured ProgrammingF.Filberg,

Approach"Third Edition, Cengage Learning, 2007.

15CUL111 Cultural Education II 2 0 0 2

Objectives:

The students will be able to deepen their understanding and further their knowledge about the different aspects of Indian culture and heritage.

Keywords:

Education,Personality, Oneness, Bhagavadgita

Contents:

Unit 1

1. Relevance of Sri Rama and Sri Krishna in this Scientific Age
2. Lessons from the Epics of India
3. Ramayana & Mahabharata

Unit 2

4. Who is a Wise Man?
5. A Ruler's Dharma
6. The Story of KingShibi

Unit 3

7. Introduction to the Bhagavad Gita
8. Bhagavad Gita – Action without Desire

Unit 4

9. Role and Position of Women inIndia
10. The Awakening of Universal Motherhood

Unit 5

Patanjali'sAstanga -Yoga System for Personality Refinement

11. Examples of Heroism and Patriotism in Modern India

Outcomes:

CO1: Get an overview of India and her contribution to the world in the field of science and literature

CO2: Understand the foundational concepts of ancient Indian education system and practices associated with them

CO3 : Learn the important concepts of Vedas, Bhagavad-Gita and Yogasutras and their relevance to daily life

CO4 : Familiarize themselves with the inspirational characters and anecdotes from the epics and Indian history

CO5 : Gain a rational understanding of the underlying principles of Indian spirituality

CO-PO Mapping:

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

TEXT BOOKS/REFERENCES:

1. The Vedas - Sri ChandrasekharendraSaraswati

2. A Concise history of Science in India - D. M. Bose, S. N. Sen. B. V. Subbarayappa

15ECE201 APPLIED *ELECTROMAGENTICS* 3 1 0 4

Objectives:

- To enable understanding of the electromagnetic phenomena, and its relevance to electronics and communication engineering

- To introduce the concepts of electric current and fields
- To inculcate knowledge on mathematical models involved in field description and analysis
- To emphasize the role of electromagnetics in evolution of present day technology.

Keywords:

Electric field, Magnetic Field, Charge, Current, Medium, Plane Electromagnetic Wave

Contents:

Static Electric Fields:Co-ordinate systems –Review - Line integral - Surface integral –Gradient – Divergence - Curl-Stoke‟s- Divergencetheorem - Helmholtz theorem- Electrostatics - Postulates - Coulomb‟s-Gauss law-Electric potential - Behaviour of conductors and dielectric in static fields - Dielectric constant - Poisson‟s and L equation.

Steady currents and magnetic fields: Current density - Point form –ofContinuityOhm‟sequation - lawLorentz force - Magneto statics –Postulates - Magnetic vector potential –Biot - savart law - Relative permeability - Hall effect.

Electromagnetic Fields:-Maxwell‟sFaraday‟s-DifferentialequationsandwIntegralof FormsInduction-Boundary Conditions for electromagnetic fields - Wave equation - Time harmonic electromagnetic fields.

Outcomes:

CO1: Able to understand basic mathematical tools required for describing and analyzing Field Effect.

CO2: Able to describe the relation between circuit parameters, field parameters, and laws governing them, in both static and time varying conditions.

CO3: Able to understand Plane Wave model and Wave –Medium Interaction. .

CO4: Able to construct Plane Wave propagation Model for a medium.

CO5: Ability to analyze wave-medium interaction and interpret its relevance for that particular electrical engineering application.

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	-	2	-	-	-	-	-	-	-	-	3	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	3	2
CO5	2	2	-	2	-	-	-	-	2	2	-	2	3	2

TEXT BOOKS/REFERENCES:

1. David K. Cheng, "Field and Wave Electrodynamics", Pearson Education, Second Edition, 2002.
2. Clayton R. Paul, Keith W. Whites, Syed A. Naser, " *Introduction to Electromagnetic Fields*", Tata McGraw-Hill Education Private Limited, Third Edition (Fifth Reprint), 2009.
3. Kraus Fleish, "*Electromagnetics with Applications*", Tata McGraw Hill Education Private Limited, Fifth Edition, 2004.

15ECE202 Digital Circuits And Systems 3 1 0 4

Objectives:

- To introduce the fundamentals of Boolean Logic and the building blocks of digital circuits

- To enable understanding of abstraction of simple practical problems into Boolean Logic and their efficient implementation

- To impart fundamental knowledge of design with combinational and sequential subsystems

Keywords:

Boolean Logic, Boolean Minimization, Combinational and Sequential Circuits

Contents:

Introduction to logic families: ECL –TTL - Tri state logic. Implementation technology: Transistor switches - NMOS logic gates - CMOS logic gates - Negative logic systems. Introduction to logic circuits: Variables and functions, inversion - Truth tables - Logic gates and Networks - Boolean algebra - Synthesis using gates - Design examples - Optimized implementation of logic functions: Karnaugh map - Strategy for minimization - Minimization of product of sums forms - Incompletely specified functions - Multiple output circuits - Tabular method for minimization - Number representation and arithmetic circuits**:** Addition of unsigned numbers - Signed numbers - Fast adders.

Combinational circuit building blocks: Multiplexers - Decoders - Encoders - Code converters - Arithmetic comparison circuits. Sequential circuit building blocks: Basic latch - Gated SR latch - Gated D latch - Master slave and edge triggered - D flip-flops - T flip-flop - JK flip-flop - Registers - Counters - Reset synchronization - Other types of counters.

Synchronous sequential circuits: Basic design steps - State assignment problem - Mealy state model - Serial adders - State minimization. Asynchronous sequential circuits: Analysis of asynchronous circuits.

Outcomes:

CO1: Able to understand the basics of Boolean logic and the number system and codes for representing Boolean variables.

CO2: Able to frame Boolean equations and truth tables for formalizing real-life phenomena

CO3: Able to apply the basics of Boolean logic and the number system and codes for representing Boolean variables.

CO4: Able to comprehend the design and working of basic combinational and sequential subsystems
CO5: Able to analyze and design sequential systems with minimal functionality

CO –PO Mapping:

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

TEXTBOOK:

Stephen Brown, ZvonkoVranesic, "Fundamentals of Digital logic with Verilog Design", Tata McGraw Hill Publishing Company Limited, Special Indian Edition, 2007.

REFERENCES:

1. Morris Mano, Michael D. Ciletti "Digital Design – with introduction to Verilog HDL", Pearson Education, Fifth Edition, 2011.
2. Charles H., Jr. Roth, LizyKurian John, Beyond Kill Lee, "Digital System Design Using Verilog", Cengage Learning, 2015.
3. Donald D Givone, "Digital Principles and Design", Tata McGraw Hill Publishing Company Limited, 2003.

15ECE 203 **NETWORK THEORY** **3 0 0 3**

Pre Requisite(s): Nil

Objectives :

- To enable review of the concepts of mesh and nodal analysis

- To introduce the different network theorems for DC and AC analysis
- To introduce transient analysis of first order and second order circuits
- To impart knowledge on basic concepts of filters and filter design

Keywords:

Mesh analysis, nodal analysis, network theorems, network parameters.

Contents:

Practice of Mesh Current and Node Voltage analysis of circuits with independent and dependent sources. Network Reduction: Source transformation - Star-Delta transformation. Network Theorems: Thevenin and Norton‟s - Superpositiontheoremstheorem - maximum power transfer theorem - Tellegan‟s theo Reciprocity theorem. Introduction to Graph Theory –Definitions - Incidence matrix - Fundamental tie-set matrix - Fundamental cutest matrix - Formulation of network equations using KCL and KVL.

Transient Analysis:

Time domain analysis of first and second order circuits - with DC Excitation - Frequency response of Series and Parallel circuits - Resonance - Q-factor and Bandwidth. Steady State Analysis of single phase AC circuits: Phasor representation and analysis of circuits applying network theorem; Power factor – power factor correction. Self and mutual Inductance - Coupled circuits –dot convention.

Two-port Networks and Filters –Voltage and Current ratios of two port networks –Admittance – impedance - hybrid and transmission parameters of two port networks. Passive filters as two port networks - Transient response and reduction of overshoot, sensitivity. Active filters: poles and zeros, filter design. Attenuators: Image and scattering parameters, insertion loss. Various types of attenuators.

Outcomes:

CO1: Able to understand the basic concepts of DC and AC networks.

CO2: Able to formulate and analyze the network equations.

CO3: Able to analyze electrical networks under steady state and transient conditions.

CO4: Able to design and analyze passive filter circuits.

CO –PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO **2**
CO1	3	2	-	-	-	-	-	-	-	-	-	2	2	-
CO2	3	-	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	2	-

TEXTBOOKS:

1. Charles K Alexander, Mathew N. O. Sadiku, "Fundamentals of Electric circuits", Tata McGraw-Hill, 2003.
2. John D. Ryder, Myril Baird Reed and W. L. Everitt, "Foundation for Electric Network Theory", Prentice Hall of India, Second Edition, 2013.

REFERENCES:

1. M. E. Van Valkenburg, "Network Analysis", Prentice Hall India Private Limited, Third Edition, 1999.
2. K. V. V. Murthy, M. S. Kamath, "Basic Circuit Analysis", Tata McGraw Hill Publishing Company Limited, 2006.
3. D. Roy Chaudhary, "Networks and Systems", New Age International Publisher, 2003
4. N. Balabanian, T. Bickart, "Linear Network Theory: Analysis, Properties, Design and Synthesis",Matrix Publishers Inc., 1981.

15ECE204 SIGNAL PROCESSING I 3 1 0 4

Objectives:

- To introduce signal characterization in time domain

- To give exposure to frequency domain analysis of signals
- To provide insight to analysis of systems in time and frequency domains

Keywords:

Signal classification, System characterization, Transform analysis

Contents:

Introduction: Integrated approach for continuous-, discrete-time cases.

Signals: Classification of signals, continuous –discrete time; even/odd signals, periodic/nonperiodic signals, deterministic/random signals, energy/power signals: Basic operations on signals: Basic (continuous/discrete) signals –unit step, unit impulse, sinusoidal and complex exponential signals etc. Systems (continuous/discrete): Representation, classification –linear/nonlinear, causal/ noncausal, time invariant/time variant, with/without memory - BIBO stability, feedback systems. LTI system response of LTI system - convolution, properties (continuous/ discrete) - LTI systems –differential/difference equation representation.

Fourier Series: Fourier series - Half range Expansions - Parseval‟s-TransformIdentityintegrals-Fourier Integrals - Fourier integral theorem. Sine and Cosine Integrals. Fourier analysis of continuous time signals and systems: Fourier series for periodic signals - Sine and Cosine Transforms - Fourier transform –properties of continuous time FT - Sampling: Sampling theorem - reconstruction of signal –aliasing.

Laplace Transform analysis of systems: Laplace Transforms, Inverse Transforms, Linearity, Shifting, Transforms of Derivatives and Integrals –ROC - inverse LT - unilateral LT - Frequency response of continuous time LTI systems, response of electronic circuits with initial conditions using Lapalce transforms. Z-Transform: Definition –ROC - inverse z-transform –properties - transform analysis of LTI Systems - Frequency response of discrete time LTI systems. Inter relationship between different representations and transforms.

Outcomes:

CO1: To understand time-domain characteristics of signals

CO2: To apply transform techniques to analyze signals

CO3: To apply time and frequency domain techniques for determining system response

CO4: To analyze behaviour of linear time invariant systems

CO –PO Mapping:

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

TEXTBOOKS:

1. *Alan V. Oppenheim, Alan S. Wilsky, S, Hamid Nawab, "Signals and Systems". Prentice Hall India private Limited, Second Edition, 1997.*
2. *E Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, Ninth Edition, 2012.*

REFERENCES:

1. Simon Haykin, Barry Van Veen, "Signals and Systems", Second Edition, John Wiley and Sons, 2005.
2. Lathi B P, " Signal Processing & Linear Systems", Oxford University Press, 2006
3. Michael J. Roberts, "Fundamentals of Signals and systems", Tata McGraw Hill Publishing Company Limited, First Edition, 2007.
4. Rodger E. Ziemer, William H. Tranter D. Ronal Fannin, "Signals and Systems", PearsonEducation, Fourth Edition, 2004.

15MAT202 **Linear Algebra** **2 1 0 3**

(Pre-Requisite: Nil)

Objectives:

- Understand real vector spaces and subspaces and apply their properties.
- Understand linear independence and dependence.
- Find the basis and dimension of a vector space, and understand the change of basis.

- Find a basis for the row space, column space and null space of a matrix and find the rank and nullity of a matrix.
- Compute linear transformations, kernel and range, and inverse linear transformations, and find matrices of general linear transformations.
- Find the dimension of spaces such as those associated with matrices and linear transformations.
- Find eigenvalues and eigenvectors and use them in applications.
- Diagonalize, and orthogonally diagonalize symmetric matrices
- Evaluate the dot product, norm, the angle between vectors, and orthogonality of two vectors in Rn .

- Compute inner products on a real vector space and compute angle and orthogonality in inner product spaces.
- Create orthogonal and orthonormal bases: Gram-Schmidt process and use bases and orthonormal bases to solve application problems.

Keywords:

Vector space, sub-space, linear independence, linear dependence, orthogonality.

Contents:

Vector Spaces: Vector spaces - Sub spaces - Linear independence - Basis - Dimension - Inner products - Orthogonality - Orthogonal basis - Gram Schmidt Process - Change of basis - Orthogonal complements - Projection on subspace - Least Square Principle.

Linear Transformations: Positive definite matrices - Matrix norm and condition number - QR-Decomposition - Linear transformation - Relation between matrices and linear transformations - Kernel and range of a linear transformation - Change of basis - Nilpotent transformations - Similarity of linear transformations - Diagonalisation and its applications - Jordan form and rational canonical form.

Outcomes:

CO1: Understand the basic concepts of vector spaces, subspaces, linear independence, span, basis and dimension and analyze such properties on the given set.

CO2: Understand the concept of inner products and apply it to define the notion of length, distance, angle, orthogonality, orthogonal complement, orthogonal projection, orthonormalization and apply these ideas to obtain least square solution.

CO3: Understand the concept of linear transformations, the relation between matrices and linear transformations, kernel, range and apply it to change the basis, to get the QR decomposition, and to transform the given matrix to diagonal/Jordan canonical form.

CO4: Understand the concept of positive definiteness, matrix norm and condition number for a given square matrix.

CO –PO Mapping:

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

TEXTBOOK:

Howard Anton and Chris Rorres, "Elementary Linear Algebra", Tenth Edition, John Wiley & Sons, 2010.

REFERENCES:

1. Gilbert Strang, "Linear Algebra and Its Applications", Fourth Edition, Cengage, 2006.
2. Kenneth Hoffmann and Ray Kunze, Linear Algebra, Second Edition, Prentice Hall, 1971.

15ECE281 Digital Circuits and Systems Lab 0 0 2 1

Objectives:

- To introduce digital components and ICs used as building blocks for realizing larger systems

- To introduce realization and troubleshooting of simple digital circuits using logic gate ICs on the breadboard and verify their truth tables

- To impart knowledge on the use of off-the-shelf components by appropriately configuring them with the help of datasheets for realizing circuits to solve engineering problems

Keywords:

Digital Logic ICs, Boolean Logic Implementation, Digital Circuit Implementation with MSI ICs

Contents:

- Study of Logic Gate ICs
- Realization of Boolean functions using logic gate ICs
- Truth table based design and implementation of simple real life problems
- Implementation of digital systems using MSI building blocks such as adders, multiplexers and decoders
- Breadboard realization of synchronous sequential circuits
- Digital system design and implementation for a real-life problem

Outcomes:

CO 1: Able to identify, configure and use off the shelf digital components

CO 2: Able to realize and troubleshoot combinational and sequential digital circuits

CO 3: Able to employ MSI ICs of appropriate configuration for realizing a digital system

CO 4: Able to design and implement small digital system for a real-life problem

CO –PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO 1	PSO2
CO1	3	2	-	-	-	-	-	-	2	2	-	-	2	-
CO2	3	2	2	-	-	-	-	-	2	2	-	-	2	-
CO3	3	2	2	-	-	-	-	-	2	2	-	-	2	-
CO4	3	2	2	-	-	-	-	-	2	2	-	2	2	2

15ECE282 Signal Processing I Lab 0 0 2 1

Objectives:

- To introduce time and frequency domain analysis of signals and systems
- To inculcate concepts for characterizing systems
- To develop skill set towards visualization of signal processing

Contents:

1. Representation of Sinusoidal Signals and Spectrum.

2. Basic operations on signal.

3. LTI systems –convolutions.

4. Fourier Series Representation of Periodic signals.

5. Continuous time Fourier Transforms

6. Discrete time Fourier Transforms

7. Time and Frequency Response of LTI Systems.

8. Sampling.

9. Term Project.

Outcomes:

CO1: Able to understand the time and frequency domain representation of signals

CO2: Able to apply various transforms for analyzing signals

CO3: Able to analyze linear time invariant systems

CO4: Able to visualize signal processing for basic applications

CO –PO Mapping:

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

15AVP201 / AMRITA VALUES PROGRAMME I / 1 0 0 1
15AVP211 AMRITA VALUES PROGRAMME II 1 0 0 1

Amrita University's Amrita Values Programme (AVP) is a new initiative to give exposure to students about richness and beauty of Indian way of life. India is a country where history, culture, art, aesthetics, cuisine and nature exhibit more diversity than nearly anywhere else in the world.

Amrita Values Programmes emphasize on making students familiar with the rich tapestry of Indian life, culture, arts, science and heritage which has historically drawn people from all over the world.

Students shall have to register for any two of the following courses, one each in the third and the fourth semesters, which may be offered by the respective school during the concerned semester.

Courses offered under the framework of Amrita Values Programmes I and II

Message from Amma's Life for the Modern World

Amma's messages can be put to action in our life through pragmatism and attuning of our thought process in a positive and creative manner. Every single word Amma speaks and the guidance received in on matters which we consider as trivial are rich in content and touches the very inner being of our personality. Life gets enriched by Amma's guidance and She teaches us the art of exemplary life skills where we become witness to all the happenings around us still keeping the balance of the mind.

Lessons from the Ramayana

Introduction to Ramayana, the first Epic in the world – Influence of Ramayana on Indian values and culture – Storyline of Ramayana – Study of leading characters in Ramayana – Influence of Ramayana

outside India – Relevance of Ramayana for modern times.

Lessons from the Mahabharata

Introduction to Mahabharata, the largest Epic in the world – Influence of Mahabharata on Indian values and culture – Storyline of Mahabharata – Study of leading characters in Mahabharata – Kurukshetra War and its significance - Relevance of Mahabharata for modern times.

Lessons from the Upanishads

Introduction to the Upanishads: Sruti versus Smrti - Overview of the four Vedas and the ten Principal Upanishads - The central problems of the Upanishads – The Upanishads and Indian

Culture – Relevance of Upanishads for modern times – A few Upanishad Personalities: Nachiketas, Satyakama Jabala, Aruni, Shvetaketu.

Message of the Bhagavad Gita

Introduction to Bhagavad Gita – Brief storyline of Mahabharata - Context of Kurukshetra War – The anguish of Arjuna – Counsel by Sri. Krishna – Key teachings of the Bhagavad Gita
– Karma Yoga, Jnana Yoga and Bhakti Yoga - Theory of Karma and Reincarnation – Concept of Dharma – Concept of Avatar - Relevance of Mahabharata for modern times.

Life and Message of Swami Vivekananda

Brief Sketch of Swami Vivekananda's Life – Meeting with Guru – Disciplining of Narendra - Travel across India - Inspiring Life incidents – Address at the Parliament of Religions – Travel in United States and Europe – Return and reception India – Message from Swamiji's life.

Life and Teachings of Spiritual Masters India

Sri Rama, Sri Krishna, Sri Buddha, Adi Shankaracharya, Sri Ramakrishna Paramahamsa, Swami Vivekananda, Sri Ramana Maharshi, Mata Amritanandamayi Devi.

Insights into Indian Arts and Literature

The aim of this course is to present the rich literature and culture of Ancient India and help students appreciate their deep influence on Indian Life - Vedic culture, primary source of Indian Culture – Brief introduction and appreciation of a few of the art forms of India - Arts, Music, Dance, Theatre.

Yoga and Meditation

The objective of the course is to provide practical training in YOGA ASANAS with a sound theoretical base and theory classes on selected verses of Patanjali's Yoga Sutra and Ashtanga Yoga. The coverage also includes the effect of yoga on integrated personality development.

Kerala Mural Art and Painting

Mural painting is an offshoot of the devotional tradition of Kerala. A mural is any piece of artwork painted or applied directly on a wall, ceiling or other large permanent surface. In the contemporary scenario Mural painting is not restricted to the permanent structures and are being done even on canvas. Kerala mural paintings are the frescos depicting mythology and legends, which are drawn on the walls of temples and churches in South India, principally in Kerala. Ancient temples, churches and places in Kerala, South India, display an abounding tradition of mural paintings mostly dating back between the 9th to 12th centuries when this form of art enjoyed Royal patronage. Learning Mural painting through the theory and practice workshop is the objective of this course.

Course on Organic Farming and Sustainability

Organic farming is emerging as an important segment of human sustainability and healthy life. Haritamritam' is an attempt to empower the youth with basic skills in tradition of organic farming and to revive the culture of growing vegetables that one consumes, without using chemicals and pesticides. Growth of Agriculture through such positive initiatives will go a long way in nation development. In Amma's words "it is a big step in restoring the lost harmony of nature".

Benefits of Indian Medicinal Systems

Indian medicinal systems are one of the most ancient in the world. Even today society continues to derive enormous benefits from the wealth of knowledge in Ayurveda of which is recognised as a viable and sustainable medicinal tradition. This course will expose students to the fundamental principles and philosophy of Ayurveda and other Indian medicinal traditions.

Traditional Fine Arts of India

India is home to one of the most diverse Art forms world over. The underlying philosophy of Indian life is 'Únity in Diversity" and it has led to the most diverse expressions of culture in India. Most art forms of India are an expression of devotion by the devotee towards the Lord and its influence in Indian life is very pervasive. This course will introduce students to the deeper philosophical basis of Indian Art forms and attempt to provide a practical demonstration of the continuing relevance of the Art.

Science of Worship in India

Indian mode of worship is unique among the world civilisations. Nowhere in the world has the philosophical idea of reverence and worshipfulness for everything in this universe found universal acceptance as it in India. Indian religious life even today is a practical demonstration of the potential for realisation of this profound truth. To see the all-pervading consciousness in everything, including animate and inanimate, and constituting society to realise this truth can be seen as the epitome of

civilizational excellence. This course will discuss the principles and rationale behind different modes of worship prevalent in India.

Outcomes:

CO1: Appreciate the significance of *Rāmāyaṇa* as an *itihāsa,* and important aspects of *Bālakāṇḍa*.

CO2: Understand the family values and ideal human relationships portrayed in the *Ayodhyakāṇḍa* and *Aranyakāṇḍa* of *Rāmāyaṇa*.

CO3: Understand *dharma* and its nuances, emphasizing its applicability in an individual's life through *Kishkindhakāṇḍa* and *Sundarakāṇḍa* of Ramayana.

CO4: Appreciate the triumph of *dharma* over *adharma* through *Yuddhakāṇḍa*of *Rāmāyaṇa*

CO5: Appreciate the spiritual values from *Rāmāyaṇa* in resolving personal and social conflicts through varied effective presentations of important episodes of the *Rāmāyaṇa*

CO-PO Mapping:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	-	-	-	-	-	2	2	3	3	3	-	3	-	-
CO2	-	-	-	-	-	3	3	3	3	2	-	3	-	-
CO3	-	-	-	-	-	3	2	3	3	3	-	3	-	-
CO4	-	-	-	-	-	3	-	3	3	3	-	3	-	-
CO5	-	-	-	-	-	3	-	3	3	2	-	3	-	-

15ECE211 **Electronic Circuits** **3 1 0 4**

(Pre-Requisite: *15ECE111 Solid State Devices*)

Objectives:

•To be able to use a pn junction diode in simple applications •To be able to operate a BJT in different configurations •To be able to understand the operation of a MOSFET

Keywords:

Semiconductor Diodes, Bipolar junction transistors, Field effect transistors.

Contents:

Diode Fundamentals: Diode characteristics - Physics of diode operation and modeling of diodes. Diode applications: Rectifiers - Clipper and clamper circuits - Voltage multipliers - Voltage regulator using Zener diode.

Bipolar junction transistors: Introduction - Operation of BJT - I-V characteristics of BJT. BJT Applications: BJT biasing techniques - Analysis of BJT as a switch and as an amplifier - Small signal analysis - Single stage BJT amplifiers (CE, CB, CC) - BJT high frequency models and amplifier frequency analysis.

Field effect transistors: Introduction - Device structure and operation of JFET (Junction Field Effect Transistor) and MOSFETs - I-V characteristics of JFET and MOSFET - MOSFET applications - MOSFET biasing techniques - Analysis of MOS as a switch and as an amplifier - Small signal analysis - Single stage MOS amplifiers (CS, CD, CG) MOS capacitances - MOS high frequency and model and amplifier frequency analysis.

Outcomes:

CO1: To understand the structure of a pn junction diode, its characteristics and modelling

CO2: Ability to use diodes and analyse their small signal operation

CO3: To understand the characteristics of a BJT and its operation

CO4: Understanding the biasing of a BJT and simple applications

CO5: Understanding of the structure and operation of MOSFETs

CO –PO Mapping

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

TEXTBOOK:

Sedra A and Smith K C, "Microelectronic circuits", Sixth Edition, Oxford University Press, 2010.

REFERENCES:

1. Neamen D A, "Electronic circuit analysis and design", McGrawHill, 2001.

2. Boylestad R L and Nashelsky L, "Electronic devices and circuit theory", Upper Saddle River N.J., Pearson/Prentice Hall, Tenth Edition, 2009.

15ECE212 **Signal Processing II** **3 1 0 4**

(Pre Requisite(s):15ECE204 Signal Processing 1)

Objectives:

- To introduce digital filter design concepts
- To provide knowledge in efficient transforms for signal analysis
- To impart the fundamental concepts on structures for realizing filters

Contents:

Discrete Fourier transforms - properties of DFT –linear filtering methods based on DFT –Fast Fourier Transform –efficient computation of the DFT–correlation –use of FFT in linear filtering and correlation.

FIR filters: symmetric and anti-symmetric FIR filters –design of linear phase FIR filter using Windows –FIR differentiators –Hilbert transforms –linear phase FIR filters- Structures for FIR systems –direct form structures - Linear phase and cascade form structures- applications.

IIR filters: design by approximation of derivatives – impulse invariance and Bilinear transformation – Butterworth filter- frequency transformations for analog and digital filters - Structures for IIR systems-direct form structures - cascade form structures - parallel form structures- applications.

Outcomes:

CO1: Able to understand algorithms for efficient computation of transforms

CO2: Able to design digital filters with desired characteristics

CO3: Able to comprehend structures for filter realization

CO4: Able to characterize and analyze digital systems

CO –PO Mapping:

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

TEXT BOOKS/ REFERENCES:

John G Proakis, G. Manolakis, "Digital Signal Processing Principles, Algorithms, Applications", Prentice Hall India Private Limited, Fourth Edition, 2007.

REFERENCES:

1. Sanjit K. Mitra, "Digital Signal Processing. A Practical approach", Tata McGraw Hill Publishing Company Limited, 2005.
2. Allen V. Oppenheim, Ronald W. Schafer, "Discrete time Signal Processing", Prentice Hall India

Private Limited, Fifth Edition, 2000.

15ECE213 TRANSMISSION LINES AND WAVEGUIDES 3 0 0 3

(Pre requisite: 15ECE201 Applied Electromagnetics)

Objectives:

- To enable understanding of electrical energy propagation and appreciate existence of two forms including wave and current
- To introduce mathematical models related to study of electrical energy transfer mechanism
- To enable knowledge development on parametric analysis of different energy transfer structures.

Keywords:

Poynting vector, Propagation Mode, Cut off frequency,Transmission Line, Wave guide,

Contents:

Plane Wave Theory:Plane waves in lossless and lossy media –Types of media –Skin effect –Poynting vector and group velocity –Normal incidence at conducting and dielectric boundary –Brief review of oblique incidence.

Transmission line theory:TEM wave along parallel plate line –Transmission line parameters –General equations –Infinite line concept –Transmission line parameters –Finite line properties –Input impedance – Smith chart calculations –Transmission line impedance matching techniques –Stub matching.

Wave Guiding Systems: Transverse Electric (TE) and Transverse Magnetic(TM) modes – Electromagnetic waves between parallel plates (TE and TM) –Properties –Rectangular waveguides – TE and TM waves in rectangular waveguides –Properties - Attenuation in waveguides.

Outcomes:

CO1: Able to understand concept of Electrical Energy transfer in both Current and Field form.

CO2: Able to understand Transmission Line Model of Energy transfer

CO3: Able to understand Guided Wave model

CO4: Able to interpret the parameters and analyze the performance of a electrical energy transmission system

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	2
CO2	3	2	-	2	-	-	-	-	-	-	-	-	3	2
CO3	3	2	-	2	-	-	-	-	-	-	-	-	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	-	3	2

TEXTBOOK:

1. *David K.Cheng, "Field and Wave Electromagnetics", Pearson Education, Second Edition, 2002.*

REFERENCES:

1. Clayton R. Paul, Keith W. Whites, Syed A. Nasar, "Introduction to Electromagnetic Fields", Tata McGraw-Hill Education Private Limited, Third Edition (Fifth Reprint), 2009.
2. John Daniel Kraus , Daniel A. Fleisch, "Electromagnetics with Applications", Tata McGraw Hill Education Private Limited, Fifth Edition, 2004.

15MAT213 **Probability and Random Processes** **3 1 0 4**

(Pre-Requisite: Nil)

Objectives:

- To understand the basic concepts of probability, types of random variables and their

distribution functions.

- To study some of the standard discrete and continuous distributions and their properties.
- To study joint variation of random variables and how they depend on each other.
- To study random process, its different interpretations, classification, relation between member functions, stationarity of different levels.
- To understand meaning of ergodicity, power spectral density, relation between autocorrelation and PSD
- To study Markov chain its properties and its applications to real problems

Keywords:

Probability, Random variables, Distribution functions, Random Processes, Markov Chains.

Contents:

Review of probability concepts - conditional probability- Bayes theorem.

Random Variable and Distributions: Introduction to random variable –discrete and continuous random variables and its distribution functions- mathematical expectations –moment generating function and characteristic function - Binomial, Poisson, Geometric, Uniform, Exponential, Normal distribution functions (moment generating function, mean, variance and simple problems) –Chebyshev‟s theorem.

Random processes: General concepts and definitions - stationarity in random processes - strict sense and wide sense stationary processes - autocorrelation and properties- special processes –Poisson points, Poisson and Gaussian processes and properties.

Systems with stochastic inputs - power spectrum- spectrum estimation, ergodicity –Markov process and Markov chain, transition probabilities, Chapman Kolmogrov theorem, limiting distributions classification of states.

Outcomes:

CO1: Understand the basic concepts of probability and probability modeling.

CO2: Gain knowledge about statistical distributions and their properties

CO3: Know the importance of two dimensional random variables and correlation studies

CO4: Understand the basic concepts of random processes and the stationarity.

CO5: Understand the purpose of some special distributions

CO6: Gain knowledge about spectrum estimation and spectral density function

CO –PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	-	-	-	-	-	-	-	-	3	1
CO2	3	3	1	2	-	-	-	-	-	-	-	-	1	3
CO3	3	3	2	2	-	-	-	-	-	-	-	-	2	3
CO4	3	3	1	2	-	-	-	-	-	-	-	-	1	2
CO5	2	2	2	1	-	-	-	-	-	-	-	-	2	1
CO6	3	3	3	3	-	-	-	-	-	-	-	-	3	3

TEXTBOOKS:

1. Douglas C. Montgomery and George C. Runger, Applied Statistics and Probability for Engineers, (2005) John Wiley and Sons Inc.
2. A. Papoulis, and Unnikrishna Pillai, "Probability, Random Variables and Stochastic Processes", Fourth Edition, McGraw Hill, 2002.

REFERENCE BOOKS:

1. J. Ravichandran, "Probability and Random Processes for Engineers", First Edition, IK International, 2015.
2. Scott L. Miller, Donald G. Childers, "Probability and Random Processes", Academic press, 2012.

15ECE285 Digital Signal Processing Lab 0 0 2 1

Objectives:

- To provide exposure and knowledge on efficient transforms for signal analysis
- To enable design of digital filters using mathematical approaches
- To develop skill set for higher learning in signal processing techniques

Keywords:

Discrete Fourier transforms, Fast Fourier Transform, Finite Impulse Response, Infinite Impulse Response filters.

Contents:

- Familiarization of Simulink
- Effects of Sampling and Aliasing
- Discrete Fourier Transform
- Properties of DFT
- Effective FFT Algorithm
- Linear Filtering using overlap add/save method
- Design of FIR Filter
- Design of IIR Filter
- Term Work

Outcomes:

CO1: Able to analyze the time domain aspects of the signals

CO2: Able to compute frequency domain transforms efficiently

CO3: Able to apply efficient techniques for digital filtering

CO4: Able to demonstrate implementation of signal processing techniques

CO –PO Mapping:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO1 2	PSO1	PSO2
CO1	3	2	2	-	3	-	-	-	2	-	-	2	3	-
CO2	3	2	2	-	3	-	-	-	2	-	-	2	3	2
CO3	3	2	3	-	3	-	-	-	2	-	-	2	3	2
CO4	3	2	3	-	3	-	-	-	2	2	-	2	3	2

15ECE286 ELECTRONIC CIRCUITS LAB. 0 0 2 1

Objectives:

- To be able to efficiently use laboratory equipment
- To be able to understand the use of simple electronic devices and circuits
- To be able to prototype and troubleshoot simple electronic circuits

Keywords:

Diode, voltage regulators, amplifiers

Contents:

P-N junction Diode and Zener Diode Characterization.

Rectifier with and without filters

Clippers / Clampers

Shunt regulator

BJT Characterization

Single stage CE amplifier

Outcomes:

CO1: Ability to use lab equipment, datasheets and handle circuit simulation

CO2: Ability to design, analyse and implement simple diode circuits

CO3: Ability to design, analyse and implement simple BJT circuits

CO4: Ability to implement and troubleshoot simple electronic circuits

CO-PO Mapping:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	2	-	2	-	-	-	2	2	-	3	2	-
CO2	3	3	2	-	2	-	-	-	2	2	-	2	3	-
CO3	3	3	2	-	2	-	-	-	2	2	-	2	3	-
CO4	3	3	3	-	2	-	-	-	2	2	-	2	3	-

15SSK221 SOFT SKILLS I 1 0 2 2

CO#	Course Outcomes	Programme Outcomes
1.	Soft Skills: At the end of the course, the students would have developed self- confidence and positive attitude necessary to compete and challenge themselves. They would also be able to analyse and manage their emotions to face real life situations.	PO8, PO9, PO10, PO12
2.	Soft Skills: At the end of the course, the students would hone their presentation skills by understanding the nuances of content creation, effective delivery, use of appropriate body language and the art of overcoming nervousness to create an impact in the minds of a target audience.	PO9, PO10, PO12
3.	Aptitude: At the end of the course, the student will have acquired the ability to analyze, understand and classify questions under arithmetic, algebra and logical reasoning and solve them employing the most suitable methods. They will be able to analyze, compare and arrive at conclusions for data analysis questions.	PO2, PO4
4.	Verbal: At the end of the course, the students will have the ability to dissect polysyllabic words, infer the meaning, inspect, classify, contextualise and use them effectively	PO10, PO12
5.	Verbal: At the end of the course, the students will have the ability to understand the nuances of English grammar and apply them effectively.	PO10, PO12
6.	Verbal: At the end of the course, the students will have the ability to identify, analyse and interpret relationship between words and use the process of elimination to arrive at the answer. They will also have the ability to judge, evaluate, summarise, criticise, present and defend their perceptions convincingly.	PO9, PO10, PO12

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1								2	3	3		3
CO2									2	3		3
CO3		3		2								
CO4										3		3
CO5										3		3
CO6									3	3		3

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work-environment. Need for change. Fears, stress and competition in the professional world.

Importance of positive attitude, self motivation and continuous knowledge upgradation.

Self-confidence: Characteristics of the person perceived, characteristics of the situation, characteristics of the perceiver. Attitude, values, motivation, emotion management, steps to like yourself, positive mental attitude, assertiveness.

Presentations: Preparations, outlining, hints for efficient practice, last minute tasks, means of effective presentation, language, gestures, posture, facial expressions, professional attire.

Vocabulary building: A brief introduction into the methods and practices of learning vocabulary. Learning how to face questions on antonyms, synonyms, spelling error, analogy, etc. Faulty comparison, wrong form of words and confused words like understanding the nuances of spelling changes and wrong use of words.

Listening skills: The importance of listening in communication and how to listen actively.

Prepositions, articles and punctuation: A experiential method of learning the uses of articles and prepositions in sentences is provided.

Problem solving level I: Number system; LCM &HCF; Divisibility test; Surds and indices; Logarithms; Ratio, proportions and variations; Partnership;

Problem solving level II: Time speed and distance; work time problems;

Data interpretation: Numerical data tables; Line graphs; Bar charts and Pie charts; Caselet forms; Mix diagrams; Geometrical diagrams and other forms of data representation.

Logical reasoning: Family tree; Deductions; Logical connectives; Binary logic; Linear arrangements; Circular and complex arrangement; Conditionalities and grouping; Sequencing and scheduling; Selections; Networks; Codes; Cubes; Venn diagram in logical reasoning; Quant based reasoning; Flaw detection; Puzzles; Cryptogrithms.

TEXTBOOKS:

1. A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.
2. Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.
3. Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.
4. The Hard Truth about Soft Skills, by Amazone Publication.
5. Quantitative Aptitude by R. S. Aggarwal, S. Chand
6. Quantitative Aptitude – Abijith Guha, TMH.
7. Quantitative Aptitude for Cat - Arun Sharma. TMH.

REFERENCES:

1. Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.
2. More Games Teams Play, by Leslie Bendaly, McGraw Hill Ryerson.
3. The BBC and British Council online resources
4. Owl Purdue University online teaching resources www.the grammarbook.com - online teaching resources
www.englishpage.com- online teaching resources and other useful websites.

15ECE301 Communication Theory 3 1 0 4

Objectives:

- To introduce the concepts of amplitude modulations and their spectral characteristics
- To provide the concepts of angle modulations and their spectral characteristics
- To enable comprehension of the effect of noise on communication systems

Keywords:

Amplitude modulation, Angle modulation, Spectral characteristics, Noise analysis.

Contents:

Introduction to analog communication system - Amplitude Modulation (AM) - Double Sideband Suppressed Carrier (DSB-SC) –Single Sideband (SSB) - Quadrature AM (QAM) - Vestigial Sideband (VSB) –Generation and demodulation of AM signal

Frequency Modulation (FM) - Phase Modulation (PM) - Bandwidth of FM signals - Generation and demodulation of FM signals –Frequency Division Multiplexing (FDM) –Super-heterodyne receiver.

Complex low pass representation of narrow band signals - Introduction to random processes - Characterization of noise - Noise analysis of analog modulation systems - Sampling theorem - Time division multiplexing.

Outcomes:

CO1: Able to understand the fundamental principles of signal modulation and demodulation.

CO2: Able to analyze the time domain and frequency domain representations of amplitude and angle modulated signals.

CO3: Able to analyze the effect of noise and other disturbances on analog communication systems.

CO4: Able to apply the concepts of modulation and demodulation for the design of communication systems.

CO –PO Mapping:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	2	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	-
CO4	3	3	3	-	-	-	-	-	-	-	-	2	3	-

TEXT BOOKS/REFERENCES:

1. Simon Haykin, *An Introduction to Analog and Digital Communications*, Wiley, Second Edition, 2006.

2. J. Proakis, M. Salehi, *Fundamentals of Communications systems*, Pearson Education, Second Edition, 2005.

3. Herbert Taub, Donald Schilling, *Principles of Communications*, Tata McGraw-Hill, 2008.

4. Bruce Carlson, *Communication Systems*, McGraw-Hill, Fifth Edition, 2010.

15ECE302 **Control Systems Engineering** **3 1 0 4**

(Pre-Requisite: 15ECE204 Signal Processing I)

Objectives:

- To introduce the concepts in model-based design process.
- To impart knowledge on system'sbehavior in time and frequency domain characteristics
- To equip with the concepts of compensation for desired system characteristics.

Keywords:

Feedback, stability, closed loop, transient response.

Contents:

Introduction - System Configurations - Analysis and design objectives - Design process - Computer-aided design - Laplace transform review - The transfer function: Electrical network Transfer functions – Translational mechanical system transfer functions - Electric circuit analogs –Nonlinearities – Linearization – Transfer function of a DC motor. Poles Zeros and system response - Time response analysis (1st, 2nd order) – System response with additional poles - System response with zeros. Reduction of multiple system - Block reduction techniques - Signal flow graph - Mason‟s gain formula-Hurwitzcriterion.Stability:-Steady-stateerror Routh for unity feedback systems - Static error constants and system type - Steady-state error specifications.

The root locus, properties of the root locus - Sketching the root locus - Transient response Design via gain adjustment - Frequency response techniques. Asymptotic approximations: Bode plots - Introduction to the Nyquist criterion –Stability - Gain margin and Phase margin via Nyquist diagram and Bode plots relation between closed loop transient and closed loop frequency responses - Relation between closed and open loop frequency responses - Relation between closed loop transient and open loop frequency responses - Steady-state error characteristics from frequency response - Systems with time delay - Obtaining transfer functions.

Design via frequency response - Transient response design via gain adjustment - Lag compensation - Lead compensation - The general state - Space representation - Applying the state-space representation - Converting a transfer function to sate-space - Converting from state-space to a transfer function.

Outcomes:

CO1: Able to understand the concepts of control engineering.

CO2: Able to determine mathematical models of simple engineering systems.

CO3: Able to evaluate the performance specifications for typical control problem.

CO4: Able to design controllers from performance specifications of control systems.

CO5: Able to design a control system using CAD tools and prepare a report.

CO –PO Mapping:

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

TEXTBOOK:

Norman Nise, "Control System Engineering", John Wiley & Sons, Inc., Sixth Edition, 2011.

REFERENCES:

1. Dorf R. C. and Bishop R. H, "Modern control systems", Addison-Wesley Longman Inc., Eighth Edition, Indian reprint, 1999.
2. Katushiko Ogata, "Modern control engineering", Pearson education, Third Edition, 2004.
3. Benjamin C.Kuo, "Automatic Control Systems", Prentice Hall India Ltd, Sixth Edition, 2000.

15ECE303 LINEAR INTEGRATED CIRCUITS 3 0 0 3

(Pre-requisite: 15ECE211 Electronic Circuits)

Objectives

- To be able to design and analyse BJT amplifiers, with and without feedback
- To be able to use operational amplifiers as a building block for circuit design
- To be able to design and analyse both linear and non-linear circuits, using operational amplifiers

Keywords:

Operation amplifier, negative feedback, linear circuits, nonlinear circuits, timers, signal generators

Contents:

Amplifier parameters - Multistage amplifiers. Feedback: Introduction to the concept of feedback - positive and negative feedback - Properties of feedback - Feedback topologies - Non-ideal effects.

Differential Amplifier: The MOS differential pair - Common-mode and Differential signals. Small-signal operation - Differential gain and CMRR. Operational amplifiers: Ideal op-amp - parameters and characteristics - Inverting and non-inverting amplifiers.

Op-amp circuits: Difference Amplifiers - Instrumentation amplifiers – Adder – Subtractor – Integrator – Differentiator –Comparators - Schmitt trigger - Peak detector - Sample and hold circuits - Precision rectifiers - Dual-slope ADC –DVM - R-2R type DAC - Multivibrators - Monostable - Astable and Bistable - Oscillators: RC phase shift and Wein-bridge oscillators - 555 Timer.

Outcomes:

CO1: Ability to determine the frequency response of amplifiers

CO2: Ability to understand negative feedback and its impact on amplifier performance

CO3: Ability to understand and interpret opamp characteristics

CO4: Ability to design and analyse linear and non-linear circuits, using opamps

CO5: Ability to use simulation tools to analyse and understand electronic circuits

CO-PO Mapping:

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

TEXTBOOK:

1. Sedra A and Smith K C, *Microelectronic",*OxfordUniversity*circuits"*Press,SixthEdition, 2010.

REFERENCES:

1. *Neamen D A, "Electronic circuit analysis and design", McGraw-Hill, 2001.*
2. *Franco S., "Design with operational amplifiers and analog integrated circuits", New York, McGraw-Hill, Third Edition, 2002.*
3. *Ramakant A. Gayakwad, "Op-amps and linear integrated circuit technology" Prentice Hall,Fourth Edition, 2000.*
4. *Application Notes and Data Sheets of ICs from various manufacturers.*

15ECE304 **Microprocessor and Microcontroller** **3 1 0 4**

(Pre-requisite: 15ECE202 Digital Circuits and Systems)

Objectives:

- To introduce basics of Microprocessors
- To provide an overview of functioning of a Microprocessor
- To introduce RISC processor(s) family and their operation
- To introduce pipelining and its impact on performance

Keywords:

8085 Microprocessor, Instructions, ARM, Pipelining.

Contents:

8085 Microprocessor: Architecture –Functional block diagram - Registers, ALU, Bus Systems - Timing and Control Signals –Machine cycles and timing diagrams, memory interfacing.

ARM Architecture: Acron RISC Machine –Architectural Inheritance –Programmers Model. ARM Assembly Language Programming: Data Processing Instructions –Data Transfer Instructions –Control Flow Instructions. ARM Organization and Implementation: 3-stage Pipeline –5-stage Pipeline –ARM Instruction Execution – ARM Implemenation –Coprocessor Interface. ARM Instruction Set – Architectural Support for High-Level Programming –Thumb Instruction Set.

Architectural Support for System Development: ARM memory Interface –AMBA Interface –The ARMulator – JTAG Boundary Scan Architecture –Embedded Trace. ARM Processor Cores: ARM7TDMI –ARM8 – ARM9TDMI –ARM10TDMI. Memory Hierarchy –Memory Size and Speed – ON-Chip Memory –Caches.

Architecture Support for Operating System: ARM System Control Coprocessor –CP15 Protection Unit Registers –ARM MMU Architecture. ARM CPU Cores: ARM710T –ARM720T –ARM740T –ARM810 – Strong ARM SA-110.

Outcomes:

CO 1: Able to identify the importance of a Microprocessor/Microcontroller

CO 2: Able to understand processor architectures

CO 3: Able to analyse Peripherals and their programming aspects.

CO 4: Able to design and develop embedded systems using microcontroller.

CO –PO Mapping:

CO/ PO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	2	2	-
CO4	3	2	2	2	-	-	-	-	-	-	-	2	2	-

TEXTBOOKS:

1. Ramesh S Goankar, "Micropocessor Architecture: Programming and Applications with the 8085", Penram International, Fifth Edition, 2002.
2. Jochen Steve Furber, "ARM System-on-Chip Architecture", Addison Wesley Trade Computer Publications, Second Edition, 2000.

REFERENCES:

1. Douglas V Hall, "Microprocessor and Interfacing: Programming and Hardware", McGraw Hill Inc,. New Delhi 2002.
2. Kenneth L Short, "Microprocessors and Programming Logic", Prentice Hall of India, Second Edition.
3. Andrew Sloss, Dominic*ARM*Symes*SystemDevelopers*and*Guide*Chris",ElsevierWright, "Third Edition, 2004.

15MAT303 **Optimization Techniques** **2 1 0 3**

(Pre-Requisite: Linear Programming Problems)

Objectives:

- To understand modeling of Optimization Problems
- To learn non-linear Optimization methods
- To understand the Optimality criteria for functions in several variables
- To learn to apply OT methods like Undirectional search and Direct search methods.
- To learn constrained optimization techniques

Keywords:

Optimization algorithms, Constrained Optimization, unidirectional search methods, Unconstrained Optimization

Contents:

Optimization - optimal problem formulation, engineering optimization problems, optimization algorithms, numerical search for optimal solution.

Optimality criteria, bracketing methods - exhaustive search method, bounding phase method- region elimination methods - interval halving, Fibonacci search, golden section search, point estimation method- successive quadratic search, gradient based methods.

Optimality criteria, unconstrained optimization - solution by direct substitution, unidirectional search – direct search methods evolutionary search method, simplex search method, Hook-Jeeves pattern search method,

gradient based methods –steepest descent, Cauchy‟s steepest desc gradient method –
constrained optimization. Kuhn-Tucker conditions.

Outcomes:

CO1: Understand different types of Optimization Techniques in engineering problems. Learn Optimization methods such as Bracketing methods, Region elimination methods,Point estimation methods

CO2: Learn gradient based Optimizations Techniques in single variables as well as

multivariables(non-linear).

CO3: Understand the Optimality criteria for functions in several variables and learn to apply OT methods like Undirectional search and Direct search methods.

CO4: Learn constrained optimization techniques. Learn to verify Kuhn-Tucker conditions and Lagrangian Method.

CO –PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	-	-	-	-	-	-	-	-	1
CO2	1	1	-	-	-	-	-	-	-	-	-	1
CO3	-	1	1	-	-	-	-	-	-	-	-	-
CO4	1	-	-	-	-	-	-	-	-	-	-	-

TEXT BOOKS/REFERENCES:

1. *S. S. Rao, "Optimization Theory and Applications", Second Edition, New Age International (P) Limited Publishers, 1995.*
2. *Kalyanmoy Deb, "Optimization for Engineering Design Algorithms and Examples", Prentice Hall of India, New Delhi, 2004.*
3. *Edwin K. P. Chong and Stanislaw H. Zak, "An Introduction to Optimization", Second Edition, Wiley-Interscience Series in Discrete Mathematics and Optimization, 2004.*
4. *M. Asghar Bhatti, "Practical Optimization Methods: with Mathematics Applications", Springer Verlag Publishers, 2000.*

15ECE381 Circuits and Communication Lab 0 0 2 1

Objectives:

- To familiarize with the usage of electronic instruments.

- To introduce the characteristics of transistors and operational amplifiers.
- To familiarize the design concepts for linear and non-linear circuits.

Keywords:

Negative feedback, Op-amp, Amplitude modulation, Frequency modulation.

Contents :

Electronic circuits

- Current mirror
- Amplifier using current biasing
- Op-Amp characterization
- Inverting and Non-inverting Amplifier
- Integrator, Differentiators
- Schmitt trigger
- Astable multivibrator using 555 Timer Communication
- Standard Amplitude Modulation and Demodulation
- Generation of Double Side Band –Suppressed Carrier using Balanced Ring Modulator
- Synchronous Detector
- Generation of Single Side Band wave
- Transistor Mixer
- Intermediate Frequency Amplifier
- Frequency Modulation
- Pre-emphasis and De-emphasis

Outcomes:

CO1: Able to design transistor-based amplifier circuits.

CO2: Able to design circuits with operational amplifiers.

CO3: Able to design and analyze electronic circuits for analog communication systems.

CO4: Able to design and analyze circuits for modulation techniques.

CO –PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	2	2	-	-	3	-
CO2	3	3	-	-	-	-	-	-	2	2	-	-	3	-
CO3	3	3	-	-	-	-	-	-	2	2	-	-	3	-
CO4	3	3	-	-	-	-	-	-	2	2	-	-	3	-

TEXTBOOKS/REFERENCES:

1. Sedra A and Smith K C, *"Microelectronic circuits"*, Oxford University Press, Sixth Edition, 2010.

2. Simon Haykin, *"An Introduction to Analog and Digital Communications"*, Wiley, Second Edition, 2006,

3. Neamen D A, *"Electronic circuit analysis and design"*, McGraw-Hill,

4. Franco S., *"Design with operational amplifiers and analog integrated circuits"*, New York, McGraw-Hill, Third Edition, 2002.

15ECE382 MICROCONTROLLER LAB 0 0 2 1

Objectives:

- To familiarize with microprocessor simulator
- To learn keil C simulator to implement arithmetic and logical operations and by interfacing peripherals

Keywords:

Arithmetic and logical operations, interfacing, indirect addressing

Contents:

- ARM Assembly program for Arithmetic and Logical Operations
- ARM Assembly program for Multi-Byte Operations
- ARM Assembly program for Control Manipulation
- ARM Assembly program for String Manipulation
- ARM Assembly program for Thumb Instructions
- Embedded C Programming using Keil Simulator

    a. Simple C Programs
    b. Port Programming
    c. Peripheral Interfacing –Keypad, Motor, LED etc.

Outcomes:

CO1:Able to implement arithmetic and logical functions in assembly language using microprocessor simulator

CO2: Able to implement array operations using microprocessor simulator

CO3: Able to familiarize with Keil C software to program RISC processor

CO4: Able to perform peripheral interfacing

CO –PO Mapping:

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

15SSK321 SOFT SKILLS II 1 0 2 2

CO#	Course Outcomes	Programme Outcomes
1.	Soft Skills: At the end of the course, the students will have the ability to communicate convincingly and negotiate diplomatically while working in a team to arrive at a win-win situation. They would further develop their inter-personal and leadership skills.	PO9, PO10, PO11, PO12
2.	Soft Skills: At the end of the course, the students shall learn to examine the context of a Group Discussion topic and develop new perspectives and ideas through brainstorming and arrive at a consensus.	PO10, PO11, PO12
3.	Aptitude: At the end of the course, students will be able to identify, recall and arrive at appropriate strategies to solve questions on geometry. They will be able to investigate, interpret and select suitable methods to solve questions on arithmetic, probability and combinatorics.	PO2, PO4
4.	Verbal: At the end of the course, the students will have the ability to relate, choose, conclude and determine the usage of right vocabulary.	PO10, PO12
5.	Verbal: At the end of the course, the students will have the ability to utilise prior knowledge of grammar to recognise structural instabilities and modify them.	PO10, PO12
6.	Verbal: At the end of the course, the students will have the ability to comprehend, interpret, deduce and logically categorise words, phrases and sentences. They will also have the ability to theorise, discuss, elaborate, criticise and defend their ideas.	PO9, PO10, PO12

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	3	3	2	3
CO2	-	-	-	-	-	-	-	-	-	3	2	2
CO3	-	3	-	2	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	3
CO5	-	-	-	-	-	-	-	-	-	3	-	3
CO6	-	-	-	-	-	-	-	-	3	3	-	3

Professional grooming and practices: Basics of corporate culture, key pillars of business etiquette. Basics of etiquette: Etiquette – socially acceptable ways of behaviour, personal hygiene, professional attire, cultural adaptability. Introductions and greetings: Rules of the handshake, earning respect, business manners. Telephone etiquette: activities during the conversation, conclude the call, to take a message. Body Language: Components, undesirable body language, desirable body language. Adapting to corporate life: Dealing with people.

Group discussions: Advantages of group discussions, structured GD – roles, negative roles to be avoided, personality traits to do well in a GD, initiation techniques, how to perform in a group discussion, summarization techniques.

Listening comprehension advanced: Exercise on improving listening skills, grammar basics: Topics like clauses, punctuation, capitalization, number agreement, pronouns, tenses etc.

Reading comprehension advanced: A course on how to approach middle level reading comprehension passages.

Problem solving level III: Money related problems; Mixtures; Symbol based problems; Clocks and calendars; Simple, linear, quadratic and polynomial equations; special equations; Inequalities; Functions and graphs; Sequence and series; Set theory; Permutations and combinations; Probability; Statistics.

Data sufficiency: Concepts and problem solving.

Non-verbal reasoning and simple engineering aptitude: Mirror image; Water image; Paper folding; Paper cutting; Grouping of figures; Figure formation and analysis; Completion of incomplete pattern; Figure matrix; Miscellaneous.

Spacial aptitude: Cloth, leather, 2D and 3D objects, coin, match sticks, stubs, chalk, chess board, land and geodesic problems etc., related problems.

TEXTBOOKS:

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., (1986),"Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
4. *The Hard Truth about Soft Skills, by Amazone Publication.*
5. *Quick Maths – Tyra.*
6. *Quicker Arithmetic – Ashish Aggarwal*
7. *Test of reasoning for competitive examinations by Thorpe.E. TMH*
8. *Non-verbal reasoning by R. S. Aggarwal, S. Chand*

REFERENCES:

1. *Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova*
2. *More Games Teams Play, by Leslie Bendaly, McGraw Hill Ryerson.*
3. *The BBC and British Council online resources*
4. *Owl Purdue University online teaching resources*

www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.

15LIV390 LIVE-IN-LABS® I 3 0 0 3

Objectives:

- Understand the principles of Human Centered Design, Participatory Rural Appraisal, Sustainable Change Agents, Ethnographic Action Research and User Need Assessment.

- Learn the various tools, techniques and templates used in the mentioned concepts to identify the challenges in the villages.

- Design a sustainable technological intervention for the identified challenge.

Contents:

Participatory Rural Appraisal (PRA**)**

Concept, Principles and Philosophy of PRA. Scope and Dimensions of PRA. Important Tools for PRA. Application of PRA.

Human Centered Design I (HCD)

Fundamentals of Human Centered Design. Design Process. User Experience. User Research. Data Analysis. Ideation.

Sustainable Social Change

Case Study. Introduction. Understanding and identifying the Community Communication Channels

Outcomes:
CO1: Using Human Centered Design Concepts to document observations and user experiences

CO2: Identify and Analyze various Challenge Indicators in the village using Participatory Rural Appraisal CO3: Selection of one Challenge that needs to be solved
CO4: Preparing Field Journal to document the observations, interviews, measurements etc.

CO5: Recording ideas, personal thoughts and experiences as well as reflections and insights through Reflective Journal

CO6: Identify and Analyze the Social Structure, Social Change Agents, etc., to implement Sustainable Social Change Models

CO7: Collating and Analyzing Current Government Policies applicable for the rural India

CO8: Quantitative and Qualitative Data Collection, Representation and Analysis for problem identification CO9: User Needs Assessment and Prioritization

CO10: Design a Technical Solution using Human Centered Design Concepts

CO11: Report Generation

CO12: Research Paper Submission CO13: Poster Presentation

CO-PO Mapping:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		3	2	1	3				3	3		
CO2	1			2	3				3	3		
CO3		1						1	3			
CO4		1	1						3			
CO5									3			2
CO6				1		2		1	3	3		
CO7								3	3			
CO8	3	3	1		3	1	2		3			
CO9		3	1			3	3		3			
CO10	3	3	3			3	3		3	3	2	3
CO11		3	3				3		3	3	3	
CO12		3	3				3		3	3	3	
CO13		3	3				3		3	3	3	1

1 –Substantial; 2 –Moderate; 3 - Strong

TEXT BOOKS/ REFERENCES:

There are no required textbooks for this course; all articles, reports and research papers assigned as required reading will be shared with the students by Live-in-Labs® faculties.

1. Ramesh, Maneesha Vinodini, Renjith Mohan, and Soumya Menon. *"Live-in-Labs: Rapid translational research and implementation-based program for rural development in India*." In 2016 IEEE Global Humanitarian Technology Conference (GHTC), pp. 164-171. IEEE, 2016.

2. Francis, C. A., N. Jordan, P. Porter, T. A. Breland, G. Lieblein, L. Salomonsson, N. Sriskandarajah et al. *"Innovative education in agroecology: Experiential learning for a sustainable agriculture."* Critical Reviews in Plant Sciences 30, no. 1-2 (2011): 226-237.

3. Akella, Devi. *"Learning together: Kolb's experiential theory and its application."* Journal of Management & Organization 16, no. 1 (2010): 100-112.

4. Harith, J., Sreeram Kongeseri, Balu M. Menon, J. V. Sivaprasad, P. Aswathi, and Rao R. Bhavani. *"Exploring Digital Tool for Participatory Rural Appraisal."* International Journal of Pure and Applied Mathematics 119, no. 12 (2018): 2787-2810.
5. *"Sustainable Development Strategies":* A Resource Book. Organization for Economic Co-operation and Development, Paris and United Nations Development Program, New York.

6. *"Field Guide to Human-Centered Design"*. By IDEO.org. 1st Edition © 2015. ISBN: 978-0-9914063-1-9

15ECE311 Data Communication and Networks 3 0 0 3

Objectives:

•Provide in-depth understanding of the fundamental networking principles and implementation issues

encountered in designing practical network protocols at Internet scale.

- Teach the techniques for analyzing the performance of network protocols and system architectural design choices.

- Connect networking principles with the actual implementation details as found in networking standards currently used in practice.
- Provide hands-on experience by simulating the network protocols.

Keywords:

Topologies, layering, protocols, services, switching, routing.

Contents:

Data Communication Concepts –Networks and open system standards –OSI reference model –Network layered architecture –Network topologies and the physical layer –Bus/Tree topology –ring topology, star topology –Transmission media and technologies.

Protocol concepts –MAC layer –LAN and standards –MAN –WAN –Network routing –Public data networks –Circuit-switched data network –Packet-switched data network –Internet protocol –ISDN.

Network Interconnections –LAN-to-LAN connections –LAN-to-Host connections –Repeaters –Bridges –Routers and Gateways –Interconnection utilities –Electronic mail –VoIP –DNS –HTTP –Networks management –WLAN.

Outcomes:

CO1: Able to understand the fundamental networking principles and protocol concepts.

CO2: Able to apply networking principles behind practical network protocols used in the Internet.

CO3: Able to analyze the performance of network protocols and system architectural design choices.

CO4: Able to simulate and monitor the performance of standard networking protocols.

CO –PO Mapping:

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

TEXTBOOKS/REFERENCES:

1. James Kurose and Keith Ross, "*Computer Networking": A Top-Down Approach*, 5th/6th Edition, Addison Wesley, 2010.

2. Larry L. Peterson and Bruce S. Davie, "*Computer Networks - A Systems Approach"*, Morgan Kaufmann, Fifth Edition, 2011.

3. Andrew. S. Tannenbaum, David J. Whetheral, "*Computer Networks"*, Prentice Hall, Fifth Edition, 2010.

15ECE312 **Digital Communication** **3 1 0 4**

(Prerequisite: 15ECE301 Communication Theory)

Objectives:

- Introduce the fundamental principles of digital modulation and demodulation methods.
- To make understand the importance of quantifying the impact of noise and channel impairments on digitally modulated signals.
- Provide the importance of optimum transmitter and receiver design.

Keywords:

Waveform coding, Binary modulation, M-ary modulation, Baseband modulation, Carrier modulation.

Contents:

Introduction –Waveform Coding –PCM –DPCM –DM –Geometric representation of signal waveforms – Binary pulse modulation –Optimum receiver for binary modulated signals in additive white Gaussian noise – M-ary binary and orthogonal pulse modulation –Probability of error for binary and M-ary pulse modulation.

Digital Transmission through band limited channels –Signal design for band limited channels –Probability of error for detection of digital PAM –System design in the presence of channel distortion.

Transmission of digital information via carrier modulation –Amplitude modulated signals –Phase modulated signals –Quadrature amplitude modulated signals –Frequency modulated signals.

Outcomes:

CO1: Able to understand the concepts of waveform coding schemes

CO2: Able to design and analyze various modulation techniques

CO3: Able to design and analyze optimum transmitter and receiver for baseband additive white Gaussian noise channel

CO4: Able to exhibit the competency in the design of digital communication systems

CO –PO Mapping:

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

TEXTBOOKS/REFERENCES:

1. John G. Proakis and Masoud Salehi, *"Fundamentals of Communication Systems"*, Pearson Education, First Edition, 2007.

2. Simon Haykin, *"Digital Communications"*, Wiley India Private Limited, First Edition, 2006.

3. Ziemer and Peterson, *"Introduction to Digital Communication"*, Pearson Education, 2000.

4. B. Sklar, *"Digital Communications"*, Pearson Education, Second Edition, 2006.

5. Amitabha Bhattacharya, *"Digital Communication"*, Tata McGraw Hill Publishing Company, First Edition, 2006.

15ECE313 **VLSI Design** **3 0 0 3**

(Pre-Requisite: 15ECE202 Digital circuits and systems)

Objectives:

- To introduce the physics of MOSFET devices and MOS layouts
- To impart knowledge on static, transient and dynamic responses of basic CMOS gates
- To enable understanding of different MOSFET networks and their characteristics

Keywords:

MOSFETs, Fabrication, Layout, CMOS switching, logic arrays, inverter chain, sizing of chain of logic BiCMOS

Contents:

An Overview of VLSI - Basic Concepts of VLSI, Design, MOSFETs - Basic Physics, I-V Characteristics and models, Threshold voltage , MOSFETs as switches, pass transistors and transmission gates , Fabrication of CMOS Circuits, CMOS Fabrication, NMOS and CMOS Physical layouts and stick diagrams.

Analysis of MOS logic Gates - DC Switching characteristics and transient response of CMOS Inverters, NAND and NOR gates transient response, Unit size transistor, inverter, Scaling of Transistor , inverter, NAND,NOR.

Designing High speed CMOS Logic Networks - Gate delays, Driving Large capacitive load, Logical Effort, BiCMOS drivers,Clocking and data flow control –advanced techniques in CMOS logic circuits : Mirror Circuits, Pseudo- NMOS , Tri state circuits , Clocked CMOS , Dynamic CMOS logic circuits , dual-rail logic networks

Outcomes:

CO 1: Able to understand physics of MOSFET devices

CO 2: Able to realize simple MOS networks and their layout

CO 3: Able to analyze static and dynamic behavior of basic MOS gates

CO 4: Able to analyze the impact of area-delay trade-off in design of MOS networks

CO - PO Mapping :

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12	PSO 1	PSO2
CO1	3	2	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	2
CO4	3	3	3	-	-	-	-	-	-	-	-	2	3	2

TEXT BOOKS/REFERENCES:

1. J.P.Uyemura, *Introduction to VLSI Circuits and Systems*, 2 nd Edition, John Wiley and Sons, 2002.

2. David A Hodges, Horace Jackson, ResveSaleth, *Analysis and Design of Digital Integrated Circuits*, 3 rd Edition, McGraw Hill Publishing Company Limited, 2003.

3. Sung-Mo Kang, Yusuf Leblechi, *CMOS Digital Integrated Circuits - Analysis and Design*, 3 rd Edition, Tata McGraw Hill Publishing Company Limited, 2003.

4. Neil Weste, David Harris, Ayan Banerjee, *CMOS VLSI Design: A Circuits and Systems Perspective*, 3 rd Edition, Pearson Education,2012.

15ECE314 **Computer System Architecture** **3 0 0 3**

(Pre-Requisite: 15ECE202 Digital circuits and systems)

Objectives:

- To introduce the basic organization of a computer system.
- To introduce the functioning of data path and control path elements in a processor.
- To impart understanding of the memory organization of a processor system.
- To familiarize the input-output operations in a processor system.

Keywords:

Computer System, Computer Arithmetic, Memory Organization, Input-Output System

Contents:

Introduction to computer system - Brief history of computer systems - Fixed point arithmetic –Addition – Subtraction - Multiplication and division - Booth‟s - algorithmNon-restoringdivision algorithm - Floating point arithmetic. Various addressing modes and designing of an Instruction set.

Data path and controller design - Introduction to CPU design - Processor organization - Execution of complete instruction - Design of control unit - Microprogrammed control unit.

Memory and system organization - Concepts of semiconductor memory - CPU-memory interaction - Organization of memory modules - Cache memory and related mapping and replacement policies - Virtual memory. Introduction to input/output processing: Programmed controlled I/O transfer - Interrupt controlled I/O transfer DMA - Secondary storage and type of storage devices - Introduction to buses - Introduction to RISC and CISC paradigm - Design issues of a RISC processor and example of an existing RISC processor - Introduction to pipelining.

Outcomes:

CO 1: Able to comprehend operations and arithmetic of computer systems.

CO 2: Able to identify data-path and control-path operations involved in the execution of an instruction.

CO 3: Able to analyse the CPU, memory and IO architecture of a processor at the system level.

CO 4: Able to analyse the trade-offs involved in the CPU and memory organization of a processor system.

CO –PO Mapping:

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

TEXT BOOKS/REFERENCES:

1. V. Carl Hamacher, Zvonko G. Varanesic and Safat G. Zaky, *"Computer Organisation"*, Fifth edition, Indian Edition, McGraw-Hill Education, 2011

2. John P. Hayes, *"Computer architecture and Organisation"*, Indian Edition, McGraw-Hill Education, 2017

3. M. Morris Mano, *"Computer System Architecture"*, Third Edition, Pearson Education, 2007.
4. Behrooz Parhami, *"Computer Architecture"*,Indian Edition, Oxford University Press, 2012

15ECE385 Digital Communication Lab 0 0 2 1

Objectives:

- Familiarize the concepts of base band and pass band communication techniques.
- Familiarize the concepts of communication techniques through simulation.

Keywords:

Base band Modulation, Pass Band Modulation

Contents

1. Pulse Amplitude Modulation and Demodulation
2. Pulse Position Modulation
3. Pulse Width Modulation
4. Amplitude Shift Keying Modulation and Demodulation
5. Frequency Shift Keying
6. Phase Shift Keying
7. Time Division Multiplexing
8. Sampling and Quantization using Matlab.
9. Gram Schmidt orthogonalization for vectors using Matlab
10. Probability of Error for BPSK using Matlab.

Outcomes:

CO1: Able to design electronic circuits for communication systems

CO2: Able to design and analyze base band modulation schemes

CO3: Able to design and analyze pass band modulation schemes

CO4: Able to analyze concepts of communication techniques using simulation tools

CO –PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	2	2	-	-	3	-
CO2	3	3	-	-	-	-	-	-	2	2	-	-	3	-
CO3	3	3	-	-	-	-	-	-	2	2	-	-	3	-
CO4	3	3	2	-	2	-	-	-	2	2	-	2	3	-

TEXTBOOKS/REFERENCES:

1. Simon Haykin, *An Introduction to Analog and Digital Communications*, Wiley, Second Edition, 2006.

2. J. Proakis, M. Salehi, *Fundamentals of Communications systems*, Pearson Education, Second Edition, 2005.

15ECE386 VLSI Design Lab 0 0 2 1

Objectives:

- To introduce modelling of digital logic in HDL
- To introduce implementation of combinational and sequential circuits in FPGA
- To introduce modelling of MOS circuits in Spice

Keywords:

Combinational circuits, sequential circuits, VHDL, FPGA, SPICE, netlist, MOS models

Contents:

1. Design of Adder –Ripple carry adder in V HDL
2. Design of Hierarchical decoder, multiplexer
3. Design of flip flops
4. Design of counters
5. FPGA implementation of adders
6. FPGA implementation of Counters
7. NMOS , PMOS, Forward and Transfer characteristics
8. Study of W/L ratio on NMOS and PMOS forward and transfer characteristics
9. CMOS inverter in SPICE
10. On time off time variation with W/L for 2, 3 input NAND gate

Outcomes:

CO1: Able to model digital circuits using HDL

CO2: Able to realize simple hardware in FPGA

CO3: Able to analyze NMOS and PMOS characteristics in SPICE

CO4: Able to analyze basic digital gates in SPICE

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO 4	PO5	PO6	PO 7	PO 8	PO9	PO 1 0	PO1 1	PO1 2	PSO1	PSO2
CO1	3	2	-	-	3	-	-	-	-	-	-	2	2	2
CO2	3	2	-	-	3	-	-	-	-	-	-	2	2	2
CO3	2	3	-	-	3	-	-	-	-	-	-	2	2	2
CO4	3	2	-	-	3	-	-	-	-	-	-	2	2	2

TEXT BOOKS/REFERENCES:

1.Stephen Brown and Zvonko Vranesic, *Fundamentals of Digital Logic with VHDL Design*, 2 nd edition, 2007.

2.Andrei Vladimirescu, *The SPICE book,* Wiley, ISBN-13:978-0471609261, 1st edition, 1994.

3.John P. Uyemura, *Introduction to VLSI Circuits and Systems* , John Wiley Student Edition, 2006.

15ECE387 **Open Lab** **0 1 2 2**

Objectives:

- To enable hands-on experience in the electronics hardware domain
- To enable development of skill set for designing and realizing prototype electronic systems

Keywords:

Simulation, Hardware, Design.

Outcomes:

CO 1: Able to conduct literature survey to identify an application oriented research problem CO 2: Able to design and validate the proposed system using simulation

CO 3: Able to prototype the proposed system

CO 4: Able to analyze the obtained results and prepare a technical report

CO –PO Mapping:

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

15SSK331 **SOFT SKILLS III** **1 0 2 2**

CO#	Course Outcomes	Programme Outcomes
1.	Soft Skills: At the end of the course, the students will have the ability to prepare a suitable resume (including video resume). They would also have acquired the necessary skills, abilities and knowledge to present themselves confidently. They would be sure-footed in introducing themselves and facing interviews.	PO9, PO10, PO12
2.	Soft Skills: At the end of the course, the students will have the ability to analyse every question asked by the interviewer, compose correct responses and respond in the right manner to justify and convince the interviewer of one‟s right ca positive attitude and courteous communication.	PO8, PO9, PO10, PO12
3.	Aptitude: At the end of the course, students will be able to interpret, critically analyze and solve logical reasoning questions. They will have acquired the skills to manage time while applying methods to solve questions on arithmetic, algebra, logical reasoning, and statistics and data analysis and arrive at appropriate conclusions.	PO2, PO4
4.	Verbal: At the end of the course, the students will have the ability to understand and use words, idioms and phrases, interpret the meaning of standard expressions and compose sentences using the same.	PO10, PO12
5.	Verbal: At the end of the course, the students will have the ability to decide, conclude, identify and choose the right grammatical construction.	PO10, PO12
6.	Verbal: At the end of the course, the students will have the ability to examine, interpret and investigate arguments, use inductive and deductive reasoning to support, defend, prove or disprove them. They will also have the ability to create, generate and relate facts / ideas / opinions and share / express the same convincingly to the audience/ recipient using their communication skills in English.	PO9, PO10, PO12

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									3	3		2
CO2								2	3	3		2
CO3		3		2								
CO4										3		3
CO5										3		3
CO6									3	3		3

Team work: Value of team work in organisations, definition of a team, why team, elements of leadership, disadvantages of a team, stages of team formation. Group development activities: Orientation, internal problem solving, growth and productivity, evaluation and control. Effective team building: Basics of team building, teamwork parameters, roles, empowerment, communication, effective team working, team effectiveness criteria, common characteristics of effective teams, factors affecting team effectiveness, personal characteristics of members, team structure, team process, team outcomes.

Facing an interview: Foundation in core subject, industry orientation/knowledge about the company professional personality, communication skills, activities before interview, upon entering interview room, during the interview and at the end. Mock interviews.

Advanced grammar: Topics like parallel construction, dangling modifiers, active and passive voices, etc.

Syllogisms, critical reasoning: A course on verbal reasoning. Listening comprehension advanced: An exercise on improving listening skills.

Reading comprehension advanced: A course on how to approach advanced level of reading, comprehension passages. Exercises on competitive exam questions.

Problem solving level IV: Geometry; Trigonometry; Heights and distances; Co- ordinate geometry; Mensuration.

Specific training: Solving campus recruitment papers, national level and state level competitive examination papers; Speed mathematics; Tackling aptitude problems asked in interview; Techniques to remember (In mathematics). Lateral thinking problems. Quick checking of answers techniques; Techniques on elimination of options, estimating and predicting correct answer; Time management in aptitude tests; Test taking

strategies.

TEXTBOOKS:

1. *A Communicative Grammar of English: Geoffrey Leech and Jan Svartvik. Longman, London.*
2. *Adair. J., (1986), "Effective Team Building: How to make a winning team", London, U.K: Pan Books.*
3. *Gulati. S., (2006) "Corporate Soft Skills", New Delhi, India: Rupa & Co.*
4. *The Hard Truth about Soft Skills, by Amazone Publication.*
5. *Data Interpretation by R. S. Aggarwal, S. Chand*
6. *Logical Reasoning and Data Interpretation – Niskit K Sinkha*
7. *Puzzles – Shakuntala Devi*
8. *Puzzles – George J. Summers.*

REFERENCES:

1. *Books on GRE by publishers like R. S. Aggrawal, Barrons, Kaplan, The Big Book, and Nova.*
2. *More Games Teams Play, by Leslie Bendaly, McGraw-Hill Ryerson.*
3. *The BBC and British Council online resources*
4. *Owl Purdue University online teaching resources www.the grammarbook.com - online teaching resources www.englishpage.com- online teaching resources and other useful websites.*

15ECE401 Information Theory and Coding Techniques 3 1 0 4

(Pre-Requisite: 15ECE301 Communication Theory)

Objectives:

- Introduce fundamentals of information theory and analyze the fundamental limits of communication systems.

- Provide an insight of Galois fields and primitive polynomials.

- Introduce traditional and modern coding theory and analyze the performance of different channel coding algorithm.

Keywords:

Entropy, Source coding, Channel model, Linear Block Codes, Convolutional codes, Viterbi decoding

Contents:

Introduction to Information Theory: Modeling of information sources –source coding theorem –source coding algorithms –modeling of communication channels –channel capacity –bounds on communication.

Linear block codes: structure –matrix description –Hamming codes. Standard array arithmetic of Galois fields: Integer ring –finite fields based on integer ring –polynomial rings –finite fields based on polynomial rings – primitive elements. structure of finite fields cyclic codes: Structure of cyclic codes - encoding and decoding of cyclic codes.

BCH codes: Generator polynomials in terms of minimal polynomial –Decoding of BCH codes –Reed-Solomon codes –Peterson –Gorenstein –Zierler decoder. Convolutional Codes: Introduction to Convolutional Codes – Basics of Convolutional Code encoding and decoding –Sequential decoding –Viterbi decoding.

Outcomes:

CO1: Able to understand the fundamentals of Information theory

CO2: Able to analyze the basic types of codes and understand the source coding algorithms

CO3: Able to derive the channel capacity of communication channel models

CO4: Able to understand the encoding and decoding technique for channel coding

CO5: Able to carry out implementation of different source coding and channel coding algorithms

CO –PO Mapping:

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

TEXTBOOKS/REFERENCES:

1. Ranjan Bose, *"Information Theory, Coding and Cryptography"*, Tata McGraw-Hill, Second Edition, 2002.

2. P. S. Satyanarayana, "*Concepts of Information Theory and Coding"*, Dynaram Publication, 2005.

3. Richard B. Wells, "*Applied Coding and Information Theory for Engineers"*, Pearson Education, LPE, First Indian Reprint, 2004.

4. Richard E. Blahut, "*Algebraic Codes for Data Transmission"*, Cambridge University Press, 2003.

5. Shu Lin and Daniel J. Costello, *Error Control Coding –"Fundamentals and Applications"*, Pearson Education, Second Edition, 2004.

6. Thomas M. Cover and Joy A. Thomas, "*Elements of Information Theory"*,MGH, 2006.

15ECE402 **Radio Frequency Engineering** **3 1 0 4**

(*Pre-requisite: 15ECE201 Applied Electromagnetics*)

Objectives:

- To introduce the principle of operation of radio frequency devices and circuits
- To provide knowledge on device performance using scattering parameters
- To introduce the concepts of wireless communication system
- To provide exposure on RF technologies used in application(s)

Keywords:

S-Parameter, Microwave device, Noise, Radio system.

Contents:

Radio Frequency network Analysis: EM Spectrum and Applications –Electrical Length –Physical Length – Significance of Microwave Spectrum –Application –Scattering Matrix Parameters and Properties –Insertion Loss, Return loss –Transmission matrix (ABCD) –Signal Flow Graph.

Waveguide Based Devices: Rectangular Waveguide Cavity –Cavity Resonator –Resonant Frequency and Quality Factor –Directional Coupler –Power Dividers and–IntroductionTee‟stoFerrites –Ferrite based Isolator and Circulator.

Radio Frequency Systems: Noise in RF Systems –Dynamic Range –Noise Equivalent Temperature – Noise Figure –Noise Figure of Cascaded System –Antenna Parameters –Gain –Directivity – Efficiency –Bandwidth

–Beamwidth –Polarization –Dipole –Loops –Horn –Parabolic Dish –Frills Formula –Radio links

Outcomes:

CO1: Able to understand the significance and analytical approaches to the unique engineering issues at radio frequencies.

CO2:Able to demonstrate the design concept of waveguide-based passive and active devices in terms of their theoretical formulation

CO3 : Able to estimate and measure the effects of noise in radio frequency systems

CO4: Able to understand the design specifications and parameters of antennas in RF communication

systems.

CO-PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	--	PO12	PSO 1	PSO 2
CO1	3	-	-	-	-	-	3	-
CO2	3	2	2	-	-	-	3	-
CO3	3	2	2	-	-	-	3	2
CO4	3	2	2	-	-	-	3	2

TEXTBOOK:

David M Pozar,"Microwave Engineering", Wiley India Pvt. Limited, Third Edition, Second Reprint, 2007.

REFERENCES:

1. *Samuel Y. Liao, "Microwave Devices and Circuits", Pearson Edition, Third Edition, 2003.*
2. *Kraus, Fleisch, "Electromagnetics with Applications", Tata McGraw Hill Education Private Limited, Fifth Edition, 2004.*

15ENV300 ENVIRONMENTAL SCIENCE AND SUSTAINABILITY 3 0 0 3

Unit 1

State of Environment and Unsustainability, Need for Sustainable Development, Traditional conservation systems in India, People in Environment, Need for an attitudinal change and ethics, Need for Environmental Education, Overview of International Treaties and Conventions, Overview of Legal and Regulatory Frameworks.

Environment: Abiotic and biotic factors, Segments of the Environment, Biogeochemical Cycles, Ecosystems (associations, community adaptations, ecological succession, Food webs, Food chain, ecological pyramids), Types of Ecosystems – Terrestrial ecosystems, Ecosystem Services, Economic value of ecosystem services, Threats to ecosystems and conservation strategies.

Biodiversity: Species, Genetic & Ecosystem Diversity, Origin of life and significance of biodiversity, Value of Biodiversity, Biodiversity at Global, National and Local Levels, India as a Mega-Diversity Nation (Hotspots) & Protected Area Network, Community Biodiversity Registers. Threats to Biodiversity, Red Data book, Rare, Endangered and Endemic Species of India. Conservation of Biodiversity. People's action.

Impacts, causes, effects, control measures, international, legal and regulatory frameworks of: Climate Change, Ozone depletion, Air pollution, Water pollution, Noise pollution, Soil / land degradation / pollution

Unit 2

Linear vs. cyclical resource management systems, need for systems thinking and design of cyclical systems, circular economy, industrial ecology, green technology. Specifically apply these concepts to: Water Resources, Energy Resources, Food Resources, Land & Forests, Waste management.

Discuss the interrelation of environmental issues with social issues such as: Population, Illiteracy, Poverty, Gender equality, Class discrimination, Social impacts of development on the poor and tribal communities, Conservation movements: people's movements and activism, Indigenous knowledge systems and traditions of conservation.

Unit 3

Common goods and public goods, natural capital / tragedy of commons, Cost benefit analysis of development projects, Environment Impact Assessment (EIA), Environment Management Plan (EMP), Green business, Eco-labeling, Problems and solutions with case studies.

Global and national state of housing and shelter, Urbanization, Effects of unplanned development case studies, Impacts of the building and road construction industry on the environment, Eco-homes / Green buildings, Sustainable communities, Sustainable Cities.

Ethical issues related to resource consumption, Intergenerational ethics, Need for investigation and resolution of the root cause of unsustainability, Traditional value systems of India, Significance of holistic value-based education for true sustainability.

Outcomes:

CO1: Integrate facts and concepts from ecological, physical and social sciences to characterize some common socio-environmental problems.

CO2: Develop simple integrated systems and frameworks for solving common interconnected socio-environmental problems.

CO3: Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

CO4: Identify the ethical underpinnings of socio-environmental issues in general.

CO-PO Mapping:

CO Code	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ENV 300.1		1		1		2	3			2		1			
ENV 300.2	1		1				3			2		1			
ENV 300.3							3	2	1	2		1			
ENV 300.4							3	3		2		1			

15ECE481 Microwave Engineering Lab 0 0 2 1

Objectives:

- To provide exposure to the operating characteristics of microwave components.
- To introduce hands-on training on electromagnetic propagation using microwave sources at X band
- To provide a knowledge on design of various microwave circuits using microwave simulator

Keywords:

Klystron oscillator, Slotted line, Circulator, Directional coupler, Magic Tee

Content:

1) Study of characteristics of Klystron calibration

2) Study the Rectangular waveguide and mode characteristics.
3) Measurement of Guided wavelength and impedance of unknown device using slotted line section.

4) Antenna Measurements

5) A. Characterization of Circulator

B. Microwave Characterization of Materials employing circulator

6) Characterization of Directional coupler

7) Characterization of E-plane, H-plane and Magic Tee using HFSS software

Outcomes:

CO1: Able to demonstrate the characteristics of Microwave source

CO2: Able to measure and analyze the characteristics of microwave components

CO3: Able to measure and analyze the radiation pattern and antenna gain

CO4: Able to design and analyze the waveguide characteristics using microwave simulator

CO-PO Mapping:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	2	2	-	-	3	-
CO2	3	3	2	2	-	-	-	-	2	2	-	-	3	-
CO3	3	3	2	2	-	-	-	-	2	2	-	-	3	-
CO4	3	3	2	2	2	-	-	-	2	2	-	2	3	-

15ECE495 Project Phase 1 0 0 0 2

Objectives:

- To introduce research methodologies focused to engineering problems
- To inculcate ethical principles of research
- To enable development of oral and technical writing skills
- To enable advancement of independent thinking and higher learning skills

Keywords:

Literature, simulation tools, hardware, research, communication, technical report

Outcomes:

CO1: Able to exhibit the research aptitude for identification of contemporary engineering problems

CO2: Able to determine appropriate scientific approaches to the given problem

CO3: Able to perform the experimental / simulation approaches for preliminary results

CO4: Able to demonstrate communication skills via oral presentation and technical report.

CO –PO Mapping:

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

15LIV490 LIVE-IN-LABS® II L-T-P-C: 3-0-0-3

Pre Requisite(s):

1. Students can enrol for Live-in-Labs® II course only if they have successfully completed Live-in-Labs® I course by meeting all the criteria set by the Live-in-Labs® team.

Objectives:

- Understand the principles of

  a. Advanced Human Centered Design

  b. Co-Design

  c. Social Change Management Models

  d. Project Management

  e. Prototyping

  f. Modelling

g. Field Implementation.

- Learn the various tools, techniques and templates used in the mentioned concepts to implement a sustainable intervention in the villages.

- Creating awareness and training the villagers.

Contents:

Co-design

Introduction to co-design. Benefits of co-design. Co-design process. Co-design tools.

Project Management

Introduction to Project Management. Project Triple Contraints. Difference between project and operation. Phases of Project Management. Project Planning.

Human Centered Design II (HCD**)**

Design Process. Design evaluation. Design implementation

Outcomes:

CO1: Presenting Proposed Technological Implementation in the respective villages

CO2: Proposal Submission

CO3: Implement the process of Co-design along with the villagers to identify the right design for implementation

CO4: Understanding and Implementing Project Management

CO5: Developing, analysing and testing a Prototype

CO6: Real time Implementation of a feasible, affordable, sustainable and efficient model

CO7: Generating Awareness and Training Users to adopt and use the Intervention

CO8: Practical Application of the theories learnt

CO9: Report Generation

CO10: Research Paper Submission

CO11: Poster Presentation

CO-PO Mapping:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3			3	3		3	3	2	3
CO2								2	3	1	3	
CO3	2	1	3			3			3			
CO4									3		3	
CO5	3		3		3		3		3			
CO6	3					1	3		3			3
CO7							1		3			
CO8	3					3	3					3
CO9		3	3				3		3	3	3	
CO10		3	3				3		3	3	3	
CO11		3	3				3		3	3	3	1

1 –Substantial; 2 –Moderate; 3 - Strong

TEXT BOOKS/ REFERENCES:

There are no required textbooks for this course; all articles, reports and research papers assigned as required reading will be shared with the students by Live-in-Labs® faculties.

1. Valentin, Anke, and Joachim H. Spangenberg. *"A guide to community sustainability indicators."* Environmental Impact Assessment Review 20, no. 3 (2000): 381-392.

2. Sipos, Yona, Bryce Battisti, and Kurt Grimm. *"Achieving transformative sustainability learning:* engaging head, hands and heart." International Journal of Sustainability in Higher Education 9, no. 1 (2008): 68-86.

3. Lee, Yanki. *"Design participation tactics: the challenges and new roles for designers in the co-design process."* Co-design 4, no. 1 (2008): 31-50.

4. Liam J. Bannon, Pelle Ehn. 06 Aug 2012, Design from*: "Routledge International Handbook of Participatory Design Routledge"*

5. *"Sustainable Development Strategies":* A Resource Book. Organization for Economic Co-operation and Development, Paris and United Nations Development Program, New York.

6. *"A Guide to the Project Management Body of Knowledge"(PMBOK® Guide),* Project Management Institute

7. *"Field Guide to Human-Centered Design". By IDEO.org. 1st Edition © 2015. ISBN: 978-0-9914063-1-9*

15ECE499 PROJECT PHASE II 10cr

Objectives:

- To introduce research methodologies focused to engineering problems
- To inculcate ethical principles of research
- To enable development of oral and technical writing skills

- To enable advancement of independent thinking and higher learning skills

Keywords:

Literature, simulation tools, hardware, research, communication, technical report

Outcomes:

CO1: Able to identify and adopt complementary research methods

CO2: Able to implement the experimental / simulation approaches

CO3: Able to perform data acquisition, interpretation and analysis

CO4: Able to demonstrate communication skills via oral presentation and technical report.

CO –PO Mapping:

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

15ECE367 **Hardware Security and Trust** **3 0 0 3**

(Pre-Requisite: 15ECE202 Digital circuits and systems)

Objectives:

To introduce Hardware Trojan architectures

To impart knowledge of Trojan insertion methods and detection approaches at various level of abstraction
To introduce VLSI design flow incorporating trust at different levels

Keywords:

Hardware Security, Trusted Design, Hardware Trojans

Contents:

Review of VLSI Design Flow - Hardware Trojan –Trojan taxonomy - Case study - Trojan detection – Classification of Trojan detection - Challenges in Trojan detection.

Design for hardware trust –Delay based methods –Shadow registers –Ring oscillators - Dummy scan Flip-Flop insertion - Trojan activation time analysis - Trojan detection and isolation flow –Architectural approaches

Security and testing –Scan-based testing –Scan-based attacks and counter measures - System-on-chip test infrastructure - Emerging areas of test security. Trojan prevention: Built-in self authentication - BISA structure and insertion flow - Analyzing BISA structure - Trusted design in FPGAs.

Outcomes:

CO 1: Able to describe and identify typical hardware security vulnerabilities at various phases of VLSI Design flow

CO 2: Able to understand fundamental approaches used in Trojan insertion,

CO 3: Able to understand different approaches for Trojan and Piracy detection and analysis

CO 4: Able to identify ways in which trust can be incorporated in VLSI Design flow

CO –PO Mapping:

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

TEXTBOOK:

Mohammad Tehranipoor and Cliff Wang (Eds.), "Introduction to Hardware Security and Trust", Springer, New York, 2012.

REFERENCE:

1. Mohammad Tehranipoor, Hassan Salmani and Xuehui Zhang, "Integrated Circuit Authentication - Hardware Trojans and Counterfeit Detection", Springer International Publishing, Switzerland 2014.

15ECE356	**Satellite Communication** (Pre-requisite:15ECE301 Communication Theory)	**3 0 0 3**

Objectives:

- To introduce the concepts of orbital mechanics for satellite communication.
- To familiarize different satellite system parameters and preparation of the link budget.
- To provide an acquaintance of different subsystems in communication satellites.
- To familiarize different applications of satellite communication.

Keywords:

Orbital mechanics, link budget, subsystems, multiple access.

Contents:

Review of Microwave Communications - Overview of satellite communications - Satellite orbits - Orbital mechanics and effects - Kepler‟s-Configurationslawsof various orbits - Orbital elements - Elevation and azimuth angles - Doppler effect - Effect of the sun and moon - Sun transit outage. Satellite link models and design - Satellite system parameters - Link budget design.

Satellite subsystems – AOCS - TTC&M - Power and communication subsystems - Computations and controlling by processors - Satellite multiple access schemes –FDMA - TDMA and CDMA - Spread spectrum concepts - Comparison of multiple access schemes.

Satellite applications –VSAT - DTH television principles - Direct broadcast radios - Principles of navigation – GPS - Satellites and launch vehicles –INSAT - IRS satellites –PSLVs –GSLVs.

Outcomes:

CO1: Able to understand the orbital mechanics and analyze its effects on satellite communication.

CO2: Able to analyze different satellite system parameters and design of link budget.

CO3: Able to understand the various subsystems in communication satellites.

CO4: Able to understand and compare various multiple access techniques used in satellite communication.

CO –PO Mapping:

CO/ PO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	3	2
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	3	2

TEXTBOOK:

T.Pratt, C.W.Bostain and J.E.Allnut, "Satellite Communications" John Wiley and Sons, Second Edition, 2003.

REFERENCE:

Dennis Roddy, "Satellite Communications" McGraw-Hill Publishing company, Fourth Edition, 2006.

15ECE344 ***ANTENNA SYSTEMS AND DESIGN*** **3 0 0 3**

(Pre-Requisite: Nil)

Objectives:

- To introduce the concept of radiation mechanism of the antenna and its fundamental parameters.
- To provide knowledge on different types of antennas and their working mechanism
- To introduce the concept of antenna array and its types
- To enable antenna design using microwave simulator

Keywords:

Radiation pattern, antenna parameters, dipole antenna, array.

Contents:

Introduction to radiation concept –Antenna parameters –Directivity –Gain –Radiation pattern –Impedance-Polarization –Beam width –Antenna temperature –Antenna measurements and Requirement for measurements.

Types of antennas –Point source –Dipole and slots –Loop antenna –Horn antenna –Helical Antenna –Patch – Reflector antennas –Parabolic reflector.

Array of two sources –Pattern multiplication –Linear arrays –Broadside array –End fire array –Planar arrays.

Outcomes:

CO 1: Able to comprehend the radiating and non-radiating elements and to compute the antenna parameters

CO 2: Able to design and analyze various types of antennas using analytical models

CO 3: Able to understand antenna array concept based on the application

CO 4: Able to implement design and analyze the antenna parameters using microwave simulator

CO –PO Mapping:

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

TEXTBOOK:

Kraus, Marhefka, "Antennas for all Applications", Tata McGraw Hill, Third Edition, 2002.

REFERENCES:

1. Vincent F. Fusco, "Foundations of Antenna Theory and Techniques", Pearson Education, First Impression, 2007.

2. C. A. Balanis, " Antenna Theory – Analysis and Design", Wiley India, 2000

15ECE339 Applications of Linear Integrated Circuits 3 0 0 3

(Pre-Requisite: 15ECE303 Linear Integrated Circuits)

Objectives:

- To be able to choose the appropriate components for a particular circuit
- To be able to design circuit for various operations, to given specifications
- To be able to understand and compensate for different non-idealities in an electronic circuit

Keywords:

Operational Amplifiers; Operational Transconductance amplifiers; Isolation Amplifiers; Analog to Digital

Converters

Contents:

Op-amp Basics; μA741 –Internal Schematic; Parameters; Frequency Compensation of voltage and current feedback amplifiers; OP07

Instrumentation Amplifiers; Current Sources using opamps; Isolation Amplifiers; Operational Transconductance Amplifiers (OTA); Log and Anti-Log amplifiers; Multipliers; Voltage to Frequency and Frequency to Voltage Converters; Phase Sensitive Detectors (PSD); Phase Locked Loops (PLL)

Voltage References; Low Noise Current Differencing and Low power operational amplifiers; Voltage regulators; IC Protection Circuits; Analog to Digital Converters - Σ-ΔADC.

Outcomes:

CO1: Ability to understand the operation of various high level circuits, using ICs

CO2: Ability to design fairly complex circuits, using ICs.

CO3: Ability to understand and use circuits and techniques to compensate for the effects of temperature and other fluctuations in an electronic circuit

CO4: Ability to effectively use simulation tools for a better understanding of electronic circuits

CO –PO Mapping:

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

TEXTBOOKS:

1. Franco S., "Design with operational amplifiers and analog integrated circuits", Third Edition, New York McGraw-Hill, 2002.

2. Sedra A and Smith K C, "Microelectronic circuits", Sixth Edition, New York Oxford University Press,

2010.

REFERENCES:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2003.
2. Graeme J., Tobey G., and Huelsman L. P., "Operational amplifiers - Design and Applications", New York McGraw-Hill, 1971.
3. Soclof S, "Applications of analog integrated circuits", Englewood Cliffs, NJ: Prentice-Hall, 1985.
4. Relevant Datasheets from Texas Instruments, Maxim and Harris Semiconductors.

15ECE345 Cellular and Mobile Communication System 3 0 0 3

Objectives:

- To introduce the concepts of cellular communication and analyze cell capacity.

- To familiarize the modeling of multipath channel and fading effects and multiple access techniques.

- To enable comprehension of the architectures of modern cellular standards.

Keywords:

Cellular radio, Interference, Wireless channel model, CDMA, LTE

Contents:

Introduction to cellular mobile systems - Basic Cellular System - Cellular communication infrastructure: Cells – Clusters - Cell Splitting - Frequency reuse concept and reuse distance calculation - Cellular system components - Operations of cellular systems –Handoff / Handover - Channel assignment - Fixed and dynamic - Cellular interferences: Co-Channel and adjacent channel and sectorization.

Channel Models: Properties of mobile radio channels –Inter-symbol interference - Multipath and fading effects - Interleaving and diversity -Multiple access schemes (TDMA, FDMA, CDMA, SDMA) – Inter-user interference - Traffic issues and cell capacity - Power control strategies - Channel assignment - Handoff.

Introduction to modern cellular standards - 2G Architecture such as GSM and CDMA based - 2.5G- GPRS: GPRS and its features - GPRS network architecture - GPRS protocol architecture - GPRS backbone network - 3G standard details such as UMTS - Introduction to LTE.

Outcomes:

CO1: Able to understand the technological evolution of mobile radio communication systems.

CO2: Able to apply the cellular concepts and analyze the associated performance measures.

CO3: Able to understand various wireless channel propagation models and signal processing techniques.

CO4: Able to compare the architectures of modern cellular standards.

CO –PO Mapping:

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

TEXTBOOKS/REFERENCES:

1. Theodore S. Rappaport," *Wireless Communications Principles and Practice*", 2nd Edition, 2002.
2. Gottapu Sasibhushana Rao, "*Mobile Cellular Communication"* Pearson Education, 2012.
3. Andrea Goldsmith, "*Wireless Communications"* ,Cambridge University Press, First Edition, 2005.
4. William Stallings, "*Wireless Communication and Networking*", PHI, 2003.

15ECE359 **Wireless Communication** **3 0 0 3**

(Pre-requisite: 15ECE312 Digital Communication)

Objectives:

- To introduce the concepts of cellular communication.
- To familiarize the modeling of multipath channel and fading effects.
- To provide the knowledge on computing the capacity of the fading channel.

Keywords:

Free space path loss, Fading channels, Equalizer, Channel capacity

Contents:

Introduction to wireless communications –Large scale path loss –Free space propagation model –Two ray model –Practical link budget design –Outdoor and indoor propagation models. Small scale multipath propagation –Impulse response model of a multipath channel –Parameters of mobile multipath channels – Types of small-scale fading

Rayleigh and Rician distributions –Statistical models for multipath fading channels –Theory of multipath shaping factor –Equalization –Linear –Decision Feedback –Adaptive equalizers –Training and tracking. Diversity –Receiver diversity –Transmitter diversity

Capacity of wireless channels –Capacity in AWGN –Flat fading channels –Frequency selective channels – Time invariant and variant channels –Performance of digital modulations over wireless channels –AWGN and Fading channels

Outcomes:

CO1: Able to understand and analyze the cellular concept and propagation models.

CO2: Able to understand the impulse response model of multipath channel.

CO3: Able to analyze the small-scale fading and mobile multipath channels.

CO4: Able to analyze the capacity in AWGN and fading channels.

CO –PO Mapping:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	-	2	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	2	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	2
CO4	3	3	3	-	-	-	-	-	-	-	-	2	3	3

TEXTBOOKS/REFERENCES:

1. Andrea Goldsmith, *"Wireless Communication"*, Cambridge University Press, 2005.

2. T. S. Rappaport, *"Wireless Communication, Principles and Practice"*, Pearson Education, Second edition, 2002.

3. Willaim C. Y. Lee, *"Wireless and Cellular Communications"*, Tata McGraw Hill Publishing Company Limited, Third edition, 2006.

4. Kamilo Feher, *"Wireless Digital Communications"*, Prentice Hall India Private Limited, 2004.

15MEC333 **Financial Management** **3 0 0 3**

(Pre-Requisite: Nil)

Objectives:

- To understand financial system and concept of time value of money
-

- To analyze the financing options and decide which is the best decision .
- To apply the appropriate capital budgeting technique and decide the investment options .
- Understand the concept of risk in decision making and use this for investment option selection
- To create awareness on financial performance analysis, ratios, working capital management, financing and cash and liquidity management

Keywords:

Financial markets, financial statements, cash flow analysis, financial ratios

Contents:

Introduction to financial management –Objectives, Functions, Scope, Evolution, Interface of financial management with other areas, Environment of corporate finance

Time value of money –Future value of single cash flow, Multiple cash flow, Annuity, Sinking fund factor, Present value of single cash flow, Annuity, Perpetuity, Comparison of interest rates, Sources of working capital –Equity finance, Preference shares, Debt finance, Term loans, Stock and debentures, Bank and institutional debt, Leasing and hire- purchase

Understanding financial statements, Balance sheet, Profit and loss account and cash flow statements

Financial statement analysis –Ratio analysis, Du Point analysis, Common size analysis, Trend analysis, Industry averages, Comparison with competitors,Cash flow and fund flow analysis, Short term financial management –Managing corporate liquidity, Managing current assets, Managing financial structure, Using the yield curve to make financial decisions

Financial ratios as perceived by commercial banks, corporate controllers, Forecasting financial failures, Financial statements and ratio analysis in different corporate sectors

Outcomes:

CO01 Able to understand financial system and concept of time value of money

CO02 Able to analyze the financing options and decide which is the best decision .

CO03 To apply the appropriate capital budgeting technique and decide the .

investment options

CO04 Able to know the risk in decision making and use this for investment option selection

CO05 To be aware of financial performance analysis, ratios, working capital management, financing and cash and liquidity management

.**CO –PO Mapping:**

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1						2				3	2	2		
CO2								2		3		2		
CO3						2		3		3	2			
CO4											3	2		
CO5						2		2				2		

TEXT BOOKS/REFERENCES:

1. Terry. S. Maness, *"Introduction to corporate finance"*, McGraw-Hill Book Company, New York, Nineth Edition (T1) 2005

2. Denzil Watson and Antony Head, *"Corporate Finance, Principles and practice"*, Pearson Education Asia, Second Edition 2002 (R1)

3. Ross Westerfield and Jordan, Fundamentals of corporate finance, Tata McGraw-Hill, Fifth Edition 1999 (R2)

15ECE331 PATTERN RECOGNITION TECHNIQUES AND ALGORITHMS 3 0 0 3

(Pre-requisite: 15MAT213 Probability and Random Processes)

Objectives:

- To introduce various pattern recognition algorithms
- To impart advanced concepts in pattern recognition algorithms for multivariate data
- To develop the skill set towards implementation of pattern recognition techniques

Keywords:

Statistical Decision Making, Supervised Learning, Unsupervised Learning, Neural Network.

Contents:

Statistical decision making techniques:-Multiple featuresBayes‟-Conditionallytheoremindependent features - Decision boundaries - Unequal costs of error - Estimation of error rates - Leaving one out technique - Characteristic curves.

Non-parametric decision making techniques: Histograms - Kernel and window estimators - Nearest neighbor classification techniques - Adaptive decision boundaries - Adaptive discriminant functions - Minimum squared error discriminant functions - Choosing a decision making technique.

Artificial neural networks: nets without hidden layers - Nets with hidden layers - Back propagation algorithm - Hopfield nets.

Outcomes:

CO1: To demonstrate the mathematical knowledge in pattern recognition domain

CO2: To determine suitable pattern recognition concepts for a given engineering problem

CO3: To apply various algorithms for pattern recognition

CO4: To implement the chosen algorithm using simulation tool(s)

CO –PO Mapping:

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

TEXTBOOK:

Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", PHI Learning Private Ltd., New Delhi, 2009.

REFERENCES:

1. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann Publishers (Elsevier), 2011.

2. K. P Soman, Shyam Diwakar, V. Ajay, "Insight into Data Mining: Theory and Practice", PHI Learning Private Ltd., New Delhi, 2006.

3. Sergios Theodoridis, Konstantinos Koutroumbas,"Pattern Recognition", Fourth Edition, Academic Press (Elsevier), 2011.

15ECE366 **Embedded Systems** **3 0 0 3**

(Pre-requisite: 15ECE304 Microprocessor and Microcontroller)

Objectives:

- To provide an overview of various Embedded Systems Architectures.
- To enable understanding of Real Time Operating Systems and its operations.
- To impart design concepts of Embedded Systems using RISC Microcontrollers.

Keywords:

ARM7TDMI, ARM Cortex M3, LPC2148.

Contents:

Introduction to Embedded Systems: Introduction to embedded systems –Application areas –Compiling - Linking and locating –Downloading and debugging. Embedded processor architecture definitions: SIMD – MIMD –SISD –MISD –VLIW –Superscalar –Pipelining - RISC –CISC. DSP processor architecture: Modified Harvard architecture - Barrel shifters –Multipliers - MAC unit - Manufacturers of DSP processors.

Real time operating system concepts: Tasks - Task states –Context switching - Message box - Message queue - Semaphores –Binary counting and mutex semaphores –Deadlock - Priority Inversion. Scheduling algorithms: Round robin - Rate monotonic - Earliest deadline first.

ARM cortex M3 processor: ARM processor - ARM cortex M3 architecture - NXP LPC214x On chip Peripherals: A/D converters, PWM, Timer/Counter, UART and its Interfacing- Application development using Keil IDE.

Outcomes:

CO1: Able to understand architecture of RISC Processor.

CO2: Able to analyze peripherals and its programming aspects.

CO3: Able to understand basic concepts of Real Time Operating Systems.

CO4: Able to analyze various embedded systems developed using Embedded C.

CO5: Able to design and develop embedded systems using RISC Microcontrollers

CO –PO Mapping:

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

TEXTBOOKS:

1. David E.Simon, "AnEmbedded Software Primer", Pearson Education, 2006.
2. Steve Furber, "ARM system On Chip Architecture", Addison Wesley, 2000.

REFERENCES:

1. Joseph Yiu, "The Definitive Guide to the ARM Cortex M3", Second Edition, Elsevier Inc., 2010.
2. Jean J. Labrosse, "Micro /OS-II, The real time kernel", Second Edition, CMP books1998.
3. Arnold S. Berger, "Embedded System Design", CMP Books, USA 2002.
4. Michael Barr, "Programming Embedded Systems with C and GNU", O Reilly, 2003.

15ECE368 **Introduction to Soft computing** **3 0 0 3**

(Pre-Requisite: Nil)

Objectives:

- To introduce the concepts of bio-inspired algorithms
- To provide knowledge on search and optimization methods
- To enable development of higher learning skill set towards engineering problems

Keywords:

Bio-inspired algorithms, Artificial Neural Networks, Genetic Algorithms, Particle Swarm Optimization.

Contents:

Overview of Artificial Neural Networks (ANN) - Models of a neuron - Network architectures - Bayes theorem - Naïve Bayes classifier - Rosenblatt‟s-PerceptronPerceptronconvergencetheorem - Multilayer Perceptrons - Back propagation - Application of ANN in Classification and Regression - Classifier performance measures - Validation techniques.

Fundamentals of Genetic Algorithms - Creation of offspring –Encoding - Fitness function - Reproduction - Inheritance operators –Crossover - Inversion and deletion –Mutation - Generational cycle - Convergence of GA - Applications.

Introduction to basic Particle Swarm Optimization (PSO) algorithm –Swarm size –Information links – Initialization –Equations of motion –Interval confinement –Proximity distributions –Applications.

Outcomes:

CO 1: To understand supervised / unsupervised learning methods

CO 2: To apply the basic principles of evolutionary algorithms

CO 3: To exemplify the use of computing methods to solve engineering problems

CO 4: To analyze the computational efficiency of search and optimization methods

CO –PO Mapping:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	2	3	3
CO2	3	2	2	2	-	-	-	-	-	-	-	2	3	-
CO3	3	2	3	3	-	-	-	-	-	-	-	2	3	-
CO4	3	2	3	2	-	-	-	-	-	-	-	2	3	-

TEXTBOOKS:

1. *Simon Haykin, "Neural Networks & Learning Machines", PHI Learning Pvt. Ltd - New Delhi, Third Edition, 2010.*
2. *Clerc, Maurice, "Particle swarm optimization", John Wiley & Sons, 2010.*

REFERENCES:

1. Rajasekaran Pai S, G. A Vijayalakshmi, "Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis And Applications", PHI Learning Pvt. Ltd - New Delhi, First Edition, 2003.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann Publishers (Elsevier), 2011.

15ECE380 ***TELECOMMUNICATION MANAGEMENT*** **3 0 0 3**

Objectives

- To introduce the concepts of management aspects in Telecommunication Engineering
- To impart knowledge about the state of art performance of the Satellite communication

- To enhance the students knowledge in the area of standards of telecommunication regulatory bodies and performance criteria

- To enable the student to understand the importance of the investigation of frequency management, business on bandwidth and network modeling.

Keywords:

Satellite communication, TCP/IP Protocols, TRAI, Bandwidth, networks modeling

Contents:

Telecom Technology Fundamentals: Signal transmission and channels – Network media – Data compression –Protocols and topology –Connectivity in networks –Ethernet principles –Wireless communication principles –Broadcasting versus link - TCP/IP model –OSI model Telecom network management: LAN –WAN – Repeaters –Bridges –Routers –Gateways –Hubs. Electronic commerce: Internet and intranet –Role of government in data communication quality of service in telecommunication. Telecommunication Standards and Regulations: International telecommunication union (ITU) and its role –Frequency management –Cost computations –Mobile and DTH operations –Role of wireless planning commission (WPC) for telecommunications in India - Service providers.

Telecom business management: Automated teller machines –Teleconferencing –Telecommuting – Enterprise applications –Customer oriented communication aspects –Wireless LAN - Telecom billing - Revenue assurance & fraud management. Business on bandwidth: Concepts of data rate and bandwidth requirements – Digital subscriber line –Broadband technologies –Digital home – Telecommuting –Voice enabled DSL - Bandwidth brokerage.

Telecommunication project management: Telecommunication design and implementation –Network analysis and design –Sources of projects –Methodology for designing, developing and implementing telecommunication capabilities –Network modeling –Phases of project management.

Outcomes:

CO1: To acquire knowledge of the application of wireless communication Protocols, TCP/IP, Satellite communication

CO2: To analyze the regulation and standards of telecommunication regulatory bodies. Performance criteria

CO3: To apply cost computation for electronic commerce such as mobile, Wi-Fi and DTH operators

CO4: To Investigate Frequency Management and Business on Bandwidth

CO5: To learn how to design the networks modeling and system evaluation

CO-PO Mapping:

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

TEXTBOOK:

Houston H.Carr and Charles A. Snyder, "The Management of Telecommunications" McGraw-Hill companies Inc, Second Edition, 2003.

REFERENCES:

1. Willium C.Y. Lee, "Wireless & Cellular Telecommunications", McGraw-Hill Companies Inc, Third Edition, 2006.

2. T. S. Rappaport, "Wireless Communication, Principles and Practice", Pearson Education, Second Edition, 2002.

15MEC411 Operations Research 3 0 0 3

Objectives:

- To possess the ability to compute, identify, formulate and solve mathematical problems for decision making.

- To allocate or use enterprise resource optimally

Keywords:

Resource optimization, project management, decision making

Contents:

Linear Programming: Formulations - graphical solutions - Simplex Method- Duality. Transportation model: Assignment model –Travelling Salesman Problem.

Decision Theory: Decision Trees. Game theory - 2 person zero sum; mixed strategies; 2 x n and m x 2 games. Network Models- Project Networks- CPM / PERT- Project Scheduling – crashing networks and cost considerations- Resource leveling and smoothing - shortest route problem, minimal spanning tree problem, maximal flow problem.

Sequencing model –2 machines „n‟ jobs,–n 2 machines„m‟. machines „n‟ jobs

Inventory models : deterministic & probabilistic models .Queuing models: Poisson arrival and exponential service times. Single server, multi-server

Simulation **–**Monte Carlo simulation: simple problems.

Outcomes:

CO01: Formulate operations research models to optimize resources and maximize profit.

CO02: Formulate transportation and assignment problems and solve and infer solutions.

CO03: Explain the scope of project planning and apply appropriate technique to analyze a project with an objective to manage resources and minimize cost.

CO04: Solve operational problems applying different decision making methods.

CO05: Classify queuing models, sequencing models and determine their performance.

CO06: Choose the appropriate inventory models to optimize inventory.

CO –PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	-	-	-	-	1	2	3	3	1	-
CO2	3	2	2	-	-	-	-	-	-	1	2	3	3	1	-
CO3	3	2	2	-	-	-	-	-	-	1	2	3	3	1	-
CO4	3	2	2	-	-	-	-	-	-	1	2	3	3	1	-
CO5	3	2	2	-	-	-	-	-	-	1	2	3	3	1	-
CO6	3	2	2	-	-	-	-	-	-	1	2	3	3	1	-

TEXTBOOK:

Wagner, H. M. - 'Principles of Operations Research - Prentice Hall, New Delhi – 1998

REFERENCES:

1. J. K. Sharma. - 'Operations Research Theory and Applications' - Macmillan India Ltd, New Delhi - 2013 - 5th Edition
2. Taha H. A. - 'Operations Research: An Introduction' - Prentice Hall, New Delhi - 2010 - 9th Edition
3. Ravindra A., Phillips, D.J. and Solberg, J. J. - 'Operations Research - Principles and Practice' - John Wiley & Sons - 2005.
4. Hardly H. M. 'Linear Programming' - Narosa Book Distributors Private Ltd. - 2006

15ECE371 VLSI Fabrication Technology 3 0 0 3

(Pre-Requisite: Nil)

Objectives:

- To understand the effects of technology scaling in device fabrication.

- To learn the fabrication techniques of BJT and MOSFETs.
- To investigate the effects of process parameters in device fabrication.

Keywords:

VLSI, Oxidation, Lithography, Diffusion, Ion Implantation.

Contents:

Brief History of Semiconductor technology, Scaling Trends and Scaling Methodologies, Scaling Challenges, ITRS Roadmap; Starting material, silicon structure and properties, Czochralski and Float Zone crystal growth, GaAs growth; Silicon oxidation methods and properties, Deal Grove Model, Photolithography –masks, pattern transfer techniques, minimum resolvable feature sizes, UV sources, photoresists.

Diffusion and ion implantation, Types of diffusion, implantation profile, variations to predicted distribution, implantation damage and annealing; Deposition

requirements and techniques –Physical and Chemical Vapor deposition, Epitaxial growth techniques; Wet and dry etching techniques, Etch requirements, Chemical Mechanical Polishing.

Interconnect Technology –Copper and Aluminum interconnects, Silicides, Isolation, CMOS and BJT Process flow; CMOS process for sub-100nm era - dielectrics and gate electrodes, Low K Dielectrics with Cu, Strained silicon, Silicon Germanium, Process Techniques to overcome Short Channel Effects, Nanolithography techniques, SOI Technology, Ultra Shallow Junction, Multiple Gate MOSFETs.

Outcomes:

CO 1: Understand the effects of technology scaling and various crystal growth methods.

CO 2: Understand the fabrication flow of BJTs and MOSFETs.

CO 3: Apply the different process models to investigate the effects of varying process parameters on device characteristics.

CO4: Understand the recent developments in IC fabrication and its application in device modeling.

CO –PO Mapping:

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

TEXT BOOKS/REFERENCES:

1.Peter Van Zant, "Microchip Fabrication: A Practical Guide to Semiconductor Processing", McGraw- Hill Professional, Sixth Edition, 2014.

2. Gary. S. May and S. M. Sze, “Fundamentals of semiconductor Fabrication” John Wiley, First Edition, 2003.

3. Marc J. Madou, “Fundamentals of Microfabrication and Nanotechnology – Volume II”, CRC Press, Third Edition, 2011.

4. Stephen Campbell, “Science of Microelectronic Fabrication”, Oxford Press, 2001.

5. James D. Plummer, Michael D. Deal, Peter B. Griff and Modeling”, PrenticeLimited, 2000Hall. India Private

15ECE474 Automotive Embedded Systems 3 0 0 3

Objectives:

- To introduce the basics of Electronic and Mechanical systems with Automotive
- To impart knowledge on vehicular networks

- To equip with the concepts of model-based design using Simulink
- To introduce the state-of-art technologies and systems available with the Industry

Keywords:
Automotive Sensors/ Actuators, Automotive graded controllers, Vehicular networks, ADAS applications

Overview of Automotive industry - Tools and Processes - Introduction to modern automotive systems - Spark and Compression Ignition Engines - Automotive Transmissions - Vehicle braking fundamentals - Steering Control - Overview of Hybrid Vehicles - Analog and Digital Systems - Basic measurements systems –Sensors: Characteristics, response and modeling –Actuators - Microcontroller and Digital Signal Processors used for Automotive applications : Renesas, Quorivva, Infineon - Tool chain for different processors - Control algorithm for different Automotive subsystems - Look-up tables and maps - Engine calibration - Torque table - Dynamometer testing

Overview of Automotive communication protocols: CAN, LIN, Flex ray, MOST, Ethernet, D2B, DSI, TCP/IP - Wireless LANs standards such as Bluetooth, IEE802.11x communication protocols - Telematics in Automotive domain : Global Positioning Systems(GPS) and General Packet Radio Service (GPRS) - Automotive Control Systems: Analog and Digital methods, modeling of linear systems and responses - Model based Development: Introduction to MATLAB : Simulink and SIMSCAPE tool boxes - Model based Design for an automotive system

Active Safety Systems: ABS, TCS, ESP, Brake assist - Passive Safety Systems: Airbag systems, Advance Driver Assistance system (ADAS) –Computer vision techniques - Connected cars technology - Trends towards Autonomous vehicles. Fundamentals of Diagnostics: Basic wiring system and Multiplex wiring system, Self-Diagnostic system – various On board and off board diagnostics in Automobiles - Diagnostics tools - Diagnostics Protocols: KWP20000 and UDS

Outcomes:

CO1: Able to understand the fundamentals of various mechanical systems along with Sensors, Controller and Actuators

CO2: Able to analyze various systems used in vehicle domains

CO3: Able to Understand the communication and diagnostic protocols

CO4: Able to design/Prototype an Automotive Embedded System based Matlab/Simulink.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	2	2
CO4	-	-	3	-	2	-	-	-	-	-	-	-	3	3

TEXT BOOKS/ REFERENCES:

1. Ronald K Jurgen : "*Automotive Electronics Hand Book"*, 2nd Edition , McGraw- Hill, 1999
2. James D Halderman: *"Automotive Electricity and Electronics"*, PHI Publication
3. Tom Denton : "*Advance Automotive Diagnosis"*2nd Edition Elsevier 2006
4. Terence Rybak. Mark Stefika: "*Automotive Electromagnetic Compatibility(EMC)"*,Springer ,2004
5. Allan Bonnick: "*Automotive Computer Controlled Systems Diagnostic Tools And Technology"*. Elsevier Science, 2001

SCIENCE ELECTIVES

15CHY239 **COMPUTATIONAL CHEMISTRY AND MOLECULAR MODELLING** **3 0 0 3**

Unit 1

Introduction: Stability, symmetry, homogeneity and quantization as the requirements of natural changes - Born - Haber cycle – Energetic – kinetics - Principles of spectra.

Computational techniques: Introduction to molecular descriptors, computational chemistry problems involving iterative methods, matrix algebra, Curve fitting.

Molecular mechanics: Basic theory - Harmonic oscillator – Parameterization - Energy equations - Principle of coupling - Matrix formalism for two masses - Hessian matrix - enthalpy of formation - enthalpy of reactions.

Introduction to Quantum mechanics - Schrodinger equation - Position and momentu - MO formation - Operators and the Hamiltonian operator - The quantum oscillator - Oscillator Eigen value problems - Quantum numbers - labeling of atomic electrons.

Unit 2

Molecular Symmetry: Elements of symmetry - Point groups - Determination of point groups of molecules.

Huckel's MO theory: Approximate and exact solution of Schrodinger equation - Expectation value of energy - Huckel's theory and the LCAO approximation - Homogeneous simultaneous equations - Secular matrix - Jacobi method - Eigen vectors: Matrix as operator - Huckel's coefficient matrix - Wheeland's method - Hoffmann's EHT method - Chemical applications such as bond length, bond energy, charge density, dipole moment, Resonance energy.

Unit 3

Self consistent fields: Elements of secular matrix - Variational calculations - Semi empirical methods - PPP self consistent field calculation - Slater determinants - Hartree equation - Fock equation – Roothaan - Hall equation - Semi empirical models and approximations.

Ab-initio calculations: Gaussian implementations – Gamess - Thermodynamic functions - Koopman's theorem - Isodesmic reactions, DFT for larger molecules - Computer aided assignments/mini projects with softwares - Introduction to HPC in Chemical calculations.

Molecular modelling software engineering - Modeling of molecules and processes - Signals and signal processing in Chemistry - QSAR studies and generation of molecular descriptors - Applications of chemical data mining - Familiarization with open source softwares useful for molecular modeling - Introduction to molecular simulation - M.D. simulation.

Course Outcome

CO01: Get to understand the structure of molecules using symmetry.

CO02: Understanding Quantum mechanical approach to calculate the energy of a system.

CO03: Applying mathematical knowledge and quantum mechanical approach in finding out the characteristics- reactivity, stability, etc., of the molecule.

CO04: To get a brief idea about molecular mechanics based chemical calculations. CO05: To get an idea about general methodology of molecular modeling.

TEXTBOOKS:

1. *Ramachandran, G Deepa and K Namboori, "Computational Chemistry and Molecular Modeling - Principles and Applications", Springer-Verlag, Berlin, Heidelberg, 2008, ISBN-13 978-3-540-77302-3.*
2. *Donald W Rogers, "Computational Chemistry Using PC", Wiley, (2003).*
3. *Alan Hinchliffe, "Chemical Modeling from atoms to liquids", Wiley, (2005).*

REFERENCES:

1. *James B Forseman and Aeleen Frisch-Gaussian, "Exploring Chemistry with Electronic Structure Method", Inc., Pittsburgh, PA, 2nd edition, (2006).*
2. *A C Philips, "Introduction to Quantum mechanics", Wiley, (2003).*
3. *Wolfram Koch, Max C. Holthausen, "A Chemist's guide to Density Functional Theory", Wiley, VCH, 2nd edition, (2001).*

15CHY241 ELECTROCHEMICAL ENERGY SYSTEMS AND PROCESSES 3 0 0 3

Unit 1

Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler-Volmer equation - Overpotential, activation, concentration and IR overpotential
- its practical significance - Tafel equation and Tafel plots - exchange current density and transfer coefficients.

Unit 2

Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc- carbon (Leclanche type), zinc alkaline (Duracell), zinc/air, zinc-silver oxide batteries; lithium primary cells - liquid cathode, solid cathode and polymer electrolyte types and lithium-ferrous sulphide cells (comparative account).

Secondary batteries: ARM (alkaline rechargeable manganese) cells, Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultra thin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.

Unit 3

Reserve batteries and Fuel cells: Reserve batteries - water activated, electrolyte activated and thermally activated batteries - remote activation - pyrotechnic materials. Fuel Cells:Principle, chemistry and functioning - carbon, hydrogen-oxygen, proton exchange membrane (PEM), direct methanol (DMFC), molten carbonate electrolyte (MCFC) fuel cells and outline of biochemical fuel cells.

Electrochemical Processes: Principle, process description, operating conditions, process sequence and applications of Electroforming – production of waveguide and plated through hole (PTH) printed circuit boards by electrodeposition; Electroless plating of nickel, copper and gold; Electropolishing of metals; Anodizing of aluminium; Electrochemical machining of metals and alloys.

Course Outcomes

CO01: Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics

CO02: Learn the application of the electrochemical principles for the functioning and fabrication of industrial batteries and fuel cells

CO03: Acquire knowledge in solving numerical problems on applied electrochemistry

CO04: Analysis and practical problem solving in fabrication of batteries and fuel cells

CO05: Application of concepts and principle in industrial electrochemical processes

CO06: Evaluation of comprehensive knowledge through problem solving

TEXTBOOKS:

1. *Derek Pletcher and Frank C. Walsh, "Industrial Electrochemistry", Blackie Academic and Professional, (1993).*
2. *Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, (2001).*

REFERENCES:

1. *Christopher M A, Brett, "Electrochemistry – Principles, Methods and Applications", Oxford University, (2004).*
2. *Watanabe T, "Nano-plating: microstructure control theory of plated film and data base of plated film microstructure", Elsevier, Oxford, UK (2004).*
3. *Kanani N, "Electroplating and electroless plating of copper and its alloy", ASM International, Metals Park, OH and Metal Finishing Publications, Stevenage, UK (2003).*
4. *Lindon David, "Handbook of Batteries", McGraw Hill, (2002).*
5. *Curtis, "Electroforming", London, (2004).*
6. *Rumyantsev E and Davydov A, "Electrochemical machining of metals", Mir, Moscow, (1989).*

15CHY243 FUELS AND COMBUSTION 3 0 0 3

Course Objectives: To provide the basic knowledge about fuels, rocket propellants and explosives.

propellants and explosives

Unit 1

Fuels - Solid fuels - Classification, preparation, cleaning, analysis, ranking and properties - action of heat, oxidation, hydrogenation, carbonization, liquefaction and gasification.

Liquid fuels – Petroleum - origin, production, composition, classification, petroleum processing, properties, testing - flow test, smoke points, storage and handling.

Secondary liquid fuels - Gasoline, diesel, kerosene and lubricating oils. Liquid fuels - refining, cracking, fractional distillation, polymerization. Modified and synthetic liquid fuels. ASTM methods of testing the fuels.

Unit 2

Gaseous fuels - Types, natural gas, methane from coal mine, water gas, carrier gas, producer gas, flue gas, blast furnace gas, biomass gas, refinery gas, LPG - manufacture, cleaning, purification and analysis. Fuels for spark ignition engines, knocking and octane number, anti knock additives, fuels for compression, engines, octane number, fuels for jet engines and rockets.

Flue gas analysis by chromatography and sensor techniques.

Unit 3

Combustion: Stochiometry, thermodynamics. Nature and types of combustion processes - Mechanism - ignition temperature, explosion range, flash and fire points, calorific value, calorific intensity, theoretical flame temperature. Combustion calculations, theatrical air requirements, flue gas analysis, combustion kinetics – hydrogen - oxygen reaction and hydrocarbon - oxygen reactions.

Rocket propellants and Explosives - classification, brief methods of preparation, characteristics; storage and handling.

Course Outcomes

CO01: Understand the types of fuels and variation in their properties

CO02: Able to analyze the fuel content

CO03: Obtain knowledge in identifying a proper fuel as per the requirement

CO04: Ability to know the preparation and working of

TEXTBOOK:

Fuels and Combustion, Samir Sarkar, Orient Longman Pvt. Ltd, 3rd edition, 2009.

REFERENCE:

3. *Fuels - Solids, liquids and gases - Their analysis and valuation, H. Joshua Philips, Biobliolife Publisher, 2008.*
4. *An introduction to combustion: Concept and applications - Stephen R Turns, Tata Mc. Graw Hill, 3rd edition, 2012.*
5. *Fundamentals of Combustion, D P Mishra, 1st edition, University Press, 2010*
6. *Engineering Chemistry - R. Mukhopadhyay and Sriparna Datta, Newage International Pvt. Ltd, 2007.*

15CHY244 GREEN CHEMISTRY AND TECHNOLOGY 3 0 0 3

Objectives

1. Understand the principles of green chemistry and its contribution to the development of sustainable products
2. Possess knowledge of the migration from a hydrocarbon-based economy to carbohydrate-based economy
3. Evaluate the deficiencies of traditional process and acknowledge the invent of new processes
4. Distinctly map the culmination of academic research to industrial chemistry

Unit 1

Our environment and its protection, chemical pollution and environmental regulations, environmental chemistry, pollution prevention strategies, challenges to the sustainability of chemical industry, Pollution Prevention Act 1990, USA, Green Chemistry and its 12 principles, toxicity of chemicals, material safety data sheet (MSDS), concept of zero pollution technologies, atom economy, functional toxicity vs non- functional toxicity, alternative solvents, energy minimization, microwave and sonochemical reactions, renewable feed stock, carbon dioxide as a feed stock.

Unit 2

Greener strategies of the synthesis of ibuprofen synthesis, teriphthalic acid etc. phase behaviour and solvent attributes of supercritical CO2, use of supercritical carbon dioxide as a medium chemical industry, use of ionic liquids as a synthetic medium, gas expanded solvents,

superheated water, etc. Synthesis of various chemicals from bio mass, polycarbonate synthesis and CO2 fixation, green plastics, green oxidations, etc.

Unit 3

Processes involving solid catalysts – zeolites, ion exchange resins, Nafion/silica nano composites and enhanced activity. Polymer supported reagents, green oxidations using TAML catalyst, membrane reactors. Green chemistry in material science, synthesis of porous polymers, green nanotechnology.

Course Outcomes

CO01: Understand the evolving concept of Green Chemistry and its application to the manufacture of sustainable products

CO02: Appreciate the need for Renewable energy and Feed stock along with carbon sequestration through the fundamentals of Green Chemistry Techniques

CO03: Develop a coherence to evaluate systematic deficiencies in traditional Chemical science process and products

CO04: Undertake a purposeful Journey through the microscopic domain of academic research to the macroscopic domain of Industrial chemistry

REFERENCES:

3. *Hand Book of Green Chemistry and Technology; by James Clarke and Duncan Macquarrie; Blakwell Publishing.*
4. *Anastas, P. T., Warner, J. C. Green Chemistry: Theory and Practice, Oxford University Press Inc., New York, 1998.*
5. *Matlack, A. S. Introduction to Green Chemistry Marcel Dekker: New York, NY, 2001.*

15CHY245 INSTRUMENTAL METHODS OF ANALYSIS 3 0 0 3

Unit 1

Error Analysis and Sampling: Accuracy - Precision - Classification of Errors - Minimization of errors - Standard deviation - Coefficient of variance - F-test - t-test - Significant figures. Sampling - Basis of sampling, Sampling and physical state - Safety measures of sampling.

Separation Techniques: Brief out line of column, paper and thin layer chromatography - Ion exchange methods - principle and application – HPLC.

Unit 2

Gas chromatography - principle and applications – gel chromatography.

Electroanalytical techniques: Potentiometry - Potentiometric titration - determination of equivalence point - acid base, complexometric, redox and precipitation titrations - merits and demerits. Voltammetry - Cyclic voltammetry - basic principle and application - Polarography - introduction - theoretical principles
- migration current - residual current - half wave potential - instrumentation - analytical applications.

Unit 3

Spectro-chemical techniques: UV-VIS spetrophotometry - principle - Beer's Law application - photometric titration - single and double beam spectrophotometer - instrumentation of IR - sample handling - IR applications - H - NMR - Instrumentation and applications - principle - instrumentation - applications of atomic absorption spectroscopy.

Thermal and Diffraction techniques: Principles and applications of DTG - DTA - DSC - X-ray - Electron Diffraction Studies - SEM, TEM.

Course Outcome

CO01: To develop an understanding of principle and working of the range of instrumental methods in analytical chemistry

CO02: To provide an understanding and skills in contemporary methods of separation and appropriate selection of instruments for the successful analysis of chemical compounds

CO03: To impart skills in the scientific method of planning, conducting, reviewing, reporting experiments and problem solving in chemical analysis.

TEXTBOOKS:

1. *Willard H W, Merritt J R, "Instrumental Methods of Analysis", 6th edition, Prentice Hall, (1986).*
2. *Skoog Douglas A, West Donald, "Fundamentals of Analytical Chemistry", 7th edition, New York Addison, Wesley, (2001).*

REFERENCES:

1. *"Vogel's Textbook of Quantitative Chemical Analysis", 5th edition, ELBS, (1989).*
2. *Kaur. H, "Instrumental Methods of Chemical Analysis", Goel Publisher, (2001).*

15CHY331 BATTERIES AND FUEL CELLS 3 0 0 3

Course Objective: To provide sound knowledge on the application of electrochemistry in energy storage systems.

Unit 1

Background Theory: Origin of potential - electrical double layer - reversible electrode potential - standard hydrogen electrode - emf series - measurement of potential - reference electrodes (calomel and silver/silver chloride) indicator and ion selective electrodes - Nernst equation - irreversible processes - kinetic treatment - Butler-Volmer equation - Overpotential, activation, concentration and IR overpotential

- its practical significance - Tafel equation and Tafel plots - exchange current density and transfer coefficients.

Unit 2

Batteries: Primary batteries: The chemistry, fabrication and performance aspects, packing classification and rating of the following batteries: (The materials taken their function and significance, reactions with equations, their performance in terms of discharge, capacity, and energy density to be dealt with). Zinc- carbon (Leclanche type), zinc alkaline (Duracell), zinc/air batteries; Lithium primary cells - liquid cathode, solid cathode and lithium-ferrous sulphide cells (comparative account).

Secondary batteries: Lead acid and VRLA (valve regulated (sealed) lead acid), nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium ion batteries, ultrathin lithium polymer cells (comparative account). Advanced Batteries for electric vehicles, requirements of the battery - sodium-beta and redox batteries.

Unit 3

Fuel Cells: Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspectsof the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells.

Membranes for fuel cells: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments.

Fuels for Fuel Cells: Hydrogen, methane, methanol - Sources and preparation, reformation processes for hydrogen – clean up and storage of the fuels – use in cells, advantages and disadvantages of using hydrogen as fuel.

Course Outcome

CO01: Understand the fundamental concepts of electrochemistry through electrode potential and reaction kinetics

CO02: Learn the application of the electrochemical principles for the functioning and fabrication industrial batteries and fuel cells

CO03: Analysis of practical problem solving in fabricating batteries and fuel cells

CO04: Evaluation of comprehensive knowledge through problem solving

TEXTBOOKS:

i. *Dell, Ronald M Rand, David A J, 'Understanding Batteries', Royal Society of Chemistry, (2001).*
ii. *M. Aulice Scibioh and B. Viswanathan 'Fuel Cells – principles and applications', University Press, India (2006).*

REFERENCES:

- *Kanani N, 'Electroplating and electroless plating of copper and its alloy', ASM International, Metals Park, OH and Metal Finishing Publications,Stevenage, UK (2003).*
- *Curtis, 'Electroforming', London, (2004).*
- *F. Barbir, 'PEM fuel cells: theory and practice', Elsevier, Burlington, MA, (2005).*

- *G. Hoogers, 'Fuel cell handbook', CRC, Boca Raton, FL, (2003).*

15CHY332 CORROSION SCIENCE 3 0 0 3

Unit 1

Basic principles: Free energy concept of corrosion - different forms of corrosion - Thermodynamic & Kinetic aspects of corrosion: The free energy criterion of corrosion possibility - Mechanism of Electrochemical corrosion - Galvanic and Electrochemical series and their significance.

Corrosion Control: Materials selection - metals and alloys - metal purification - non metallic - changing medium.

Unit 2

Anodic and cathodic protection methods - Coatings - metallic and other inorganic coatings - organic coatings - stray current corrosion - cost of corrosion control methods.

Corrosion protection by surface treatment: CVD and PVD processes - Arc spray - Plasma spray - Flame spray.

Corrosion Inhibitors: Passivators - Vapour phase inhibitor.

Unit 3

Stress and fatigue corrosion at the design and in service condition - control of bacterial corrosion. Corrosion protection: Automobile bodies – engines – building construction.

Course Outcome:

CO01: Development of skill in identifying the nature and type of corrosion

CO02: Understanding the mechanism of various types of corrosion

CO03: Analysing the problem and find out a solution to combat corrosion in any sort of environment.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	1	2	-	-	-	-	-	-	-	-	-	-	3	1	-	-
CO2	-	3	1	2	-	-	-	-	-	-	-	1	1	2	-	-
CO3	-	3	3	3	2	3	3	-	-	-	-	1	3	2	3	-

TEXTBOOKS:

1. *Fontana and Mars G, "Corrosion Engineering", 3rd edition, McGraw Hill, (1987).*
2. *Uhlig H H and Reviees R W, "Corrosion and its Control", Wiley, (1985).*

REFERENCES:

1. *ASM Metals Handbook, "Surface Engineering", Vol. 5, ASM Metals Park, Ohio, USA, (1994).*
2. *ASM Metals Handbook, "Corrosion", Vol. 13, ASM Metals Park, Ohio, USA, (1994).*
3. *Brain Ralph, "Material Science and Technology", CRC Series, Boston, New York.*

15PHY230 ADVANCED CLASSICAL DYNAMICS 3 0 0 3

Unit 1

Introduction to Lagrangian dynamics

Survey of principles, mechanics of particles, mechanics of system of particles, constraints, D'Alembert's principle and Lagrange's equation, simple applications of the Lagrangian formulation, variational principles and Lagrange's equations, Hamilton's principles, derivation of Lagrange's equations from Hamilton's principle, conservation theorems and symmetry properties.

Unit 2

Central field problem

Two body central force problem, reduction to the equivalent one body problem, Kepler problem, inverse square law of force, motion in time in Kepler's problem, scattering in central force field, transformation of the scattering to laboratory system, Rutherford scattering, the three body problem.

Rotational kinematics and dynamics

Kinematics of rigid body motion, orthogonal transformation, Euler's theorem on the motion of a rigid body.

Unit 3

Angular momentum and kinetic energy of motion about a point, Euler equations of motion, force free motion of rigid body.

Practical rigid body problems

Heavy symmetrical spinning top, satellite dynamics, torque-free motion, stability of torque-free motion - dual-spin spacecraft, satellite maneouvering and attitude control - coning maneuver - Yo-yo despin mechanism - gyroscopic attitude control, gravity-gradient stabilization.

Course Outcomes

CO1 - Able to use the Lagrangian formalism to solve simple dynamical system

CO2- Able to understand Hamiltonian formalism and apply this in solving dynamicalsystems

CO3- Able to apply Lagrangian formalism in bound and scattered states with specific reference to Kepler’s laws and Scattering states

CO4- Able to solve problems in the Centre of Mass frame and connect it to Laboratory Frame of Reference

CO5- Understand and solve problems in rigid body rotations applying of Euler’s equations.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	0	0	0	0	0	0	0	1	0	0	0
CO2	3	3	1	1	0	0	0	0	0	0	0	1	0	0	0
CO3	3	3	3	1	0	0	0	0	0	0	0	1	0	0	0
CO4	3	3	3	1	0	0	0	0	0	0	0	2	0	0	0
CO5	3	3	3	2	0	0	0	0	0	0	0	2	0	0	0

TEXTBOOKS:

1. H. Goldstein, Classical Mechanics, Narosa Publishing House, New Delhi, 1980, (Second Edition)

2. H. Goldstein, Charles Poole, John Safko, Classical Mechanics, Pearson education, 2002 (Third Edition)
3. Howard D. Curtis, Orbital Mechanics for Engineering Students, Elsevier, pp.475 - 543

4. Anderson John D, Modern Compressible flow, McGraw Hill.

REFERENCE BOOKS:

1. D. A. Walls, Lagrangian Mechanics, Schaum Series, McGraw Hill, 1967.

2. J. B. Marion and S. T. Thornton, Classical dynamics of particles and systems, Ft. Worth, TX: Saunders, 1995.

15PHY238 ELECTRICAL ENGINEERING MATERIALS 3 0 0 3

Unit 1

Conducting materials: The nature of chemical bond, crystal structure Ohm's law and the relaxation time, collision time, electron scattering and resistivity of metals, heat developed in a current carrying conductor, thermal conductivity of metals, superconductivity.

Semiconducting materials: Classifying materials as semiconductors, chemical bonds in Si and Ge and it's consequences, density of carriers in intrinsic semiconductors, conductivity of intrinsic semiconductors, carrier densities in n type semiconductors, n type semiconductors, Hall effect and carrier density.

Unit 2

Magnetic materials: Classification of magnetic materials, diamagnetism, origin of permanent, magnetic dipoles in matter, paramagnetic spin systems, spontaneous magnetization and Curie Weiss law, ferromagnetic domains and coercive force, anti ferromagnetic materials, ferrites and it's applications.

Unit 3

Dielectric materials: Static dielectric constant, polarization and dielectric constant, internal field in solids and liquids, spontaneous polarization, piezoelectricity.

PN junction: Drift currents and diffusion currents, continuity equation for minority carriers, quantitative treatment of the p-n junction rectifier, the n-p-n transistor.

Course Outcomes

CO1: To understand the nature of interaction between atoms in crystalline solid materials that determines their dielectric, magnetic and electrical properties.

CO2: Analyze the relation between the macroscopic dielectric constant and the atomic structure of an insulator.

CO3: Fundamental concepts of magnetic fields required to illustrate the magnetic dipoles. This forms the basis to understand the magnetic properties of dia, para, ferro, antiferro and ferri magnetic materials.

CO4: Fundamentals concerned with conduction mechanism in metals and superconductors.

CO5: Understand the basics for classification of materials based on its conductivity, nature of chemical bonds in Si and Ge, carrier density, energy band structure and conduction mechanism in intrinsic and extrinsic semiconductors.

CO-PO Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	1	1											1	-
CO2	2	2	2										1	-
CO3	2	2	2										2	-
CO4	2	2	2										2	-
CO5	2	2	2					2					1	-

TEXTBOOK:

A J Decker, "Electrical Engineering materials", PHI, New Delhi, 1957.

REFERENCES:

1. A J Decker, "Solid State Physics", Prentice Hall, Englewood Cliffs, N J 1957.
2. C Kittel, "Introduction to solid state Physics", Wieley, New York, 1956 (2nd edition).
3. Allison, Electronic Engineering materials and Devices, Tata Mc Graw Hill
4. F K Richtmyer E H Kennard, John N Copper, "Modern Physics", Tata Mc Graw Hill, 1995 (5th edition).

15PHY248 PHYSICS OF LASERS AND APPLICATIONS 3 0 0 3

Unit 1

Review of some basic concepts and principle of laser.

Introduction to light and its properties: Reflection, refraction, interference, diffraction and polarization. Photometry – calculation of solid angle. Brewster's law. Snell's law and, its analysis.

Introduction to LASERS: Interaction of radiation with matter - induced absorption, spontaneous emission, stimulated emission. Einstein's co-efficient (derivation). Active material. Population inversion – concept and discussion about different techniques. Resonant cavity.

Unit 2

Properties of LASERS

Gain mechanism, threshold condition for PI (derivation), emission broadening - line width, derivation of FWHM natural emission line width as deduced by quantum mechanics - additional broadening process: collision broadening, broadening due to dephasing collision, amorphous crystal broadening, Doppler broadening in laser and broadening in gases due to isotope shifts. Saturation intensity of laser, condition to attain saturation intensity.

Properties – coherency, intensity, directionality, monochromaticity and focussibility. LASER transition – role of electrons in LASER transition, levels of LASER action: 2 level, 3 level and 4 level laser system.

Unit 3

Types of LASERS

Solid state LASER: (i) Ruby LASER – principle, construction, working and application. (ii) Neodymium (Nd) LASERS. gas LASER: (i) He-Ne LASER - principle, construction, working and application. (i) CO2 LASER - principle, construction, working and application.

Liquid chemical and dye LASERS. Semiconductor LASER: Principle, characteristics, semiconductor diode LASERS, homo-junction and hetero-junction LASERS, high power semi conductor diode LASERS.

Applications in Communication field:

LASER communications: Principle, construction, types, modes of propagation, degradation of signal, analogue communication system, digital transmission, fiber optic communication.

Applications of LASERS in other fields:

Holography: Principle, types, intensity distribution, applications. laser induced fusion.

Harmonic generation. LASER spectroscopy. LASERS in industry: Drilling, cutting and welding. Lasers in medicine: Dermatology, cardiology, dentistry and ophthalmology.

Course Outcomes

CO 1- Understand, Comprehend and acquaint with concepts of NanoPhysics

CO2- To familiarize the material's property changes with respect to the dimensional confinements.

CO3- Acquire knowledge on the modern preparation process and analysis involved inthe nanomaterial's research

CO4- To learn about the technological advancements of the nano-structural materialsand devices in the engineering applications

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3	2												
CO2	2	3												
CO3				3										
CO4						3	2					1		

REFERENCES:

1. William T Silfvast, "Laser Fundamentals", Cambridge University Press, UK (2003).
2. B B Laud, "Lasers and Non linear Optics", New Age International (P) Ltd., New Delhi.
3. Andrews, "An Introduction to Laser Spectroscopy (2e)", Ane Books India (Distributors).
4. K R Nambiar, "Lasers: Principles, Types and Applications", New Age International(P) Ltd., New Delhi.
5. T Suhara, "Semiconductor Laser Fundamentals", Marcel Dekker(2004).

15PHY532 ASTROPHYSICS 3 0 0 3

Unit 1

Historical introduction: Old Indian and western – astronomy - Aryabhatta, Tycho Brahe, Copernicus, Galileo - Olbers paradox - solar system – satellites, planets, comets, meteorites, asteroids.

Practical astronomy - telescopes and observations & techniques – constellations, celestial coordinates, ephemeris.

Celestial mechanics - Kepler's laws - and derivations from Newton's laws.

Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

Unit 2

Stellar astronomy: H-R diagram, color-magnitude diagram - main sequence - stellar evolution

- red giants, white dwarfs, neutron stars, black holes - accretion disc - Schwartzchild radius - stellar masses Saha–Boltzman equation - derivation and interpretation.

Variable stars: Cepheid, RR Lyrae and Mira type variables - Novae and Super novae. Binary and multiple star system - measurement of relative masses and velocities. Interstellar clouds - Nebulae.

Unit 3

Galactic astronomy: Distance measurement - red shifts and Hubble's law – age of the universe, galaxies – morphology - Hubble's classification - gravitational lens, active galactic nuclei (AGNs), pulsars, quasars.

Relativity: Special theory of relativity - super-luminal velocity - Minkowski space - introduction to general theory of relativity – space - time metric, geodesics, space-time curvature. Advance of perihelion of Mercury, gravitational lens.

Cosmology: Comic principles, big bang and big crunch – cosmic background radiation - Nucleo- synthesis - plank length and time, different cosmic models - inflationary, steady state. Variation of G. anthropic principle.

COURSE OUTCOMES (CO):

After completion of the course students should be able to

CO1: Get a broad knowledge of scientific and technical methods in astronomy and astrophysics.

CO2: Apply mathematical methods to solve problems in astrophysics.

CO3: Develop critical/logical thinking, scientific reasoning and skills in the area of modern astrophysics.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	3											1		
CO2	2	2												
CO3	1	2												

REFERENCES:

1. "Textbook of Astronomy and Astrophysics with elements of Cosmology", V. B. Bhatia, Narosa publishing 2001.
2. William Marshall Smart, Robin Michael Green "On Spherical Astronomy", (Editor) Carroll, Bradley W Cambridge University Press ,1977
3. Bradley W.Carroll and Dale A. Ostlie. "Introduction to modern Astrophysics" Addison- Wesley, 1996.
4. Bradley W.Carroll and Dale A. Ostlie, "An Introduction to Modern Astrophysics" Addison-Wesley Publishing Company,1996
5. 'Stellar Astronomy' by K. D Abhayankar.
6. 'Solar Physics' by K. D Abhayankar.

HUMANITIES ELECTIVES

15ENG230 BUSINESS COMMUNICATION 1 0 2 2

Course Objectives

To introduce business vocabulary
T o introduce business style in writing and speaking
To expose students to the cross-cultural aspects in a globalised world
To introduce the students to the art of persuasion and negotiation in business contexts

Course Outcomes

CO1	Familiarize and use appropriate business vocabulary and etiquettes in verbal communication in the professional context
CO2	Understand organizational structures, pay structures and performance assessments
CO3	Apply language skills in drafting various business documents and other necessary communications in the business context
CO4	Understand and address cross cultural differences in the corporate environment
CO5	articipate in planned and extempore enactments of various business situations

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO 3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1										3		2
CO2									1		1	
CO3										3		
CO4						2						
CO5									2			

Syllabus
Unit 1:

Business Vocabulary - Writing: Drafting Notices, Agenda, and Minutes - Reading: Business

news, Business articles

Unit 2:

Writing: Style and vocabulary - Business Memorandum, letters, Press Releases, reports – proposals – **Speaking**: Conversational practice, telephonic conversations, addressing a gathering, conducting meetings

Unit 3:

Active Listening: Pronunciation – information gathering and reporting - **Speaking**: Cross-Cultural Issues, Group Dynamics, negotiation & persuasion techniques

Activities

Case studies & role-plays

Books recommended:

1. Jones, Leo & Richard Alexander. *New International Business English*. CUP. 2003.
2. Horner, David & Peter Strutt. *Words at Work*. CUP. 1996.
3. Levi, Daniel. *Group Dynamics for Teams*. 3 ed. Sage Publications India Pvt. Ltd. New Delhi, 2011.
4. Owen, Roger. *BBC Business English*. BBC. 1996.
5. Henderson, Greta Lafollette & Price R Voiles. *Business English Essentials*. 7th Edition. Glencoe / McGraw Hill.
6. Sweeney, Simon. *Communicating in Business*. CUP. 2000.

15ENG233 TECHNICAL COMMUNICATION 1 0 2 2

Course Objectives:

To introduce the students to the elements of technical style To introduce the basic elements of formal correspondence
To introduce technical paper writing skills and methods of documentation To improve oral presentation skills in formal contexts

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

CO1	Understand and use the basic elements of formal correspondence and methods of documentation
CO2	Learn to edit technical content for grammatical accuracy and appropriate tone and style
CO3	Use the library and internet recourses for research purposes
CO4	Demonstrate the ability to communicate effectively through group mock-technical presentations and other activities

Mapping of course outcomes with program outcomes:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1										3				
CO2										3				
CO3				1										
CO4									3	3				

Syllabus:

Unit 1

Mechanics of writing: Grammar rules – punctuation - spelling rules - tone and style- graphical Representation

Unit 2

Different kinds of written documents: Definitions - descriptions- instructions-recommendations- manuals - reports – proposals; Formal Correspondence: Letter Writing including job applications with Resume

Unit 3

Technical paper writing: Library research skills- documentation style - document editing – proof reading - formatting

Practice in oral communication: Practice in Oral communication and Technical presentations

References

1. Hirsh, Herbert. L "Essential Communication Strategies for Scientists, Engineers and Technology Professionals". II Edition. New York: IEEE press, 2002
2. Anderson, Paul. V. "Technical Communication: A Reader-Centred Approach". V Edition. Harcourt Brace College Publication, 2003
3. Strunk, William Jr. and White. EB. "The Elements of Style" New York. Alliyan & Bacon, 1999.
4. Riordan, G. Daniel and Pauley E. Steven. "Technical Report Writing Today" VIII Edition (Indian Adaptation). New Delhi: Biztantra, 2004.

15HIN101 HINDI I 1 0 2 2

To teach Hindi for effective communication in different spheres of life:- Social context , Education, Research & Media.

Syllabus Unit-1

Introduction to Hindi Language, -National Language, Official Language, link Language etc.. S
Introduction to Hindi language , Devanagari script and Hindi alphabet.
Shabda Bhed , Roopanthar ki Drishti se- Bhasha – Paribhasha aur Bhed - Sangya - Paribhasha Aur Bhed- Sangya ke Roopanthar- kriya.

Unit-2

Common errors and error corrections in Parts of Speech with emphasis on use of pronouns, Adjective and verb in different tenses – Special usage of adverbs, changing voice and conjunctions in sentences, gender& number - General vocabulary for conversations in given context –understanding proper pronunciation – Conversations, Interviews, Short speeches.

Unit -3

Poems – Kabir Ist 8 Dohas, Surdas 1st 1 Pada; Tulsidas 1st 1 Pada; Meera 1st 1 Pada

Unit- 4

Letter writing – personal and Formal –Translation from English to Hindi

Unit- 5

Kahani –Premchand : Kafan , Abhilasha, Vidroh, Poos ki rath, Juloos

Course Outcomes:

After the completion of the course the student will be able to:

CO1 Gain knowledge about the nature and culture of Hindi language

CO2 Understand the structural aspects of Hindi language

CO3 Apply the knowledge of the grammatical structures to communicate in Hindi

CO4 Analyse the social significance of modern literature.

CO5 Develop the ability to translate a given text to Hindi

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1									**2**	**3**				
CO2									**2**	**3**				
CO3									**2**	**3**				
CO4										**3**				
CO5									**2**					

Text Books :

1. Prem Chand Ki Srvashrestha Kahaniyam: Prem Chand ; Diamond Pub Ltd. New Delhi
2. Vyavaharik Hindi Vyakaran ,Anuvad thaha Rachana : Dr. H. Parameswaran, Radhakrishna publishing House,New Delhi
3. Kamtha Prasad Guru : Hindi Vyakaran, Best Book pub House, New Delhi
4. Poetry : Kavya Ras-Ed: T.V. Basker- Pachouri Press; Mathura

15HIN111 HINDI II 1 0 2 2

Appreciation and assimilation of Hindi Literature - both *drishya* and *shravya* - using the best specimens provided as anthology.

Syllabus:

Unit -1

Kavya Tarang;-Dhumil ke Anthim Kavitha[Poet-Dhumil],Dhabba[Poet-Kedarnath Singh],Proxy[Poet- Venugopal],Vakth[Poet-Arun Kamal],Maachis[Poet-Suneeta Jain].

Unit -2

Communicative Hindi - Moukhik Abhivyakthi

Unit -3

Audio- Visual –Media in Hindi – Movies like Tare Zameen par , Paa, Black etc., appreciation and evaluation . News reading and presentations in Radio and TV channels in Hindi .

Unit -4

Gadya Manjusha – Budhapa , Kheesa, Sadachar ka Thavis

Unit -5

Translation: Theory and Practice - Letter writing: Formal and Personal – Introduction to Hindi Software.

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

CO1	Understand the grammatical structures of Hindi
CO2	and the post modern trends of literature
CO3	e critical thinking and writing skills
CO4	and analyse different literary and audio-visual material
CO5	undamental knowledge of Hindi in formal and informal writing

Mapping of course outcomes with program outcomes:

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1									**1**	**2**				
CO2									**1**	**2**				
CO3									**1**	**2**				
CO4										**3**				
CO5									**1**	**2**				

Text Books:

1. Kavay Tarang : Dr. Niranjan , Jawahar Pusthakalay , Mathura.
2. Gadya Manjusha: Editor: Govind , Jawahar Pusthakalay , Mathura
3. Prem Chand Ki Srvashrestha Kahaniyam: Prem Chand ; Diamond Pub Ltd. New Delhi
4. Kamtha Prasad Guru : Hindi Vyakaran, Best Book pub House, New Delhi
5. 5.Poetry : Kavya Ras-Ed: T.V. Basker- Pachouri Press; Mathura

15HUM239 PSYCHOLOGY FOR EFFECTIVE LIVING 2 0 0 2

Course Objectives

1. To help students acquire the basic knowledge of behavior and effective living
2. To create an awareness of the hazards of health compromising behaviours
3. To develop and strengthen the tools required to handle the adversities of life

Syllabus

Unit 1

SELF AWARENESS & SELF MOTIVATION

Definition of motivation-Maslow's hierarchy of motivation-Self-analysis through SWOT and Johari window - Importance of self-esteem and Enhancement of self-esteem-techniques and Strategies for self-motivation.

Unit 2

THE NATURE AND COPING OF STRESS

Definition of stress, stressors, eustress, distress-PTSD-stress among college students- stress assessment-coping with stress-progressive muscle relaxation-RET-guided imagery-bio feedback- religious and spiritual way of coping with stress

Unit 3

APPLICATION OF HEALTH PSYCHOLOGY

Health compromising behaviors-smoking and alcoholism-biological and psychological effects of addiction-deaddiction-behavior modifications-CBT in handling problem behavior-cancer risks- AIDS.

Course Outcome

CO 1: Understand the basic concepts of Behavioral Psychology

CO 2: Demonstrate self reflective skills through activities

CO 3: Apply the knowledge of psychology to relieve stress

CO 4: Analyse the adverse effects of health compromising behaviours.

CO 5: Evaluate and use guided techniques to overcome and cope with stress related problems.

CO-PO Mapping

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

Text Book(s)

V.D.Swaminathan&K.V.Kaliappan, Psychology for Effective living-An introduction to Health

Reference(s)

1.S.Sunder. (2002). Textbook of Rehabilitation,2nd edition,Jaypee Brothers,New Delhi.

2.Weiben&Lloyd. (2004). Psychology applied to Modern Life,Thompson Learning,Asia Ltd.

15HUM240 PSYCHOLOGY FOR ENGINEERS 2 0 0 2

Course Objectives

1. To strengthen the fundamental knowledge of human behavior
2. To strengthen the ability to understand the basic nature and behavior of humans in organizations as a whole
3. To connect the concepts of psychology to personal and professional life

Syllabus

Unit 1

PSYCHOLOGY OF ADOLESCENTS

Psychology-definition-scope-adolescence-characteristics-developmental tasks-physical and psychological changes-interests-family relationships-emotions-peer pressure-positive and Negative effects of peer pressure-types of friends-choice of friends

Unit 2

LEARNING, MEMORY AND STUDY SKILLS

Definitions-Classical conditioning-Operant conditioning-Insight learning-reinforcement-its principles and its effects-role of reward and punishment in learning-forgetting-causes-techniques for improving study skills-Mnemonics-Intelligence-Emotional and social intelligence

Unit 3

ATTENTION & PERCEPTION

Definition-types of attention-span of attention-division of attention- factors determining attention-perception-difference between sensation and perception-laws of perception-errors in perception-illusion and hallucination

Course Outcome

CO 1: Understand the fundamental processes underlying human behavior such as learning, motivation, individual differences, intelligence and personality.
CO 2: Apply the principles of psychology in day- to- day life for a better understanding of oneself and others.
CO 3: Apply the knowledge of Psychology to improve study skills and learning methods
CO 4: Apply the concepts of defense mechanisms to safeguard against abusive relationships and to nurture healthy relationships.

CO-PO Mapping

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

Text Book(s)

S.K.Mangal General Psychology,Sterling Publishers Pvt.Ltd.2007

Reference(s)

1.Elizabeth B. Hurlock, Developmental Psychology - A Life span approach,6th edition 2.Cliffordm Organ, Richard King, John Scholper, Introduction to Psychology, Tata McGraw Hill, Pvt Ltd 2004.

15HUM244 UNDERSTANDING SCIENCE OF FOOD AND NUTRITION1022

Course Objectives:

- To introduce the significance of food, nutrients, locally available food resources, synergic food combinations, good cooking methods and importance of diversity in foods
- To understand nutritional imbalances and chronic diseases associated with the quality of food.
- To gain awareness about the quality of food - Organic food, genetically modified food, adulterated food, allergic food, , food poisoning and food safety.
- To understand food preservation processing, packaging and the use of additives.

UNIT I: FOOD AND FOOD GROUPS: Introduction to foods, food groups, Identifying locally available foods and plant nutrients. Nutrients and its variety. Cooking methods, effects of cooking on nutritive value of foods, while preparation and preservation of foods, cooking utensils & instruments. Synergy between foods, Do and Don'ts while cooking. Science behind foods.Food allergies, food poisoning, food safety standards.

UNIT II: NUTRIENTS AND NUTRITION: Nutrition through life cycle, RDA intake for all age groups. Nutrition in disease – Malnutrition (under & over), other diseases. Adulteration of foods & Food additives. Packaging and labeling of foods, certification, logo & symbols.

UNIT III: INTRODUCTION TO FOOD BIOTECHNOLOGY: Future foods- Organic foods and genetically modified foods, Fortification of foods, bio fortification of foods, value addition of foods, functional foods, nutraceuticals, weaning foods/supplementary. Processing and preservation of foods, applications of food technology in daily life, and your prospects associated with food industry – Nanoparticles, biosensors, advanced research.

Course Outcome:

CO1: Acquire knowledge about the various food and food groups
CO2: Understand nutritional imbalances and chronic diseases prevailing among different age groups.
CO3: Understand the significance of safe food and apply the food safety standards
CO4: Demonstrate skills of food processing, preservation and packaging methods with or without additives
CO5: Evaluate the quality of food based on the theoretical knowledge of Food and Nutrition

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1		1	1			1	2	1	1	1	1	3
CO 2		1	1			1	1	1	1	1	1	3
CO 3		1	1			1	1	1	1	1	1	3
CO 4		1	1			1	1	1	1	1	1	3
CO 5		1	1			1	2	1	2	1	1	3

Reference Books:

- C. Gopalanetal, **Nutritive Value of Indian Foods**, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, 2017.
- B.SriLakhmi, **Dietetics**, New age international, 2015.
- N, ShakuntalaManay, M. Shadaksharaswamy, **Foods Facts and Principles**, New Age International, New Delhi, 2008.
- Sumati.RMudamri, and M.V.Rajagopal, **Fundamental of foods, Nutrition and Diet Therapy**, New Age International, New Delhi, 2008.

15MAL101 **MALAYALAM I** **1 0 2 2**

Course Objectives:

To teach Malayalam for effective communication in different spheres of life:- Social context , Education, Research & Media

Unit 1

Ancient poet trio:*Adhyatmaramayanam,LakshmanaSwanthanam (Lines: valsasoumitre… mungikidakayal),*Ezhuthachan -Medieval period classics – *Jnanappana(Lines: kalaminnu… vilasangalingane*),Poonthanam.

Unit 2

Modern Poet trio: *EnteGurunathan,* VallatholNarayanaMenon- Critical analysis of the poem.

Unit 3

Short stories from period 1/2/3:*Poovanpazham*-VaikaomMuhammedBasheer-Literary & Cultural figures of Kerala and about their literary contributions.

Unit 4

Literary Criticism: *BharathaParyadanam-VyasanteChiri*–Ithihasa studies-KuttikrishnaMararu-Outline of literary Criticism in Malayalam Literature-Introduction to KuttikrishnaMararu& his outlook towards literature &life.

Unit 5

Error-freeMalayalam: **1**.Language; **2**.Clarity of expression; **3**.Punctuation-Thettillatha Malayalam – Writing-**a**. Expansion of ideas; **b**.PrecisWriting; **c**. Essay Writing; **d**.Letter writing; **e**.RadioSpeech;**f**.Script/Feature/Script Writing;**g**.NewsEditing;**h**.Advertising;**i.**Editing;j.EditorialWriting;**k**.Critical appreciation of literary works (Any one or two as an assignment).

Course Outcome :

After the completion of the course the student will be able to:

CO1	Understand and inculcate philosophical thoughts and practices
CO2	Understand and appreciate the post modern trends of literature.
CO3	Analyse the literary texts and comprehend the cultural diversity of Kerala
CO4	Distinguish the different genres in Malayalam literature
CO5	Demonstrate the ability to effectively communicate in Malayalam

CO-PO Mapping Mapping of course outcomes with program outcomes:

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

REFERENCES:

1. Prof. PanmanaRamachandranNair(Edited),*Thunjanpadhanangal*, Current Books, 2012.
2. Prof. G.Balakrishnan Nair,. *Jnanappanayum Harinama Keerthanavum,* N.B.S, 2005.
3. Dr. M.N.Karasseri,*BasheerintePoonkavanam*, D.C.Books, 2008.
4. Prof. M.N.Vijayan, *MarubhoomikalPookkumbol,*D.C.Books, 2010.
5. Prof. M.ThomasMathew,*LavanyanubhavathinteYukthisasthram*, Kerala Sahitya Academy, 2006.
6. Dr. .M.Leelavathy,*KavithaSahityacharitram,* Kerala Sahitya Academy, 1996.
7. Thayattu Sankaran, *VallatholNavayugathinteKavi*,VallatholVidyapeetham

15MAL111 MALAYALAM II 1 0 2 2

Course Objectives

- To appreciate the aesthetics and understand the cultural implications in Malayalam Literature
- To enhance creative thinking in Malayalam
- To equip the students to read and write effectively in Malayalam
- To acquire pronunciation skills

Course Outcome:

After the completion of the course the student will be able to:

CO1	Understand the different cultural influences in linguistic translation
CO2	Identify and appreciate the Romantic elements of modern literature
CO3	Analyze the genre of autobiographical writing
CO4	Critically evaluate the significance of historical, political and socio cultural aspects in literature
CO5	Demonstrate good writing skills in Malayalam

CO-PO Mapping Mapping of course outcomes with program outcomes:

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

Unit1

Ancient poet trio: *Kalayanasougandhikam,(Lines: kallummarangalum… namukkennarikavrikodara),*KunjanNambiar - Critical analysis of his poetry-Ancient Drama: *Kerala Sakunthalam* (Act 1), Kalidasan (Transilated by Attor Krishna Pisharody).

Unit 2

Modern/romantic/contemporary poetry: *Manaswini,* Changampuzha Krishna Pillai – Romanticism – modernism.

Unit 3

Anthology of short stories from period 3/4/5: *NinteOrmmayku*, M.T.Vasudevan Nair- literary contributions of his time.

Unit 4

Part of an autobiography/travelogue: *Kannerum Kinavum,*
Chapter: Valarnnuvarunnoratmavu, V.T.Bhattathirippadu-Socio-cultural literature-historical importance.

Unit 5

Error-free Malayalam-**1**.Language; **2**.Clarity of expression; **3**.Punctuation-Thettillatha Malayalam- Writing-**a**.Expansion of ideas;**b**.PrécisWriting;**c.** Essay Writing; **d**.Letter writing;**e**.RadioSpeech;**f**.Script/Feature/ScriptWriting;**g**.NewsEditing;**h.**Advertising;**i**.Edit ing; **j**.EditorialWriting;**k**.Critical appreciation of literary works (Any one or two as an assignment).

REFERENCES:

1. Prof.P.K.NarayanaPillai.,(SahityaPanchanan), *Vimarsanathrayam,* Kerala Sahitya Academy,2000.
2. Prof.M.P. SankunniNair.,*ChathravumChamaravum,* D.C.Books, 2004. 3.Prof.M.K.Sanu, *Changampuzha: Nakshatrangalude Snehabhajanam*,N.B.S.,1989.
4. Prof.S.GupthanNair,*AsthiyudePookkal*, D.C Books.2005.
5. Prof. PanmanaRamachandranNair,*ThettillathaMalayalam,Sariyumthettum etc*., D.C.Book, 2006.
6. Prof.M. Achuthan, *Cherukatha-Innale, innu*, National Book Stall, 1998.
7. Prof.N.KrishnaPillai,*KairaliyudeKatha*,National Book Stall, 2001.

15TAM101 **TAMIL I** **2 0 0 2**

Course Objectives

- To introduce the students to different literature- Sangam literature, Epics, Bhakthi literatureandmodern literature.
- To improve their ability tocommunicate with creative concepts, and also to introduce them to the usefulness of basicgrammaticalcomponents in Tamil.

Syllabus

Unit1

The history ofTamilliterature: Nāṭṭupuṟap pāṭalkaḷ, kataikkaḷ, paḻamoḻikaḷ -
ciṟukataikaḷ tōṟṟamum vaḷarcciyum,
ciṟṟilakkiyaṅkaḷ: Kaliṅkattup paraṇi (pōrpāṭiyatu) - mukkūṭaṟ paḷḷu 35.
Kāppiyaṅkaḷ: Cilappatikāram – maṇimēkalai naṭaiyiyal āyvu maṟṟum aimperum – aiñciṟuṅ kāppiyaṅkaḷ toṭarpāṉa ceytikaḷ.

Unit 2

tiṇai ilakkiyamum nītiyilakkiyamum - patiṉeṇkīḻkkaṇakku nūlkaḷ toṭarpāṉa piṟa ceytikaḷ -
tirukkuṟaḷ (aṉpu, paṇpu, kalvi, oḻukkam, naṭpu, vāymai, kēḷvi, ceynaṉṟi, periyāraittuṇakkōṭal,
viḻippuṇarvu pēṉṟa atikārattiluḷḷa ceytikaḷ.
Aṟanūlkaḷ: Ulakanīti (1-5) – ēlāti (1,3,6). - Cittarkaḷ: Kaṭuveḷi cittar pāṭalkaḷ (āṉantak kaḷippu –1, 4, 6, 7, 8), maṟṟum akappēy cittar pāṭalkaḷ (1-5).

Unit 3

tamiḻ ilakkaṇam: Vākkiya vakaikaḷ – taṉviṉai piṟaviṉai – nērkkūṟṟu ayaṟkūṟṟu

Unit 4

tamiḻaka aṟiñarkaḷiṉ tamiḻ toṇṭum camutāya toṇṭum: Pāratiyār, pāratitācaṉ, paṭṭukkōṭṭai kalyāṇacuntaram, curatā, cujātā, ciṟpi, mēttā, aptul rakumāṉ, na.Piccaimūrtti, akilaṉ, kalki, jī.Yū.Pōp, vīramāmuṉivar, aṇṇā, paritimāṟ kalaiñar, maṟaimalaiyaṭikaḷ.

Unit 5

tamiḻ moḻi āyvil kaṇiṉi payaṉpāṭu. - Karuttu parimāṟṟam - viḻampara moḻiyamaippu – pēccu
- nāṭakam paṭaippu - ciṟukatai, katai, putiṉam paṭaippu.

Course Outcomes

CO 1: To understand the Sangam literature
CO 2: To understand the creative literature
CO 3: To understand the literary work on religious scriptures
CO 4: To improve the communication and memory skills
CO 5: To understand the basic grammar components of Tamil language and their usage and applications.
CO 6: Understand creative writing aspects and apply them.

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			-	-	-	-	-	-	2	2	-	-
CO2			-	-	-	-	-	-	2	2	-	-
CO3			-	-	-	-	-	-	2	2	-	-
CO4			-	-	-	-	-	-	2	2	-	-
CO5			-	-	-	-	-	-	2	2	-	-
CO6			-	-	-	-	-	-	2	2	-	-

Textbooks:

- http:/Www.tamilvu.trg/libirary/libindex.htm.
- http:/Www.tunathamizh.tom/2013/07/blog0post_24.html
- Mu.Varatarācaṉ "tamiḻ ilakkiya varalāṟu" cāhitya akaṭemi papḷikēṣaṉs, 2012
- nā.Vāṉamāmalai "paḻaṅkataikaḷum, paḻamoḻikaḷum" niyū ceñcuri puttaka veḷiyīṭṭakam, 1980,2008
- nā.Vāṉamāmalai, "tamiḻar nāṭṭuppāṭalkaḷ" niyū ceñcuri puttaka veḷiyīṭṭakam 1964,2006
- poṉ maṇimāṟaṉ "aṭōṉ tamiḻ ilakkaṇam "aṭōṉ papḷiṣiṅ kurūp, vañciyūr, tiruvaṉantapuram, 2007.

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15TAM111 **TAMIL II** **2 0 0 2**

Course Objectives

- To learn the history ofTamilliterature.
- To analyze different styles of Tamil Language.
- To strengthen thecreativity in communication, Tamilbasicgrammar and use of computer on Tamil Language.

Syllabus

Unit 1

The history ofTamilliterature: Nāṭṭupuṟap pāṭalkaḷ, kataikkaḷ, paḷamoḻikaḷ - ciṟukataikaḷ tōṟṟamum vaḷarcciyum,
ciṟṟilakkiyaṅkaḷ: Kaliṅkattup paraṇi (pōrpāṭiyatu) - mukkūṭaṟ paḷḷu 35.
Kāppiyaṅkaḷ: Cilappatikāram – maṇimēkalai naṭaiyiyal āyvu maṟṟum aimperum – aiñciṟuṅ kāppiyaṅkaḷ toṭarpāṉa ceytikaḷ.

Unit 2

tiṇai ilakkiyamum nītiyilakkiyamum - patiṉeṇkīḻkkaṇakku nūlkaḷ toṭarpāṉa piṟa ceytikaḷ - tirukkuṟaḷ (aṉpu, paṇpu, kalvi, oḻukkam, naṭpu, vāymai, kēḷvi, ceynaṉṟi, periyāraittuṇakkōṭal, viḻippuṇarvu pēṉṟa atikārattil uḷḷa ceytikaḷ.
Aṟanūlkaḷ: Ulakanīti (1-5) – ēlāti (1,3,6). - Cittarkaḷ: Kaṭuveḷi cittar pāṭalkaḷ (āṉantak kaḷippu –1, 4, 6, 7, 8), maṟṟum akappēy cittar pāṭalkaḷ (1-5).

Unit 3

tamiḻ ilakkaṇam: Vākkiya vakaikaḷ – taṉviṉai piṟaviṉai – nērkkūṟṟu ayaṟkūṟṟu

Unit 4

tamiḻaka aṟiñarkaḷiṉ tamiḻ toṇṭum camutāya toṇṭum: Pāratiyār, pāratitācaṉ, paṭṭukkōṭṭai kalyāṇacuntaram, curatā, cujātā, ciṟpi, mēttā, aptul rakumāṉ, na.Piccaimūrtti, akilaṉ, kalki, jī.Yū.Pōp, vīramāmuṉivar, aṇṇā, paritimāṟ kalaiñar, maṟaimalaiyaṭikaḷ.

Unit 5

tamiḻ moḻi āyvil kaṇiṉi payaṉpāṭu. - Karuttu parimāṟṟam - viḻampara moḻiyamaippu – pēccu - nāṭakam paṭaippu - ciṟukatai, katai, putiṉam paṭaippu.

Course Outcomes

CO 1: Understand the history of Tamil literature.
CO 2: Apply practical and comparative analyses on literature.
CO 3: Understand thinai literature, literature on justice, Pathinenkeelkanaku literature.
CO 4: Understand the tamil scholars' service to Tamil language and society.
CO 5: Understand components of Tamil grammar and its usage
CO 6: Understand creative writing aspects and apply them

CO-PO Mapping

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			-	-	-	-	-	-	2	2	-	-
CO2			-	-	-	-	-	-	2	2	-	-
CO3			-	-	-	-	-	-	2	2	-	-
CO4			-	-	-	-	-	-	2	2	-	-
CO5			-	-	-	-	-	-	2	2	-	-
CO6			-	-	-	-	-	-	2	2	-	-

Text Books / References

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nā.Vāṉamāmalai “paḻaṅkataikaḷum, paḻamoḻikaḷum” niyū ceñcuri puttaka veḷiyīṭṭakam, 1980,2008
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1964,2006 poṉ maṇimāṟaṉ “aṭōṉ tamiḻ ilakkaṇam “aṭōṉ papḷiṣiṅ kurūp,
vañciyū