Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF ELECTRICAL ENGINEERING

B. Tech Electronics and Instrumentation Engineering

(B.Tech EIE)

Curriculum (*2019*)

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

World class Education: Excellence in education, grounded in ethics and critical thinking, for improvement of life.

Cutting edge Research: An innovation ecosystem to extend knowledge and solve critical problems.

Impactful People: Happy, accountable, caring and effective workforce and students.

Rewarding Co-creations: Active collaboration with national & international industries & universities for productivity and economic development

Service to Society: Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF ELECTRICAL ENGINEERING

To be a leader for academic excellence in the field of electrical, instrumentation and control engineering imparting high quality education and research leading to global competence for the societal and industrial developments.

MISSION STATEMENT OF THE SCHOOL OF ELECTRICAL ENGINEERING

M1: Impart high quality education and interdisciplinary research by providing conducive teaching learning environment and team spirit resulting in innovation and product development.

M2: Enhance the core competency of the students to cater to the needs of the industries and society by providing solutions in the field of electrical, electronics, instrumentation, and automation engineering.

M3: Develop interpersonal skills, leadership quality and societal responsibility through ethical value-added education.

B. Tech Electronics and Instrumentation Engineering

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The school of Electrical Engineering has established and sustained a well-defined set of educational objectives and preferred program outcomes. Educational objectives of the program satisfy to the requirements of the stakeholders such as students, parents, employers, alumni, faculty etc. The Program Educational Objectives (PEOs) are as follows.

PEO-1: Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems in electrical engineering and allied disciplines.

PEO-2: Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.

PEO-3: Graduates will function in their profession with social awareness and responsibility.

PEO-4: Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.

PEO-5: Graduates will be successful in pursuing higher studies leading to careers in engineering, management, teaching, and research.

B. Tech Electronics and Instrumentation Engineering

PROGRAMME OUTCOMES (POs)

POs are statements that describe what students are expected to know and be able to do upon graduating from the program. These relate to the skills, knowledge, analytical ability attitude and behaviour that students acquire through the program.

NBA has defined the following twelve POs for an engineering graduate. These are in line with the Graduate Attributes as defined by the Washington Accord:

PO_01: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO_02: Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO_03: 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.

PO_04: 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 for complex problems:

- that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline as against problems given at the end of chapters in a typical text book that can be solved using simple engineering theories and techniques
- that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints / requirements not explicitly given in

the problem statement such as cost, power requirement, durability, product life, etc.

• which need to be defined (modelled) within appropriate mathematical framework

• that often require use of modern computational concepts and tools, for example, in the design of an antenna or a DSP filter.

PO_05: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO_06: 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.

PO_07: 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.

PO_08: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO_09: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO_10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO_11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO_12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On completion of B. Tech. (Electronics and Instrumentation Engineering) programme, graduates will be able to

- PSO1: Design and develop electronics and instrumentation systems for fulfilling socio-economic and environmental requirements.

- PSO2: Analyze and design signal conditioning circuits for sensors, measurement, instrumentation system, process control and automation techniques by considering economic and environmental constraints.

- PSO3: Apply and implement intelligent systems using modern tools for instrumentation engineering.

B. Tech Electronics and Instrumentation Engineering

CREDIT STRUCTURE

Category-wise Credit distribution

Distribution	**Credits**
University Core (UC)	53
University Elective (UE)	12
Programme Core (PC)	59
Programme Elective (PE)	36
Total	**160**

B. Tech Electronics and Instrumentation Engineering

DETAILED CURRICULUM

University Core

University Core (53 Credits)							
S. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**J**	**C**
1.	CHY1701	Engineering Chemistry	3	0	2	0	4
2.	CHY1002	Environmental Sciences	3	0	0	0	3
3.	CSE1001	Problem Solving and Programming	0	0	6	0	3
4.	CSE1002	Problem Solving and Object Oriented Programming	0	0	6	0	3
5.	EEE1901	Technical Answers for Real World Problems (TARP)	1	0	0	4	2
6.	EEE4098	Comprehensive Examination	0	0	0	0	1
7.	EEE4099	Co-op /Capstone Project	0	0	0	0	12
8.	ENG1901/ ENG1902/ ENG1903	Technical English I Technical English II Advanced Technical English	0/0/0	0/0/0	4/4/2	0/0/4	2
9.	ENG 1000/ ENG 2000	Foundation English I Foundation English II	0	0	4	0	2
10.	HUM1021	Ethics and Values	2	0	0	0	2
11.	MAT1011	Calculus for Engineers	3	0	2	0	4
12.	MAT2001	Statistics for Engineers	3	0	2	0	4
13.	MGT1022	Lean Start-up Management	1	0	0	4	2
14.	PHY1701	Engineering Physics	3	0	2	0	4
15.	PHY1901	Introduction to Innovative Projects	1	0	0	0	1
16.	EXC4097	Extra & Co- Curricular Activities	0	0	0	0	2
17.	EEE1902	Industrial Internship	0	0	0	0	1
18.	FLC4097	Foreign Language Courses Basket	2	0	0	0	2
19.	STS4097	Soft Skills	-	-	-	-	6

B. Tech Electronics and Instrumentation Engineering

Programme Core

Programme Core (59 Credits)							
S. No.	**Course Code**	**Course Title**	**L**	**T**	**P**	**J**	**C**
1.	EEE1002	Electric Circuits	3	0	0	0	3
2.	EEE1004	Engineering Electromagnetics	3	0	2	0	4
3.	EEE1005	Signals and Systems	3	0	0	0	3
4.	EEE2001	Network Theory	3	0	0	0	3
5.	EEE2002	Semiconductor Devices and Circuits	2	0	2	4	4
6.	EEE2005	Digital Signal Processing	2	0	2	0	3
7.	EEE3001	Control Systems	3	0	2	0	4
8.	EEE3002	Analog and Digital Circuits	3	0	2	0	4
9.	EEE4001	Microprocessor and Microcontroller	2	0	2	0	3
10.	EEE4021	Sensors and Signal Conditioning	3	0	2	0	4
11.	EEE4031	Electrical and Electronic Instrumentation	3	0	2	0	4
12.	EEE4032	Process Automation and Control	3	0	2	0	4
13.	EEE4033	Industrial Instrumentation	3	0	0	4	4
14.	MAT2002	Applications of Differential and Difference Equations	3	0	2	0	4
15.	MAT3003	Complex Variables and Partial Differential Equations	3	1	0	0	4
16.	MAT3005	Applied Numerical Methods	3	1	0	0	4

B. Tech Electronics and Instrumentation Engineering

Programme Elective

S. No.	Course Code	Course Title	L	T	P	J	C
1.	EEE1007	Neural Network and Fuzzy Control	2	0	0	4	3
2.	EEE1008	Bio-Medical Instrumentation	3	0	0	4	4
3.	EEE1011	Automated Test Engineering	2	0	2	0	3
4.	EEE1012	Optoelectronic Instrumentation	3	0	0	0	3
5.	EEE1013	Analytical Instrumentation	3	0	0	0	3
6.	EEE1014	Fiber Optic Sensors	3	0	0	0	3
7.	EEE1015	Micro Electromechanical Systems	3	0	0	4	4
8.	EEE1016	Non-Destructive Testing	3	0	0	0	3
9.	EEE1018	Nanotechnology Fundamentals and its Applications	3	0	0	0	3
10.	EEE1020	Engineering Optimization	2	1	0	4	4
11.	EEE2006	Communication Engineering	3	0	2	0	4
12.	EEE2008	Electrical Technology	3	0	2	0	4
13.	EEE3008	Data Communication Network	3	0	0	0	3
14.	EEE3009	Digital Image Processing	3	0	0	4	4
15.	EEE4018	Advanced Control Theory	3	0	0	4	4
16.	EEE4019	Advanced Digital System Design With FPGAs	2	0	0	4	3
17.	EEE4020	Embedded System Design	2	0	0	4	3
18.	EEE4022	Analog VLSI Design	3	0	0	0	3
19.	EEE4024	Computer Architecture and Organization	3	0	0	0	3
20.	EEE4026	Digital Control Systems	2	0	0	4	3
21.	EEE4027	Robotics and Control	2	0	0	4	3
22.	EEE4028	VLSI Design	3	0	2	0	4
23.	EEE4029	Advanced Microcontrollers	2	0	0	4	3

24.	EEE4030	System on Chip Design	3	0	0	4	4
25.	EEE4034	Wireless Sensor Networks	3	0	0	4	4
26.	EEE4035	Virtual Instrumentation	0	0	2	4	2
27.	EEE4037	Rapid Prototyping with FPGAs	0	0	4	0	2
28.	EEE4038	Testing and Calibration Systems	0	0	2	0	1
29.	MEE1006	Applied Mechanics and Thermal Engineering	2	0	2	0	3
30.	ECE3501	IoT Fundamentals	2	0	2	4	4
31.	ECE3502	IoT Domain Analyst	2	0	2	4	4

University Elective Baskets

Management courses

Sl.No	**Code**	**Title**	**L**	**T**	**P**	**J**	**C**
1	MGT1001	Basic Accounting	3	0	0	0	3
2	MGT1002	Principles of Management	2	0	0	4	3
3	MGT1003	Economics for Engineers	2	0	0	4	3
4	MGT1004	Resource Management	2	0	0	4	3
5	MGT1005	Design, Systems and Society	2	0	0	4	3
6	MGT1006	Environmental and Sustainability Assessment	2	0	0	4	3
7	MGT1007	Gender, Culture and Technology	2	0	0	4	3
8	MGT1008	Impact of Information Systems on Society	2	0	0	4	3
9	MGT1009	Technological Change and Entrepreneurship	2	0	0	4	3
10	MGT1010	Total Quality Management	2	2	0	0	3
11	MGT1014	Supply Chain Management	3	0	0	0	3
12	MGT1015	Business Mathematics	3	0	0	0	3
13	MGT1016	Intellectual Property Rights	3	0	0	0	3
14	MGT1017	Business Regulatory Framework For Start-ups	3	0	0	0	3
15	MGT1018	Consumer Behaviour	3	0	0	0	3

16	MGT1019	Services Marketing	3	0	0	0	3
17	MGT1020	Marketing Analytics	2	0	2	0	3
18	MGT1021	Digital and Social Media Marketing	3	0	0	0	3
19	MGT1022	Lean Start-up Management	1	0	0	4	2
20	MGT1023	Fundamentals of Human Resource Management	3	0	0	4	4
21	MGT1024	Organizational Behaviour	3	0	0	4	4
22	MGT1025	Foundations of Management And Organizational Behaviour	3	0	0	4	4
23	MGT1026	Information Assurance and Auditing	2	0	0	4	3
24	MGT1028	Accounting and Financial Management	2	2	0	4	4
25	MGT1029	Financial Management	2	1	0	4	4
26	MGT1030	Entrepreneurship Development	3	0	0	4	4
27	MGT1031	International Business	3	0	0	4	4
28	MGT1032	Managing Asian Business	3	0	0	4	4
29	MGT1033	Research Methods in Management	2	1	0	4	4
30	MGT1034	Project Management	3	0	0	4	4
31	MGT1035	Operations Management	3	0	0	0	3
32	MGT1036	Principles of Marketing	3	0	0	4	4
33	MGT1037	Financial Accounting and Analysis	2	1	0	4	4
34	MGT1038	Financial Econometrics	2	0	0	4	3
35	MGT1039	Financial Markets and Institutions	2	0	0	4	3
36	MGT1040	Personal Financial Planning	2	0	0	4	3
37	MGT1041	Financial Derivatives	2	1	0	4	4
38	MGT1042	Investment Analysis and Portfolio Management	2	0	0	4	3
39	MGT1043	Applications in Neuro Marketing	3	0	0	4	4
40	MGT1044	Global Brand Marketing Strategies	3	0	0	4	4
41	MGT1045	Industrial Marketing	3	0	0	4	4
42	MGT1046	Sales and Distribution Management	3	0	0	4	4

43	MGT1047	Social Marketing	3	0	0	4	4
44	MGT1048	Political Economy of Globalization	3	0	0	4	4
45	MGT1049	Sustainable Business Models	3	0	0	4	4
46	MGT1050	Software Engineering Management	2	0	0	4	3
47	MGT1051	Business Analytics for Engineers	2	2	0	0	3
48	MGT1052	Bottom of the Pyramid Operations	3	0	0	0	3
49	MGT1053	Entrepreneurship Development, Business Communication and IPR	1	0	2	0	2
50	MGT1054	Product Planning and Strategy	2	2	0	0	3
51	MGT1055	Design Management	2	2	0	0	3
52	MGT1056	Accounting and Financial Management	3	0	0	4	4
53	MGT6001	Organizational Behaviour	2	0	0	4	3

Humanities courses

Sl.No	**Code**	**Title**	**L**	**T**	**P**	**J**	**C**
1	HUM1001	Fundamentals of Cyber Laws	3	0	0	0	3
2	HUM1002	Business Laws	3	0	0	0	3
3	HUM1003	Basic Taxation for Engineers	3	0	0	0	3
4	HUM1004	Corporate Law for Engineers	3	0	0	0	3
5	HUM1005	Cost Accounting for Engineers	3	0	0	0	3
6	HUM1006	Business Accounting for Engineers	3	0	0	0	3
7	HUM1007	Contemporary Legal Framework for Business	3	0	0	0	3
8	HUM1009	International Business	3	0	0	0	3
9	HUM1010	Foreign Trade Environment	3	0	0	0	3
10	HUM1011	Export Business	3	0	0	0	3
11	HUM1012	Introduction to Sociology	3	0	0	0	3
12	HUM1013	Population Studies	3	0	0	0	3
13	HUM1021	Ethics and Values	2	0	0	0	2

14	HUM1022	Psychology in Everyday Life	2	0	0	4	2
15	HUM1023	Indian Heritage and Culture	2	0	0	4	2
16	HUM1024	India and Contemporary World	2	0	0	4	2
17	HUM1025	Indian Classical Music	1	0	2	4	1
18	HUM1033	Micro Economics	3	0	0	0	3
19	HUM1034	Macro Economics	3	0	0	0	3
20	HUM1035	Introductory Econometrics	2	0	2	0	2
21	HUM1036	Engineering Economics and Decision Analysis	2	0	0	4	2
22	HUM1037	Applied Game Theory	2	0	0	4	2
23	HUM1038	International Economics	3	0	0	0	3
24	HUM1039	Community Development in India	2	0	0	4	2
25	HUM1040	Indian Social Problems	3	0	0	0	3
26	HUM1041	Indian Society Structure and Change	3	0	0	0	3
27	HUM1042	Industrial Relations and Labour Welfare in India	3	0	0	0	3
28	HUM1043	Mass Media and Society	2	0	0	4	2
29	HUM1044	Network Society	3	0	0	0	3
30	HUM1045	Introduction to Psychology	2	0	2	0	2
31	HUM1706	Business Accounting for Engineers	3	0	0	0	3

CHY1002	Environmental Sciences	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	**NIL**	**Syllabus version**				
		v:1.1				

Course Objectives:

1. To make students understand and appreciate the unity of life in all its forms, the implications of life style on the environment.
2. To understand the various causes for environmental degradation.
3. To understand individuals contribution in the environmental pollution.
4. To understand the impact of pollution at the global level and also in the local environment.

Expected Course Outcome:

1. Students will recognize the environmental issues from a problem-oriented interdisciplinary perspective.
2. Students will understand the key environmental issues, the science behind those problems, and potential solutions.
3. Students will demonstrate the significance of biodiversity and its preservation.
4. Students will identify various environmental hazards.
5. Students will design various methods for the conservation of resources.
6. Students will formulate action plans for sustainable alternatives that incorporate science, humanity, and social aspects.
7. Students will have foundational knowledge enabling them to make sound life decisions as well as enter a career in an environmental profession or higher education.
8. Understand the need for eco-balance
9. Acquire basic knowledge about global climate change with a particular reference to the Indian context.
10. Find ways to protect the environment and play pro-active roles

Module:1	Environment and Ecosystem	7 hours

Key environmental problems, their basic causes and sustainable solutions. IPAT equation. Ecosystem, earth – life support system and ecosystem components; Food chain, food web, Energy flow in ecosystem; Ecological succession- stages involved, Primary and secondary succession, Hydrarch, mesarch, xerarch; Nutrient, water, carbon, nitrogen, cycles; Effect of human activities
on these cycles.

Module:2	Biodiversity	6 hours

Importance, types, mega-biodiversity; Species interaction - Extinct, endemic, endangered and rare species; Hot-spots; GM crops- Advantages and disadvantages; Terrestrial biodiversity and Aquatic
biodiversity – Significance, Threats due to natural and anthropogenic activities and Conservation methods.

Module:3	**Sustaining Natural Resources and Environmental Quality**	**7 hours**
Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards. Water footprint; virtual water, blue revolution. Water quality management and its conservation. Solid and hazardous waste – types and waste management methods.		
Module:4	**Energy Resources**	**6 hours**
Renewable - Non renewable energy resources- Advantages and disadvantages - oil, Natural gas, Coal, Nuclear energy. Energy efficiency and renewable energy. Solar energy, Hydroelectric power, Ocean thermal energy, Wind and geothermal energy. Energy from biomass, solar-Hydrogen revolution.		
Module:5	**Environmental Impact Assessment**	**6 hours**
Introduction to environmental impact analysis. EIA guidelines, Notification of Government of India (Environmental Protection Act – Air, water, forest and wild life). Impact assessment methodologies. Public awareness. Environmental priorities in India.		
Module:6	**Human Population Change and Environment**	**6 hours**
Urban environmental problems; Consumerism and waste products; Promotion of economic development – Impact of population age structure – Women and child welfare, Women empowerment. Sustaining human societies: Economics, environment, policies and education.		
Module:7	**Global Climatic Change and Mitigation**	**5 hours**
Climate disruption, Green house effect, Ozone layer depletion and Acid rain. Kyoto protocol, Carbon credits, Carbon sequestration methods and Montreal Protocol. Role of Information technology in environment-Case Studies.		
Module:8	**Contemporary issues**	**2 hours**
Lecture by Industry Experts		
	Total Lecture hours:	**45 hours**
Text Books		
1.	G. Tyler Miller and Scott E. Spoolman (2016), Environmental Science, 15th Edition, Cengage learning.	
2.	George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment – Principles, Connections and Solutions, 17th Edition, Brooks/Cole, USA.	

Reference Books			
1.	David M.Hassenzahl,Mary Catherine Hager, Linda R.Berg (2011), Visualizing Environmental Science, 4thEdition, John Wiley & Sons, USA.		
Mode of evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT			
Recommended by Board of Studies	**12.08.2017**		
Approved by Academic Council	**46th AC**	Date	**24.08.2017**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CHY1002.1	2	1	-	-	-	3	3	-	1	1	-	2	-	-	-
CHY1002.2	2	1	-	-	-	2	2	-	-	-	-	2	-	-	-
CHY1002.3	2	1	-	-	-	2	2	-	-	-	-	2	-	-	-
CHY1002.4	2	1	-	-	-	3	3	-	-	-	-	2	-	-	-
CHY1002.5	2	1	-	-	-	3	3	-	-	-	-	2	-	-	-
CHY1002.6	2	1	-	-	-	3	3	-	1	1	-	2	-	-	-
CHY1002.7	2	1	-	-	-	2	2	-	1	1	-	2	-	-	-
CHY1002.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHY1002.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CHY1002.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	1	-	-	-	3	3	-	1	1	-	2	-	-	-

CHY1701	Engineering Chemistry		L	T	P	J	C
			3	0	2	0	4
Pre-requisite	NIL	**Syllabus version**					
		v.1					

Course Objectives:

1. To impart technological aspects of applied chemistry
2. To lay foundation for practical application of chemistry in engineering aspects

Expected Course Outcomes (CO): Students will be able to

1. Recall and analyze the issues related to impurities in water and their removal methods and apply recent methodologies in water treatment for domestic and industrial usage
2. Evaluate the causes of metallic corrosion and apply the methods for corrosion protection of metals
3. Evaluate the electrochemical energy storage systems such as lithium batteries, fuel cells and solar cells, and design for usage in electrical and electronic applications
4. Assess the quality of different fossil fuels and create an awareness to develop the alternative fuels
5. Analyze the properties of different polymers and distinguish the polymers which can be degraded and demonstrate their usefulness
6. Apply the theoretical aspects: (a) in assessing the water quality; (b) understanding the construction and working of electrochemical cells; (c) analyzing metals, alloys and soil using instrumental methods; (d) evaluating the viscosity and water ab

Module:1	**Water Technology**		**5 hours**

Characteristics of hard water - hardness, DO, TDS in water and their determination – numerical problems in hardness determination by EDTA; Modern techniques of water analysis for industrial use - Disadvantages of hard water in industries.

Module:2	**Water Treatment**		**8 hours**

Water softening methods: - Lime-soda, Zeolite and ion exchange processes and their applications. Specifications of water for domestic use (ICMR and WHO); Unit processes involved in water treatment for municipal supply - Sedimentation with coagulant- Sand Filtration - chlorination; Domestic water purification – Candle filtration- activated carbon filtration; Disinfection methods- Ultrafiltration, UV treatment, Ozonolysis, Reverse Osmosis; Electro dialysis.

Module:3	**Corrosion**		**6 hours**

Dry and wet corrosion - detrimental effects to buildings, machines, devices & decorative art forms, emphasizing Differential aeration, Pitting, Galvanic and Stress corrosion cracking; Factors that enhance corrosion and choice of parameters to mitigate corrosion.

Module:4	**Corrosion Control**		**4 hours**

Corrosion protection - cathodic protection – sacrificial anodic and impressed current protection methods; Advanced protective coatings: electroplating and electroless plating, PVD and CVD. Alloying for corrosion protection – Basic concepts of Eutectic composition and Eutectic mixtures - Selected examples – Ferrous and non-ferrous alloys.

Module:5	**Electrochemical Energy Systems**		**6 hours**

Brief introduction to conventional primary and secondary batteries; High energy electrochemical energy systems: Lithium batteries – Primary and secondary, its Chemistry, advantages and applications.

Fuel cells – Polymer membrane fuel cells, Solid-oxide fuel cells- working principles, advantages, applications.

Solar cells – Types – Importance of silicon single crystal, polycrystalline and amorphous silicon solar cells, dye sensitized solar cells - working principles, characteristics and applications.			
Module:6	**Fuels and Combustion**		**8 hours**
Calorific value - Definition of LCV, HCV. Measurement of calorific value using bomb calorimeter and Boy's calorimeter including numerical problems. Controlled combustion of fuels - Air fuel ratio – minimum quantity of air by volume and by weight-Numerical problems-three way catalytic converter- selective catalytic reduction of NO_X; Knocking in IC engines-Octane and Cetane number - Antiknocking agents.			
Module:7	**Polymers**		**6 hours**
Difference between thermoplastics and thermosetting plastics; Engineering application of plastics - ABS, PVC, PTFE and Bakelite; Compounding of plastics: moulding of plastics for Car parts, bottle caps (Injection moulding), Pipes, Hoses (Extrusion moulding), Mobile Phone Cases, Battery Trays, (Compression moulding), Fibre reinforced polymers, Composites (Transfer moulding), PET bottles (blow moulding); Conducting polymers- Polyacetylene- Mechanism of conduction – applications (polymers in sensors, self-cleaning windows)			
Module:8	**Contemporary issues:**		**2 hours**
Lecture by Industry Experts			
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Sashi Chawla, A Text book of Engineering Chemistry, Dhanpat Rai Publishing Co., Pvt. Ltd., Educational and Technical Publishers, New Delhi, 3rd Edition, 2015.
2.	O.G. Palanna, McGraw Hill Education (India) Private Limited, 9th Reprint, 2015.
3.	B. Sivasankar, Engineering Chemistry 1st Edition, Mc Graw Hill Education (India), 2008
4.	"Photovoltaic solar energy : From fundamentals to Applications", AngÃ¨le Reinders, Pierre Verlinden, Wilfried van Sark, Alexandre Freundlich, Wiley publishers, 2017.
Reference Books	
1.	O.V. Roussak and H.D. Gesser, ***Applied Chemistry-A Text Book for Engineers and Technologists***, Springer Science Business Media, New York, 2nd Edition, 2013.
2.	S. S. Dara, ***A Text book of Engineering Chemistry,*** S. Chand & Co Ltd., New Delhi, 20th Edition, 2013.
Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT	
List of Experiments	

	Experiment title	Hours
1.	Water Purification: Estimation of water hardness by EDTA method and its removal by ion-exchange resin	3 Hours
2.	Water Quality Monitoring: Assessment of total dissolved oxygen in different water samples by Winkler's method	3 Hours
3.	Estimation of sulphate/chloride in drinking water by conductivity method	3 Hours
4/5	Material Analysis: Quantitative colorimetric determination of divalent metal ions of Ni/Fe/Cu using conventional and smart phone digital-imaging methods	6 Hours
6.	Analysis of Iron in carbon steel by potentiometry	3 Hours
7.	Construction and working of an Zn-Cu electrochemical cell	3 Hours

8.	Determination of viscosity-average molecular weight of different natural/synthetic polymers	3 Hours
9.	Arduino microcontroller based sensor for monitoring pH/temperature/conductivity in samples.	3 Hours
	Total Laboratory Hours	**30 hours**

Mode of Evaluation: Viva-voce and Lab performance & FAT			
Recommended by Board of Studies	**31-05-2019**		
Approved by Academic Council	**54th AC**	Date	**13-06-2019**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CHY1701.1	2	1	-	-	-	2	2	-	1	1	-	1	-	-	-
CHY1701.2	3	2	-	-	-	2	2	-	1	1	-	-	-	-	-
CHY1701.3	3	2	-	-	-	1	1	-	1	1	-	-	-	-	-
CHY1701.4	3	2	-	-	-	1	-	-	1	1	-	-	-	-	-
CHY1701.5	3	2	-	-	-	2	2	-	2	2	-	-	-	-	-
CHY1701.6	3	2	-	-	1	2	1	-	2	2	-	1	-	-	-
	3	2	-	-	1	2	2	-	2	2	-	1	-	-	-

CSE1001	**Problem Solving and Programming**	**L**	**T**	**P**	**J**	**C**
		0	**0**	**6**	**0**	**3**
Pre-requisite	**NIL**	**Syllabus version**				
		v.1				

Course Objectives:

1. To develop broad understanding of computers, programming languages and their generations
2. Introduce the essential skills for a logical thinking for problem solving
3. To gain expertise in essential skills in programming for problem solving using computer

Expected Course Outcome:

1. Understand the working principle of a computer and identify the purpose of a computer programming language.
2. Learn various problem solving approaches and ability to identify an appropriate approach to solve the problem
3. Differentiate the programming Language constructs appropriately to solve any problem
4. Solve various engineering problems using different data structures
5. Able to modulate the given problem using structural approach of programming
6. Efficiently handle data using flat files to process and store data for the given problem

List of Challenging Experiments (Indicative)

1	Steps in Problem Solving Drawing flowchart using yEd tool/Raptor Tool	4 Hours
2	Introduction to Python, Demo on IDE, Keywords, Identifiers, I/O Statements.	4 Hours
3	Simple Program to display Hello world in Python.	4 Hours
4	Operators and Expressions in Python	4 Hours
5	Algorithmic Approach 1: Sequential	4 Hours
6	Algorithmic Approach 2: Selection (if, elif, if.. else, nested if else	4 Hours
7	Algorithmic Approach 3: Iteration (while and for)	6 Hours
8	Strings and its Operations	6 Hours
9	Regular Expressions	6 Hours
10	List and its operations.	6 Hours
11	Dictionaries: operations	6 Hours
12	Tuples and its operations	6 Hours
13	Set and its operations	6 Hours
14	Functions, Recursions	6 Hours
15	Sorting Techniques (Bubble/Selection/Insertion)	6 Hours
16	Searching Techniques : Sequential Search and Binary Search	6 Hours
17	Files and its Operations	6 Hours
	Total Lecture hours:	45 hours

Text Book(s)			
1.	John V. Guttag., 2016. Introduction to computation and programming using python: with applications to understanding data. PHI Publisher.		
Reference Books			
1.	Charles Severance.2016.Python for everybody: exploring data in Python 3, Charles Severance.		
2.	Charles Dierbach.2013.Introduction to computer science using python: a computational problem-solving focus. Wiley Publishers.		
Mode of Evaluation:	PAT / CAT / FAT		
Recommended by Board of Studies	**04-04-2014**		
Approved by Academic Council	**38th AC**	Date	**23-10-2015**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CSE1001.1	2	1	-	-	1	-	-	-	1	1	-	2	-	-	-
CSE1001.2	2	1	-	-	1	-	-	-	1	1	-	2	-	-	-
CSE1001.3	3	2	-	-	2	-	-	-	2	2	-	2	-	-	-
CSE1001.4	3	2	-	-	2	-	-	-	2	2	-	2	-	-	-
CSE1001.5	3	2	-	-	2	-	-	-	2	2	-	2	-	-	-
CSE1001.6	3	2	-	-	2	-	-	-	2	2	-	2	-	-	-
	3	2	-	-	2	-	-	-	2	2	-	2	-	-	-

CSE1002	Problem Solving and Object Oriented Programming	L	T	P	J	C
		0	0	6	0	3
Pre-requisite	**NIL**	**Syllabus version**				
		v.1.0				

Course Objectives:

1. To emphasize the benefits of object oriented concepts
2. To enable the students to solve the real time applications using object oriented programming features.
3. To improve the skills of a logical thinking and to solve the problems using any processing elements

Expected Course Outcome:

1. Demonstrate the basics of procedural programming and to represent the real world entities as programming constructs
2. Enumerate object oriented concepts and translate real-world applications into graphical representations
3. Demonstrate the usage of classes and objects of the real world entities in applications
4. Discriminate the reusability and multiple interfaces with same functionality based features to solve complex computing problems
5. Illustrate possible error handling constructs for unanticipated states or inputs and to use generic programming constructs to accommodate different data types.
6. Validate the program against file inputs towards solving the problem

List of Challenging Experiments (Indicative)

1.	**Postman Problem** A postman needs to walk down every street in his area in order to deliver the mail. Assume that the distances between the streets along the roads are given. The postman starts at the post office and returns back to the post office after delivering all the mails. Implement an algorithm to help the post man to walk minimum distance for the purpose.
2.	**Budget Allocation for Marketing Campaign** A mobile manufacturing company has got several marketing options such as Radio advertisement campaign, TV non peak hours campaign, City top paper network, Viral marketing campaign, Web advertising. From their previous experience, they have got a statistics about paybacks for each marketing option. Given the marketing budget (rupees in crores) for the current year and details of paybacks for each option, implement an algorithm to determine the amount that shall spent on each marketing option so that the company attains the maximum profit.
3.	**Missionaries and Cannibals** Three missionaries and three cannibals are on one side of a river, along with a boat that can hold one or two people. Implement an algorithm to find a way to get everyone to the other side of the river, without ever leaving a group of missionaries in one place outnumbered by the cannibals in that place.
4.	**Register Allocation Problem** A register is a component of a computer processor that can hold any type of data and can be accessed faster. As registers are faster to access, it is desirable to use them to the maximum so that the code execution is faster. For each code submitted to the processor, a register interference graph (RIG) is constructed. In a RIG, a node represents a temporary variable and an edge is added between two nodes (variables) t1 and t2 if they are live simultaneously at some point in the program. During register allocation, two temporaries can be allocated to the

	same register if there is no edge connecting them. Given a RIG representing the dependencies between variables in a code, implement an algorithm to determine the number of registers required to store the variables and speed up the code execution.
5.	**Selective Job Scheduling Problem** A server is a machine that waits for requests from other machines and responds to them. The purpose of a server is to share hardware and software resources among clients. All the clients submit the jobs to the server for execution and the server may get multiple requests at a time. In such a situation, the server schedule the jobs submitted to it based on some criteria and logic. Each job contains two values namely time and memory required for execution. Assume that there are two servers that schedules jobs based on time and memory. The servers are named as Time_Schedule_Server and memory_Schedule_Server respectively. Design a OOP model and implement the time_Schedule_Server and memory_Schedule_Server. The Time_Schedule_Server arranges jobs based on time required for execution in ascending order whereas memory_Schedule_Server arranges jobs based on memory required for execution in ascending order.
6.	**Fragment Assembly in DNA Sequencing** DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other organisms. The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), and thymine (T). In DNA sequencing, each DNA is sheared into millions of small fragments (reads) which assemble to form a single genomic sequence ("superstring"). Each read is a small string. In such a fragment assembly, given a set of reads, the objective is to determine the shortest superstring that contains all the reads. For example, given a set of strings, {000, 001, 010, 011, 100, 101, 110, 111} the shortest superstring is 0001110100. Given a set of reads, implement an algorithm to find the shortest superstring that contains all the given reads.
7.	**House Wiring** An electrician is wiring a house which has many rooms. Each room has many power points in different locations. Given a set of power points and the distances between them, implement an algorithm to find the minimum cable required.
	Total Laboratory Hours: 90 Hours
Text Book(s)	
1.	Stanley B Lippman, Josee Lajoie, Barbara E, Moo, "C++ primer", Fifth edition, Addison-Wesley, 2012.
2.	Ali Bahrami, Object oriented Systems development, Tata McGraw - Hill Education, 1999
3.	Brian W. Kernighan, Dennis M. Ritchie , The „C" programming Language, 2nd edition, Prentice Hall Inc., 1988.
Reference Books	
1.	Bjarne stroustrup, The C++ programming Language, Addison Wesley, 4th edition, 2013
2.	Harvey M. Deitel and Paul J. Deitel, C++ How to Program, 7th edition, Prentice Hall, 2010.
3.	Maureen Sprankle and Jim Hubbard, Problem solving and Programming concepts, 9th edition, Pearson Eduction, 2014
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

Recommended by Board of Studies	**29-10-2015**		
Approved by Academic Council	**39^{th} AC**	Date	**17-12-2015**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CSE1002.1	2	1	-	-	1	-	-	-	1	1	-	2	-	-	-
CSE1002.2	3	2	-	-	2	-	-	-	2	2	-	2	-	-	-
CSE1002.3	2	1	-	-	1	-	-	-	1	1	-	2	-	-	-
CSE1002.4	3	2	-	-	2	-	-	-	2	2	-	2	-	-	-
CSE1002.5	3	2	-	-	2	-	-	-	2	2	-	2	-	-	-
CSE1002.6	3	2	-	-	2	-	-	-	2	2	-	2	-	-	-
	3	2	-	-	2	-	-	-	2	2	-	2	-	-	-

EEE1901	**Technical Answers for Real World Problems (TARP)**	**L**	**T**	**P**	**J**	**C**
		1	**0**	**0**	**4**	**2**
Pre-requisite	**PHY1901 and 115 Credits Earned**	**Syllabus version**				
		v. 1.0				

Course Objectives:

1. To help students to identify the need for developing newer technologies for industrial / societal needs
2. To train students to propose and implement relevant technology for the development of the prototypes / products
3. To make the students learn to the use the methodologies available to assess the developed prototypes / products

Expected Course Outcome:

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

1. Identify real life problems related to society
2. Apply appropriate technology(ies) to address the identified problems using engineering principles and arrive at innovative solutions

1. Identification of real life problems
2. Field visits can be arranged by the faculty concerned
3. 6 – 10 students can form a team (within the same / different discipline)
4. Minimum of eight hours on self-managed team activity
5. Appropriate scientific methodologies to be utilized to solve the identified issue
6. Solution should be in the form of fabrication/coding/modeling/product design/process design/relevant scientific methodology(ies)
7. Consolidated report to be submitted for assessment
8. Participation, involvement and contribution in group discussions during the contact hours will be used as the modalities for the continuous assessment of the theory component
9. Project outcome to be evaluated in terms of technical, economical, social, environmental, political and demographic feasibility
10. Contribution of each group member to be assessed
11. The project component to have three reviews with the weightage of 20:30:50

Mode of Evaluation: (No FAT) Continuous Assessment the project done – Mark weightage of 20:30:50 – project report to be submitted, presentation and project reviews

Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1901.1	3	2	1	1	-	3	3	3	3	3	3	2	3	2	-
EEE1901.2	3	2	1	1	3	3	3	3	3	3	3	2	3	2	3
	3	2	1	1	3	3	3	3	3	3	3	2	3	2	3

EEE4098	Comprehensive Examination	L	T	P	J	C
		0	0	0	0	1
Pre-requisite	NIL	Syllabus version				
		v.1.0				

Module:1	Electrical Circuits
Voltage and current sources: independent, dependent, ideal and practical; V-I relationships of resistor, inductor, mutual inductor and capacitor; transient analysis of RLC circuits with dc excitation. Kirchhoff's laws, mesh and nodal analysis, superposition, Thevenin's, Norton, maximum power transfer and reciprocity theorems. Peak, average and rms values of ac quantities; apparent, active and reactive powers; phasor analysis, impedance and admittance; series and parallel resonance, locus diagrams, realization of basic filters with R, L and C elements. One-port and two-port networks, driving point impedance and admittance, open-, and short circuit parameters	

Module:2	Signals and Systems
Periodic, aperiodic and impulse signals; Laplace, Fourier and z-transforms; transfer function, frequency response of first and second order linear time invariant systems, impulse response of systems; convolution, correlation. Discrete time system: impulse response, frequency response, pulse transfer function; DFT and FFT; basics of IIR and FIR filters	

Module:3	Control Systems
Mathematical modelling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-state analysis of linear time invariant systems, Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Stability analysis, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model, State transition matrix	

Module:4	Analog and Digital Circuits
Characteristics and applications of diode, Zener diode, BJT and MOSFET; small signal analysis of transistor circuits, feedback amplifiers. Characteristics of operational amplifiers; applications of opamps: difference amplifier, adder, sub tractor, integrator, differentiator, instrumentation amplifier, precision rectifier, active filters and other circuits. Oscillators, signal generators, voltage controlled oscillators and phase locked loop. Combinational logic circuits, minimization of Boolean functions. IC families: TTL and CMOS. Arithmetic circuits, comparators, Schmitt trigger, multi-vibrators, sequential circuits, flip-flops, shift registers, timers and counters; sample- and-hold circuit, multiplexer, analog-to-digital (successive approximation, integrating, flash and sigma-delta) and digital-to-analog converters (weighted R, R-2R ladder and current steering logic). Characteristics of ADC and DAC (resolution, quantization, significant bits, conversion/settling time); basics of number systems, microcontroller: applications, memory and input-output interfacing; basics of data acquisition systems.	
Module:5	**Electrical and Electronic Instrumentation**
SI units, systematic and random errors in measurement, expression of uncertainty - accuracy and precision index, propagation of errors. PMMC, MI and dynamometer type instruments; dc potentiometer; bridges for measurement of R, L and C, Q-meter. Measurement of voltage, current and power in single and three phase circuits; ac and dc current probes; true rms meters, voltage and current scaling, instrument transformers, timer/counter, time, phase and frequency measurements, digital voltmeter, digital multimeter; oscilloscope, shielding and grounding	
Module:6	**Industrial Instrumentation**

Resistive-, capacitive-, inductive-, piezoelectric-, Hall effect sensors and associated signal conditioning circuits; transducers for industrial instrumentation: displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (differential pressure, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor); liquid level, pH, conductivity and viscosity measurement			
Module:7	**Optoelectronic Instrumentation**		
Optical sources and detectors: LED, laser, photo-diode, light dependent resistor and their characteristics; interferometer: applications in metrology; basics of fiber optic sensing.			
Module:8	**Communication Engineering**		
Amplitude- and frequency modulation and demodulation; Shannon's sampling theorem, pulse code modulation; frequency and time division multiplexing, amplitude-, phase-, frequency-, pulse shift keying for digital modulation.			
Mode of Evaluation: Witten Exam			
Recommended by Board of Studies	**05.06.2015**		
Approved by Academic Council	**37th AC**	Date	**16.06.2015**

ENG1901	Technical English - I	L	T	P	J	C
		0	0	4	0	2
Pre-requisite	Foundation English-II	**Syllabus Version**				
		v.1.1				

Course Objectives:

1. To enhance students' knowledge of grammar and vocabulary to read and write error-free language in real life situations.
2. To make the students' practice the most common areas of written and spoken communications skills.
3. To improve students' communicative competency through listening and speaking activities in the classroom.

Expected Course Outcome:

1. Develop a better understanding of advanced grammar rules and write grammatically correct sentences.
2. Acquire wide vocabulary and learn strategies for error-free communication.
3. Comprehend language and improve speaking skills in academic and social contexts.
4. Improve listening skills so as to understand complex business communication in a variety of global English accents through proper pronunciation.
5. Interpret texts, diagrams and improve both reading and writing skills which would help them in their academic as well as professional career.

Module:1	**Advanced Grammar**	**4 hours**
Articles, Tenses, Voice and Prepositions Activity: Worksheets on Impersonal Passive Voice, Exercises from the prescribed text		
Module:2	**Vocabulary Building I**	**4 hours**
Idioms and Phrases, Homonyms, Homophones and Homographs Activity: Jigsaw Puzzles; Vocabulary Activities through Web tools		
Module:3	**Listening for Specific Purposes**	**4 hours**
Gist, monologues, short conversations, announcements, briefings and discussions Activity: Gap filling; Interpretations		
Module:4	**Speaking for Expression**	**6 hours**
Introducing oneself and others, Making Requests & responses, Inviting and Accepting/Declining Invitations Activity: Brief introductions; Role-Play; Skit.		
Module:5	**Reading for Information**	**4 hours**
Reading Short Passages, News Articles, Technical Papers and Short Stories Activity: Reading specific news paper articles; blogs		
Module:6	**Writing Strategies**	**4 hours**
Joining the sentences, word order, sequencing the ideas, introduction and conclusion Activity: Short Paragraphs; Describing familiar events; story writing		
Module:7	**Vocabulary Building II**	**4 hours**

Enrich the domain specific vocabulary by describing Objects, Charts, Food, Sports and Employment. Activity: Describing Objects, Charts, Food, Sports and Employment		
Module:8	**Listening for Daily Life**	**4 hours**
Listening for statistical information, Short extracts, Radio broadcasts and TV interviews Activity: Taking notes and Summarizing		
Module:9	**Expressing Ideas and Opinions**	**6 hours**
Telephonic conversations, Interpretation of Visuals and describing products and processes. Activity: Role-Play (Telephonic); Describing Products and Processes		
Module: 10	**Comprehensive Reading**	**4 hours**
Reading Comprehension, Making inferences, Reading Graphics, Note-making, and Critical Reading. Activity: Sentence Completion; Cloze Tests		
Module: 11	**Narration**	**4 hours**
Writing narrative short story, Personal milestones, official letters and E-mails. Activity: Writing an E-mail; Improving vocabulary and writing skills.		
Module:12	**Pronunciation**	**4 hours**
Speech Sounds, Word Stress, Intonation, Various accents Activity: Practicing Pronunciation through web tools; Listening to various accents of English		
Module:13	**Editing**	**4 hours**
Simple, Complex & Compound Sentences, Direct & Indirect Speech, Correction of Errors, Punctuations. Activity: Practicing Grammar		
Module:14	**Short Story Analysis**	**4 hours**
"The Boundary" by Jhumpa Lahiri Activity: Reading and analyzing the theme of the short story.		
	Total Lecture hours	**60 hours**

Text Book / Workbook	
1.	Wren, P.C.; Martin, H.; Prasada Rao, N.D.V. (1973–2010). High School English Grammar & Composition. New Delhi: Sultan Chand Publishers.
2	Kumar, Sanjay,; Pushp Latha. (2018) English Language and Communication Skills for Engineers, India: Oxford University Press.
Reference Books	
1.	Guptha S C, (2012) Practical English Grammar & Composition, 1st Edition, India: Arihant Publishers
2.	Steven Brown, (2011) Dorolyn Smith, Active Listening 3, 3rd Edition, UK: Cambridge University Press.

3.	Liz Hamp-Lyons, Ben Heasley, (2010) Study Writing, 2nd Edition, UK: Cambridge University Pres.
4.	Kenneth Anderson, Joan Maclean, (2013) Tony Lynch, Study Speaking, 2nd Edition, UK: Cambridge, University Press.
5.	Eric H. Glendinning, Beverly Holmstrom, (2012) Study Reading, 2nd Edition, UK: Cambridge University Press.
6.	Michael Swan, (2017) Practical English Usage (Practical English Usage), 4th edition, UK: Oxford University Press.
7.	Michael McCarthy, Felicity O'Dell, (2015) English Vocabulary in Use Advanced (South Asian Edition), UK: Cambridge University Press.
8.	Michael Swan, Catherine Walter, (2012) Oxford English Grammar Course Advanced, Feb, 4th Edition, UK: Oxford University Press.
9.	Watkins, Peter. (2018) Teaching and Developing Reading Skills: Cambridge Handbooks for Language teachers, UK: Cambridge University Press.
10.	(The Boundary by Jhumpa Lahiri) URL: https://www.newyorker.com/magazine/2018/01/29/the-boundary?intcid=inline_amp

Mode of evaluation: Quizzes, Presentation, Discussion, Role play, Assignments and FAT

List of Challenging Experiments (Indicative)		
1.	Self-Introduction	**12 hours**
2.	Sequencing Ideas and Writing a Paragraph	**12 hours**
3.	Reading and Analyzing Technical Articles	**8 hours**
4.	Listening for Specificity in Interviews (Content Specific)	**12 hours**
5.	Identifying Errors in a Sentence or Paragraph	**8 hours**
6.	Writing an E-mail by narrating life events	**8 hours**
	Total Laboratory Hours	**60 hours**

Mode of evaluation**:** Quizzes, Presentation, Discussion, Role play, Assignments and FAT

Recommended by Board of Studies	**08.06.2019**	
Approved by Academic Council	**55th AC**	Date: **13-06-2019**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ENG1901.1	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
ENG1901.2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
ENG1901.3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
ENG1901.4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
ENG1901.5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

ENG 1902	**Technical English - II**	**L**	**T**	**P**	**J**	**C**
		0	**0**	4	**0**	**2**
Pre-requisite	71% to 90% EPT score	**Syllabus Version**				
		v. 1.1				

Course Objectives:

1. To acquire proficiency levels in LSRW skills on par with the requirements for placement interviews of high-end companies / competitive exams.
2. To evaluate complex arguments and to articulate their own positions on a range of technical and general topics.
3. To speak in grammatical and acceptable English with minimal MTI, as well as develop a vast and active vocabulary.

Expected Course Outcome:

1. Communicate proficiently in high-end interviews and exam situations and all social situations
2. Comprehend academic articles and draw inferences
3. Evaluate different perspectives on a topic
4. Write clearly and convincingly in academic as well as general contexts
5. Synthesize complex concepts and present them in speech and writing

Module:1	**Listening for Clear Pronunciation**	**4 hours**

Ice-breaking, Introduction to vowels, consonants, diphthongs.
Listening to formal conversations in British and American accents (BBC and CNN) as well as other 'native' accents
Activity: Factual and interpretive exercises; note-making in a variety of global English accents

Module:2	**Introducing Oneself**	**4 hours**

Speaking: Individual Presentations
Activity: Self-Introductions, Extempore speech

Module:3	**Effective Writing**	**6 hours**

Writing: Business letters and Emails, Minutes and Memos
Structure/ template of common business letters and emails: inquiry/ complaint/ placing an order; Formats of Minutes and Memos
Activity: Students write a business letter and Minutes/ Memo

Module:4	**Comprehensive Reading**	**4 hours**

Reading: Reading Comprehension Passages, Sentence Completion (Technical and General Interest), Vocabulary and Word Analogy
Activities: Cloze tests, Logical reasoning, Advanced grammar exercises

Module:5	**Listening to Narratives**	**4 hours**

Listening: Listening to audio files of short stories, News, TV Clips/ Documentaries, Motivational Speeches in UK/ US/ global English accents.
Activity: Note-making and Interpretive exercises

Module:6	**Academic Writing and Editing**	**6 hours**

Writing: Editing/ Proofreading symbols
Citation Formats
Structure of an Abstract and Research Paper
Activity: Writing Abstracts and research paper; Work with Editing/ Proofreading exercise

Module:7	**Team Communication**	**4 hours**

Speaking: Group Discussions and Debates on complex/ contemporary topics Discussion evaluation parameters, using logic in debates Activity: Group Discussions on general topics		
Module:8	**Career-oriented Writing**	**4 hours**
Writing: Resumes and Job Application Letters, SOP Activity: Writing resumes and SOPs		
Module:9	**Reading for Pleasure**	**4 hours**
Reading: Reading short stories Activity: Classroom discussion and note-making, critical appreciation of the short story		
Module: 10	**Creative Writing**	**4 hours**
Writing: Imaginative, narrative and descriptive prose Activity: Writing about personal experiences, unforgettable incidents, travelogues		
Module: 11	**Academic Listening**	**4 hours**
Listening: Listening in academic contexts Activity: Listening to lectures, Academic Discussions, Debates, Review Presentations, Research Talks, Project Review Meetings		
Module:12	**Reading Nature-based Narratives**	**4 hours**
Narratives on Climate Change, Nature and Environment Activity: Classroom discussions, student presentations		
Module:13	**Technical Proposals**	**4 hours**
Writing: Technical Proposals Activities: Writing a technical proposal		
Module:14	**Presentation Skills**	**4 hours**
Persuasive and Content-Specific Presentations Activity: Technical Presentations		
	Total Lecture hours:	**60 hours**

Text Book / Workbook	
1.	Oxenden, Clive and Christina Latham-Koenig. New English File: Advanced Students Book. Paperback. Oxford University Press, UK, 2017.
2	Rizvi, Ashraf. Effective Technical Communication. McGraw-Hill India, 2017.
Reference Books	
1.	Oxenden, Clive and Christina Latham-Koenig, New English File: Advanced: Teacher's Book with Test and Assessment. CD-ROM: Six-level General English Course for Adults. Paperback. Oxford University Press, UK, 2013.
2.	Balasubramanian, T. English Phonetics for the Indian Students: A Workbook. Laxmi Publications, 2016.
3.	Philip Seargeant and Bill Greenwell, From Language to Creative Writing. Bloomsbury Academic, 2013.
4.	Krishnaswamy, N. Eco-English. Bloomsbury India, 2015.
5.	Manto, Saadat Hasan. Selected Short Stories. Trans. Aatish Taseer. Random House India, 2012.
6.	Ghosh, Amitav. The Hungry Tide. Harper Collins, 2016.
7.	Ghosh, Amitav. The Great Derangement: Climate Change and the Unthinkable. Penguin Books, 2016.
8.	The MLA Handbook for Writers of Research Papers, 8th ed. 2016.
	<u>Online Sources:</u>

	https://americanliterature.com/short-short-stories. (75 *short* short stories) http://www.eco-ction.org/dt/thinking.html (Leopold, Aldo."Thinking like a Mountain") /www.esl-lab.com/; www.bbc.co.uk/learningenglish/; /www.bbc.com/news; /learningenglish.voanews.com/a/using-voa-learning-english-to-improve-listening-skills/3815547.html

Mode of evaluation**:** Quizzes, Presentation, Discussion, Role play, Assignments and FAT

List of Challenging Experiments (Indicative)		
1.	Self-Introduction using SWOT	**12 hours**
2.	Writing minutes of meetings	**10 hours**
3.	Writing an abstract	**10 hours**
4.	Listening to motivational speeches and interpretation	**10 hours**
5.	Cloze Test	**6 hours**
6.	Writing a proposal	**12 hours**
	Total Laboratory Hours	**60 hours**

Mode of evaluation**:** Quizzes, Presentation, Discussion, Role play, Assignments and FAT

Recommended by Board of Studies	**08.06.2019**	
Approved by Academic Council	**55^{th} AC**	Date: **13-06-2019**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ENG 1902.1	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
ENG 1902.2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
ENG 1902.3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
ENG 1902.4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
ENG 1902.5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

ENG1903	Advanced Technical English	L	T	P	J	C
		0	0	2	4	2
Pre-requisite	Greater than 90 % EPT score	**Syllabus Version**				
		v. 1.1				

Course Objectives:

1. To review literature in any form or any technical article
2. To infer content in social media and respond accordingly
3. To communicate with people across the globe overcoming trans-cultural barriers and negotiate successfully

Expected Course Outcome:

1. Analyze critically and write good reviews
2. Articulate research papers, project proposals and reports
3. Communicate effectively in a trans-cultural environment
4. Negotiate and lead teams towards success
5. Present ideas in an effective manner using web tools

Module:1	**Negotiation and Decision Making Skills through Literary Analysis**	**5 hours**
Concepts of Negotiation and Decision Making Skills Activity: Analysis of excerpts from Shakespeare's "The Merchant of Venice" (court scene) and discussion on negotiation skills. Critical evaluation of excerpts from Shakespeare's "Hamlet"(Monologue by Hamlet) and discussion on decision making skills		
Module:2	**Writing reviews and abstracts through movie interpretations**	**5 hours**
Review writing and abstract writing with competency Activity: Watching Charles Dickens "Great Expectations" and writing a movie review Watching William F. Nolan's "Logan's Run" and analyzing it in tune with the present scenario of depletion of resources and writing an abstract		
Module:3	**Technical Writing**	**4 hours**
Stimulate effective linguistics for writing: content and style Activity: Proofreading Statement of Purpose		
Module:4	**Trans-Cultural Communication**	**4 hours**
Nuances of Trans-cultural communication Activity:Group discussion and case studies on trans-cultural communication. Debate on trans-cultural communication.		
Module:5	**Report Writing and Content Writing**	**4 hours**
Enhancing reportage on relevant audio-visuals Activity: Watch a documentary on social issues and draft a report Identify a video on any social issue and interpret		
Module:6	**Drafting project proposals and article writing**	**4 hours**
Dynamics of drafting project proposals and research articles Activity: Writing a project proposal., Writing a research article.		
Module:7	**Technical Presentations**	**4 hours**
Build smart presentation skills and strategies Activity: Technical presentations using PPT and Web tools		
	Total Lecture hours	**30 hours**

Text Book / Workbook

1.	Raman, Meenakshi & Sangeeta Sharma. Technical Communication: Principles and Practice, 3rd edition, Oxford University Press, 2015.	
Reference Books		
1	Basu B.N. Technical Writing, 2011 Kindle edition	
2	Arathoon, Anita. Shakespeare's The Merchant of Venice (Text with Paraphrase), Evergreen Publishers, 2015.	
3	Kumar, Sanjay and Pushp Lata. English Language and Communication Skills for Engineers, Oxford University Press, India, 2018.	
4	Frantisek, Burda. On Transcultural Communication, 2015, LAP Lambert Academic Publishing, UK.	
5	Geever, C. Jane. The Foundation Center's Guide to Proposal Writing, 5th Edition, 2007, Reprint 2012 The Foundation Center, USA.	
6	Young, Milena. Hacking Your Statement of Purpose: A Concise Guide to Writing Your SOP, 2014 Kindle Edition.	
7	Ray, Ratri, William Shakespeare's Hamlet, The Atlantic Publishers, 2011.	
8	C Muralikrishna & Sunitha Mishra, Communication Skills for Engineers, 2nd edition, NY: Pearson, 2011.	
Mode of Evaluation: Quizzes, Presentation, Discussion, Role Play, Assignments		
List of Challenging Experiments (Indicative)		
1.	Enacting a court scene - Speaking	**6 hours**
2.	Watching a movie and writing a review	**4 hours**
3.	Trans-cultural – case studies	**2 hours**
4.	Drafting a report on any social issue	**6 hours**
5.	Technical Presentation using web tools	**6 hours**
6.	Writing a research paper	**6 hours**
J- Component Sample Projects		
1.	Short Films	
2.	Field Visits and Reporting	
3.	Case studies	
4.	Writing blogs	
5.	Vlogging	
	Total Hours (J-Component)	**60 hours**
Mode of evaluation**:** Quizzes, Presentation, Discussion, Role play, Assignments and FAT		

Recommended by Board of Studies	**08.06.2019**	
Approved by Academic Council	**55^{th} AC**	Date: **13-06-2019**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ENG1903.1	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
ENG1903.2	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
ENG1903.3	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
ENG1903.4	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
ENG1903.5	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-
	-	-	-	-	-	-	-	-	2	3	-	2	-	-	-

ENG1000	Foundation English - I	L	T	P	J	C
		0	0	4	0	0
Pre-requisite	Less than 50% EPT score	**Syllabus Version**				
		v. 1.1				

Course Objectives:

1. To equip learners with English grammar and its application.
2. To enable learners to comprehend simple text and train them to speak and write flawlessly.
3. To familiarize learners with MTI and ways to overcome them.

Expected Course Outcome:

1. Develop the skills to communicate clearly through effective grammar, pronunciation and writing.
2. Understand everyday conversations in English
3. Communicate and respond to simple questions about oneself.
4. Improve vocabulary and expressions.
5. Prevent MTI (Mother Tongue Influence) during usual conversation.

Module	Title	Hours
Module:1	**Essentials of grammar**	**3 Hours**

Understand basic grammar-Parts of Speech
Activity: Grammar worksheets on parts of speech

Module	Title	Hours
Module:2	**Vocabulary Building**	**3 Hours**

Vocabulary development; One word substitution
Activity: Elementary vocabulary exercises

Module	Title	Hours
Module:3	**Applied grammar and usage**	**4 Hours**

Types of sentences; Tenses
Activity: Grammar worksheets on types of sentences; tenses

Module	Title	Hours
Module:4	**Rectifying common errors in everyday conversation**	**4 Hours**

Detect and rectify common mistakes in everyday conversation
Activity: Common errors in prepositions, tenses, punctuation, spelling and other parts of speech; Colloquialism

Module	Title	Hours
Module :5	**Jumbled sentences**	**2 Hours**

Sentence structure; Jumbled words to form sentences; Jumbled sentences to form paragraph/ short story
Activity: Unscramble a paragraph / short story

Module	Title	Hours
Module:6	**Text-based Analysis**	**4 Hours**

Wings of Fire -Autobiography of APJ Abdul Kalam (Excerpts)
Activity: Enrich vocabulary by reading and analyzing the text

Module	Title	Hours
Module:7	**Correspondence**	**3 Hours**

Letter, Email, Application Writing
Activity: Compose letters; Emails, Leave applications

Module	Title	Hours
Module:8	**Listening for Understanding**	**4 Hours**

Listening to simple conversations & gap fill exercises
Activity: Simple conversations in Received Pronunciation using audio-visual materials.

Module:9	**Speaking to Convey**	**6 Hours**
Self-introduction; role-plays; Everyday conversations Activity**:** Identify and communicate characteristic attitudes, values, and talents; Working and interacting within groups		
Module:10	**Reading for developing pronunciation**	**6 Hours**
Loud reading with focus on pronunciation by watching relevant video materials Activity: Practice pronunciation by reading aloud simple texts; Detecting syllables; Visually connecting to the words shown in relevant videos		
Module:11	**Reading to Contemplate**	**4 Hours**
Reading short stories and passages Activity: Reading and analyzing the author's point of view; Identifying the central idea.		
Module:12	**Writing to Communicate**	**6 Hours**
Paragraph Writing; Essay Writing; Short Story Writing Activity: Writing paragraphs, essays and short- stories		
Module:13	**Interpreting Graphical Data**	**6 Hours**
Describing graphical illustrations; interpreting basic charts, tables, and formats Activity: Interpreting and presenting simple graphical representations/charts in the form of PPTs		
Module:14	**Overcoming Mother Tongue Influence (MTI) in Pronunciation**	**5 Hours**
Practicing common variants in pronunciation Activity: Identifying and overcoming mother tongue influence.		
	Total Laboratory Hours	**60 Hours**

Text Book / Workbook	
1.	Wren, P.C., & Martin, H. (2018).High School English Grammar & Composition N.D.V. PrasadaRao (Ed.). NewDelhi: S. Chand & Company Ltd.
2.	McCarthy, M. O'Dell, F.,& Bunting, J.D. (2010).Vocabulary in Use(High Intermediate students book with answers). Cambridge University Press
Reference Books	
1.	Watkins, P.(2018).Teaching and Developing Reading Skills: Cambridge Handbooks for Language teachers. Cambridge University Press.
2.	Mishra, S., &Muralikrishna, C. (2014).Communication Skills for Engineers. Pearson Education India
3	Lewis, N. (2011).Word Power Made Easy. Goyal Publisher
4	https:/americanliterature.com/short-short-stories
5	Tiwari, A., &Kalam, A. (1999).Wings of Fire - An Autobiography of Abdul Kalam. Universities Press (India) Private Limited.
Mode of Evaluation**:** Quizzes, Presentation, Discussion, Role Play, Assignments	

List of Challenging Experiments (Indicative)		
1.	Rearranging scrambled sentences	**8 hours**
2.	Identifying errors in oral and written communication	**12 hours**
3.	Critically analyzing the text	**8 hours**
4.	Developing passages from hint words	**8 hours**
5.	Role-plays	**12 hours**
6.	Listening to a short story and analyzing it	**12 hours**
	Total Laboratory Hours	**60 hours**
Mode of Evaluation**:** Quizzes, Presentation, Discussion, Role Play, Assignments		

Recommended by Board of Studies	**08-06-2019**		
Approved by Academic Council	**55th AC**	Date	**13-06-2019**

ENG2000	Foundation English - II	L	T	P	J	C
		0	0	4	0	0
Pre-requisite	51% - 70% EPT Score / Foundation English I	Syllabus version				
		v.1.1				

Course Objectives:

1. To practice grammar and vocabulary effectively
2. To acquire proficiency levels in LSRW skills in diverse social situations.
3. To analyze information and converse effectively in technical communication.

Expected Course Outcome:

1. Accomplish a deliberate reading and writing process with proper grammar and vocabulary.
2. Comprehend sentence structures while Listening and Reading.
3. Communicate effectively and share ideas in formal and informal situations.
4. Understand specialized articles and technical instructions and write clear technical correspondence.
5. Critically think and analyze with verbal ability.

Module:1	Grammatical Aspects	4 hours

Sentence Pattern, Modal Verbs, Concord (SVA), Conditionals, Connectives
Activity : Worksheets, Exercises

Module:2	Vocabulary Enrichment	4 hours

Active & Passive Vocabulary, Prefix and Suffix, High Frequency Words
Activity : Worksheets, Exercises

Module:3	Phonics in English	4 Hours

Speech Sounds – Vowels and Consonants – Minimal Pairs- Consonant Clusters- Past Tense Marker and Plural Marker
Activity : Worksheets, Exercises

Module:4	Syntactic and Semantic Errors	2 Hours

Tenses /SVA/Articles/ Prepositions/ Punctuation & Right Choice of Vocabulary
Activity : Worksheets, Exercises

Module:5	Stylistic errors	2 Hours

Dangling Modifiers, Parallelism, Standard English, Ambiguity, Redundancy, Brevity
Activity : Worksheets, Exercises

Module:6	Listening and Note making	6 Hours

Intensive and Extensive Listening - Scenes from plays of Shakespeare (Eg: Court scene in The Merchant of Venice, Disguise Scene in The Twelfth Night, Death of Desdemona in Othello, Death scene in Julius Caesar and Balcony scene from Romeo and Juliet)
Activity : Summarizing; Note-making and drawing inferences from Short videos

Module:7	Art of Public Speaking	6 Hours

Impromptu, Importance of Non-verbal Communication, Technical Talks, Dynamics of Professional Presentations – Individual & Group
Activity : Ice Breaking; Extempore speech; Structured technical talk and Group presentation

Module:8	Reading Comprehension Skills	4 Hours

Skimming, scanning, comprehensive reading, guessing words from context, understanding text organization, recognizing argument and counter-argument; distinguishing between main information and supporting detail, fact and opinion, hypothesis versus evidence; summarizing and note-taking, Critical Reasoning Questions – Reading and Discussion Activity: Reading of Newspapers Articles and Worksheets on Critical Reasoning from web resources		
Module: 9	**Creative Writing**	**4 Hours**
Structure of an essay, Developing ideas on analytical/ abstract topics Activity: Movie Review, Essay Writing on suggested Topics, Picture Descriptions		
Module: 10	**Verbal Aptitude**	**6 hours**
Word Analogy, Sentence Completion using Appropriate words, Sentence Correction Activity: Practicing the use of appropriate words and sentences through web tools.		
Module: 11	**Business Correspondence**	**4 hours**
Formal Letters- Format and purpose: Business Letters - Sales and complaint letter Activity: Letter writing- request for Internship, Industrial Visit and Recommendation		
Module: 12	**Career Development**	**6 hours**
Telephone Etiquette, Resume Preparation, Video Profile Activity: Preparation of Video Profile		
Module: 13	**Art of Technical Writing - I**	**4 hours**
Technical Instructions, Process and Functional Description Activity: Writing Technical Instructions		
Module: 14	**Art of Technical Writing – II**	**4 hours**
Format of a Report and Proposal Activity: Technical Report Writing, Technical Proposal		
	Total Lecture hours:	**60 hours**

Text Book / Workbook	
1.	Sanjay Kumar & Pushp Lata, Communication Skills, 2nd Edition, OUP, 2015
2	Wren & Martin, High School English Grammar & Composition, Regular ed., ND: Blackie ELT Books, 2018
Reference Books	
1	Peter Watkins, Teaching and Developing Reading Skills: Cambridge Handbooks for Language Teachers, Cambridge, 2018
2	Aruna Koneru, Professional Speaking Skills, OUP, 2015.
3	J.C.Nesfield, English Grammar English Grammar Composition and Usage, Macmillan. 2019.
4	Richard Johnson-Sheehan, Technical Communication Today, 6th edition, ND: Pearson, 2017.
5	Balasubramaniam, Textbook of English Phonetics For Indian Students , 3rd Edition , S. Chand Publishers, 2013.

Web Resources
1. https://www.hitbullseye.com/Sentence-Correction-Practice.php 2. https://hitbullseye.com/Critical-Reasoning-Practice-Questions.php
Mode of Evaluation: Presentation, Discussion, Role Play, Assignments , FAT

List of Challenging Experiments (Indicative)		
1.	Reading and Analyzing Critical Reasoning questions	**8 hours**
2.	Listening and Interpretation of Videos	**12 hours**
3.	Letter to the Editor	**6 hours**
4.	Developing structured Technical Talk	**12 hours**
5.	Drafting SOP (Statement of Purpose)	**10 hours**
6.	Video Profile	**12 hours**
	Total Laboratory Hours	**60 hours**

Mode of Evaluation**:** Presentation, Discussion, Role Play, Assignments , FAT			
Recommended by Board of Studies	**08.06.2019**		
Approved by Academic Council	**55th AC**	Date	**13-06-2019**

EEE1904	Capstone Project		L	T	P	J	C
			0	0	0	0	12
Pre-requisite	**As per the academic regulations**	**Syllabus version**					
		v. 1.0					

Course Objectives:

1. To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.

Expected Course Outcome:

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

1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.
2. Perform literature search and / or patent search in the area of interest.
3. Conduct experiments / Design and Analysis / solution iterations and document the results.
4. Perform error analysis / benchmarking / costing
5. Synthesise the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

Contents

1. Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.
2. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.
3. Can be individual work or a group project, with a maximum of 3 students.
4. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.
5. Carried out inside or outside the university, in any relevant industry or research institution.
6. Publications in the peer reviewed journals / International Conferences will be an added advantage

Mode of Evaluation: Periodic reviews, Presentation, Final oral viva, Poster submission

Recommended by Board of Studies	**10.06.2015**		
Approved by Academic Council	**37th AC**	Date	**16.06.2015**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1904.1	3	2	1	1	-	3	3	3	3	3	3	2	3	2	-
EEE1904.2	2	1	-	-	1	-	-	2	3	2	2	2	-	-	1
EEE1904.3	3	3	2	2	2	3	3	3	3	3	3	2	3	3	2
EEE1904.4	3	3	2	2	2	3	3	3	3	3	3	2	3	3	2
EEE1904.5	3	3	2	2	2	3	3	3	3	3	3	2	3	3	2
EEE1904.6	2	1	-	-	2	-	-	2	3	2	2	2	-	-	2
	3	3	2	2	2	3	3	3	3	3	3	2	3	3	2

EEE1902	Industrial Internship	L	T	P	J	C
		0	**0**	**0**	**0**	**1**
Pre-requisite	Completion of minimum of Two semesters	**Syllabus version**				
		v. 1.0				

Course Objectives:

1. The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns.

Expected Course Outcome:

At the end of this internship the student should be able to:

1. Have an exposure to industrial practices and to work in teams
2. Communicate effectively
3. Understand the impact of engineering solutions in a global, economic, environmental and societal context
4. Develop the ability to engage in research and to involve in life-long learning
5. Comprehend contemporary issues
6. Engage in establishing his/her digital footprint

Contents	**4**	**Weeks**

Four weeks of work at industry site.

Supervised by an expert at the industry.

Mode of Evaluation: Internship Report, Presentation and Project Review

Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1902.1	2	1	-	-	-	-	-	2	3	2	-	1	-	-	-
EEE1902.2	2	1	-	-	-	-	-	-	3	3	-	1	-	-	-
EEE1902.3	2	1	2	-	-	2	2	-	-	-	-	1	-	-	-
EEE1902.4	3	2	1	1	-	-	3	3	3	3	-	1	2	-	-
EEE1902.5	2	1	-	-	-	-	2	-	-	-	-	1	-	-	-
EEE1902.6	2	1	-	-	2	-	2	2	3	2	-	1	-	-	2
	3	2	2	1	2	2	3	3	3	3	-	1	2	-	2

MAT1011	Calculus for Engineers		L	T	P	J	C
			3	0	2	0	4
Pre-requisite	**MAT1001**	**Syllabus Version**					
		v.1.0					

Course Objectives :

1. To provide the requisite and relevant background necessary to understand the other important engineering mathematics courses offered for Engineers and Scientists.
2. To introduce important topics of applied mathematics, namely Single and Multivariable Calculus and Vector Calculus etc.
3. To impart the knowledge of Laplace transform, an important transform technique for Engineers which requires knowledge of integration

Expected Course Outcome:

At the end of this course the students should be able to

1. Apply differentiation to solve max/min problems and compute volumes of revolution and surface areas of revolution using Integration.
2. Apply the concepts of Laplace Transforms and solve problems with periodic functions, step functions, impulse functions and convolution.
3. Evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and optimization problems involving several variables.
4. Evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates.
5. Analyse the concepts of gradient, directional derivatives, divergence, curl and apply them to find the circulation, work done, conservative field and Greens, Stokes, Gauss divergence theorem.
6. Develop programming tools for engineering problems and visualize solutions.
7. Apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions

Module:1	**Application of Single Variable Calculus**	**9 hours**

Differentiation- Extrema on an Interval-Rolle's Theorem and the Mean Value Theorem-Increasing and Decreasing functions and First derivative test-Second derivative test-Maxima and Minima-Concavity. Integration-Average function value - Area between curves - Volumes of solids of revolution - Beta and Gamma functions–interrelation

Module:2	**Laplace transforms**	**7 hours**

Definition of Laplace transform-Properties-Laplace transform of periodic functions-Laplace transform of unit step function, Impulse function-Inverse Laplace transform-Convolution.

Module:3	**Multivariable Calculus**	**4 hours**

Functions of two variables-limits and continuity-partial derivatives –total differential-Jacobian and its properties.

Module:4	**Application of Multivariable Calculus**	**5 hours**

Taylor's expansion for two variables–maxima and minima–constrained maxima and minima-Lagrange's multiplier method.

Module:5	**Multiple integrals**		**8 hours**
Evaluation of double integrals–change of order of integration–change of variables between Cartesian and polar co-ordinates - Evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical co-ordinates- evaluation of multiple integrals using gamma and beta functions.			
Module:6	**Vector Differentiation**		**5 hours**
Scalar and vector valued functions – gradient, tangent plane–directional derivative-divergence and curl–scalar and vector potentials–Statement of vector identities-Simple problems			
Module:7	**Vector Integration**		**5 hours**
line, surface and volume integrals - Statement of Green's, Stoke's and Gauss divergence theorems -verification and evaluation of vector integrals using them.			
Module:8	**Contemporary Issues:**		**2 hours**
Industry Expert Lecture			
	Total Lecture hours:		**45 hours**

Text Book(s)

1.	Thomas' Calculus, George B.Thomas, D.Weir and J. Hass, 13th edition, Pearson, 2014.
2.	Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, Wiley India, 2015.

Reference Books

1.	Higher Engineering Mathematics, B.S. Grewal, 43rd Edition ,Khanna Publishers, 2015
2.	Higher Engineering Mathematics, John Bird, 6th Edition, Elsevier Limited, 2017.
3.	Calculus: Early Transcendentals, James Stewart, 8th edition, Cengage Learning, 2017.
4.	Engineering Mathematics, K.A.Stroud and Dexter J. Booth, 7th Edition, Palgrave Macmillan (2013)

Mode of Evaluation**:** Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test

List of Challenging Experiments (Indicative)		
1.	Introduction to MATLAB through matrices, and general Syntax	2 hours
2	Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB	2 hours
3.	Evaluating Extremum of a single variable function	2 hours
4.	Understanding integration as Area under the curve	2 hours
5.	Evaluation of Volume by Integrals (Solids of Revolution)	2 hours
6.	Evaluating maxima and minima of functions of several variables	2 hours
7.	Applying Lagrange multiplier optimization method	2 hours
8.	Evaluating Volume under surfaces	2 hours
9.	Evaluating triple integrals	2 hours
10.	Evaluating gradient, curl and divergence	2 hours
11.	Evaluating line integrals in vectors	2 hours

12	Applying Green's theorem to real world problems		2 hours
		Total Laboratory Hours	**24 hours**
Mode of Assessment**:** Weekly assessment, Final Assessment Test			
Recommended by Board of Studies	**12-06-2015**		
Approved by Academic Council	**37th AC**	Date	**16-06-2015**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MAT1011.1	3	2	-	-	-	-	-	-	-	1	-	2	-	-	-
MAT1011.2	2	1	-	-	-	-	-	-	-	1	-	2	-	-	-
MAT1011.3	3	2	-	-	-	-	-	-	1	1	-	2	-	-	-
MAT1011.4	3	2	-	-	-	-	-	-	1	1	-	2	-	-	-
MAT1011.5	3	2	-	-	-	-	-	-	1	1	-	2	-	-	-
MAT1011.6	3	2	-	-	2	-	-	-	1	2	-	3	-	-	-
MAT1011.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	2	-	-	2	-	-	-	1	2	-	3	-	-	-

MAT2001	Statistics for Engineers	L	T	P	J	C
		3	0	2	0	4
Prerequisites	MAT1011	Syllabus Version:				v.1.0

Course Objectives :

1. To provide students with a framework that will help them choose the appropriate descriptive methods in various data analysis situations.
2. To analyse distributions and relationship of real-time data.
3. To apply estimation and testing methods to make inference and modelling techniques for decision making.

Expected Course Outcome:

At the end of the course the student should be able to:

1. Analyze statistical data using measures of central tendency and dispersion.
2. Analyze and apply the concepts of random variables and distribution functions to obtain moments and characteristic functions.
3. Analyze the experimental data using correlation and regression analysis and interpret the results.
4. Apply the concepts of inferential statistics and interpret the results.
5. Apply the statistical methodology in solving reliability engineering problems.
6. Develop programming tools for engineering problems and visualize solutions.
7. Compute and interpret descriptive statistics using numerical and graphical techniques
8. Understand the basic concepts of random variables and find an appropriate distribution for analysing data specific to an experiment
9. Apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data.
10. Make appropriate decisions using statistical inference that is the central to experimental research.
11. Use statistical methodology and tools in reliability engineering problems
12. demonstrate R programming for statistical data

Module: 1	Introduction to Statistics	6 hours

Introduction to statistics and data analysis-Measures of central tendency –Measures of variability-[Moments-Skewness-Kurtosis (Concepts only)].

Module: 2	Random variables	8 hours

Introduction -random variables-Probability mass Function, distribution and density functions - joint Probability distribution and joint density functions- Marginal, conditional distribution and density functions- Mathematical expectation, and its properties Covariance , moment generating function – characteristic function.

Module: 3	Correlation and regression	4 hours

Correlation and Regression – Rank Correlation- Partial and Multiple correlation- Multiple regression.

Module: 4	Probability Distributions	7 hours

Binomial and Poisson distributions – Normal distribution – Gamma distribution – Exponential distribution – Weibull distribution.		
Module: 5	**Hypothesis Testing I**	**4 hours**
Testing of hypothesis – Introduction-Types of errors, critical region, procedure of testing hypothesis-Large sample tests- Z test for Single Proportion, Difference of Proportion, mean and difference of means.		
Module: 6	**Hypothesis Testing II**	**9 hours**
Small sample tests- Student's t-test, F-test- chi-square test- goodness of fit - independence of attributes- Design of Experiments - Analysis of variance – one and two way classifications - CRD-RBD- LSD.		
Module: 7	**Reliability**	**5 hours**
Basic concepts- Hazard function-Reliabilities of series and parallel systems- System Reliability - Maintainability-Preventive and repair maintenance- Availability.		
Module: 8	**Contemporary Issues**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours	**45 hours**

Text book(s)	
1.	Probability and Statistics for engineers and scientists, R.E.Walpole, R.H.Myers, S.L.Mayers and K.Ye, 9th Edition, Pearson Education (2012).
2.	Applied Statistics and Probability for Engineers, Douglas C. Montgomery, George C. Runger, 6th Edition, John Wiley & Sons (2016).
Reference books	
1.	Reliability Engineering, E.Balagurusamy, Tata McGraw Hill, Tenth reprint 2017.
2.	Probability and Statistics, J.L.Devore, 8th Edition, Brooks/Cole, Cengage Learning (2012).
3.	Probability and Statistics for Engineers, R.A.Johnson, Miller Freund's, 8th edition,
4.	Prentice Hall India (2011).
5.	Probability, Statistics and Reliability for Engineers and Scientists, Bilal M. Ayyub and Richard H. McCuen, 3rd edition, CRC press (2011).

Mode of Evaluation**:** Digital Assignments, Continuous Assessment Tests, Quiz, Final Assessment Test.

List of Experiments (Indicative)		
1.	Introduction: Understanding Data types; importing/exporting data.	2 hours
2.	Computing Summary Statistics /plotting and visualizing data using Tabulation and Graphical Representations.	2 hours

3.	Applying correlation and simple linear regression model to real dataset; computing and interpreting the coefficient of determination.	2 hours
4.	Applying multiple linear regression model to real dataset; computing and interpreting the multiple coefficient of determination.	2 hours
5.	Fitting the following probability distributions: Binomial distribution	2 hours
6.	Normal distribution, Poisson distribution	2 hours
7.	Testing of hypothesis for One sample mean and proportion from real-time problems.	2 hours
8.	Testing of hypothesis for Two sample means and proportion from real-time problems	2 hours
9.	Applying the t test for independent and dependent samples	2 hours
10.	Applying Chi-square test for goodness of fit test and Contingency test to real dataset	2 hours
11.	Performing ANOVA for real dataset for Completely randomized design, Randomized Block design ,Latin square Design	2 hours
	Total laboratory hours	**22 hours**

Mode of Evaluation**:** Weekly Assessment, Final Assessment Test			
Recommended by Board of Studies	**25-02-2017**		
Approved by Academic Council	**47^{th} AC**	Date:	**05-10-2017**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MAT2001.1	3	2	-	-	-	-	-	-	1	1	-	2	-	-	-
MAT2001.2	2	1	-	-	-	-	-	-	-	-	-	2	-	-	-
MAT2001.3	3	2	-	-	-	-	-	-	1	1	-	2	-	-	-
MAT2001.4	3	2	-	-	-	-	-	-	-	1	-	2	-	-	-
MAT2001.5	3	2	-	-	-	-	-	-	1	1	-	2	-	-	-
MAT2001.6	3	2	-	-	2	-	-	-	1	2	-	2	-	-	-
MAT2001.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MAT2001.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MAT2001.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MAT2001.10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MAT2001.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MAT2001.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	2	-	-	2	-	-	-	1	2	-	2	-	-	-

MGT1022	Lean Start up Management	L	T	P	J	C
		1	0	0	4	2
Pre-requisite	NIL	**Syllabus version**				
		v.1.0				

Course Objectives: To develop the ability to

1. Learn methods of company formation and management.
2. Gain practical skills in and experience of stating of business using pre-set collection of business ideas.
3. Learn basics of entrepreneurial skills.

Expected Course Outcome: On the completion of this course the student will be able to:

1. Understand developing business models and growth drivers
2. Use the business model canvas to map out key components of enterprise
3. Analyze market size, cost structure, revenue streams, and value chain
4. Understand build-measure-learn principles
5. Foreseeing and quantifying business and financial risks

Module:1		**2 Hours**
Creativity and Design Thinking (identify the vertical for business opportunity, understand your customers, accurately assess market opportunity)		
Module:2		**3 Hours**
Minimum Viable Product (Value Proposition, Customer Segments, Build- measure-learn process)		
Module:3		**3 Hours**
Business Model Development(Channels and Partners, Revenue Model and streams, Key Resources, Activities and Costs, Customer Relationships and Customer Development Processes, Business model canvas –the lean model- templates)		
Module:4		**3 Hours**
Business Plan and Access to Funding(visioning your venture, taking the product/ service to market, Market plan including Digital & Viral Marketing, start-up finance - Costs/Profits & Losses/cash flow, Angel/VC,/Bank Loans and Key elements of raising money)		
Module:5		**3 Hours**
Legal, Regulatory, CSR, Standards, Taxes		
Module:6		**2 Hours**
Lectures by Entrepreneurs		
	Total Lecture	**15 hours**

Text Book(s)

1.	The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company, Steve Blank, K & S Ranch; 1st edition (March 1, 2012)
2	The Four Steps to the Epiphany, Steve Blank, K&S Ranch; 2nd edition (July 17, 2013)

3	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries, Crown Business; (13 September 2011)		
Reference Books			
1.	Holding a Cat by the Tail, Steve Blank, K&S Ranch Publishing LLC (August 14, 2014)		
2	Product Design and Development, Karal T Ulrich, SD Eppinger, McGraw Hill		
3	Zero to One: Notes on Startups, or How to Build the Future, Peter Thiel, Crown Business(2014)		
4	Lean Analytics: Use Data to Build a Better Startup Faster (Lean Series), Alistair Croll& Benjamin Yoskovitz, O'Reilly Media; 1st Edition (March 21, 2013)		
5	Inspired: How To Create Products Customers Love, Marty Cagan, SVPG Press; 1st edition (June 18, 2008)		
6	**Website References:** 1. http://theleanstartup.com/ 2. https://www.kickstarter.com/projects/881308232/only-on-kickstarter-the-leaders-guide-by-eric-ries 3. http://businessmodelgeneration.com/ 4. https://www.leanstartupmachine.com/ 5. https://www.youtube.com/watch?v=fEvKo90qBns 6. http://thenextweb.com/entrepreneur/2015/07/05/whats-wrong-with-the-lean-startup-methodology/#gref 7. http://www.businessinsider.in/Whats-Lean-about-Lean-Startup/articleshow/53615661.cms 8. https://steveblank.com/tools-and-blogs-for-entrepreneurs/ 9. https://hbr.org/2013/05/why-the-lean-start-up-changes-everything 10. chventures.blogspot.in/ platformsandnetworks.blogspot.in/p/saas-model.html		
Mode of Evaluation: Assignments; Field Trips, Case Studies; e-learning; Learning through research, TED Talks			
Project			
1.	Project		60 hours
		Total Project	**60 hours**
Recommended by Board of Studies	**08-06-2015**		
Approved by Academic Council	**37th AC**	Date	**16-06-2015**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MGT1022.1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MGT1022.2	-	-	-	3	-	-	3	-	3	-	-	-	-	-	-
MGT1022.3	-	3	-	-	-	-	-	-	-	-	3	-	-	-	-
MGT1022.4	-	-	-	-	-	-	-	-	-	2	-	2	-	-	-
MGT1022.5	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-
	2	3	-	3	-	-	3	-	3	2	3	2	-	-	-

PHY1701	Engineering Physics	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**NIL**	**Syllabus version**				
		v.1.0				

Course Objectives:

1. Having an ability to apply mathematics and science in engineering applications
2. Having a clear understanding of the subject related concepts and of contemporary issues
3. Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)

Expected Course Outcome:

Students will acquire the necessary knowledge about modern physics and its applications in various engineering and technology disciplines.This course meets the following student outcomes

1. CO1 Comprehend the dual nature of radiation and matter.
2. CO2 Compute Schrodinger equations to solve finite and infinite potential problems.
3. CO3 Analyze quantum ideas at the nanoscale
4. CO4 Apply quantum ideas for understanding the operation and working principle of optoelectronic devices
5. CO5 To analyze the Maxwell equations in differential and integral form.
6. CO6 To classify the optical fiber for different Engineering applications.
7. CO7 Apply the various types of optoelectronic devices for designing a typical optical fiber communication system.
8. CO8 To demonstrate the quantum mechanical ideas

Module:1	**Introduction to Modern Physics**	**6 hours**

Planck's concept (hypothesis), Compton Effect, Particle properties of wave: Matter Waves, Davisson Germer Experiment, Heisenberg Uncertainty Principle, Wave function, and Schrodinger equation (time dependent & independent).

Module:2	**Applications of Quantum Physics**	**5 hours**

Particle in a 1-D box (Eigen Value and Eigen Function), 3-D Analysis (Qualitative), Tunneling Effect (Qualitative) (AB 205), Scanning Tunneling Microscope (STM).

Module:3	**Nanophysics**	**5 hours**

Introduction to Nano-materials, Moore's law, Properties of Nano-materials, Quantum confinement, Quantum well, wire & dot, Carbon Nano-tubes (CNT), Applications of nanotechnology in industry.

Module:4	**Laser Principles and Engineering Application**	**6 hours**

Laser Characteristics, Spatial and Temporal Coherence, Einstein Coefficient & its significance, Population inversion, Two, three & four level systems, Pumping schemes, Threshold gain coefficient, Components of laser, Nd-YAG, He-Ne, CO2 and Dye laser and their engineering applications.

Module:5	**Electromagnetic Theory and its application**	**6 hours**

Physics of Divergence, Gradient and Curl, Qualitative understanding of surface and volume integral, Maxwell Equations (Qualitative), Wave Equation (Derivation), EM Waves, Phase velocity, Group velocity, Group index , Wave guide (Qualitative)

Module:6	**Propagation of EM waves in Optical fibers**	**6 hours**

Sources-LED & Laser Diode, Detectors-Photodetectors- PN & PIN - Applications of fiber optics in communication- Endoscopy.
Special Theory of Relativity:
Frame of reference, Galilean relativity, Postulate of special theory of relativity, Simultaneity, length contraction and time dilation.

Module:8	**Contemporary issues:**	**2 hours**
Lecture by Industry Experts		

Total Lecture hours:	**45 hours**

Text Book(s)

1.	Arthur Beiser et al., Concepts of Modern Physics, 2013, Sixth Edition, Tata McGraw Hill.
2.	William Silfvast, Laser Fundamentals, 2008, Cambridge University Press.
3.	D. J. Griffith, Introduction to Electrodynamics, 2014, 4th Edition, Pearson.
4.	Djafar K. Mynbaev and Lowell L.Scheiner, Fiber Optic Communication Technology, 2011, Pearson.

Reference Books

1.	Raymond A. Serway, Clement J. Mosses, Curt A. Moyer Modern Physics, 2010, 3rd Indian Edition Cengage learning.
2.	John R. Taylor, Chris D. Zafiratos and Michael A. Dubson, Modern Physics for Scientists and Engineers, 2011, PHI Learning Private Ltd.
3.	Kenneth Krane Modern Physics, 2010, Wiley Indian Edition.
4.	Nityanand Choudhary and Richa Verma, Laser Systems and Applications, 2011, PHI Learning Private Ltd.
6.	S. Nagabhushana and B. Sathyanarayana, Lasers and Optical Instrumentation, 2010, I.K. International Publishing House Pvt. Ltd.,
7.	R. Shevgaonkar, Electromagnetic Waves, 2005, 1st Edition, Tata McGraw Hill
8.	Principles of Electromagnetics, Matthew N.O. Sadiku, 2010, Fourth Edition, Oxford.
9.	Ajoy Ghatak and K. Thyagarajan, Introduction to Fiber Optics, 2010, Cambridge University Press.

Mode of Evaluation**:** Quizzes , Digital Assignments, CAT-I and II and FAT

List of Challenging Experiments (Indicative)

1.	Determination of Planck's constant using electroluminescence process (Module 1)	2 hours
2.	Electron diffraction (Module 1)	2 hours
3.	Determination of wavelength of laser source (He -Ne laser and diode lasers of different wavelengths) using diffraction technique (Module 4)	2 hours
4.	Dispersive power of prism (Module 6)	2 hours
5.	Optical Fiber communication (source + optical fiber + detector) (Modules 7+8)	2 hours
6.	Determination of size of fine particle using laser diffraction (Module 3)	2 hours
7.	Determination of the track width (periodicity) in a written CD (Module 4)	2 hours

8.	PIN diode characteristics (Module 8)	2 hours
9.	Black body Radiation (Module 1+2)	2 hours
10.	Optical Fiber communication (source + optical fiber + detector) (Modules 7 + 8)	2 hours
11.	Analysis of crystallite size and strain in a nano -crystalline film using X-ray diffraction (Module 3)	2 hours
12.	Numerical solutions of Schrödinger equation (e.g. particle in a box problem) (Module 2) (can be given as an assignment)	2 hours
13.	Laser coherence length measurement (Module 4)	2 hours
14.	Proof for transverse nature of E.M. waves (Module 6)	2 hours
15.	Quantum confinement and Heisenberg's uncertainty principle (Module 1 + 3)	2 hours
	Total Laboratory Hours	**30 hours**

Recommended by Board of Studies	**11.08.2017**		
Approved by Academic Council	**46th AC**	Date	**24.08.2017**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PHY1701.1	2	1	-	-	-	-	-	-	2	2	-	1	-	-	-
PHY1701.2	2	1	-	-	-	-	-	-	1	1	-	-	-	-	-
PHY1701.3	3	2	-	-	-	-	-	-	1	1	-	1	-	-	-
PHY1701.4	3	2	-	-	-	-	-	-	2	2	-	1	-	-	-
PHY1701.5	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
PHY1701.6	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
PHY1701.7	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
PHY1701.8	2	1	-	-	2	-	-	-	1	1	-	1	-	-	-
	3	2	-	-	2	-	-	-	2	2	-	1	-	-	-

PHY1901	Introduction to Innovative Projects	L	T	P	J	C
		1	0	0	4	2
Pre-requisite	**NIL**	**Syllabus version**				
		v.1.0				

Course Objectives:

This course is offered to the students in the 1st Year of B.Tech. in order to orient them towards independent, systemic thinking and be innovative.

1. To make students confident enough to handle the day to day issues.
2. To develop the "Thinking Skill" of the students, especially Creative Thinking Skills
3. To train the students to be innovative in all their activities
4. To prepare a project report on a socially relevant theme as a solution to the existing issues

Expected Course Outcome: Students will be able to

1. Develop innovative thinking skills
2. Apply tools and techniques for generating innovative ideas
3. Propose innovative solutions for societal/technical problems

Module:1 A	**Self Confidence**	**1 hour**

Understanding self – Johari Window –SWOT Analysis – Self Esteem – Being a contributor – Case Study

Project : Exploring self, understanding surrounding, thinking about how s(he) can be a contributor for the society, Creating a big picture of being an innovator – writing a 1000 words imaginary autobiography of self – Topic "Mr X – the great innovator of 2015" and upload. **(4 non- contact hours)**

Module:1 B	**Thinking Skill**	**1 hour**

Thinking and Behaviour – Types of thinking– Concrete – Abstract, Convergent, Divergent, Creative, Analytical, Sequential and Holistic thinking – Chunking Triangle – Context Grid – Examples – Case Study.

Project : Meeting at least 50 people belonging to various strata of life and talk to them / make field visits to identify a min of100 society related issues, problems for which they need solutions and categories them and upload along with details of people met and lessons learnt. **(4 non- contact hours)**

Module:1 C	**Lateral Thinking Skill**	**1 hour**

Blooms Taxonomy – HOTS – Outof the box thinking – deBono lateral thinking model – Examples

Project : Last weeks - incomplete portion to be done and uploaded

Module:2 A	**Creativity**	**1 hour**

Creativity Models – Walla – Barrons – Koberg & Begnall – Examples

Project : Selecting 5 out of 100 issues identified for future work. Criteria based approach for prioritisation, use of statistical tools & upload . **(4 non- contact hours)**

Module:2 B	**Brainstorming**	**1 hour**

25 brainstorming techniques and examples

Project : Brainstorm and come out with as many solutions as possible for the top 5 issues identified & upload . **(4 non- contact hours)**

Module:3	**Mind Mapping**	**1 hour**

Mind Mapping techniques and guidelines. Drawing a mind map

Project : Using Mind Maps get another set of solutions forthe next 5 issues (issue 6 – 10) . **(4 non- contact hours)**		
Module:4 A	**Systems thinking**	**1 hour**
Systems Thinking essentials – examples – Counter Intuitive condemns **Project :** Select 1 issue / problem for which the possible solutions are available with you. Apply Systems Thinking process and pick up one solution [explanation should be given why the other possible solutions have been left out]. Go back to the customer and assess the acceptability and upload. . **(4 non- contact hours)**		
Module:4 B	**Design Thinking**	**1 hour**
Design thinking process – Human element of design thinking – case study **Project :** Apply design thinking to the selected solution, apply the engineering & scientific tinge to it. Participate in “design week” celebrations upload the weeks learning out come.		
Module:5 A	**Innovation**	**1 hour**
Difference between Creativity and Innovation – Examples of innovation –Being innovative. **Project:** A literature searches on prototyping of your solution finalized. Prepare a prototype model or process and upload. . **(4 non- contact hours)**		
Module:5 B	**Blocks for Innovation**	**1 hour**
Identify Blocks for creativity and innovation – overcoming obstacles – Case Study **Project :** Project presentation on problem identification, solution, innovations-expected results – Interim review with PPT presentation. . **(4 non- contact hours)**		
Module:5 C	**Innovation Process**	**1 hour**
Steps for Innovation – right climate for innovation **Project:** Refining the project, based on the review report and uploading the text. . **(4 non- contact hours)**		
Module:6 A	**Innovation in India**	**1 hour**
Stories of 10 Indian innovations **Project:** Making the project better with add ons. . **(4 non- contact hours)**		
Module:6 B	**JUGAAD Innovation**	**1 hour**
Frugal and flexible approach to innovation - doing more with less Indian Examples **Project:** Fine tuning the innovation project with JUGAAD principles and uploading (Credit for JUGAAD implementation) . **(4 non- contact hours)**		
Module:7 A	**Innovation Project Proposal Presentation**	**1 hour**
Project proposal contents, economic input, ROI – Template **Project:** Presentation of the innovative project proposal and upload . **(4 non- contact hours)**		
Module:8 A	Contemporary issue in Innovation	**1 hour**
Contemporary issue in Innovation **Project:** Final project Presentation , Viva voce Exam (**4 non- contact hours)**		
Total Lecture hours:		**15 hours**
Text Book(s)		

1.	How to have Creative Ideas, Edward debone, Vermilon publication, UK, 2007
2.	The Art of Innovation, Tom Kelley & Jonathan Littman, Profile Books Ltd, UK, 2008
Reference Books	
1.	Creating Confidence, Meribeth Bonct, Kogan Page India Ltd, New Delhi, 2000
2.	Lateral Thinking Skills, Paul Sloane, Keogan Page India Ltd, New Delhi, 2008
3.	Indian Innovators, Akhat Agrawal, Jaico Books, Mumbai, 2015
4.	JUGAAD Innovation, Navi Radjou, Jaideep Prabhu, Simone Ahuja Random house India, Noida, 2012.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Three reviews with weightage of 25 : 25 : 50 along with reports

Recommended by Board of Studies	15-12-2015		
Approved by Academic Council	**39th AC**	Date	17-12-2015

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PHY1901.1	-	-	-	-	1	1	-	-	1	1	-	2	-	-	-
PHY1901.2	-	-	-	-	1	1	-	-	2	2	-	2	-	-	-
PHY1901.3	2	1	-	-	2	2	-	-	2	2	-	2	-	-	-
	2	1	-	-	2	2	-	-	2	2	-	2	-	-	-

HUM1021	Ethics and Values	L	T	P	J	C
		2	0	0	0	2
Pre-requisite	NIL	**Syllabus version**				
		v. 1.2				

Course Objectives:

1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity
2. To understand the negative health impacts of certain unhealthy behaviors
3. To appreciate the need and importance of physical, emotional health and social health

Expected Course Outcome:

Students will be able to:

1. Comprehend ethical and moral values.
2. Understand various social problems and learn to act ethically.
3. Understand the concept of addiction and how it will affect the physical and mental health.
4. Identify ethical concerns in research and intellectual contexts, including academic integrity, use and citation of sources, the objective presentation of data, and the treatment of human subjects.
5. Identify the main typologies, characteristics, activities, actors and forms of cybercrime.

Module:1	**Being Good and Responsible**	**5 hours**

Gandhian values such as truth and non-violence – Comparative analysis on leaders of past and present – Society's interests versus self-interests - Personal Social Responsibility: Helping the needy, charity and serving the society

Module:2	**Social Issues 1**	**4 hours**

Harassment – Types - Prevention of harassment, Violence and Terrorism

Module:3	**Social Issues 2**	**4 hours**

Corruption: Ethical values, causes, impact, laws, prevention – Electoral malpractices;
White collar crimes - Tax evasions – Unfair trade practices

Module:4	**Addiction and Health**	**5 hours**

Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – Ill effects of smoking - Prevention of Suicides;
Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases

Module:5	**Drug Abuse**	**3 hours**

Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention

Module:6	**Personal and Professional Ethics**	**4 hours**

Dishonesty - Stealing - Malpractices in Examinations – Plagiarism

Module:7	**Abuse of Technologies**	**3 hours**

Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking

Module:8	**Contemporary issues:**	**2 hours**

Guest lectures by Experts

	Total Lecture hours:	30 hours	
Reference Books			
1.	Dhaliwal, K.K , "Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts,2016, Writers Choice, New Delhi, India.		
2.	Vittal, N, "Ending Corruption? - How to Clean up India?", 2012, Penguin Publishers, UK. Pagliaro, L.A. and Pagliaro, A.M, "Handbook of Child and Adolescent Drug and Substance		
3.	Abuse: Pharmacological , Developmental and Clinical Considerations", 2012Wiley Publishers, U.S.A.		
4.	Pandey, P. K (2012), "Sexual Harassment and Law in India", 2012, Lambert Publishers, Germany.		
Mode of Evaluation: CAT, Assignment, Quiz, FAT and Seminar			
Recommended by Board of Studies	**26-07-2017**		
Approved by Academic Council	**46th AC**	Date	**24-08-2017**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
HUM1021.1	-	-	-	-	-	3	2	3	1	2	-	2	-	-	-
HUM1021.2	-	-	-	-	-	3	2	3	2	2	-	2	-	-	-
HUM1021.3	-	-	-	-	-	3	2	3	1	2	-	2	-	-	-
HUM1021.4	-	-	-	-	-	3	2	3	2	2	-	2	-	-	-
HUM1021.5	-	-	-	-	-	3	2	3	1	2	-	2	-	-	-
	-	-	-	-	-	3	2	3	2	2	-	2	-	-	-

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<tr><td>Pre-requisite</td><td>NIL</td><td colspan="6">Syllabus version</td></tr>
<tr><td>Anti-requisite</td><td>NIL</td><td colspan="6">v. 1.0</td></tr>
<tr><td colspan="8">Course Objectives:</td></tr>
<tr><td colspan="8">1. Formulate the mathematical model of the electric circuits using basic laws
2. Apply various network theorems to solve the electric circuits
3. Compute and analyze the steady state and transient responses of DC and AC circuits</td></tr>
<tr><td colspan="8">Expected Course Outcome:</td></tr>
<tr><td colspan="8">On the completion of this course the student will be able to:
1. Formulate the equations of the electric circuits using basic laws
2. Determine the response of DC circuits using basic analysis methods
3. Compute the response of DC circuits using network theorems
4. Analyze the transient behavior of electric circuits with different types of source
5. Describe the elements of AC circuits and the phasor concept
6. Design resonance circuits, and solve three phase ac circuits
7. Solve simple magnetic circuits</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Module:1</td><td>Fundamentals of Electric Circuits</td><td colspan="6">5 Hours</td></tr>
<tr><td colspan="8">Introduction to Circuit Elements, Ohms Law and Kirchhoff's Laws. Voltage and Current Division, Star-Delta Transformation and Source Transformation.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Module:2</td><td>Linear Circuit Analysis</td><td colspan="6">5 Hours</td></tr>
<tr><td colspan="8">Nodal and Mesh Analysis of Linear Network with Independent and Dependent DC sources.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Module:3</td><td>Network Theorems</td><td colspan="6">7 Hours</td></tr>
<tr><td colspan="8">Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem and Superposition Theorem for circuits with independent and dependent sources.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Module:4</td><td>Transient Circuit Analysis</td><td colspan="6">7 Hours</td></tr>
<tr><td colspan="8">Dynamic Circuit Elements – L and C. Analysis of Source Free RC, RL and RLC Circuits, Singularity Functions, Step Response of RC, RL and RLC Circuits.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Module:5</td><td>Introduction to Phasors</td><td colspan="6">7 Hours</td></tr>
<tr><td colspan="8">Introduction to Sinusoids and Phasors, Impedance and Admittance with Phasors Representation. RMS and Average Values of Sinusoids, Instantaneous and Average Power, and Complex Power - Real Power, Reactive Power and Apparent Power Calculations and Power Factor.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Module:6</td><td>AC Circuits and Resonance</td><td colspan="6">7 Hours</td></tr>
<tr><td colspan="8">Sinusoidal Steady State Analysis for AC circuits with independent sources. Frequency Response of Circuits with R, L and C Combinations. Resonance in Series and Parallel RLC Circuits. Balanced Three Phase Circuits, Power in a Balanced System, Three Phase Power Measurement.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td>Module:7</td><td>Magnetic Circuits</td><td colspan="6">Hours 5</td></tr>
<tr><td colspan="8">Magnetically Coupled Circuits, Self and Mutual Inductance, Dot Convention, Energy in Coupled Circuits, Mesh Analysis of Magnetically Coupled Circuits.</td></tr>
</table>

Module:8	Contemporary issues:	2 hours
	Total Lecture hours:	45 Hours

Text Book(s)	
1.	Charles K Alexander, Mathew N O Sadiku, 'Fundamentals of Electric Circuits, Tata McGraw Hill, 2012.
Reference Books	
1.	Allan R. Hambley, 'Electrical Engineering-Principles & Applications', Pearson Education Limited, 7/e, 2017.
2.	Robert L Boylestad, 'Introductory Circuit Analysis', Pearson Education Limited, 13/e, 2016.
3.	W. H. Hayt, J.E. Kemmerly and S. M. Durbin, 'Engineering Circuit Analysis', McGraw Hill, New York, 8/e, 2012.
4.	Abhijit Chakrabarti, 'Circuit Theory : Analysis and Synthesis', Dhanpat Rai & Co., New Delhi, 6/e, 2014
5.	Mahmood Nahvi; Joseph A Edminister, 'Electric Circuits', McGraw Hill Education, 6/e, 2015.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**29/05/2015**		
Approved by Academic Council	**37th AC**	Date	**16/06/2015**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1002.1	3	2	1	1	1	-	-	-	-	-	-	1	2	1	1
EEE1002.2	3	2	1	1	1	-	-	2	2	1	-	1	2	1	1
EEE1002.3	3	2	1	1	1	-	-	2	2	1	-	1	2	1	1
EEE1002.4	3	3	2	2	1	-	-	-	-	-	-	1	2	2	1
EEE1002.5	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
EEE1002.6	3	2	1	1	1	-	-	2	2	1	-	1	2	1	1
EEE1002.7	3	2	1	1	1	-	-	-	-	-	-	1	2	1	1
	3	2	2	2	1	-	-	2	2	1	-	1	2	2	1

EEE1004	Engineering Electromagnetics	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	MAT1011	Syllabus version				
Anti-requisite	NIL	v. 1.1				

Course Objectives:

1. To convey the basic physical concepts that lie behind all electrical engineering, the interactions between charged particles, whether stationary or in motion.
2. To examine the electric and magnetic forces between stationary and steadily moving charged particles.
3. To study the various electric & magnetic field concepts both in static and time varying condition.

Expected Course Outcome:

On the completion of this course the student will be able to:
1. Explore different coordinate systems related to magnetic fields.
2. Define the electric flux density, field intensity and different charge distributions.
3. Demonstrate the boundary conditions and method of images.
4. Compare the electric and magnetic boundary conditions, calculate the capacitance and inductance.
5. Analyze Maxwell equations.
6. Summarise the electric magnetic waves and wave propagation in different medium.
7. Apply the electric and magnetic field concepts
8. Design and Conduct experiments, as well as analyze and interpret data

Module:1	Review of Scalar and Vector Fields	6 Hours

Different Co-ordinate Systems: Cartesian, Cylindrical and Spherical –Differential elements in different coordinate systems – Del Operator: Divergence, Curl and Gradient, Divergence Theorem – Stoke’s Theorem - Helmholtz’s Decomposition.

Module:2	Electrostatics: Charges	5 Hours

Coulomb’s law – Electric Field Intensity – Electric Flux – Gauss’s Law – Potential due to Point, Line and Surface Charge Distributions.

Module:3	Electric Fields in Dielectrics and Conductors	8 Hours

Different current flow mechanisms – Continuity equation and relaxation time - Boundary conditions – Laplace and Poisson’s equations - Solutions – Analytical Methods – Variables separable methods – Method of images – Numerical Techniques - Finite Difference Method – Electrostatic Energy – Capacitance Calculations

Module:4	Magneto statics	8 Hours

Magnetic Fields – Magnetic Flux – Biot Savart’s Law – Ampere’s Law – Magnetic Torque and Moment – Forces due to Magnetic Fields – Vector Potential – Magnetic Boundary Conditions – Inductors and Inductances – Calculations - Magnetic Energy

Module:5	Electromagnetic Fields	8 Hours

Faraday’s law – Lenz’s Law – Maxwell’s equations – Displacement current – Maxwell’s Equations in Final Forms – Time Varying Fields - Relation between field theory and circuit theory

Module:6	**Electromagnetic Waves Generation**	**8 Hours**
Propagation of waves in lossy dielectrics, conductors and free space – Skin effect – Complex Permittivity- Power and Poynting Vector.		
Module: 7	**Application**	**2 hours**
Sources, Effects and application of Electromagnetic fields		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		

List of Challenging Experiments (Indicative)		
1.	Electromagnetic concepts using Matlab tool functions	2 hours
2.	Vector Representation ,Coordinate Systems and conversion	2 hours
3.	Volume and surface integration (Vectorial)	2 hours
4.	Determining electric field distribution for an infinite sheet charges and line charge	2 hours
5.	Determining voltage due to line charge or surface or volume charge	2 hours
6.	Energy stored in a region due to electric field	2 hours
7.	Solving dielectric(□r1) - dielectric (□r2) boundary condition problem	2 hours
8.	Determination of electrical field and potential inside the parallel plate capacitor.	2 hours
9.	Determination of voltage and electric field distribution inside the co-axial cable. (Laplace equation).	2 hours
10.	Determining and plotting the magnetic field due to infinite sheet current	2 hours
11.	Determination of an inductance of a solenoid	2 hours
12.	Determination of the mutual inductance between an infinite line current and a rectangular coil	2 hours
13.	Electromagnetic wave propagation in good conductors.	2 hours
14.	Determination of Electric field and Voltage profile for a single core cable which is ruptured by the presents of a needle inclusion on the outer sheath.	2 hours
15.	Determination of static magnetic field induced by the stator windings in a two pole electric motor.	2 hours
	Total Laboratory Hours	**30 hours**
Mode of Evaluation: Assignment / FAT		

Text Book(s)

1. Matthew N. O. Sadiku & S. V. Kulkarni, ‘Principles of Electromagnetics’, Oxford University Press, New York, Sixth Edition, 2015.

Reference Books

1. Hart Hayt, John A. Buck, ‘Engineering Electromagnetics’, McGraw-Hill, Eighth Edition, 2012.
2. A. Edminister, ‘Schaum's Outline of Electromagnetics’, McGraw-Hill Professional, Fourth Edition, 2013.
3. Karl E. Lonngren, Sava Savov, Randy J. Jost, ‘Fundamental of Electomagnetic with MATLAB’, 2007.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1004.1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
EEE1004.2	2	1	-	-	-	-	-	2	2	1	-	1	-	-	-
EEE1004.3	2	1	-	-	-	-	-	2	2	1	-	1	-	-	-
EEE1004.4	2	1	-	-	-	-	-	2	2	1	-	1	-	-	-
EEE1004.5	3	3	2	2	-	-	-	-	-	-	-	1	3	1	2
EEE1004.6	2	1	-	-	-	-	-	-	-	-	-	1	-	-	-
EEE1004.7	3	2	1	1	-	-	-	2	2	1	-	1	3	2	-
EEE1004.8	3	3	2	2	2	-	-	3	3	3	-	2	3	2	2
	3	2	2	2	2	-	-	3	3	2	-	2	3	2	2

EEE1005	Signals and systems	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	**MAT2002**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To understand the mathematical representations of signals and systems in continuous and discrete domain.
2. Analyse and perform various operations with the signals.
3. Analyse the response of linear time invariant (LTI) systems in continuous and discrete domain.
4. Understand sampling theorem and represent signals in the frequency domain.

Expected Course Outcome:

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

1. Apply mathematical tools to perform operations and classify different types of signalsAnalyse LTI systems
2. i) Analyze various types of LTI systems based on their behaviour and ii) Analyze continuous and discrete LTI systems using Fourier seriesDifferentiate the behaviour of LTI systems as periodic and aperiodic signals using Fourier Transforms
3. Differentiate the behaviour of LTI systems as periodic and aperiodic signals using Fourier TransformsExtend the analysis to unstable systems using the Laplace Transforms
4. Construct the original signal from samples using interpolation
5. Apply Laplace transform to analyse continuous LTI systems
6. Apply Z-transform to analyse discrete LTI systems

Module:1	**Fundamentals of Signals**	**5 Hours**

Representation of Continuous and Discrete-time Signals, Unit Step, Unit Ramp, Unit Impulse, Sinusoidal and Complex Exponentials. Classification of signals – Periodic and Aperiodic Signal, Even and Odd Signal, Energy and Power Signal, Deterministic and Random signals. Transformation of Independent Variables –Time Shifting, Time Scaling and Time Reversal.

Module:2	**Fundamentals of Systems**	**5 Hours**

Representation of Continuous and Discrete Time Systems. Classification of systems - Static and Dynamic, Linear and Nonlinear, Time variant and Time Invariant, Causal and Non–Causal, Stable and unstable, Invertible and non- invertible systems. Block Diagram Representation and Interconnection of Systems

Module:3	**Analysis of LTI System**	**6 Hours**

Impulse Response of Continuous and Discrete Time LTI Systems. Convolution, Basic properties of systems using impulse response.

Module:4	**Fourier Representation of Periodic Signals and LTI Systems**	**6 Hours**

Fourier Series Representation of Continuous Time and Discrete-time periodic signals, Properties of Fourier Series, Parseval's relation, Response of LTI Systems to Complex Exponentials.

Module:5	**Fourier Representation of Aperiodic Signals and LTI Systems**	**7 Hours**

Continuous Time and Discrete Time Fourier Transforms, Properties of Fourier Transforms, Frequency response of LTI system. Applications: Modulation for communications, Filtering, Time–Frequency representation and uncertainty principle.

Module:6	**Representation of Continuous time signals by its samples**	**5 Hours**
Sampling Theorem, Effects of Sampling and Aliasing. Sampling of Continuous Time Signals with Sample and Hold, Reconstruction of Signal from Samples – Interpolation.		
Module:7	**Analysis of Continuous and Discrete LTI Systems with Laplace Transform and Z-Transform**	**9 Hours**
Review of Laplace Transform, Region of Convergence, Characterization of LTI systems with Laplace Transforms, transfer functions. Mapping of s-plane to z-plane, Review of Z-Transform, Region of Convergence, Power series expansion, and partial fraction expansion. Characterization of LTI systems using Z -Transforms.		
Module:8	**Lecture by industry experts.**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)	
1.	Signals and Systems by Alan V. Oppenhein, Alan S. Willsky and S. Hamid, Pearson 2016.
Reference Books	
1.	Signals and systems by Simon Haykin, John Wiley, 2016.
2.	Fundamentals of Signals and Systems Usin Web and MATLAB, Edward W Kamen, Bonnie S. Heck, Pearson, 2014.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	**30/11/2015**		
Approved by Academic Council	**39^{th} AC**	Date	**17/12/2015**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1005.1	3	2	1	1	1								1	2	1
EEE1005.2	3	3	2	2	1			2	2	2		1	3	3	1
EEE1005.3	2	1												1	
EEE1005.4	3	2	1	1	1							1		2	1
EEE1005.5	3	3	2	2	1			2	2	2		1	2	3	1
EEE1005.6	3	2	1	1	1			2	2	2		1	2	2	1
	3	3	2	2	1	-	-	2	2	2	-	1	3	3	1

EEE2001	**Network theory**		**L**	**T**	**P**	**J**	**C**
			3	**0**	**0**	**0**	**3**
Pre-requisite	**EEE1002, MAT1011**	**Syllabus version**					
Anti-requisite	NIL	v. 1.0					

Course Objectives:

1. Analyse the steady state response of circuits and discuss various theorems and their applications
2. Apply Laplace transform and Fourier transform techniques to circuits and obtain the complete response
3. Design passive filters and analyse its frequency response.

Expected Course Outcome:

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

1. Apply node voltage and mesh current methods to analyse circuits in steady state.
2. i) Apply Laplace transform techniques for solving problems and discuss the complete response of circuits ii)Derive the transfer function and identify its poles and zerosDerive the transfer function and identify its poles and zeros
3. Analyse the harmonics in nonsinusoidal inputs to circuits using Fourier series.
4. Apply Fourier transform to circuits with nonsinusoidal inputs
5. Design passive filters and analyse the frequency response.
6. Evaluate and relate two-port network parameters.

Module:1	**Sinusoidal Steady State Analysis**	**6 Hours**

Review of Phasors. Nodal Analysis, Mesh Analysis, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem and Superposition Theorem for circuits with independent and dependent sinusoidal sources

Module:2	**Modeling of Network in s-Domain**	**6 Hours**

Circuit Models of R, L and C in s-Domain. Application of Laplace Transforms to integro-differential equations of RL, RC and RLC circuits. Transfer Function. Impulse Response of RL and RC Circuits and Response to any other sources using convolution integral.

Module:3	**Complete Response of Networks**	**6 Hours**

Circuit Analysis with zero and non zero initial conditions in s-domain. Pole-Zero Maps. Network Stability.

Module:4	**Networks with Periodic Non-Sinusoidal Excitation**	**7 Hours**

Trigonometric Fourier Series for Non-Sinusoidal Functions. Circuit Analysis. Average Power and RMS Values using Fourier Coefficients. Exponential Fourier Series.

Module:5	**Network Analysis using Fourier Transform**	**7 Hours**

Fourier Transform for commonly used periodic and aperiodic functions. Circuit Analysis in frequency domain. Energy in the signal using Parseval's Theorem.

Module:6	**Design of Filters**	**4 Hours**

Review of Frequency Response of RL, RC and RLC circuits. Passive Filters– Low Pass, High Pass, Band Pass and Band Stop. Magnitude and Frequency Scaling.

Module:7	**Two Port Networks**	**6 Hours**

Introduction to Two-Port Networks - Impedance and Admittance parameters, Transmission and

Hybrid Parameters. Relationship between parameter, Interconnection of Networks.			
Module:8	**Contemporary issues:**		**2 hours**
	Total Lecture hours:		**45 Hours**
Text Book(s)			
1.	Charles K Alexander, Mathew N O Sadiku, “Fundamentals of Electric Circuits”, Tata McGraw Hill, 2012.		
Reference Books			
1.	Allan R. Hambley, ‘Electrical Engineering-Principles & Applications’ Pearson Education, First Impression, 6/e, 2013.		
2.	Robert L Boylestad, ‘Introductory Circuit Analysis’ Pearson Education Ltd, 12th Edition, 2010.		
3.	H. Hayt, J.E. Kemmerly and S. M. Durbin, ‘Engineering Circuit Analysis’, 6/e, Tata McGraw Hill, New Delhi, 2011.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**29/05/2015**		
Approved by Academic Council	**37th AC**	Date	**16/06/2015**

CO	PO1	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	PSO 3
EEE2001. 1	3	2	1	1								1	1	2	
EEE2001. 2	3	2	1	1				2	2	2		1	1	2	
EEE2001. 3	3	3	2	2								1	2	3	
EEE2001. 4	3	2	1	1								1	2	2	
EEE2001. 5	3	3	2	2				2	2	2		1	2	3	
EEE2001. 6	3	2	1	1								1	1	2	
	3	3	2	2	-	-	-	2	2	2	-	1	2	3	-

EEE2002	Semiconductor Devices and Circuits	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	**EEE1002**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To apply the knowledge of solid state devices principles to analyze electronic circuits.
2. To design amplifiers under different configurations and study their responses
3. To have hands on learning experience and software knowledge by doing practical exercises and projects.

Expected Course Outcome:

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

1. Explain the behaviour of semiconductor devicesAnalyze diode circuits
2. Analyze diode circuits to determine voltages and currentsCompare the various configurations of BJT
3. i) Explain the characteristics and biasing methods of BJTs and MOSFETs ii) Compare the BJT amplifiers configurations.iii) Compare the MOSFET amplifiers configurationsAnalyze the high speed response of semiconducting devices.
4. i)Analyze the high frequency response of semiconductor devices ii)Compare and contrast the negative and positive feedback in amplifier ii)Compare and contrast the negativeDesign and conduct experiments, as well as analyze and interpret data
5. Design and experimentally verify the circuit for the given specifications
6. Design and development of an electronic circuit for engineering applications

Module:1	**Semiconductor Device Physics**	**2 Hours**

Semi-conductors, charge carriers, intrinsic and extrinsic semi-conductors, carrier generation, recombination, injection of carriers, Drift and diffusion, carrier mobility, conductivity.

Module:2	**Diode Circuit Analysis**	**4 Hours**

PN junction diode – Formation of Junction, Junction Capacitance, characteristics, Diode equations, Diode Circuits – Clipper and Clamper, rectifiers with and without filters, other multiple diode circuits, Regulated power supplies.

Module:3	**Transistor DC Analysis**	**5 Hours**

BJT Characteristics, current gains, h-parameters, MOSFET Characteristics, Load line and Operating point analysis, DC analysis and biasing of BJTs and MOSFETs.

Module:4	**BJT Amplifiers**	**5 Hours**

Small signal analysis of BJT amplifiers, Calculation of Gain, Input Impedance and Output Impedance. Basic BJT amplifier Configurations (CE, CC and CB). Power Amplifiers.

Module:5	**MOSFET Amplifiers**	**4 Hours**

Small signal analysis of MOSFET amplifiers. Calculation of Gain, Input Impedance and Output Impedance. Basic MOSFET amplifier configurations - (CS, CD and CG) amplifiers.

Module:6	**Frequency response**	**5 Hours**

Amplifier Frequency Response, System Transfer Functions, Frequency Response of Transistor Amplifier with Circuit Capacitors, Frequency Response of the FET, High-Frequency Response of Transistor Circuits.

Module:7	**Feedback Amplifiers and Oscillators**	**3 Hours**
Basic concepts of feedback-Negative feedback advantages and types. Voltage/Current Series/Shunt, Positive feedback, Stability, Conditions for Oscillations RC and LC oscillators.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**30 Hours**
Text Book(s)		
1.	A.S.Sedra, K.C. Smith, "Microelectronic Circuits: Theory with Applications", 6Ed, Oxford University Press, 2013.	
Reference Books		
1.	D.A. Neamen, Electronic Circuits – Analysis and Design, 3Ed, McGraw Hill, 2011.	
2.	David A. Bell, "Electronic Devices and Circuits", 5ed, Oxford University Press, 2008.	
3.	Behzad Razavi, Fundamentals of Microelectronics, 3Ed, Wiley, 2013.	
4.	Ben Streetman, Sanjay Banerjee, Solid State Electronic Devices, 7ED, Pearson, 2014.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		

List of Challenging Experiments (Indicative)		
1.	Realization of logic gates using diodes	2 hours
2.	Design line and load voltage regulation circuits using Zener diode	2 hours
3.	Design a capacitor for a rectifier circuit	2 hours
4.	Design various clamping circuits using diode	2 hours
5.	Design various clipping circuits using diode	2 hours
6.	Design the circuit using BJT as a switch in an alarm system	2 hours
7.	Obtain the h-parameters for different configurations in BJT using input – output characteristics	2 hours
8.	Design the circuit for a verification of BJT as a switch and amplifier using Darlington pair	2 hours
9.	Design the circuit to perform DC analysis of a BJT	2 hours
10.	Switching characteristics of MOSFET	2 hours
11.	Design the circuit for verifying UJT as a triggering switch	2 hours
12.	Design a RC coupled amplifier	2 hours
13.	Design a common collector amplifier	2 hours
14.	Design a common source FET amplifier	2 hours
	Total Laboratory Hours	**30 hours**
Mode of Evaluation: Assignment /FAT		

Recommended by Board of Studies	**29/05/2015**		
Approved by Academic Council	**37th AC**	Date	**16/06/2015**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE2002.1	2	1													
EEE2002.2	3	3	2	2								1		3	
EEE2002.3	2	1										1		1	
EEE2002.4	3	3	2	2	2			2	2	2		1	2	2	2
EEE2002.5	3	3	2	2	2			2	2	2		2	2		2
EEE2002.6	3	3	2	2	2	2	2	2	2	3	2	2	3	2	2
	3	3	2	2	2	2	2	2	2	3	2	2	3	2	2

EEE2005	Digital Signal Processing	L	T	P	J	C
		2	0	2	0	3
Pre-requisite	**EEE1005**	**Syllabus version**				
Anti-requisite	NIL	v. 2.0				

Course Objectives:

1. To recognize Linear Time-Invariant (LTI) discrete-time systems
2. To design IIR filters using impulse invariance & bilinear transformation techniques
3. To design FIR filters using various window functions
4. To obtain knowledge and ability to use the appropriate tools like digital signal processors to build DSP systems for real time problems

Expected Course Outcome:

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

1. Apply transform techniques to analyze the discrete time systemsAnalyze and design analog filters
2. i)Design analog filters using Chebyshev and Butterworth polynomials for given specifications ii) Design IIR filters using transformation techniques iii) Design of FIR filters using various windowing techniques
3. Construct various structures for digital filter realization
4. Design of Wiener Filter and adaptive filter to remove artefacts and interferences for signal processing application
5. Explain filter operations in Fixed point and floating point digital signal processors
6. Analyze the performance characteristics of filters using simulation tools and implement DSP algorithms using digital signal processor

Module:1	Frequency Analysis of Signals and Systems	6 Hours

Review of discrete -time signals and systems – Classification, Z- transform – ROC- stability/causality analysis, DTFT- Frequency domain sampling - DFT-Properties-Frequency analysis of signals using DFT-FFT Algorithm-Radix-2 FFT algorithms-Applications of FFT.

Module:2	Theory and Design of Analog Filters	4 Hours

Design techniques for analog low pass filter -Butterworth and Chebyshev approximations, frequency transformation, Properties.

Module:3	Design of IIR Digital Filters	4 Hours

IIR filter design - Bilinear and Impulse Invariant Transformation techniques - Spectral transformation of digital filters.

Module:4	Design of FIR Digital Filters	4 Hours

FIR Filter Design - Phase and group delay - Design characteristics of FIR filters with linear phase – Frequency response of linear phase FIR filters – Design of FIR filters using Rectangular, Hamming, Hanning, Bartlett and Blackmann window functions.

Module:5	Realization of Digital Filters	4 Hours

Direct Forms I and II, Cascade, Parallel and Lattice structures.

Module:6	Filters for removal of artefacts and interference	4 Hours

Optimum Filter - The Wiener Filter, Adaptive filters and their applications.

Module:7	**Digital Signal Processors**	**2 Hours**
General-purpose digital signal processors - Fixed point and floating point DSP - Finite word length effects - MAC, filter operation in different DSP architectures - typical implementation of DSP algorithms.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**30 Hours**

Text Book(s)

1.	John G. Proakis, D.G. Manolakis and D.Sharma, "Digital Signal Processing Principles, Algorithms and Applications", 4th edition, Pearson Education, 2012.
2.	Sanjit K. Mitra, Digital Signal Processing, 4th edition, TMH, 2013.

Reference Books

1.	Sophocles J. Orfanidis, "Introduction to Signal Processing" 2nd edition, Prentice Hall, Inc, 2010
2.	Oppenhiem V.A.V and Schaffer R.W, "Discrete – time Signal Processing", 3rd edition, Pearson new international edition, 2014.
3.	Lawrence R Rabiner and Bernard Gold, "Theory and Application of Digital Signal Processing", Pearson India Education Services, 2016.
4.	Emmanuel C. Ifeachor, "Digital Signal Processing- A Practical Approach" 2nd edition, Prentice Hall, 2011.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Analysis of continuous time and discrete time signals.	2 hours
2.	Consider a symmetric square wave with frequency 100 Hz. Plot the 4-term, 10-term and 25-term Fourier series approximations. Compare the FS approximations with the actual square wave. Observe the approximation behavior at the points of discontinuity.	2 hours
3.	Write a program to convolve two discrete time square pulse signals. Observe the effects of repeated convolution with a square pulse.	2 hours
4.	Study the effects of signal length and windowing on the spectrum of a signal computed with FFT.	2 hours
5.	Plot the frequency response and impulse response of an ideal discrete-time low-pass filter.	2 hours
6.	Analyze the effect of the following window functions on the magnitude of the frequency response: Rectangular, Hamming and Blackman.	2 hours
7.	Generate a sinusoidal signal which contains 50Hz, 70Hz, 100Hz and 120Hz frequencies. Analyse the frequency components present in the signal with and without AWGN for a SNR of 0.6. Obtain the plot and comment on the results.	2 hours
8.	Design an IIR filter to filter out noise from the sinusoidal signal for the following specifications. Plot the spectra. Comment and infer your results. Type of filter: Butterworth Pass band frequency: 100 Hz; Stop band frequency: 150 Hz Pass band ripple: 0.1 dB; Stop band ripple: 40 dB	2 hours

9.	Design a FIR filter and estimate the filter coefficients for the following specifications. Plot, comment and infer your results. Type of filter: Band stop Order of the filter: 10 Pass band frequency: 200 Hz ; Stop band frequency: 300 Hz.	2 hours
10.	Design Chebyshev Type 1 and Type 2 high pass and band pass analog filters for the following specifications. Passband ripple =0.04dB ; Stopband attenuation= 30dB Passband frequency = 400Hz ; Stopband frequency = 800Hz Sampling frequency = 2000Hz Plot their magnitude and phase characteristics.	2 hours
11.	Signal processing methods for Music Signals using DSP Processor	2 hours
12.	Signal processing mechanisms for Bio-Signals using DSP processor	2 hours
	Total Laboratory Hours	**30 hours**

Mode of Evaluation: Assignment /FAT			
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40^{th} AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE2005.1	3	2	1	1								1		2	
EEE2005.2	3	3	2	2	2			2	2	1		1	3	2	2
EEE2005.3	3	2	1	1	1			1	1	1		1	2	2	1
EEE2005.4	3	3	2	2	1			1	1	1		1	2	2	1
EEE2005.5	2	1										1			
EEE2005.6	3	3	2	2	3			2	2	2		2	2	3	3
	3	3	2	2	2	-	-	2	2	2	-	2	3	3	2

EEE3001	Control Systems	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**EEE2001, MAT2002/EEE1001**	**Syllabus version**				
		v. 1.0				

Course Objectives:

1. To present a clear exposition of the classical methods of control engineering, physical system modelling, and basic principles of frequency and time domain design techniques.
2. To teach the practical control system design with realistic system specifications.
3. To provide knowledge of state variable models and fundamental notions of state feedback design

Expected Course Outcome:

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

1. Formulate the transfer function model for electrical, mechanical and electromechanical systems
2. Analyze the time response characteristics of given first and second order system for various input signals
3. i) Determine the stability of linear systems using root locus technique ii) Determine the frequency response specifications using bode and polar plot iii)Determine the stability of linear system in the frequency domain
4. Design compensators and controllers for the given specifications using bode plot
5. Analyze the system using state space model
6. Analyze the performance of the designed controller by conducting suitable experiments

Module:1	Systems and their Representations	6 hours

Basic elements in control systems - open loop & closed loop - Transfer functions of mechanical, electrical and analogous systems. Block diagram reduction - signal flow graphs.

Module:2	Time Response Analysis	6 hours

Standard test signals, Time response of first and second order system, Time domain specifications, Steady state error, error constants, generalized error coefficient.

Module:3	Stability Analysis and Root Locus	6 hours

Stability - concept and definition, Characteristic equation – Location of poles – Routh Hurwitz criterion - Root locus techniques: construction, properties and applications.

Module:4	Frequency Response Analysis	6 hours

Bode plot - Polar plot - Correlation between frequency domain and time domain specifications

Module:5	Stability in Frequency Domain	6 hours

Relative stability, Gain margin, Phase margin, stability analysis using frequency response methods, Nyquist stability criterion.

Module:6	Compensator and Controller	7 hours

Realization of basic compensators, cascade compensation in time domain and frequency domain, feedback compensation - Design of lag, lead, lag-lead series compensator (using Bode plot), P, PI and PID controllers in frequency domain.

Module:7	State Space Analysis	6 hours

Concepts of state variable and state model, Solution of state equation, State space to transfer function conversion, Controllability, Observability, Pole placement control

Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Norman S. Nise, "Control System Engineering", John Wiley & Sons, 6th Edition, 2011.
2.	Benjamin C Kuo "Automatic Control System" John Wiley & Sons, 8th Edition, 2007.
Reference Books	
1.	K. Ogata, "Modern Control Engineering", Pearson, 5th Edition, 2010.
2.	R.C. Dorf & R.H. Bishop, "Modern Control Systems", Pearson Education, 11th Edition, 2008.
3.	M. Gopal, "Control Systems-Principles And Design", Tata McGraw Hill –4th Edition, 2012.
4.	Graham C. Goodwin, Stefan F. Graebe, Mario E. Sagado, " Control System Design", Prentice Hall, 2003'
5.	J.Nagrath and M.Gopal," Control System Engineering", New Age International Publishers, 4th Edition, 2006.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)		
1.	Block Diagram Reduction	**2 hours**
2.	Determination of Time Domain Specifications	**2 hours**
3.	Stability analysis of linear systems	**2 hours**
4.	PID Controller Design using Bode Plot	**2 hours**
5.	PID Controller Design using Root Locus	**2 hours**
6.	Compensator Design in Frequency and Time Domains	**2 hours**
7.	Transfer Function to State Space Conversion with Controllability and Observability Tests	**2 hours**
8.	Lag compensator design for linear servo motor for speed control application	**2 hours**
9.	Pole placement controller design for inverted pendulum	**2 hours**
10.	PD controller design for position control of servo plant	**2 hours**
11.	Cascade control design for ball and beam system	**2 hours**
12.	PID controller design for magnetic levitation system	**2 hours**
13.	Transfer function of Separately excited DC generator	**2 hours**
14.	Transfer function of Field Controlled DC Motor	**2 hours**
15.	Study of First and Second order systems	**2 hours**
	Total Laboratory Hours	**30 hours**
Mode of evaluation: CAM/ FAT		

Recommended by Board of Studies	**30/11/2015**		
Approved by Academic Council	**39th AC**	Date	**17/12/2015**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE3001.1	3	2	1	1								1	2	2	
EEE3001.2	3	3	2	2	1							1	2	3	1
EEE3001.3	3	2	1	1	1			2	2	1		1		2	1
EEE3001.4	3	3	2	2	2							1	3	3	2
EEE3001.5	3	3	2	2	2			2	2	1		1	3	3	2
EEE3001.6	3	3	2	2	3			2	2	1		2	3	3	3
	3	3	2	2	2	-	-	2	2	1	-	2	3	3	2

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

EEE3002	**Analog and Digital Circuits**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**2**	**0**	**4**
Pre-requisite	**EEE2002**	**Syllabus version**				
Anti-requisite	NIL	v.2.0				

Course Objectives:

1. To introduce the functional building blocks, characteristics and applications of Analog ICs
2. To understand different methods for design and implementation of Digital circuits
3. To introduce the various applications of digital and analog ICs

Expected Course Outcome:

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

1. Explain the performance characteristics of Op-Amp
2. Design Op-Amp based circuits for various linear and non-linear applications
3. Design 555 timer based multi-vibrators and fixed & variable voltage regulators
4. Realization of Boolean operations using De Morgan's laws, Karnaugh map and Quine-Mccluskey method
5. i)Design of combinational circuit ii) Design of synchronous sequential circuit iii)Design of asynchronous sequential circuit using state diagram and design of analog/digital IC based circuit for industrial control applications"
6. Analyze the performance of linear & non-linear and sequential & combinational circuit using simulation and hardware experimentation

Module:1	**Operational Amplifier**	**6 Hours**

DC Performance - The operational amplifier, Input resistance, Output resistance, Open loop gain, Bias currents, Offset currents, Offset voltage, Common mode rejection ratio. Negative feedback Amplifier, closed loop gain, Differential amplifier.AC Performance - Frequency response, Transient response, Stability, Compensation, Poles and zeros cancelation

Module:2	**Opamp Applications**	**7 Hours**

Linear applications of op-amp – summing, subtracting, averaging amplifier, voltage to current converter, current to voltage converter, differentiator and integrator. Nonlinear applications – comparator, Multivibrators, Schmitt Triggers, Precision Diode, Half wave and full wave rectifiers, Peak detector, Wave form generators and Active Filters.

Module:3	**Timer And Power Supplies**	**5 Hours**

555 Timer and its applications, monostable multivibrator, Astable multivibrator. Linear voltage regulator, 78XX and 79XX family, 723 IC voltage regulator, Switching regulators.

Module:4	**Digital Techniques**	**6 Hours**

Number systems - Binary, octal and hexadecimal numbers. Binary codes, Logic Gates, Boolean algebra - Conversion and operations. De Morgan's laws, Truth tables, Karnaugh's map, Min term, Max term, SOP, POS, Synthesis of Boolean functions, Quine Mccluskey method.		
Module:5	**Combinational Circuit Design**	**6 Hours**
Arithmetic circuits, Parity generator, Seven-segment display, Analysis and Design Procedure - Multiplexer, Decoder, Encoder, Design using programmable logic Devices.		
Module:6	**Synchronous Sequential Circuit Design**	**6 Hours**

Flip Flops - SR, D, T and JK Flip-flops, Master slave Flip Flops, Counters, Registers. Design using State machines-Moore and Mealy machines, Design Examples.		
Module:7	**Asynchronous Sequential Circuit Design**	**6 Hours**
Design Procedure- Asynchronous Sequential Circuits-State Diagram-State assignment-implication table-Design examples. Applications: Temperature Indicator and Controller, Speed control of DC Motor using Analog/Digital ICs		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**
Text Book(s)		
1.	Op-Amps & Linear Integrated Circuits by Ramakant Gayakwad, Prentice Hall of India, New Delhi, 4th edition, 2002.	
2.	Digital Design by M. Morris Mano and Mictael Ciletti, Pearson Education, 5th Edition, 2013.	
Reference Books		
1.	Operation Amplifiers & Linear Integrated Circuits by Robert F. Coughlin and Frederick F. Driscoll, Prentice Hall of India, New Delhi, 6th Edition, 2009.	
2.	Design with Operational Amplifiers & Analog Integrated Circuits by Sergio Franco, Tata McGraw Hill Education, 4rd Edition, 2015.	
3.	Digital Fundamentals by Floyd, Madrid Pearson Education, 11th Edition, 2016.	
4.	Digital System Design using Verilog by Charles Roth, Lizy John and Byeong Kil Lee, Cengage Learning, 1st Edition, 2016.	
5.	Electronic Principles by Albert Malvino, David.J.Bates, Tata Mcgraw Hill Education, 8th Edition, 2016.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		

1.	Design and implementation of inverting and non-inverting amplifier	2 hours
2.	Design and implementation of precision rectifier using op-amp	2 hours
3.	Design and implementation of low pass and high pass filter	2 hours
4.	Design of implementation of integrator and differentiator using op-amp	2 hours
5.	Design and implementation of triangular wave generator using op-amp	2 hours

6.	Design and implementation of summing and difference amplifier	2 hours
7.	Design and implementation of astable multivibrator	2 hours
8.	Design and implementation of half and full adder circuit	2 hours
9.	Design and implementation of multiplexer	2 hours
10.	Design and implementation of magnitude comparator	2 hours
11.	Design and implementation of BCD to 7 segment display	2 hours
12.	Design and implementation of code converters	2 hours
13.	Design and implementation of J,K and D flip flops	2 hours
14.	Design and implementation of shift registers	2 hours
15.	Design and implementation of synchronous decade counter	2 hours
	Total Laboratory Hours	**30 hours**

Mode of Evaluation: Assignment /FAT			
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40^{th} AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE3002.1	2	1													
EEE3002.2	3	3	2	2	2			2	2	1		1	3	3	2
EEE3002.3	3	2	1	1								1	2	2	
EEE3002.4	3	2	1	1	1							1	2	2	1
EEE3002.5	3	3	2	2	2			2	2	1		1	3	3	2
EEE3002.6	3	3	2	2	2			2	2	1		2	3	3	2
	3	3	2	2	2	-	-	2	2	1	-	2	3	3	2

EEE4001	Microprocessor and Microcontroller	L	T	P	J	C
		2	0	2	0	3
Pre-requisite	**EEE3002**	**Syllabus version**				
Anti-requisite	NIL	v. 2.0				

Course Objectives:

1. To emphasis on the hardware functionality of Intel 8051 and ARM
2. To create the essential knowledge on operating modes of I/O ports ,Timers/Counters, control registers and various types of interrupts.
3. To analyse various interfacing techniques.

Expected Course Outcome:

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

1. Interpret the architecture of microprocessor and classify the different modes of ARM
2. Classify the instructions and differentiate the instruction under various categories
3. Solve real time problems using ARM
4. Develop a broad knowledge on the complete architecture of 8051 microcontroller
5. Analyse the instructions and write simple programs using 8051 microcontroller
6. Summarize various interrupts and write programs to handle interrupts
7. Design a microcontroller based embedded systems by interfacing external devices
8. Design and Conduct experiments, as well as analyze and interpret data

Module:1	Introduction to ARM Processor	4 Hours

Introduction to RISC processor – Comparison between CISC and RISC - Overview of ARM architecture – Different modes of ARM processor – Program status register

Module:2	ARM Instruction Set	3 Hours

Data transfer instruction – Arithmetic instruction - Logical Instruction – Multiply instruction – Branch instruction – Load/Store instruction – Swap instruction.

Module:3	Programming using ARM Processor	2 Hours

Solving an simple equation – generation of square wave form – Memory operations

Module:4	8051 Microcontroller Architecture	4 Hours

Architecture of 8051 Micro controller – Program Status Register – Structure of Random Access Memory – Special Function Registers - Pin diagram of 8051 Microcontroller – Ports of 8051 microcontroller.

Module:5	Instruction set of 8051 microcontroller	3 Hours

Data transfer Instructions – Arithmetic and Logical Instructions – Boolean Instructions – Control transfer Instructions – Programming using 8051 microcontroller – Demonstration of HEX file generation and program execution.

Module:6	8051 Microcontroller Programming	5 Hours

Programming I/O ports - Different modes of timer programs – Counters – Transferring data serially – Receive data serially - Interrupts and Interrupt Handling – Interrupt priority

Module:7	Interfacing Techniques	7 Hours

Interfacing of Analog to Digital Converter – Digital to Analog Converter – Sensor Interface – Keypad Interface.Display Interface: 7 segment interface – LCD.Communication Interface: GSM – Xbee – GPS – Bluetooth.			
Module:8	**Contemporary issues:**		**2 Hours**
	Total Lecture hours:		**30 Hours**
Text Book(s)			
1.	Andrew N Sloss , Dominic Symes , Chris Wright, " ARM System Developer's Guide: Designing and Optimizing System Software ", Morgan Kaufmann Publishers, 1st edition, 2009.		
2.	Mohammad Ali Mazidi, Janice Gillispie Mazidi, " The 8051 Microcontroller and Embedded Systems ", Pearson education, 2nd Edition, 2014.		
Reference Books			
1.	Kenneth J.Ayla, “The 8051 Micro controller", Thomson learning, 3rd Edition, 2010.		
2.	D Karuna Sagar, “Microcontroller 8051, Oxford : Alpha Science, 2011.		
3.	P.V Guruprasad, “Arm Architecture System on Chip and More ", Apress, 2013.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			

List of Challenging Experiments (Indicative)		
1.	to perform the arithmetic operations	2 hours
2.	Write a program to solve the given equation. D= (A.B.C2 + A2B + AB2 – A3B2)/ (A+B+C) Assume : A, B & C are 8 bit numbers.	2 hours
3.	Write a program to perform the following data transfer a. RAM to RAM b. ROM to RAM c. EXTERNAL to EXTERNAL d. RAM to EXTERNA	2 hours
4.	to solve the following Boolean expression	2 hours
5.	Write a program to perform the following tasks (see table below)	2 hours
6.	Write a program to generate the following wave forms. a. Generate 2 Hz square wave on P0.0. use Timer 1 in mode 1. Assume XTAL = 16MHz. b. Generate step wave form on P0.	2 hours
7.	Write a program to interface LED’s with 8051 microcontroller also generate any pattern using LED’s.	2 hours
8.	Write a program to generate 50 Hz square wave on P1.1 normally. When INT1 is pressed,generate 100 Hz square wave on P1.1. Use timer 0 in mode 1. Assume XTAL = 11.0592 MHz.	2 hours

Table for experiment 5:

Option	0	1	2	3	9
Task	A + B	~B +1	A*B	AB + ~A~B	~A +1
Option	4	5	6	7	8
Task	A A to P1	55H to P1	A ^ B	~A	~B

9.	Write a program to display the following sequence in 7 segment display. 0 – 2 – 4 – 6 – 8			2 hours
10.	Write ARM processor program to solve the following expression. $Ab^2 + c^2d$ where, a,b,c,d are 16 bit numbers.			2hours
			Total Laboratory Hours	**30 hours**
Mode of Evaluation: Assignment / FAT				
Recommended by Board of Studies	**05/03/2016**			
Approved by Academic Council	**40th AC**	Date	**18/03/2016**	

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4001.1	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
EEE4001.2	2	1	-	-	-	-	-	-	-	-	-	1	2	-	-
EEE4001.3	3	3	2	2	2	-	-	2	2	1	-	1	3	3	2
EEE4001.4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
EEE4001.5	3	3	2	2	2	-	-	2	2	1	-	1	3	3	2
EEE4001.6	3	3	2	2	2	-	-	2	2	1	-	1	3	3	2
EEE4001.7	3	3	2	2	2	-	-	2	2	1	-	1	3	3	2
EEE4001.8	3	3	2	2	3	-	-	2	2	1	-	2	3	3	3
	3	3	2	2	3	-	-	2	2	1	-	2	3	3	3

EEE4021	**Sensors and Signal Conditioning**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**2**	**0**	**4**
Pre-requisite	**PHY 1001, EEE3002**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To give an understanding of the general concepts and terminology of measurement systems and transducer classifications.
2. To introduce the basics of various sensors and transducers and their construction.
3. To describe the principle of operation and function of sensors.
4. To teach the design of signal conditioning circuits.

Expected Course Outcome:

1. Explain the static and dynamic of characteristics of transducers, standards, calibration and error analysis of measurement system
2. Analyze various types of resistive sensors for measurement of various physical parameters
3. Apply reactive variation sensors for measurement of various physical parameters
4. i)Design various signal conditioning circuits for resistive sensors ii)Design various signal conditioning for reactance variation sensors
5. i)Describe the Self-generating sensors and its signal conditioning circuits ii)Explain the performance characteristics of various Electromagnetic ,Optical and Digital Sensors
6. Analyze the performance characteristics of various measurement systems

Module:1 | | **7 Hours**

Introduction: General concepts and terminology of measurement systems, Transducers classification, General input-output configuration, Static and dynamic characteristics of a measurements system, Calibration and standards. Errors and statistical analysis in measurement systems, least square fit of experimental data in measurement systems.

Module:2 | **Resistive Sensors** | **5 Hours**

Strain gages: Introduction - Beam, column and Ring type force, torque measurement, Piezo resistive effect, RTDs, Thermistor- models-types and applications-linearization, Magneto resistors, Light dependent resistors.

Module:3 | **Reactance Variation Sensors** | **4 Hours**

Capacitive sensors-variable-differential, Inductive sensors- variable reluctance-eddy current-LVDT-Synchros-resolvers- inductosyn- magnetoelastic- magnetostrictive

Module:4 | **Signal conditioning for resistive sensors** | **5 Hours**

Voltage dividers - amplifiers for voltage dividers, Wheatstone bridge- balance measurements-deflection measurements- sensitivity, linearity, and analog linearization of resistive sensor bridges, Differential and Instrumentation amplifiers. Grounding and Isolation

Module:5 | **Signal conditioning for reactance variation sensors** | **5 Hours**

AC bridges, Operation Amplifier based inductance and capacitance measuring circuits, carrier amplifiers and coherent detection, signal conditioners for capacitive sensors.

Module:6 | **Self-generating Sensors and its signal conditioning** | **8 Hours**

Thermocouple, piezoelectric sensors-effect-materials-applications, pyroelectric sensors- effect-materials-applications, and electrochemical sensors. Signal conditioning circuits: Chopper and low drift amplifiers, electrometer and trans impedance amplifiers, charge amplifiers, noise in amplifiers

Module:7 | **Electromagnetic ,Optical and Digital Sensors** | **9 Hours**

Electromagnetic sensors- sensors based on Faraday's law-Hall effect sensor, Ultrasonic based sensors,

Optical transducer, Photo emissive cells, Photoconductive cells, Photo diodes, Photo transistors, Photovoltaic cells – Measurement of physical quantities. Position encoders-absolute position encoder-incremental position encoder, Resonant sensors- sensors based on quartz resonators- digital quartz thermometer- quartz micro balance-quartz resonators for force and pressure sensing- quartz angular rate sensor, SAW sensors.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)

1.	Ramon Pallas-Areny,John G.Webster, "Sensors and Signal Conditioning", Wiley India Pvt.Ltd.,NewDelhi, 2nd Edition 2013.
2.	D.V.S.Murthy, "Transducers and Instrumentation", Prentice Hall of India Learning Pvt. Ltd. 2nd edition 2012.

Reference Books

1.	Doebelin E.O., "Measurement System Application and Design", McGraw Hill, 5th Edition 2004.
2.	Patranabis, "Sensors and Transducers", Prentice Hall of India, New Delhi, 2003.
3.	A.K.Shawney, "A course in Electrical and Electronic measurement and Instrumentation", Dhanpat Rai &Company, 18th Edition, 2010.
4.	John P. Bentley, "Principles of Measurement Systems", 3rd edition Addison Wesley Longman Ltd, UK 2000
5.	Jacob Fraden, "Handbook of Modern Sensors: Physics, Designs, and Application"', Springer Science + Business Media, Inc, 3rd Edition, 2004.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)		**Hours**
1.	Strain gauge based torque measurement	2 Hours
2.	Temperature Measurement using RTD	2 Hours
3.	Temperature Measurement using Thermistor	2 Hours
4.	Temperature Measurement using J and K type Thermocouples	2 Hours
5.	Displacement Measurement using LVDT	2 Hours
6.	Speed measurement using magnetic sensor	2 Hours
7.	Displacement Measurement using Inductive Pickup	2 Hours
8.	Pressure Measurement using Diaphragm pressure gauge	2 Hours
9.	Velocity measurement using Piezo-electric Transducer	2 Hours
10.	Acceleration measurement using Piezo-electric Transducer	2 Hours
11.	Design a signal conditioning circuit for thermocouple cold junction compensation using K-type thermocouple and analyse its output.	2 Hours
12.	Design the linearization circuit for the 5KΩ thermistor	2 Hours
13.	Design the signal conditioning circuit using RTD PT100with a input range of 30 °C to 100 °C to get an output voltage of 0 to 4 V with α = 0.004 and	2 Hours

	Power dissipation = 30 mW and test its performance.	2 Hours
14.	Design signal conditioning circuit for strain gauge sensor to compensate temperature effects.	2 Hours
15.	Design the signal conditioning circuit for the pressure cell using Piezo electric sensor having the sensitivity of 10mV/g.	2 Hours
	Total Laboratory Hour	30 Hours
Mode of Evaluation: Assignment /FAT		

Recommended by Board of Studies	**25/10/2017**		
Approved by Academic Council	**37th AC**	Date	**05/10/2017**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4021.1	2	1								1		1	1	2	1
EEE4021.2	3	3	2	1						1			1	2	1
EEE4021.3	3	3	2	1						1		1	1	2	1
EEE4021.4	3	2	2					2	2	1			1	2	1
EEE4021.5	2	1						2	2	1		1	1	2	1
EEE4021.6	3	3	2	2	2			2	2	2		2	1	3	2
	3	2	2	2	2	-	-	2	2	2	-	2	1	3	2

EEE4031	Electrical and Electronic Instrumentation	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**EEE2002, EEE4021**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To provide basic understanding of electrical and electronic measurement systems.
2. To give a thorough knowledge of varieties of measuring instruments, its operating principles, and limitations.
3. To provide basic understanding of data acquisition systems and virtual instrumentation

Expected Course Outcome:

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

1. Explain the construction of various types of voltmeters, ammeters and watt-meters ii) Explain the construction and working principle of energy, magnetic power factor and high voltage measuring instruments
2. Design an AC and DC bridges to measure the unknown resistance, capacitance and inductance ii) Design a DC-AC potentiometer to measure the unknown voltage and resistance
3. Explain the construction and working principle of voltmeter, signal generator, multimeter, DSO and function generator
4. Illustrate the working principle of various signal analysers
5. Design A/D and D/A converters for the given specifications
6. Conduct the hardware experiments to measure various electrical parameters and data acquisition using LabVIEW

Module:1	**Electrical Measurements - I**	**8 Hours**

PMMC, Moving coils, moving iron, dynamometer type, rectifier type, and thermal instruments - Power Measurement: Hall effect Wattmeter, Thermal type wattmeter, Compensated wattmeter, Single and three-phase power measurement.

Module:2	**Electrical Measurements - II**	**6 Hours**

Energy measurement: energy meter - Magnetic measurements: Ballistic tests - Maximum demand meter - P.F. meter - High voltage measurements.

Module:3	**DC & AC Bridges**	**6 Hours**

Series and Shunt type ohmmeter – Megger - DC Bridges: Wheatstone Bridge, Kelvin Bridge - AC Bridges: Maxwell Bridge, Wien Bridge, Anderson, Hay, Desauty, and Schering Bridges – Q meter.

Module:4	**Potentiometers**	**5 Hours**

Transformer ratio Bridges - Detectors in Bridge measurements - Wagner Ground connections - DC and AC Potentiometers: Various types, Working Principle and applications.

Module:5	**Electronic Measurements**	**6 Hours**

Solid State measurement Design and Instruments: BJT, FET and MOSFET Voltmeter circuits, Solid State Multi-meter, Digital Multi-meter – DSO - Signal Generation: Audio and Radio frequency signal generators, Function generator.

Module:6	**Signal Analyzers**	**5 Hours**

Wave analyzer - Spectrum analyzer - Frequency Measurement - Measurement of period and time - Phase angle measurement.

Module:7	Data Acquisition & LABVIEW	7 Hours
A/D converters: Types, resolution, dynamic range, accuracy, sampling concepts and techniques, A/D boards - D/A converters: Types, D/A boards - Digital I/O boards - Counter/Timer I/O boards. Virtual Instrumentation: Components of LabView - Front panel - LOOP Behaviour and inter loop communication - Block diagram - SubVI- DAQ cards and accessories-Data Acquisition with LabVIEW.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**
Text Book(s)		
1.	David A. Bell, “Electronic Instrumentation and Measurements”, 3rd Edition, Oxford university press, New Delhi, 2013.	
2.	Cooper W.D and Helfrick A.D, “Modern Electronic Instrumentation and Measurement Techniques”, 4th Edition, Pearson India Education, 2015.	
Reference Books		
1.	H.S. Kalsi, “Electronic Instrumentation”, 3rd Edition, Mc-Graw Hill education, 2015.	
2.	A.K. Sawhney, “A Course In Electrical And Electronic Measurements And Instrumentation”, Dhanpat Rai Publications, 2012.	
3.	Jovitha Jerome, “Virtual Instrumentation using LABVIEW”, Prentice Hall India, 2013.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		

List of Experiments (Indicative)		
1.	Design a bridge circuit to measure a resistance in low and medium range.	2 hours
2.	Design a circuit to measure high values of current and voltage using low range meters.	2 hours
3.	Design of inductance measurement bridge circuit.	2 hours
4.	Design of capacitance measurement bridge circuit	2 hours
5.	Design a circuit for calibrating the given single phase energy meter at unity power factor.	2 hours
6.	Design a circuit for Calibrating the single phase electro dynamometer type wattmeter with direct loading.	2 hours
7.	Design a circuit for Calibrating the given voltmeter and ammeter.	2 hours
8.	Measurement of insulation resistance using Megger.	2 hours
9.	Build a VI to acquire and process a real time signals using NI DAQ cards.	2 hours
10.	Develop a VI to check the amplitude of sinusoidal signal for a pre-set value and activate the alarm if it exceeds the limit.	2 hours
11.	Develop a VI to read the LVDT output voltage using USB 6221and plot the response.	2 hours
12.	Develop a VI diagram to calculate the monthly EMI for a loan received.	2 hours
13.	Build a VI that reverses the order of an array that contains 100 random numbers.	2 hours
14.	Build a VI diagram using formula node in case structure palette.	2 hours

15.	Develop a VI to check the amplitude of sinusoidal signal for a pre-set value and activate the alarm if it exceeds the limit.	2 hours
	Total Laboratory Hours	**30 hours**

Mode of Evaluation: Assignment / FAT

Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40^{th} AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4031.1	2	1						1	2	1		1	2	2	1
EEE4031.2	3	2	1	1				1	2	1		1	3	2	1
EEE4031.3	2	1						1				1	2	1	1
EEE4031.4	2	1										1	2	1	1
EEE4031.5	3	3	2	2	2				1	1		1	3	3	2
EEE4031.6	3	3	2	2	2			1	3	2		2	3	3	2
	3	2	2	2	2	-	-	1	2	2	-	2	3	2	2

EEE4032	Process Automation and Control	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**EEE3001, EEE4021**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

2. Prepare the learner to have successful career in process industries and motivate for higher studies.
3. Provide strong foundation to solve control and instrumentation problems in continuous or batch problems.
4. Impart knowledge on advanced control strategies and industrial network protocols.

Expected Course Outcome:

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

1. i)Develop the mathematical model for interacting, non-interacting, continuous and batch processes ii)Design ON -OFF, analog and digital PID controller using different tuning methods for various processes
2. i)Identify an appropriate final control element for a given application ii) Select an advanced control strategy for a given industrial process
3. Design various subsystems, HMI and SCADA for process automation
4. Develop PLC program and configure DCS to handle local and distributed automation tasks
5. Design industrial network protocols for the given automation task
6. Design and conduct experiments to control level, pressure, temperature process and automate 3-axis positioner, pick and place robotic arm and conveyor control

Module:1 | Process Dynamics: | 8 Hours

Need for process control – Mathematical model of Processes – Interacting and non-interacting systems – Degrees of freedom – Continuous and batch processes – Self regulation – Servo and regulatory operations – Lumped and Distributed parameter models.

Module:2 | Control Actions & Tuning: | 8 Hours

Characteristic of on-off, proportional, integral and derivative controllers – P+I, P+D and P+I+D control modes – Electronic PID controller – Selection of control modes for different process. Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio - Tuning:- Process reaction curve method, Continuous cycling method and Damped oscillation Method. Direct Digital Control - Digital forms of PID Controller.

Module:3 | Final Control Elements: | 5 Hours

I/P converter – Pneumatic and electric actuators – Valve Positioner – Control Valves – Characteristic of Control Valves:- Inherent and Installed characteristics – Classification of control valves – globe, butterfly, diaphragm, ball valves – Valve body – Commercial valve bodies – Control valve sizing – Cavitation and flashing – Selection criteria.

Module:4 | Process Control Strategies: | 6 Hours

Feed-forward control – Ratio control – Cascade control – Inferential control – Split-range and introduction to multivariable control – Case studies from distillation column and boiler systems – IMC– Model Predictive Control – Adaptive control – Dead – time Compensation – Smith Predictor Algorithm.

Module:5 | Automation Structure: | 4 Hours

Automation Pyramid - Subsystems: Instrumentation- Measurement and data acquisition, Control, Human Machine Interface: Definition, need, Hardware based, Software based: Operator stations.- Data acquisition and control unit (DACU) - Network Control Systems (NCS) - Supervisory Control and Data Acquisition (SCADA) systems.

Module:6	Logical Control Units:	5 Hours
Programmable Logic Controller (PLC): Ladder Logic Programming, Remote Terminal Unit (RTU). Distributed Control System (DCS): detail engineering, specifications, configuration and programming - Performance Criteria for DCS and other automation tools.		

Module:7	Instrumentation Standard Protocols:	7 Hours
HART Protocol introduction, frame structure, programming, implementation examples, Benefits, Advantages and Limitations. Foundation Fieldbus H1, introduction, structure, programming, FDS configuration, implementation examples, Benefits, Advantages and Limitations. Other Industrial networking protocols MODBUS - Device net – Profibus (Process Field Bus) – Controlnet – CAN - Industrial Ethernet.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)	
1.	Stephanopoulos, G., 'Chemical Process Control - An Introduction to Theory and Practice', Pearson India Education Services, 2015.
2.	Terry L. M. Bartelt , 'Industrial Automated Systems: Instrumentation and Motion Control', Cengage Learning, 2011.
3.	Frank D. Petruzella, 'Programmable logic controllers', McGraw Hill Education, 3rd Edition, 2010.
Reference Books	
1.	Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., 'Process Dynamics and Control', Wiley John and Sons, 3rd Edition, 2010.
2.	Coughanowr, D.R., 'Process Systems Analysis and Control", McGraw –Hill International Edition, 2009.
3.	Bequette, B.W., 'Process Control Modeling, Design and Simulation', Prentice Hall, 2010.
4.	Curtis D. Johnson, 'Process Control Instrumentation Technology', 8th Edition, 2006. London: Pearson, 2014.
5.	Stuart A. Boyer, SCADA: 'Supervisory control and Data Acquisition', ISA Publication, 4th Edition, 2010.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)		
1.	Implementation of Level control process using SCADA	2 hours
2.	Implementation of Temperature process using SCADA	2 hours
3.	Implementation of Pressure control process using SCADA	2 hours
4.	Analysis of interacting and non-interacting systems	2 hours
5.	Conical tank control using LabVIEW	2 hours
6.	Tuning of controllers for single loop and multi loop setup	2 hours
7.	Analyzing inherent and installed characteristics of control valves	2 hours
8.	IMC and Smith predictive control strategies using MATLAB	2 hours
9.	Analysis of timer and counter functions using PLC	2 hours
10.	Batch process control and Sequential control using PLC	2 hours
11.	Controlling a pick and place robotic arm using PLC	2 hours

12.	Controlling a gantry crane using PLC	2 hours
13.	Controlling a 3 axis positioner using PLC	2 hours
14.	Multi-level conveyor control using PLC	2 hours
15.	HMI module interface and coding with PLC	2 hours
	Total Laboratory Hours	**30 hours**
Mode of evaluation: CAM / FAT		

Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**47th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4032.1	3	2	1	1	1			1	1	1		1	1	2	2
EEE4032.2	2	1						1	1	1			2	1	1
EEE4032.3	3	2	1	1	2			1					1	2	2
EEE4032.4	3	2	1	1	2			1	2	2		1	2	2	2
EEE4032.5	3	2	1		2			1					2	2	2
EEE4032.6	3	2	1	1	3			2	3	2		2	1	2	3
	3	2	1	1	3	-	-	2	3	2	-	2	2	2	2

EEE4033	Industrial Instrumentation		L	T	P	J	C
			3	0	0	4	4
Pre-requisite	EEE4021	**Syllabus version**					
Anti-requisite	NIL	v. 1.0					

Course Objectives:

1. To develop a better understanding of various sensors & instrumentation system applications in industrial monitoring and control.
2. To provide a good design level understanding of industrial measurement systems.
3. To understand the instrumentation methods available to monitor and control process variables like temperature, pressure flow & level.

Expected Course Outcome:

On successful completion of this programme the graduate will

1. i)Demonstrate the working principles of various pressure measurement techniques ii)Illustrate the various methodologies for wide range of flow measurement
2. i)Illustrate the principles of various temperature sensor based measurement system ii)Design various level measurement systems for the given specifications
3. Determine the response of force and torque sensor based measurement system
4. Illustrate the concepts and methods pertaining to speed measurement
5. Design various types of accelerometer for measuring the vibration
6. Develop a model/prototype for measurement system by applying the relevant standards with realistic constraints

Module:1	Pressure Measurement	8 Hours

Elastic type pressure gauges – Bourdon tubes, bellows, diaphragms; Electrical methods – elastic elements with LVDT and strain gauges – capacitive type pressure gauge – piezo resistive pressure sensor – resonator pressure sensor ; measurement of vacuum – McLeod gauge – pirani gauge - thermal conductivity gauges – Ionization gauge cold cathode and hot cathode types.

Module:2	Flow Measurements:	7 Hours

Pressure gradient techniques, Positive displacement flow meters, turbine flow meter; Rotameter: Design– Coriolis mass flow meters – thermal mass flow meter – volume flow meter; Electrical type flow meter: Electromagnetic flow meter, different types of ultrasonic flow meters – laser doppler anemometer systems; vortex shedding flow meter – target flow meter – solid flow rate measurement.

Module:3	Temperature, Measurements:	6 Hours

RTDs and Thermistor characteristics; Thermocouples-Laws, Principals, cold junction compensation; Radiation methods of temperature measurement total and selective radiation pyrometers – optical pyrometer; Thermal conductivity measurements-liquids and gases.

Module:4	Level Measurements:	6 Hours

Gauge glass technique coupled with photo electric readout system; float type level indication – different schemes – level switches level measurement using displacer and torque tube – bubbler system; differential pressure method; electrical types of level gauges using resistance, capacitance, nuclear radiation and ultrasonic sensors.

Module:5	Force and Torque Measurements:	6 Hours

Hydraulic – Pneumatic – Resistive (Strain gauge) Force measurement: Different methods of torque measurement – Strain gauge, relative regular twist.		
Module:6	**Speed measurement:**	**6 Hours**
Revolution counter – Capacitive tacho-drag cup type tacho – D.C and A.C tacho generators – Stroboscope.		
Module:7	**Vibration Measurement:**	**6 Hours**
Nature of vibrations – Seismic transducer – Types of accelerometers – Potentiometric type – LVDT Accelerometer – Piezo electric type.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 Hours**
Text Book(s)		
1.	D. Patranabis, 'Principles of Industrial Instrumentation', Tata McGraw Hill, 2010.	
2.	R.K.Jain, 'Mechanical and Industrial Measurements', Khanna Publishers, 6th edition New Delhi 2010.	
Reference Books		
1.	J.P Holman, 'Experimental Methods for Engineers' Tata McGraw Hill International, 2010.	
2.	Donald. P Eckman, 'Industrial Instrumentation', CBS publishers, 2012.	
3.	Doeblein E.O, 'Measurement Systems, Applications and Design', McGraw Hill International, 2013.	
4.	Alan S. Morris, 'Principles of Measurement and Instrumentation', PHI, 2009.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		

Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**47th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4033.1	3	2	1	1				1		1		1	2	2	
EEE4033.2	3	2	1	1				2	1	1		1	1	2	1
EEE4033.3	3	2	1	1				1		1		1	2	2	
EEE4033.4	3	2	1	1				1	1	1		1	3	2	
EEE4033.5	3	2	1	1				1		1		1	2	2	2
EEE4033.6	3	3	2	2	3	2	1	2	2	3	2	2	2	1	3
	3	3	2	2	3	2	1	2	2	2	-	2	3	2	2

		L	T	P	J	C
MAT2002	**Applications of Differential and Difference Equations**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**2**	**0**	**4**
Pre-requisite	**MAT1011**	**Syllabus Version**				
		v.1.0				

Course Objectives
The course is aimed at 1. Presenting the elementary notions of Fourier series, which is vital in practical harmonic analysis 2. Imparting the knowledge of eigenvalues and eigen vectors of matrices and the transform techniques to solve linear systems, that arise in sciences and engineering 3. Enriching the skills in solving initial and boundary value problems 4. Impart the knowledge and application of difference equations and the Z-transform in discrete systems, that are inherent in natural and physical processes
Expected Course Outcome
At the end of the course the student should be able to 1. Employ the tools of Fourier series to find harmonics of periodic functions from the tabulated values 2. Apply the concepts of eigenvalues, eigen vectors and diagonalisation in linear systems 3. Know the techniques of solving differential equations 4. understand the series solution of differential equations and finding eigen values, eigen functions of Strum-Liouville's problem 5. Know the Z-transform and its application in population dynamics and digital signal processing 6. demonstrate MATLAB programming for engineering problems

Module:1	**Fourier series:**	**6 hours**
Fourier series - Euler's formulae - Dirichlet's conditions - Change of interval - Half range series – RMS value – Parseval's identity – Computation of harmonics		
Module:2	**Matrices:**	**6 hours**
Eigenvalues and Eigen vectors - Properties of eigenvalues and eigen vectors – Cayley-Hamilton theorem - Similarity of transformation - Orthogonal transformation and nature of quadratic form		
Module:3	**Solution of ordinary differential equations**:	**6 hours**
Linear second order ordinary differential equation with constant coefficients – Solutions of homogenous and non-homogenous equations - Method of undetermined coefficients – method of variation of parameters – Solutions of Cauchy-Euler and Cauchy-Legendre differential equations		
Module:4	**Solution of differential equations through Laplace transform and matrix method**	**8 hours**

Solution of ODE's - Nonhomogeneous terms involving Heaviside function, Impulse function - Solving nonhomogeneous system using Laplace transform – Reduction of *n*th order differential equation to first order system - Solving nonhomogeneous system of first order differential equations $(X' = AX + G)$ and $X'' = AX$		
Module:5	**Strum Liouville's problems and power series Solutions:**	**6 hours**
The Strum-Liouville's Problem - Orthogonality of Eigen functions - Series solutions of differential equations about ordinary and regular singular points - Legendre differential equation - Bessel's differential equation		
Module:6	**Z-Transform:**	**6 hours**
Z-transform -transforms of standard functions - Inverse Z-transform: by partial fractions and convolution method		
Module:7	**Difference equations:**	**5 hours**
Difference equation - First and second order difference equations with constant coefficients - Fibonacci sequence - Solution of difference equations - Complementary function - Particular integral by the method of undetermined coefficients - Solution of simple difference equations using Z-transform		
Module:8	**Contemporary Issues**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, John Wiley India, 2015

Reference Books

1.	Higher Engineering Mathematics, B. S. Grewal, 43rd Edition, Khanna Publishers, India, 2015
2.	Advanced Engineering Mathematics by Michael D. Greenberg, 2nd Edition, Pearson Education, Indian edition, 2006

Mode of Evaluation

Digital Assignments (Solutions by using soft skills), Continuous Assessment Tests, Quiz, Final Assessment Test		
1.	Solving Homogeneous differential equations arising in engineering problems	2 hours
2.	Solving non-homogeneous differential equations and Cauchy, Legendre equations	2 hours
3.	Applying the technique of Laplace transform to solve differential equations	2 hours
4.	Applications of Second order differential equations to Mass spring system (damped, undamped, Forced oscillations), LCR circuits etc.	2 hours
5.	Visualizing Eigen value and Eigen vectors	2 hours
6.	Solving system of differential equations arising in engineering applications	2 hours
7.	Applying the Power series method to solve differential equations arising in engineering applications	2 hours

8.	Applying the Frobenius method to solve differential equations arising in engineering applications	2 hours
9.	Visualising Bessel and Legendre polynomials	2 hours
10.	Evaluating Fourier series-Harmonic series	2 hours
11.	Applying Z-Transforms to functions encountered in engineering	2 hours
12.	Solving Difference equations arising in engineering applications	2 hours
	Total Laboratory Hours	**24 hours**

Mode of Evaluation**:** Weekly Assessment, Final Assessment Test			
Recommended by Board of Studies	**25-02-2017**		
Approved by Academic Council	**37th AC**	Date	**05-10-2017**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MAT2002.1	3	1	-	-	-	-	-	-	-	1	-	1	-	-	-
MAT2002.2	3	2	-	-	-	-	-	-	-	1	-	1	-	-	-
MAT2002.3	3	1	-	-	-	-	-	-	1	1	-	-	-	-	-
MAT2002.4	3	2	-	-	-	-	-	-	1	1	-	1	-	-	-
MAT2002.5	3	2	-	-	-	-	-	-	1	1	-	-	-	-	-
MAT2002.6	3	2	-	-	2	-	-	-	1	2	-	2	-	-	-
	3	2	-	-	2	-	-	-	1	2	-	2	-	-	-

MAT3003	Complex Variables and Partial Differential Equation	L	T	P	J	C
		3	2	0	0	4
Pre-requisite	MAT2002	Syllabus version				
		v.1.1				

Course Objectives :

The aim of this course is to present a comprehensive, compact and integrated treatment of two most important branches of applied mathematics for engineers and scientists namely the functions of complex variable and Partial differential equations in finite and infinite domains

Expected Course Outcome:

At the end of the course the student should be able to

1. construct analytic functions and find complex potential of fluid flow and electric fields
2. find the image of straight lines by elementary transformations and
3. express analytic functions in power series
4. evaluate real integrals using techniques of contour integration
5. analyze partial differential equations, and its applications, design the boundary value problems (one dimensional heat and wave equations) and find Fourier series, Fourier transform techniques in their respective engineering problems.

Module:1	Analytic Functions	6 hours

Complex variable-Analytic functions and Cauchy – Riemann equations - Laplace equation and Harmonic functions - Construction of Harmonic conjugate and analytic functions - Applications of analytic functions to fluid-flow and Field problems.

Module:2	Conformal and Bilinear transformations	5 hours

Conformal mapping - Elementary transformations-translation, magnification, rotation, inversion. Exponential and Square transformations ($w = e^z$, z^2) - Bilinear transformation - Cross-ratio-Images of the regions bounded by straight lines under the above transformations.

Module:3	Power series	4 hours

Functions given by Power Series - Taylor and Laurent series -singularities - poles – Residues.

Module:4	Complex Integration	5 hours

Integration of a complex function along a contour - Cauchy-Goursat theorem- Cauchy's integral formula -Cauchy's residue theorem - Evaluation of real integrals - Indented contour integral.

Module:5	Partial Differential equations of first order	6 hours

Formation and solution of partial differential equation - General, Particular, Complete and Singular integrals - Partial Differential equations of first order of the forms: F(p,q)=0, F(z,p,q)=0, F(x,p)=G(y,q) and Clairaut's form - Lagrange's equation: Pp+Qq = R.		
Module:6	**Applications of Partial Differential Equations**	**10 hours**

Linear partial differential equations of higher order with constant coefficients. Solution of a partial differential equation by separation of variables - Boundary Value Problems-one dimensional wave and heat equations- Fourier series solution.		
Module:7	**Fourier transforms**	**7 hours**
Complex Fourier transform and properties - Relation between Fourier and Laplace transforms - Fourier sine and cosine transforms – Convolution Theorem and Parseval's identity.		
Module:8	**Contemporary issues:**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours:	**45 hours**
Tutorial	1. A minimum of 10 problems to be worked out by students inventory Tutorial Class 2. Another 5 problems per Tutorial Class to be given as home work	**30 hours**
Text Book(s)		
1.	Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, John Wiley & Sons (Wiley student Edison) (2015)	
Reference Books		
1	Higher Engineering Mathematics, B. S. Grewal, 43rd Edition (2019), Khanna Publishers, New Delhi	
2	A first course in complex analysis with applications, G.Dennis Zill, Patrick D. Shanahan, 3rd Edition, 2013, Jones and Bartlett Publishers Series in Mathematics:	
3	Advanced Engineering Mathematics, Michael, D. Greenberg, 2nd Edition, Pearson Education (2006)	
4	Advanced Engineering Mathematics, Peter V. O' Neil, 7th Edition, Cengage Learning (2012)	
5	Complex Analysis for Mathematics and Engineers, JH Mathews, R. W. Howell, 5th Edition, Narosa Publishers (2013)	
Mode of Evaluation**:** Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test		

Recommended by Board of Studies	**25-02-2017**		
Approved by Academic Council	**47th AC**	Date	**05-10-2017**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MAT3003.1	3	-	-	-	-	-	-	-	-	-	-	-	1	-	1
MAT3003.2	2	-	-	-	-	2	-	-	-	-	-	-	2	-	1
MAT3003.3	-	3	-	-	-	2	-	-	-	-	-	-	1	-	1
MAT3003.4	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1
MAT3003.5	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
	3	3	-	-	-	2	-	-	-	-	-	-	2	-	1

MAT3005	**Applied Numerical Methods**	**L**	**T**	**P**	**J**	**C**
		3	**2**	**0**	**0**	**4**
Pre-requisite	**MAT2002**	**Syllabus Version**				
		v.1.1				

Course Objectives

The aim of this course is to
1. cover certain basic, important computer oriented numerical methods for analyzing problems that arise in engineering and physical sciences.
2. use MATLAB as the primary computer language to obtain solutions to a few problems that arise in their respective engineering courses.
3. impart skills to analyse problems connected with data analysis,
4. solve ordinary and partial differential equations numerically

Expected Course Outcome

At the end of the course the student should be able to
1. Observe the difference between exact solution and approximate solution.
2. Use the numerical techniques to find the solution of algebraic equations and system of equations.
3. Fit the data using interpolation technique and spline methods.
4. Find the solution of ordinary differential equations, Heat and Wave equation numerically.
5. Apply calculus of variation techniques to extremize the functional and also find approximate series solution to ordinary differential equations

Module:1	**Algebraic and Transcendental Equations**	**5 hours**
General iterative method- rates of convergence- Secant method - Newton – Raphson method- System of non-linear equations by Newton's method.		
Module:2	**System of Linear Equations and Eigen Value Problems**	**6 hours**
Gauss –Seidel iteration method. Convergence analysis of iterative methods-LU Decomposition -Tri diagonal system of equations-Thomas algorithm- Eigen values of a matrix by Power and Jacobi methods.		
Module:3	**Interpolation**	**6 hours**
Finite difference operators- Newton's forward-Newton's Backward- Central differences-Stirling's interpolation - Lagrange's interpolation - Inverse Interpolation-Newton's divided difference-Interpolation with cubic splines.		
Module:4	**Numerical Differentiation and Integration**	**6 hours**
Numerical differentiation with interpolation polynomials-maxima and minima for tabulated values-Trapezoidal rule, Simpsons $1/3^{rd}$ and $3/8^{th}$ rules. –Romberg's method. Two and Three point Gaussian quadrature formula.		
Module:5	**Numerical Solution of Ordinary Differential Equations**	**8 hours**
First and second order differential equations - Fourth order Runge – Kutta method. Adams-Bashforth-Moulton predictor-corrector methods. Finite difference solution for the second order ordinary differential equations.		
Module:6	**Numerical Solution of Partial Differential**	**6 hours**

	Equations		
Classification of second order linear partial differential equations-Laplace equation –Gauss-Seidal method-One dimensional heat equation- Schmidt explicit method-Crank-Nicolson implicit method.-One dimensional wave equation–Explicit method.			
Module:7	**Variational Methods**	**6 hours**	
Introduction - functional –variational problems- extremals of functional of a single dependent variable and its first derivative- functional involving higher order derivatives- Isoperimetric problems- Galerkins- Rayleigh Ritz methods.			
Module:8	**Contemporary Issues**	**2 hours**	
Industry Expert Lecture			
	Total Lecture hours:	**45 hours**	
Tutorial	1. A minimum of 10 problems to be worked out by students in every Tutorial Class. 2. Another 5 problems per Tutorial Class to be given for practise.	**30 hours**	
Text Book(s)			
1.	Numerical Methods for Scientific and Engineering, M. K. Jain, S. R. K. Iyengar and R. K. Jain, New Age International Ltd., 6^{th} Edition, 2012.		
2.	Applied Numerical Analysis, C. F. Gerald and P.V. Wheatley, Addition-Wesley, 7^{th} Edition, 2004.		
Reference Books			
1.	Introductory Methods of Numerical Analysis, S.S. Sastry, PHI Pvt. Ltd., 5th Edition, New Delhi, 2009.		
2.	Applied Numerical Methods Using MATLAB, W.Y. Yang, W. Cao, T.S. Chung and		
3.	J. Morris, Wiley India Edn., 2007.		
4.	Numerical Methods for Engineers with Programming and Software Applications, Steven C. Chapra and Ra P. Canale, 7^{th} Edition, Tata McGraw Hill, 2014.		
5.	Numerical Analysis, R.L. Burden and J. D. Faires, 4^{th} Edition, Brooks Cole, 2012.		
6.	Numerical Methods: Principles, Analysis and Algorithms, Srimanta Pal, Oxford University Press India, 2009.		
Mode of Evaluation**:** Digital Assignments, Continuous Assessment Tests, Final Assessment Test			
Recommended by Board of Studies	**25-02-2017**		
Approved by Academic Council	**47^{th} AC**	Date	**05-10-2017**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
MAT3005.1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MAT3005.2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
MAT3005.3	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-
MAT3005.4	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-
MAT3005.5	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
	3	3	3	-	-	3	-	-	-	-	-	-	-	-	-

EEE1007	Neural Networks and Fuzzy Control	L	T	P	J	C
		2	0	0	4	3
Pre-requisite	**MAT1011**	**Syllabus version**				
Anti-requisite	NIL	v. 1.1				

Course Objectives:

1. Apply the design concepts of feed forward and feedback neural networks for solving Engineering problems
2. Select appropriate weight and learning constant values for every learning
3. Formulate and analyze the real time system with the knowledge of fuzzy logic control

Expected Course Outcome:

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

1. Design the mathematical model for single and multi-layer Perceptron for real time systems
2. Demonstrate the concepts of feed forward and re-current neural networks to find the optimal solution.
3. Explore the concepts of Recurrent and feedback networks in multilayer neurons.
4. Design the competitive learning neural networks for solving the engineering problems.
5. Estimate the performance of Self organizing networks
6. Design of fuzzy systems for non-linear simulation with extension principle
7. Apply membership functions with suitable Defuzzification method and apply neuro-fuzzy inference system concepts to modern controllers.

Module:1	**Introduction to Artificial Neural Networks and Learning Laws**	**7 Hours**

Artificial neural networks and their biological motivation – Terminology – Models of neuron – Topology – Characteristics of artificial neural networks – Types of activation functions.
Learning Laws: Learning methods – Error correction learning – Hebbian learning – Perceptron – XOR problem – Perceptron learning rule convergence theorem – Adaline – Madaline.

Module:2	**Feed Forward Networks**	**4 Hours**

Multilayer Perceptron – Delta Learning – Back Propagation learning algorithm – Universal function approximation – Associative memory: auto association and hetero association.

Module:3	**Recurrent Neural Networks**	**2 Hours**

Bi-directional associative memory – Hopfield neural network – Travelling Salesman Problem.

Module:4	**Unsupervised Learning**	**3 Hours**

Competitive learning neural networks – Max net – Maxican Hat – Hamming net.

Module:5	**Self Organizing Networks**	**5 Hours**

Kohonen Self organizing Feature Map – Counter propagation – Learning Vector Quantization – Adaptive Resonance Theory – Concept of support vector machines – Applications of neural networks in image processing, signal processing, modeling and control.

Module:6	**Fuzzy Sets and Fuzzy Relations**	**5 Hours**

Introduction – Classical sets and fuzzy sets – Classical relations and fuzzy relations – Membership

functions – Fuzzy to Crisp conversion, Fuzzy Arithmetic, numbers, vectors and extension principle.		
Module:7	**Fuzzy Decision Making**	**2 Hours**
Fuzzy rule based systems – Fuzzy nonlinear simulation – Fuzzy control systems and Defuzzification methods. **Neuro Fuzzy:** Mathematical formulation of adaptive Neuro – Fuzzy inference systems.		
Module:8	**Contemporary issues:**	**2 Hours**
Text Book(s)		
1.	Jacek. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishing House, 2006.	
2.	Simon Haykin, Neural Networks and learning Machines", Mac Millen College Pubco., New York, 2016.	
Reference Books		
1.	Laurene Fausett, Fundamentals of Neural Networks – Architectures, algorithms and applications, Pearson Education Inc., 2004	
2.	Timothy J.Ross, Fuzzy Logic with Engineering Applications, John Wiley and sons, 2017.	
3.	J.S.R. Jang, C.T. Sun, E. Mizutani, "Neural Fuzzy and Soft Computing – A computational Approach to learning and Machine Intelligence", Pearson Education Inc., 2010.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		

Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1007.1	3	3	3	1	1	-	-	-	1	-	-	1	3	1	1
EEE1007.2	3	2	1	1	1	-	-	-	1	-	-	1	3	1	1
EEE1007.3	3	2	1	1	1	-	-	-	1	-	-	1	2	1	1
EEE1007.4	3	2	3	1	1	-	-	-	1	-	-	1	3	1	1
EEE1007.5	3	3	1	1	1	-	-	-	1	-	-	1	2	1	1
EEE1007.6	3	3	3	1	1	-	-	-	1	-	-	1	3	1	1
EEE1007.7	3	3	1	1	1	-	-	-	1	-	-	1	2	1	1
	3	3	3	1	1	-	-	-	1	-	-	1	3	1	1

EEE1008	Bio-Medical Instrumentation	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**NIL**	**Syllabus version**				
Anti-requisite	NIL	v. 2.0				

Course Objectives:

1. To give an understanding of the biological signals and signal acquisition
2. To provide the design concepts of bioelectric amplifiers
3. To learn the principle and operation of various biomedical systems

Expected Course Outcomes:

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

1. Evaluate and analyse the different physiological signals
2. Relate the knowledge to select appropriate medical instruments
3. Design the bio electric devices used for diagnostic equipment
4. Develop and analyse the therapeutic devices.
5. Understand the procedure for blood analysis in medical laboratory
6. Analyze the process involved in blood cell counters and sensors
7. Differentiate the advanced diagnostic techniques.
8. Design a component or a product applying all the relevant standards with realistic constraints

Module:1	**Introduction to Biomedical Instrumentation and Measurement**	**8 Hours**

Sources of bioelectric potentials, cardiovascular system, Central nervous system, Muscular System, linear/nonlinear analysis of different physiological signals (ECG, EEG, EMG), Electrode theory- mathematical analysis including Nernst equation, Goldman equation, Electrical conductivity of electrode, Electrodes for ECG, EEG &EMG.

Module:2	**General Considerations of Medical Instruments**	**8 Hours**

Operational Amplifiers, Bioelectric Amplifiers, Selection of biomedical amplifiers – Isolation amplifiers, Charge amplifiers and Chopper amplifier. Characteristics of biomedical recorder amplifiers, Physiological effects of electric currents, Electric shock hazards and leakage currents, Methods of accident prevention.

Module:3	**Diagnostic Equipment**	**7 Hour**

ECG Lead Configuration, Vector cardiograph, Phono-cardiograph, EEG and EMG Electrode system, Recorders, Measurement of various volumes/capacity of lungs, Spirometer. Measurement of cardiac output, blood flow and blood pressure.

Module:4	**Therapeutic Equipment**	**6 Hours**

Cardiac pacemakers, cardiac defibrillators, nerve & muscle stimulators, diathermy-types, ventilators, Dialyzer.

Module:5	**Medical Laboratory Instrumentation**	**5 Hours**

Analysis of Blood-Measurement of pH, pO2 and pCO2 value of blood using pH/gas analyzers

Module:6	**Medical Laboratory Measurement**	**4 Hours**

Photometers, Hematology, Blood cell counters, Electrophoresis- Serum detection and classification, Blood Glucose Sensors, GSR measurements.

Module:7	**Advanced Diagnostic Techniques**	**5 Hours**

2D, 3D Analysis and Visualization (X-Ray, MRI, CT), Biomedical Spectroscopy, Optical coherence tomography, Fluorescence based Bio-detection & Bio-imaging- Case study: Telemedicine based health care monitoring system.

Module:8	**Contemporary issues:**	**2 hours**

Text Book(s)

1.	Leslie Cromwell, Fred J, Weibell & Erich A and P Feiffer, 'Biomedical Instrumentation and Measurements', 2nd Edition, PHI, 2011.
2.	J.J. Carr & J.M. Brown, 'Introduction to biomedical Equipment Technology', Prentice Hall, 4th Edition, 2011.
Reference Books	
1.	R. S. Khandpur, 'Handbook of Biomedical Instrumentation', Tata Mc-Graw Hill, 2nd edition, 2014.
2.	John.E. Hall, Guyton and Hall, Textbook of Medical Physiology, Saunders; 13th Edition, 2015.
3.	Rangaraj M. Rangayyan, 'Biomedical Signal Analysis', A Case-Study Approach, Wiley, 2nd Edition, 2015.

Mode of Evaluation:	**CAT I & II – 30%, DA I & II – 20%, Quiz – 10%, FAT – 40%**		
Recommended by Board of Studies	**30/11/2015**		
Approved by Academic Council	**39th AC**	Date	**17/12/2015**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1008.1	3	3	2	2	-	-	-	-	2	2	-	1	2	2	1
EEE1008.2	3	2	2	1	2	-	-	-	2	1	-	-	3	3	1
EEE1008.3	3	3	2	3	3	-	-	-	2	2	-	1	3	3	1
EEE1008.4	3	2	2	2	2	-	-	-	1	2	-	2	2	2	1
EEE1008.5	3	2	1	2	3	-	-	-	2	1	-	-	3	3	1
EEE1008.6	3	3	1	2	2	-	-	-	1	-	-	1	3	3	1
EEE1008.7	3	2	1	2	-	-	-	-	2	1	-	2	1	1	1
EEE1008.8	2	2	2	1	3	-	-	-	3	3	-	2	3	3	2
	3	2	2	2	2	-	-	-	2	2	-	2	3	3	1

EEE1011	Automated Test Engineering		L	T	P	J	C
			2	0	2	0	3
Pre-requisite	**EEE3002**	**Syllabus version**					
Anti-requisite	NIL	v. 1.0					

Course Objectives:

1. Aims to provide knowledge about the testing of IC's using automated Testing Equipment (ATE).
2. Providing hands-on in Simulation software's used to simulate the evaluation conditions.
3. Practical knowledge imparted on LabVIEW usage in PCBA testing for its full functional behaviour

Expected Course Outcome:

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

1. Discover the component faults in electronic manufacturing
2. Classify the faults in PCBs
3. Analyze the practical skills involved in troubleshooting
4. Test the various parameters involved in automated test engineering
5. Distinguish the Boundary Scan and Board Testing
6. Conduct the experiments on automated testing techniques

Module:1	**Introduction Topcb Assemblies:**	**3 Hours**

Printed Circuit Board (PCB)-types of PCB-multilayer PCBs-Plat Plated though Hole Technology - Surface Mount Technology (SMT) – Ball Grid Array (BGA) Technology – PCB Bare board manufacturing process – Bare board testing– PCB Inspection methods – Visual, Optical and X-ray Inspection systems– Electrical tests in PCBs

Module:2	**PCBA Troubleshoot Methods:**	**2 Hours**

PCB assembly troubleshoot – locating faults & Manual troubleshoot – Online & Offline troubleshoot – Fault types and causes in circuits – Tools and instruments for usage – DMM(Digital Multimeter) – CRO (Cathode Ray Oscilloscope) - Logic probes – Logic pulser – Logic Analyzer.

Module:3	**PCBA Troubleshoot Methods:**	**2 Hours**

Automated Testing of PCBs – Out-circuit & In-circuit test methods – VI Trace Technique – signature analysis – Board Functional Testing Techniques– Boundary Scan Test Strategy & methods – External Instrumentation in Automated Testing – PCB diagnostic testers – Diagnostic Testing technique.

Module:4	**Automated Test Techniques:**	**5 Hours**

Automated Test Techniques – Various parameters – AC – DC Parametric testing– QA testing– Identify and troubleshoot the failures of parameters– Environmental, Electrical Standards & Requirements for IC testing – In-circuit Testing methodologies – Back Driving – functional test– Digital, Analog and Mixed Signal ICs– Guarding Technique – VI Trace Technique of components – Boundary Scan Test for components on board – In-circuit measurement of passive components – Kelvin measurement – Test Fixtures – Types of Test Fixtures – Bed of Nails Fixtures – Card Edge

Test Fixtures – Reverse Engg to rebuild the Schematic Diagram using ATE and Software.				
Module:5	**Board Functional Testing (BFT):**			**6 Hours**
Board Functional Test (BFT) techniques – Go-No-go Test – Cluster Test – Guided Probe Backtracking Technique – Simulators – Online and Offline Simulation - Fault Simulation– Comprehensiveness of Board program – Fault Dictionary– Analysis – BS and Non-BS device testing– BCSS– Interface adaptor or personality adaptor(Pod) - Sample board programming and testing – External Instrumentation used for board testing – PXI Instrumentation – Integration of PXI instruments.				
Module:6	**DFT:**			**4 Hours**
Design for testability (DFT)- test issues – Fault Models — Boundary Scan Test– Self Test design – ATE for test.				
Module:7	**DFM:**			**6 Hours**
Design for manufacturability (DFM) - Manufacturing phases in industry oriented Production process – strategies – new strategy for DFM – benefits of new strategies – ATE for manufacturing – Various applications.				
Module:8	**Contemporary issues:**			**2 Hours**
	Total Lecture hours:			**30 Hours**
Text Book(s)				
1.	S R Sabapathi, “Test Engineering for Electronic Hardware”, Tata McGraw Hill, First Edition, 2011.			
Reference Books				
1.	Gordon Rogers and Yon Mayheq , “Engineering Thermodynamics”, Pearson,2009			
2.	Floyd , “The Fundamentals of Digital Semiconductor Testing”, Pearson Education India, Sep-2005			

List of Challenging Experiments (Indicative)		
1.	Functional Test Using Boundary Scan Tester	2hours
2.	Cluster Test Using Boundary Scan Tester	2 hours
3.	Out Circuit Functional Test	2 hours
4.	In Circuit Functional Test	2 hours
5.	QSMVI Signature Test	2 hours
6.	Scan Chain Test	2 hours
7.	Continuity Test Using Short Locater	2 hours
8.	Analog Test Using ATE	2 hours
9.	Parametric Testing DC and AC parameters	2 hours
10.	VLSI high speed Testing using ATE	2 hours
	Total Laboratory Hours	**20 hours**

Mode of Evaluation:	CAT I & II – 30%, DA I & II – 20%, Quiz – 10%, FAT – 40%		
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40^{th} AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1011.1	3	2	-	2	2	-	-	1	1	1	-	1	2	1	1
EEE1011.2	3	2	1	1	2	-	-	1	2	1	-	1	2	1	1
EEE1011.3	3	3	2	2	2	-	-	1	1	1	-	1	-	3	2
EEE1011.4	3	3	2	3	2	-	-	1	1	1	-	1	3	2	3
EEE1011.5	3	2	1	1	3	-	-	1	1	1	-	1	3	2	1
EEE1011.6	3	2	1	1	3	-	-	1	1	1	-	1	2	2	3
	3	2	2	2	2			1	1	1		1	2	2	3

EEE1012	Optoelectronic Instrumentation	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	**PHY1001/PHY1701**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To understand the principles underlying the theory and wide applications of optical instrumentation.
2. To design and develop an optical instrument for non-contact measurements.
3. To provide an exposure on latest developments of optical instrumentation

Course Outcome:

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

1. Comprehend the various types of noncontact optical instruments
2. Understand the working principle of various optical sources and detectors
3. Infer the optical fiber characteristics and their usage in measurement.
4. Design the fiber optic sensor for various physical parameter measurements.
5. Design the laser based optical instrumentation.
6. Understand the use of laser in optical non-destructive testing.
7. Develop solutions for real world problems using optical instrumentation

Module:1	**Overview Of Optical Instrumentation:**	**3 Hours**

Introduction - advantages of noncontact measurements, competing technologies, classification of optical measurements.

Module:2	**Optical Sources and detectors :**	**10 Hours**

Principle of light emission, materials, population inversion, pumping processes, optical amplification. Semiconductor Optical Sources - homojunction and double heterostructure - LEDs and LASERs. Response time, design of drive circuitry. Classifications: Ruby lasers, Neodymium Lasers, He-Ne Lasers, CO2 Lasers, Dye Lasers, Fiber lasers. Detectors: PN, P-i-N and Avalanche Photodiodes (APD), gain and responsivity calculation. Quadrant photodiode, CCD cameras and displays.

Module:3	**Fundamentals of Fiber Optics:**	**5 Hours**

Optical Fiber Characteristics and Classifications. Manufacturing of Optical fibers, Light sources - Source-to-Fiber power coupling, calculations, Fiber connectors and splices - Splicing techniques. Fiber Amplifier and optical modulators.

Module:4	**Fiber Optic Instrumentation:**	**5 Hours**

Fiber optic sensors – measurement of displacement, pressure, temperature, acceleration, torque, strain, fluid level and flow. Electric and magnetic field sensors.

Module:5	**Laser Instrumentation**:	**10 Hours**

Principles of laser measurements and applications. Laser Interferometer- principle, performance parameters and applications. Alignment, position and sizing Instruments - position detecting sensor wire diameter sensor, particle sizing. Laser doppler velocimetry - Principle of operation,

performance parameters, electronic processing of doppler signal. Holography - Basic principles - Methods of holographic interferometry and applications.		
Module:6	**Optical Non-Destructive Testing:**	**5 Hours**
Fiber optics, Laser speckle, Infrared thermography, endoscopy, holography and terahertz technology.		
Module:7	**Advanced optical Instrumentation:**	**5 Hours**
Laser remote sensing (LIDAR), advanced optical pollution measurements, optical imaging, lithography, spectrometers.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)

1. David A. Krohn, Trevor W. MacDougall and Alexis Mendez, "Fiber optic Sensors: Fundamental and Applications", SPIE, 4th Edition, 2015.
2. Silvano Donati, 'Electro-Optical Instrumentation: Sensing and Measurements with lasers', PHI, 2010.
3. W. Osten and N. Reingand, P," Advanced Methods for Optical Nondestructive Testing, in Optical Imaging and Metrology: Advanced Technologies", Wiley-VCH Verlag GmbH & Co. KGaA, 2012.

Reference Books

1. Gerd Keiser, "Optical Fiber Communications", Tata McGraw Hill, 5th Edition, 2013.
2. A.K.Ganguly, " Optical and Optoelectronics Instrumentation", Alpha Science Intl Ltd, 2010.
3. John G. Webster, Halit Eren, "Measurement, Instrumentation, and Sensors Handbook, Second Edition: Electromagnetic, Optical, Radiation, Chemical, and Biomedical Measurement", CRC press, 2014.

Mode of valuation:	CAT I & II – 30%, DA I & II – 20%, Quiz – 10%, FAT – 40%		
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1012.1	2	1	1	-	1	-	-	-	-	2	-	-	3	1	2
EEE1012.2	2	1	1	-	1	-	-	-	2	2	-	-	3	1	2
EEE1012.3	3	2	2	-	2	-	-	1	2	2	-	1	3	1	2
EEE1012.4	3	2	2	-	2	-	-	1	2	2	-	2	3	1	2
EEE1012.5	3	2	2	-	2	-	-	1	2	2	-	1	3	1	2
EEE1012.6	3	3	2	-	2	-	-	-	2	2	-	1	3	1	2
EEE1012.7	3	3	2	-	2	-	-	1	2	2	-	1	3	1	2
	3	2	2	-	2	-	-	1	2	2	-	2	3	1	2

EEE1013	**Analytical Instrumentation**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**3**
Pre-requisite	**PHY1001**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To analyze and interpret data from different chromatography spectrums.
2. To design the radiation sources, detectors and optical systems for various spectrometers.
3. To understand the working principles of spectrometry and spectrophotometer.
4. To analyze the performance of various nuclear radiation sources and detectors.

Course Outcome:

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

1. Demonstrate the interaction of electromagnetic radiations with matter and spectroscopy and its types
2. Apply and analyse the analytical techniques to determine the elements present in the given sample accurately.
3. Analyse the concepts of NMR, Spectrometers and their working.
4. Demonstrate contemporary measurement techniques related to analyzers.
5. Apply chromatography to analyse industrial environments.
6. Illustrate the working principle of Ion Selective Electrodes, PH electrodes and conductivity meters.
7. Measure and formulate the composition of dissolved oxygen, sodium, silica elements present in the given samples.

Module:1	**Electromagnetic Radiation:**	**5 Hours**

EM Radiation characteristics – interaction of EM radiation with matter; spectral methods of analysis – absorption spectroscopy – Beer-Lamberts Law – radiation sources – monochromators – filters – prisms – diffraction gratings.

Module:2	**Instrumentation for Absorption and Emission spectroscopy:**	**8 Hours**

UV – Visible spectroscopy – single beam and double beam instruments – instrumentation, sources and detectors; IR spectroscopy - FTIR spectrometer – instrumentation- sources and detectors. Atomic absorption spectroscopy – instrumentation, sources and detectors; Flame emission photometry – instrumentation, sources and detectors; Applications of absorption spectroscopy techniques.

Module:3	**Nuclear Magnetic Resonance and Radiation Techniques:**	**8 Hours**

Nuclear Magnetic Resonance – basic principles –Constructional features and working of NMR spectrometers – applications. Nuclear radiation detectors – GM counter – proportional counter – scintillation counter; X- ray diffraction- instrumentation and applications.

Module:4	**Mass spectroscopy:**	**4 Hours**

Mass spectroscopy – basic principles – Constructional features and working and applications.

Module:5	**Chromatography:**	**8 Hours**

Basic principles-Gas chromatography – Liquid chromatography – High pressure liquid

chromatography – instrumentation and applications.		
Module:6	**pH Conductivity & Dissolved Component Analyser:**	**5 Hours**
Ion selective electrodes – conductivity meters – pH meters – dissolved oxygen analyser – sodium analyser – silica analyser – moisture balance.		
Module:7	**Gas Analysers:**	**5 Hours**
Gas analysers for Oxygen, CO, NOx - dust and smoke detectors – analysers based on thermal conductivity measurement.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)	
1.	R.S.Khandpur, 'Hand book of Analytical Instruments', McGraw Hill Publishing Company Ltd., 3rd Edition, 2015.
2.	Douglas A. Skoog, F. James Holler and Stanley R. Crouch, 'Principles of Instrumental Analysis', Thomson Brooks/Cole, 7th Edition, 2007.
Reference Books	
1.	Ewing G.W., 'Instrumental methods of chemical analysis, McGraw-Hill, Newyork.2009.
2.	Sivasankar B, 'Instrumental Methods of Analysis', Oxford University press.2012.
3.	Willard, H.H., Merrit L.L., Dean J.A Seattle F.L., 'Instrumental Methods of Analysis', CBS Publishing and Distribution, 2012.

Mode of Evaluation:	**CAT I & II – 30%, DA I & II – 20%, Quiz – 10%, FAT – 40%**		
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1013.1	3	2	1	-	2	-	-	1	2	1	-	2	3	3	2
EEE1013.2	2	3	2	3	3	-	-	2	-	2	-	2	3	3	2
EEE1013.3	2	3	-	2	2	-	-	1	2	2	-	2	2	2	2
EEE1013.4	3	2	2	1	3	-	-	1	2	-	-	3	2	2	2
EEE1013.5	2	3	2	3	3	-	-	1	2	1	-	3	2	2	2
EEE1013.6	3	2	2	2	3	-	-	1	2	-	-	2	2	2	2
EEE1013.7	3	3	2	2	3	-	-	1	2	-	-	3	2	2	2
	3	3	2	2	3	-	-	1	2	1	-	3	2	2	2

EEE1014	Fiber Optic Sensors	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	**PHY1001/PHY1701**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To understand the principles underlying the theory and its wide application.
2. To design and develop fiber optic sensors for industrial applications.
3. To design and implementation of fiber optic distributed sensors for various applications.

Expected Course Outcome:

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

1. Understand the overview of fiber optic sensors and its unique applications
2. Analyze the optical fiber characteristics
3. Comprehend the working principle of various optical sources and detectors
4. Analyze the working principle of fiber optic sensors
5. Apply the fiber optic sensor for different physical parameter measurements
6. Design the multiplexing and distributed sensing of optical fiber sensors

Module:1	**Overview of Optical Sensors:**	**3 Hours**

Introduction - Advantages of optical sensors, Competing technologies, Classification of optical sensors.

Module:2	**Fundamentals of Fiber Optics:**	**5 Hours**

Basic characteristics of optical fiber, Classification, dispersion, attenuation, nonlinear optical effects-SRS, SBS, SPM. Modal birefringence and polarization maintaining fibers. Source to fiber coupling, fiber to fiber joints, fiber splicing, optical fiber connectors

Module:3	**Optical Sources and Detectors:**	**5 Hours**

Light sources – LED and laser diodes – various structures, radiation pattern, characteristics, modulation of light sources. Photo detector – PIN Photodiodes and Avalanche Photodiodes-principles, quantum efficiency, responsivity, detector noises.

Module:4	**Optical Fiber Components and Devices:**	**3 Hours**

Directional couplers, polarizers, polarization splitters, polarization controllers, optical isolators, fiber filters, wavelength division multiplexers and demultiplexers, switches, intensity, phase and frequency modulators.

Module:5	**Principles of Fiber Optic Sensors:**	**10 Hours**

Intensity modulation sensors – Extrinsic and intrinsic type – Transmissive, Reflective, Microbending and other Optic Effects sensor. Phase modulation sensors – Michelson Interferometers, Fabry – Perot Interferometer, Mach – Zender Interferometer and Sagnac Interferometer. Polarization based sensors

Module:6	**Applications of Fiber Optic Sensors:**	**8 Hours**

Temperature Measurement, Pressure Measurement, Fluid – Level Measurement, Flow Measurement, Current – Voltage Measurement, Vibration Measurement. Laser Doppler velocimetry. Optical gyroscope. Fiber Bragg grating sensors – strain, temperature, pressure and acceleration measurement – distributed sensing. Nonlinear fiber optic sensor for very high temperature sensing.

Module:7	**Sensor Multiplexing, Distributed Sensors and smart Structures:**	**9 Hours**

Sensor network architectures. Multiplexing of intensity-based sensors. Multiplexing of Interferometric sensors. Distributed sensing – quasi and fully distributed sensing – linear backscattering, nonlinear backscattering and forward scattering systems. Fiber optic smart sensor system – Application of fiber optic smart structures and skins

Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)

1.	David A. Krohn, Trevor W. MacDougall and Alexis Mendez, "Fiber optic Sensors: Fundamental and Applications", SPIE, Fourth Edition, 2015.
2.	Eric Uddand William B. Spillman, Jr., "Fiber optics sensors: An introduction for Engineers and scientists", John Wiley & Sons, Second Edition, 2011.

Reference Books

1.	Gerd Keiser, "Optical Fiber Communications", Tata McGraw Hill, Fifth Edition, 2013.
2.	José Miguel López-Higuera, "Handbook of Optical Fibre Sensing Technology", John Wiley & Sons Ltd., 2002.
3.	Zujie Fang, Ken Chin, Ronghui Qu, Haiwen Cai, Kai Chang, "Fundamentals of Optical Fiber Sensors", John Wiley &Sons Inc, 2012.
4.	Eric Udd, William B. Spillman., "Field guide to Fiber optics sensors", SPIE, 2014.

Mode of Evaluation:	CAT I & II – 30%, DA I & II – 20%, Quiz – 10%, FAT – 40%		
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1014.1	3	1	1	1	-	-	-	-	1	-	-	1	3	2	-
EEE1014.2	3	3	1	1	-	-	-	-	1	-	-	1	2	3	-
EEE1014.3	3	2	1	1	-	-	-	-	1	-	-	1	2	2	-
EEE1014.4	3	3	1	1	-	-	-	-	1	-	-	1	2	2	-
EEE1014.5	3	3	2	1	2	-	-	-	1	-	-	1	2	2	3
EEE1014.6	3	3	2	1	2	-	-	-	1	-	-	1	2	2	3
	3	3	1	1	2				1			1	2	2	3

EEE1015	Micro Electromechanical Systems	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**MAT2002**	**Syllabus version**				
Anti-requisite	**NIL**	v. 1.1				

Course Objectives:

1. To understand the operation principles of MEMS Devices,
2. To understand the various micromachining techniques used to fabricate MEMS devices
3. To become familiar with a wide variety of MEMS application areas such as MEMS sensors, RF MEMS, Optical MEMS, and Fluidic MEMS

Expected Course Outcome:

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

1. Understand microfabrication techniques and scaling laws for miniaturization
2. Analyze manufacturing process and strategies for micro fabrication
3. Explore the working principles of MEMS sensors and Actuators
4. Analyze the measurement and characterization of mechanical parameters
5. Examine Bio-MEMS and relevant detection methods
6. Apply MEMS based devices for various applications

Module:1	**Introduction to MEMS:**	**4 Hours**

Introduction - Evolution from microelectronics-Comparative Study - Multidisciplinary nature of MEMS

Module:2	**MEMS and Miniaturization:**	**6 Hours**

Scaling Laws of Miniaturization - Scaling in Geometry - Rigid Body Dynamics - Electrostatic Forces - Electromagnetic Forces – Electricity - Fluid Mechanics - Heat Transfer

Module:3	**Materials and Process:**	**10 Hours**

Substrates-Silicon, Glass, Ceramics; Photolithography, Bulk Micromachining : Wet etching- Isotropic Etching and Anisotropic Etching; Dry Etching; Wafer Bonding, High Aspect-Ratio Processes (LIGA); Surface Micromachining: basic process flow, release, Stiction, material choices, residual stress; CVD, PVD; Epitaxy

Module:4	**MEMS Actuators and Sensors:**	**10 Hours**

Cantilevers, Hinges, Pumps, Motors; comb drive, levitation, equivalent circuits; resonator, SAW, Piezoelectric transducers; Thermoelectric devices; accelerometers & gyroscopes; RF MEMS Switch

Module:5	**FEM for MEMS:**	**5 Hours**

Stress, strain, material properties, measurement & characterization of mechanical parameters; bending moment and strain, flexural rigidity, residual stress, boundary conditions, spring combinations

Module:6	**MOEMS and Bio-MEMS:**	**4 Hours**

MOEMS : Overview, MOEM technology and applications to telecom, micro-optics; MOEMS related sensors, micro-optic components, testing and applications.

Bio-MEMS: Materials and processes for Bio-MEMS; Biochips and microarrays; Systems on Chip; Biochip Sensors & detection methods - Electrochemical; Optical (labeled and unlabeled)		
Module:7	**Applications of MEMS:**	**4 Hours**
Piezo resistive Pressure Sensors, Capacitive Accelerometers; Electrostatic Projection Displays; Piezoelectric Gyroscope; DNA Amplification; Thermoelectric Inkjet Print heads; Micro valves and Pumps		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)	
1.	Richard C. Jaeger, "Introduction to Microelectronic Fabrication", Singapore: Pearson Education South Asia, 2014.
2.	Stephen D Senturia, " Microsystem design", Kluwer Academic Publishers, 2003.
Reference Books	
1.	Marc. J. Madou, "Fundamentals of microfabrication and nanotechnology. Volume II, Manufacturing techniques for microfabrication and nanotechnology", Boca Raton, FL : CRC Press, 2012.
2.	P. Rai-Choudhury, "MEMS and MOEMS Technology and Applications", SPIE, 2017.
3.	Thomas Adams and Richard Layton, "Introductory MEMS: Fabrication and Applications", Springer, 2010.
4.	M-H. Bao, "Micromechanical Transducers: Pressure sensors, accelerometers and gyroscopes", Elsevier, 2000.
5.	Wanjun Wang, Steven A. Soper, "Bio-MEMS: Technologies and Applications", CRC Press, 2007.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1015.1	3	2	1	1	-	-	-	-	1	1	-	1	3	1	-
EEE1015.2	3	2	1	1	-	-	-	-	1	1	-	1	2	1	-
EEE1015.3	3	2	2	1	-	-	-	-	1	-	-	1	2	2	-
EEE1015.4	3	3	2	1	-	-	-	-	1	1	-	1	2	3	-
EEE1015.5	3	2	1	1	-	-	-	-	1	-	-	1	2	2	-
EEE1015.6	3	1	1	1	-	-	-	-	1	-	-	1	2	2	-
	3	2	1	1		-	-	-	1	1		1	2	2	

EEE1016	Non Destructive Testing	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	**PHY1001**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications

Expected Course Outcome:

On the completion of this course the student will be able to:
1. Extrapolate the Non Destructive Testing techniques to determine defects and characterization of industrial components
2. Study and realize the visual testing
3. Develop and demonstrate liquid penetrant testing methods
4. Acquire the skills of magnetic particle and eddy current testing
5. Analyse the practical implementation of radiographic testing
6. Practise and implement ultrasonic testing for NDT
7. Promote advancement of research and implementation of NDE technology

Module:1	**Visual Testing:**	**6 Hours**

Fundamentals of Visual Testing - Vision, lighting, material attributes, environmental factors, Visual perception, direct and indirect methods - mirrors, magnifiers, Boroscopes Fibroscopes, closed circuit television, light sources and special lighting, A systems, computer enhanced system, standards units and codes.

Module:2	**Liquid Penetrant Testing:**	**6 Hours**

Principles – types and properties of liquid penetrants - developers – advantages and limitations of various methods - Preparation of test materials - Application of penetrants to parts, removal of surface penetrants, post cleaning - - selection of penetrant method - solvent removable, water washable, standards units and codes

Module:3	**Magnetic Particle Testing:**	**7 Hours**

Theory of magnetism -magnetisation by means of direct and alternating current - surface strength characteristics - Depth of penetration factors, Direct pulsating current typical fields, advantages - Circular magnetisation techniques, field around a strength conductors, right hand rule field - Prods technique, current calculation - Longitudinal magnetization - field produced by current in a coil, shape and size of coils, field strength, current calculations, Magnetic Burghausan Noise Analysis (MBN).

Module:4	**Radiography:**	**6 Hours**

X-rays, Properties of X-rays relevant to NDE. Absorption of rays,scattering, types and use of filters, screens, geometric factors, inverse square, law, film type and processing, characteristics of films - density, speed, contrast, Characteristic curves, Penetrameters, Exposure charts, radiographic equivalence, Radiography of pipes, welds and castings. Safety with X-rays Special Radiographic Techniques

Module:5	**Eddy Current Testing**:	**7 Hours**

Generation of eddy currents - effect of created fields - effect of change of impedance on

instrumentation - properties of eddy currents - eddy current sensing elements, probes, type of arrangement - a) absolute b) differential lift off, operation, applications, advantages, limitations - Through encircling or around coils, type of arrangements a)absolute b) differential fill factor, operation, application, advantages, limitations - Factors affecting sensing elements and coil impedance - test part and test system - Signal to noise ratio, relationship to eddy current testing - equipment's		
Module:6	**Ultrasonic Testing:**	**6 Hours**
Ultrasonic NDT principles, Different types of wave modes, Physics of wave generation, reception, interactions and propagation. Calibration, data collection, quantification, and interpretation, New methods using guided waves, Resonance and other Low Frequency Methods; Angle beam inspection – thickness measurements – Applications.		
Module:7	**Other Techniques:**	**5 Hours**
Holography and Acoustic emission technique. Pressure and leak testing. Condition monitoring of machines, Wear monitoring, Spark testing. Brief over view of Non- Destructive testing standards - ASTM, ISO, ASNT, API, ASME boiler and pressure vessel code.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)	
1.	B Hull,"Non-destructive testing¨, S.l. : Springer, 2012.
2.	Ravi Prakash,"Non-Destructive Testing Techniques¨, Tunbridge Wells : New Academic Science, 2012.
Reference Books	
1.	Charles, J. Hellier, Handbook of Non destructive evaluation, McGraw Hill, New York 2013.
2.	Baldev Raj, T.Jayakumar, M.Thavasimuthu , Practical Non-Destructive Testing¨, Narosa Publishing House, 2009.
3.	Paul E Mix, Introduction to Non-destructive testing: a training guide¨, Wiley, 2nd Edition New Jersey, 2005.

Mode of Evaluation:	CAT I & II – 30%, DA I & II – 20%, Quiz – 10%, FAT – 40%		
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40^{th} AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1016.1	2	1	-	-	-	-	-	1	3	1	-	-	2	-	-
EEE1016.2	2	1	-	-	-	-	-	1	3	1	-	-	2	-	-
EEE1016.3	3	2	1	-	1	-	-	1	-	1	-	-	-	-	-
EEE1016.4	3	2	-	-	1	-	-	-	3	1	-	-	2	2	-
EEE1016.5	3	2	1	1	2	-	-	3	3	1	-	-	2	-	1
EEE1016.6	3	2	1	-	2	-	-	3	-	1	-	-	2	-	1
EEE1016.7	3	3	2	-	2	-	-	3	3	1	-	1	-	-	1
	3	2	1	1	2	-	-	2	3	1	-	1	2	2	1

EEE1018	Nano Technology Fundamentals And Its Applications	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	**PHY1001**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To understand the basic concepts involved in Nanoscience
2. To gain knowledge about various methods of synthesis, characterization and applications in Nanotechnology.

Expected Course Outcomes:

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

1. Understand the fundamental aspects of nanoscience
2. Identify various types of nanomaterials, their properties and applications
3. Compare the different nano fabrication processes
4. Synthesize and understand the properties & application of Carbon Nanotubes
5. Characterize nanoscale particles using various characterization techniques
6. Understand the limitations of current technology and advancements of nanoscale electronic devices.
7. Apply nanotechnology in photonic devices

Module:1	**Basic Concepts**	**8 Hours**
Basic properties of Conductors, Insulators and Semiconductors; Band diagram concept of typical semiconductors; Basic Chemistry Concepts; Physical aspects, Bonding, Wave-particle duality, Heisenberg Uncertainty Principle, Schrödinger wave equation, Quantum confinement in 1-D, 2-D and 3-D; Effects of the nanometer length scale- Change in properties.		
Module:2	**Nanomaterials**	**6 Hours**
Basic Types of Nanostructures- Quantum wells, Quantum Wires-Carbon Nanotubes, Nanowires; Quantum Dots, Nanoclusters; Nanoparticles- Colloidal nanoparticle crystals, Functionalized nanoparticles		
Module:3	**Fabrication Methods**	**5 Hours**
Top-down processes, Bottom-up processes, Nanolithography techniques, Arc discharge method, Laser Ablaton method, Ion Implantation, Chemical Vapour deposition.		
Module:4	**Carbon Nanotubes & its applications**	**6 Hours**
Synthesis of CNTs, Electronic properties, Mechanical properties; Applications- CNTs as interconnects, CNTFETs, CNTs for solar cell and energy storage applications		
Module:5	**Characterization Techniques**	**8 Hours**
Classification of characterization methods, Different Microscopy techniques-Light Microscopy, Principle & Resolution, Electron Microscopy- Scanning Electron Microscopy (SEM), Principle & Resolution, Scanning Probe Microscopy- Scanning Tunneling Microscopy (STM) & Atomic Force Microscopy (AFM), Principle & Resolution.		
Module:6	**Nanoelectronics**	**5 Hours**
Si Technology and its limitations, Nanoscale Devices, Single Electron Devices, Organic Field-effect transistors, Spintronics.		
Module:7	**Nanophotonics**	**8 Hours**

Photonic Crystals and their applications, Plasmonics, Near field optics, Q-Dot Lasers				
Module:8	**Contemporary issues:**			**2 Hours**
	Total Lecture hours:			**45 Hours**
Text Book(s)				
1	Jeremy J. Ramsden, Nanotechnology-An Introduction, Second Edition, Elseiver, 2016			
2	Amretashis **Sengupta**, Chandan Kumar **Sarkar** (Eds.) "Introduction to Nano-Basics to Nanoscience and Nanotechnology", Springer, 2015			
Reference Books				
1	Chris Binns , "Introduction to Nanoscience and Nanotechnology", Wiley, 2010			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
Recommended by Board of Studies	**05/03/2016**			
Approved by Academic Council	**40th AC**	Date	**18/03/2016**	

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1018.1	2	2	1	-	-	-	-	1	1	2	-	-	1	1	-
EEE1018.2	3	2	1	-	-	-	-	1	2	2	-	1	1	1	-
EEE1018.3	3	3	1	-	-	-	-	1	2	2	-	-	1	1	-
EEE1018.4	3	3	1	-	-	-	-	1	2	2	-	-	1	1	-
EEE1018.5	3	3	1	-	-	-	-	1	2	2	-	1	1	1	-
EEE1018.6	3	3	1	-	-	-	-	1	2	2	-	-	1	1	-
EEE1018.7	3	3	1	-	-	-	-	1	2	2	-	1	1	1	-
	3	3	1	-	-	-	-	1	2	2	-	1	1	1	-

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

EEE1020	Engineering Optimization	L	T	P	J	C
		2	1	0	1	4
Pre-requisite	NIL	Syllabus version				
Anti-requisite	NIL	v. 1.1				

Course Objectives:

1. Exposure to and learning of engineering optimization concepts applied across the spectrum of courses in engineering curriculum

Expected Course Outcome:

On the completion of each module the student will be able to:

1. Understand the basic concepts of engineering optimization techniques
2. Analyze 1- D search methods
3. Design gradient based optimization method for various algorithms
4. Formulate algorithms using conjugate direction methods
5. Analyze dynamic optimization techniques
6. Explore gradient-free optimization techniques and its limitations

Module	Title	Hours
Module:1	**Classical Optimization basics**	**7 Hours**
Taylor's series, Single-variable optimization, Multivariable optimization without and with equality and inequality constraints, Definitness of matrices, Sylvester's criterion, Convex programming problem.		
Module:2	**1-D search methods**	**5 Hours**
Golden Section Search, Fibonacci Search, Inexact line search.		
Module:3	**Gradient based optimization**	**7 Hours**
Gradient descent method, method of steepest descent, Newton's Method, Levenberg-Marquardt algorithm.		
Module:4	**Conjugate Direction Methods:**	**7 Hours**
Conjugate directions and conjugate gradient method, Fletcher-Reeves formula. Convergence analysis of all algorithms.		
Module:5	**Miscellaneous topics**	**6 Hours**
Dynamic programming. Dynamic optimization. Sample applications of gradient based and gradient free methods in engineering.		
Module:6	**Application of optimization methods to neural networks**	**5 Hours**
NN basics, capabilities and limitations of single perceptron, multilayer perceptron. Training by gradient based and gradient free methods.		
Module:7	**Gradient-free Optimization**	**6 Hours**
Direct and indirect methods, Limitations of gradient based methods, metaheuristic algorithms, Introduction to the genetic algorithm, particle swarm optimization. Simulated annealing.		
Module:8	**Contemporary issues:**	**2 Hours**

Text Book

1. Introduction to Optimization by Chong and Zak, John Wiley & Sons, Inc., IV Ed., 2013.

Reference Books	
1.	Engineering Optimization, Theory and Practice by S S Rao, John Wiley & Sons, Inc., IV Ed., 2009.
2.	Practical Methods of Optimization, by Fletcher, John Wiley & Sons, Inc., II Ed., 2006
3.	Current literature.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE1020.1	3	2	1	1	1	-	-	-	1	1	-	1	1	1	1
EEE1020.2	3	3	1	1	1	-	-	1	-	-	-	1	1	1	1
EEE1020.3	3	2	2	1	1	-	-	1	1	-	-	1	2	1	1
EEE1020.4	3	2	1	1	1	-	-	-	1	1	-	1	2	1	1
EEE1020.5	3	2	1	1	1	-	-	1	-	-	-	1	2	1	1
EEE1020.6	3	3	1	1	1	-	-	-	-	-	-	1	2	1	1
	3	2	1	1	1		-	1	1	1		1	2	1	1

EEE2006	Communication Engineering		L	T	P	J	C
			3	0	2	0	4
Pre-requisite	**EEE1005**	**Syllabus version**					
Anti-requisite	NIL	v. 2.0					

Course Objectives:

1. To equip students with the knowledge of analog and digital communication engineering fundamentals.
2. To teach the students various communication systems and its analysis & applications
3. To provide basic understanding of appropriate tools and technologies to develop communication-engineering solutions.

Expected Course Outcome:

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

1. Demonstrate the need for modulation.
2. Examine the presence of noise in communication systems.
3. Analyze modulation techniques for analog and digital Signals.
4. Design transmitters and receivers for communication systems
5. Assess various shift keying techniques.
6. Demonstrate spread spectrum techniques and channel assignment strategies.
7. Analyze and design modern communication systems.
8. Design and Conduct experiments, as well as analyze and interpret data

Module:1	Introduction to Communication System	6 Hours

Communication systems: Introduction, need, importance, elements, block diagram and role of each block, types, frequency ranges – bandwidth– pre-emphasis and de-emphasis –modulation and its need– applications of electronic communications.

Module:2	Noise in CW Modulation System	4 Hours

Internal noise – external noise – noise voltage – signal-to-noise ratio– noise figure – noise temperature– noise in CW modulation systems.

Module:3	Amplitude Modulation	8 Hours

Representation and generation of analog modulation systems including AM, SSB, DSB,VSB – frequency spectrum, power relation– different types of modulators – AM transmitter: low level and high level modulation – SSB transmitter – AM demodulators: Square-law detector, envelope detector, rectifier detector, synchronous detector – characteristics of receivers – Super heterodyne principle – AM super heterodyne receiver – SSB receiver – comparison of different AM systems.

Module:4	Phase Modulation:	10 Hours

Representation and generation of frequency and phase modulation (FM and PM) – generation of NBFM and WBFM – FM transmitters – comparison of AM and FM – comparison of FM and PM – conversion of FM to PM and PM to FM – TRF Receivers – Choice of IF and oscillator frequencies – AVC – AFC – FM super heterodyne receiver– slope detectors – HF Communication Receiver – diversity reception.

Module:5	Pulse Modulation Systems	5 Hours

Pulse modulations– sampling theorem – pulse amplitude modulation– pulse width modulation – pulse position modulation – signal to noise ratio of pulse modulation systems – delta modulation – pulse code modulation

Module:6	Digital modulation systems	5 Hours

Amplitude shift keying – frequency shift keying – phase shift keying – advantages and

disadvantages of digital communication systems.		
Module:7	**Cellular concept**	**5 Hours**
Channel assignment strategies – interference and system capacity – spread spectrum modulation – direct sequence spread spectrum – Frequency hop spread spectrum – code division multiplexing – OFDM for wireless communication – Broadband integrated services network.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)

1.	Simon Haykin; Michael Moher, "An Introduction to Analog and Digital Communications.", Hoboken : Wiley Textbooks, 2012.
2.	Leon W Couch, " Digital and analog communication systems", Upper Saddle River, N.J, Prentice Hall, 2013
3.	Rappaport T.S., "Wireless Communications", Pearson Education, 2010.

Reference Books

1.	Herbert Taub; Donald L Schilling; Goutam Saha, "Principles of communication systems", New Delhi : McGrew Hill Education, 2013.
2.	Ramjee Prasad, "OFDM for wireless communications systems", Boston; London: Artech House, 2004.
3.	Wayne Tomasi, "Electronic Communication Systems – Fundamentals through advanced", 4th edition, Pearson Education, 2005.
4.	John G Proakis; Masoud Salehi, "Digital Communication", 5th edition, New York McGraw-Hill 2014.
5.	Kennedy and Davis, "Electronic Communication Systems", 4th edition, Tata McGraw Hill, 2008.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

List of Challenging Experiments (Indicative)

1.	Amplitude Modulation	2 hours
2.	Pre-Emphasis and De-Emphasis	2 hours
3.	Pulse Amplitude Modulation	2 hours
4.	Pulse Width Modulation	2 hours
5.	Frequency Modulation/Mixer	2 hours
6.	Generation of Shift Keying Methods	2 hours
7.	DSB, SSB Modulation and Detection	2 hours
8.	FM and PM Modulation and Detection	2 hours
9.	Pulse Code Modulation and Delta Modulation	2 hours
10.	Generation and Detection of spread spectrum	2 hours
	Total Laboratory Hours	**30 hours**

Recommended by Board of Studies	**30/11/2015**		
Approved by Academic Council	**39th AC**	Date	**17/12/2015**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE2006.1	2	1	-	-	-	-	-	2	2	2	-	2	2	-	2
EEE2006.2	2	1	-	-	1	-	-	-	1	2	-	1	2	1	2
EEE2006.3	3	3	2	2	2	-	-	-	2	3	-	1	2	-	2
EEE2006.4	2	1	-	-	-	-	-	-	-	-	-	-	3	-	2
EEE2006.5	3	3	2	2	2	-	-	-	2	3	-	1	2	-	2
EEE2006.6	3	3	-	-	2	-	-	-	-	1	-	-	2	-	2
EEE2006.7	3	3	-	-	2	-	-	-	-	1	-	-	2	-	2
EEE2006.8	3	3	3	2	3	-	-	2	3	2	-	1	2	2	2
	3	3	3	2	2	-	-	2	2	2	-	2	3	2	2

EEE2008	Electrical Technology	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**EEE1002**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To analyze the basic working principle of DC Machines
2. To understand the various performance and testing of transformer
3. Evaluate the various characteristics of AC Machines and Special Machines

Expected Course Outcome:

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

1. Understand the constructional details and working principle of DC Generator
2. Analyse and evaluate the performance characteristics of DC motor
3. Understand the theory and operation of transformer
4. Compute the equivalent circuit parameters of transformer
5. Analyse the working principle of synchronous generator
6. Comprehend the working principle of synchronous motor and applications
7. Understand the different types of induction motor and miscellaneous machines

Module:1	**DC Generators:**	**7 Hours**

Constructional details of DC machines, Operation of DC generators – EMF equation – Characteristics of different types of generators.

Module:2	**DC Motors:**	**6 Hours**

Principle of operation of DC motors – Torque and speed equation – Characteristics of different types of DC motors – Starting, braking and speed control of DC motors, Simple problems of emf.

Module:3	**Construction of Transformers:**	**6 Hours**

Principle – Types – general constructional feature of single phase and three phase transformers.

Module:4	**Performance evaluation of Transformers:**	**6 Hours**

Phasor diagrams and equivalent circuit – Regulation and efficiency – OC and SC Test on transformers – Simple problems on emf induced in the Primary & Secondary windings, Autotransformers.

Module:5	**Synchronous Generator:**	**6 Hours**

Principle of operation – Types and general constructional features – synchronous generators – Characteristics – EMF equation – Regulation –Simple problems on emf.

Module:6	**Synchronous Motor:**	**5 Hours**

Principle of operation-Phasor diagram of synchronous motor – V curve – Starting methods, Hunting.

Module:7	**Induction and Miscellaneous Machines:**	**7 Hours**

Types – Constructional features of 3-phase induction motors – phasor diagram – Slip torque characteristics – Starting and speed control methods – principles of operation and types of single-phase induction motor. DC/AC servomotors – Stepper motors – Brushless motors – Reluctance and hysteresis motors – Linear induction motors.

Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

List of Challenging Experiments (Indicative)

1.	OCC of DC shunt generator	2 hours
2.	Load characteristics of DC shunt generator	2 hours
3.	Load test on DC compound generator	2 hours
4.	No load saturation characteristics of separately excited DC generator	2 hours
5.	Load characteristics of DC series generator	2 hours
6.	Load characteristics of DC separately excited generator	2 hours
7.	Load test on DC series motor	2 hours
8.	Load test on DC shunt motor	2 hours
9.	Speed control of DC shunt motor	2 hours
10.	Swinburne's Test	2 hours
11.	OC/SC test on a single phase transformer	2 hours
12.	Load test on single phase transformer	2 hours
13.	Parallel operation of single phase transformer	2 hours
14.	Predetermination of percentage regulation of alternator by synchronous impedance method	2 hours
15.	Load test on three phase alternator with resistive load	2 hours
16.	Load test on three phase alternator with RL load	2 hours
17.	Load test on single phase Induction motor	2 hours
18.	Load test on three phase squirrel cage induction motor	2 hours
19.	Load test on three phase slip-ring induction motor	2 hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1. D.P. Kothari and I.J. Nagrath, "Electrical Machines", Tata McGraw-Hill Education, 4th Edition, 2014.
2. Abhijit Chakrabarti, Sudipta Debnath, "Electrical Machines", Tata McGraw-Hill Education, 2012.

Reference Books

1. Cotton H, "Advanced Electrical Technology", CBS Publishers and Distributors, New. Delhi, 2001.
- R.K.Rajput, "A Text Book Electrical Machines", Laxmi Publication, 4th Edition, 2016.
- B.L.Theraja and A.K.Theraja, "A Text Book of Electrical Technology", S.Chand, Vol. No. 2, 9th Edition, 2014.

Mode of Evaluation:	CAT I & II – 30%, DA I & II – 20%, Quiz – 10%, FAT – 40%		
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE2008.1	3	1	1	1	-	-	-	-	1	-	-	-	2	1	-
EEE2008.2	3	3	3	1	-	-	-	-	1	-	-	-	1	3	-
EEE2008.3	3	1	1	1	-	-	-	-	1	-	-	-	1	1	-
EEE2008.4	3	3	1	1	-	-	-	-	1	-	-	-	1	3	-
EEE2008.5	3	3	1	1	-	-	-	-	1	-	-	-	1	2	-
EEE2008.6	3	1	1	1	-	-	-	-	1	-	-	-	1	1	-
EEE2008.7	3	1	1	1	-	-	-	-	1	-	-	-	2	1	-
	3	3	3	3	-	-	-	-	1	-	-	-	2	3	-

EEE3008	Data Communication Network		L	T	P	J	C
			3	0	0	0	3
Pre-requisite	**EEE2006**	**Syllabus version**					
Anti-requisite	NIL	v. 1.0					

Course Objectives:

1. To teach the basic fundamentals in network topology.
2. To provide essential knowledge on various layer in OSI model
3. To expose the students to the recent advances in various protocol in application layer.
4. To teach various networking.

Expected Course Outcome:

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

1. Understand the overview of a data communication and network.
2. Analyze the bandwidth utilization and switching of data networks
3. Understand the protocol of seven layer model.
4. Comprehend and configure Local Area Networks
5. Apply the various communication methods in transmission media.
6. Understand the different coding methods to avoid error in communication in data link layer.
7. Formulate the strategies for QoS network applications
8. Appreciate usefulness and importance of application layer protocol in today life and society

Module:1	**Overview of data communication:**	**4 Hours**

Introduction- Data Communications, Networks, The Internet, Protocols and Standards, Network Models- The OSI Model, Layers in the OSI Model, TCP/IP Protocol Suite, Addressing, Physical Layer and Media.

Module:2	**Bandwidth utilization and switching:**	**6 Hours**

Multiplexing and Spreading, Transmission Media Wireless. Switching - Circuit-Switched Networks, Datagram Networks, Virtual-Circuit Networks, Structure of a Switch.

Module:3	**Data Link Layer:**	**7 Hours**

Error Detection and Correction- Block Coding, Liner Block Codes, Cyclic Codes, Checksum, Data Link Control - Framing, Flow and Error Control, Protocols, Noiseless Channels, HDLC, Point-to- Point Protocol, Multiple Access - Random Access, Controlled Access, Channelization, IEEE Standards - Standard Ethernet, Changes in the Standard, Fast Ethernet, Gigabit Ethernet, IEEE 802.11, Bluetooth

Module:4	**Local Area Network:**	**6 Hours**

Connecting LANs, Backbone Networks, and Virtual LANs, Connecting Devices, Cellular Telephony, Satellite Networks, Sonet/SDH, Architecture, STS Multiplexing, Sonet Networks, Virtual Tributaries, Virtual-Circuit Networks: Frame Relay and ATM, Frame Relay, ATM, ATM LANs.

Module:5	**Network Layer:**	**6 Hours**

Network Layer: Internet Protocol, Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6, Address Mapping, Error Reporting and Multicasting, ICMP, IGMP, ICMPv6, Delivery, Forwarding and Routing, Unicast and Multicast Routing Protocols.

Module:6	**Transport Layer:**	**6 Hours**
Process-Process Delivery: UDP, TCP and SCTP, Process-to-Process Delivery, User Datagram Protocol (UDP), TCP, SCTP, Congestion Control and Quality of Service, Data Traffic, Congestion, Congestion Control, Quality Service, Techniques to improve QoS, Integrated Services, Differentiated Services, QoS in Switched Networks.		
Module:7	**Application Layer:**	**8 Hours**
Domain Name System - Name Space, Domain Name Space, Distribution of Name Space, DNS in the Internet, Resolution, DNS Messages, Types of Records, Registrars, Dynamic Domain Name System (DDNS), Encapsulation, Remote Logging, Electronic Mail and File Transfer, Remote Logging, Telnet, Electronic Mail, File Transfer. **WWW and HTTP:** Architecture, Web Documents, HTTP, Network Management: SNMP, Network Management System, Simple Network Management Protocol (SNMP), Multimedia, Digitizing Audio and Video, Audio and Video Compression, Streaming Stored Audio/Video, Streaming Live Audio/Video, Real- Time Interactive Audio/Video, RTP, RTCP, Voice over IP.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)

1. Behrouz A. Forouzan, "Data Communications and Networking", McGraw Hill, Fifth Edition, 2017.
2. A. S. Tanenbaum, "Computer Networks", Pearson education, 5th Edition, 2013.

Reference Books

1. W. Tomasi, "Introduction to Data communications and Networking", Pearson education, 4thEdition, 2005.
2. G.S.Hura and M.Singhal, "Data and Computer Communications", CRC Press, 2001.
3. S.Keshav, "An Engineering Approach to Computer Networks", Pearson Education, 2ndEdition, 2010.
4. W.A.Shay,“Understanding communications and Networks”,Cengage Learning,3rd Edition, 2008.

Mode of valuation:	CAT I & II – 30%, DA I & II – 20%, Quiz – 10%, FAT – 40%		
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE3008.1	3	2	2	1	-	-	-	-	1	-	-	1	2	1	-
EEE3008.2	3	3	1	1	-	-	-	-	1	-	-	1	1	3	-
EEE3008.3	3	2	1	1	-	-	-	-	1	-	-	1	1	1	-
EEE3008.4	3	2	1	1	-	-	-	-	1	-	-	1	1	1	-
EEE3008.5	3	3	3	2	-	-	-	-	1	-	-	1	2	1	-
EEE3008.6	3	2	1	1	-	-	-	-	1	-	-	1	1	1	-
EEE3008.7	3	3	1	1	-	-	-	-	1	-	-	1	1	3	-
EEE3008.8	3	1	1	1	-	-	-	-	1	-	-	1	2	3	-
	3	3	3	1	-	-	-	-	1	-	-	1	3	3	-

EEE3009	Digital Image Processing		L	T	P	J	C
			3	0	0	4	4
Pre-requisite	**EEE2005**	**Syllabus version**					
Anti-requisite	NIL	v. 2.1					

Course Objectives:

1. To develop student's skills in performing spatial and transform domain transformations associated with image processing and skills associated with techniques related to coding.
2. To resolve complex algorithms and to reinstate sophisticated techniques to improve the performance.

Expected Course Outcome:

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

1. Understand the fundamentals of digital image processing
2. Analyse the various image transform techniques
3. Implement frequency domain in image enhancement
4. Comprehend the image compression techniques
5. Analyse the images using various segmentation techniques
6. Represent and describe the image processing techniques
7. Apply the image processing techniques in various applications
8. Design a component or a product applying all the relevant standards with realistic constraints

Module:1		**8 Hours**

Basics of Digital Image Processing (DIP):

Introduction, Fundamental steps in DIP – Elements of visual perception -Image sensing and Acquisition – Image Sampling and Quantization – Imaging geometry, discrete image mathematical characterization- Basic relationship between pixels. Basic Gray level Transformations – Histogram Processing – Smoothing spatial filters- Sharpening spatial filters -color Image Processing-Color models-pseudo color image processing- color transformations.

Module:2		**10 Hours**

Image Transforms:

Two dimensional Fourier Transform- Properties – Fast Fourier Transform – Inverse FFT- Discrete cosine transform and KL transform.-Discrete Short time Fourier Transform. Discrete Wavelet Transform- the Haar wavelet family-Multirate solution analysis and the scaling function-Implementation using filters.

Module:3		**8 Hours**

Image Enhancement in Frequency domain:

Smoothing frequency domain filters- sharpening frequency domain filters- Homomorphic filtering, A model of the image degradation and restoration process, Noise models, Spatial filtering, Frequency domain filtering –Inverse filtering ,Wiener filtering, Constrained Least square filtering

Module:4		**4 Hours**

Image Compression:

Overview of Image Compression Techniques- Quantization- Entropy Encoding-JPEG and MPEG standards-

Module:5		**6 Hours**

Image Segmentation: Detection of discontinuities – edge linking and boundary detection- thresholding -edge based segmentation-region based segmentation- matching-morphological segmentation- watershed algorithm		
Module:6		**3 Hours**
Representation and Description: Boundary descriptions-Region descriptors- Use of Principal Components and Description, Texture description.		
Module:7		**3 Hours**
Applications of Image Processing: Machine Vision- Image Analysis-pattern recognition and introduction to video processing		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)	
1.	Rafael C.Gonzalez, Richard E.Woods, “Digital Image Processing”, Pearson Education 4th Edition, 2017.
2.	Anil.K.Jain, “Fundamentals of Digital Image Processing”, Pearson Education, 2000.
Reference Books	
1.	Scott E Umbaugh, “Digital Image Processing and Analysis: Human and Computer Vision Applications with CVIPtools”, Second Edition, CRC press, Taylor and Francis, 2nd Edition, 2016.
2.	William K. Pratt, “Digital Image Processing”, John Wiley & Sons, 2016.
3.	Stephane Mallat , “A Wavelet tour of signal processing: The Sparse Way”, 3rd Edition, Academic Press, 2009.
4.	Mark Nixon, Alberto Aguado, “Feature Extraction, and Image Processing”, Elsevier’s Science & Technology Publicatiton, Second Edition,2010.
5.	K.P.Soman, K.I Ramchandran, N.G.Resmi, “Insights into Wavelets: From Theory to Practice”, Third Edition, PHI, 2010.
6.	B.Chanda,D.DuttaMajumder, “Digital Image Processing and Analysis”, Prentice Hall of India, 2011

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE3009.1	2	1	-	-	-	-	-	1	-	-	-	1	-	-	-
EEE3009.2	3	3	2	1	2	-	-	1	1	1	-	1	-	3	2
EEE3009.3	3	2	1	-	1	-	-	1	-	-	-	-	-	3	2
EEE3009.4	2	1	1	-	1	-	-	1	-	-	-	-	-	-	-
EEE3009.5	3	3	2	1	2	-	-	1	1	1	-	1	-	2	2
EEE3009.6	3	2	1	1	2	-	-	1	1	2	-	1	-	-	2
EEE3009.7	3	2	1	1	2	-	-	1	1	2	-	1	-	-	2
EEE3009.8	3	3	3	3	3	-	-	3	3	3	1	2	2	-	3
	3	3	2	2	2	-	-	2	2	2	1	2	2	3	3

EEE4018	Advanced Control Theory	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**EEE 3001**	**Syllabus version**				
Anti-requisite	NIL	v. 2.0				

Course Objectives:

1. To impart in-depth knowledge in the field of control theory, analysis and design of MIMO systems in state space
2. Basic understanding on features of linear and nonlinear systems
3. To analyze the features of linear and nonlinear systems using phase plane analysis and describing function analysis
4. To analyze the stability of linear and nonlinear systems using stability concepts

Expected Course Outcome:

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

1. Model physical systems using state variable approach
2. Analyze MIMO systems by state space approach
3. Design state feedback controller and observer for simple and practical dynamic systems
4. Identify and classify the nonlinearities in the physical systems
5. Analyze the features and stability of nonlinear systems using phase portraits
6. Analyze the systems with common nonlinearities using describing function
7. Analyze stability of linear and non – linear systems
8. Design a component or a product applying all the relevant standards with realistic constraints

Module:1	**State Variable Representation**	**6 Hours**
Introduction, Concept of State Equation for Dynamic Systems, Non Uniqueness of State model, State Diagrams, Physical Systems and State Assignments - State space representation of multivariable systems		
Module:2	**Solution Of State Equations**	**6 Hours**
State transition matrix – Properties and Computation. Controllability and Observability, Stabilizability and Detectability.		
Module:3	**Design In State Space**	**7 Hours**
State Feedback, Output Feedback, Design Methods, Pole Assignment, Full Order and Reduced Order Observers. Introduction to Linear Quadratic problems.		
Module:4	**Introduction To Non Linear Sytems**	**5 Hours**
Introduction, Features of Linear and Non Linear Systems, Types of non-linearity, Common nonlinearities in control systems, Typical Examples , Concept of phase portraits – Singular points – Limit cycles		
Module:5	**PHASE PLANE ANALYSIS**	**7 Hours**
Construction of phase portrait, Concepts of phase plane analysis Phase plane analysis of linear system and nonlinear system, Existence of limit cycles.		
Module:6	**Describing Function Analysis**	**6 Hours**
Describing function fundamentals, Describing functions of common nonlinearities, Describing function analysis of nonlinear systems, Limit cycles , Stability of Oscillations		
Module:7	**Stability Analysis**	**6 Hours**
Stability Concepts, Equilibrium Points, BIBO and Asymptotic Stability, Lyapunov theory,		

Lyapunov's Direct method, Variable gradient method Frequency Domain Stability Criteria, Popov's Method & its Extension.			
Module:8	**Contemporary issues:**		**2 Hours**
	Total Lecture hours:		**45 Hours**
Text Book(s)			
1.	Katsuhiko Ogata, "Modern Control Engineering ", PHI Learning Pvt Ltd, 5th Edition, 2010.		
2.	Hassan K Khalil, "Nonlinear Control ", Pearson Prentice Hall, 1st Edition, 2014.		
Reference Books			
1.	M. Gopal, "Modern Control Systems Theory", New Age Publishers, 3rd Edition, 2014.		
2.	Richard C. Dorf, Robert H. Bishop, "Modern Control Systems", Prentice Hall, 12th Edition, 2010.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4018.1	3	3	2	3	3	-	-	1	2	-	-	3	3	2	2
EEE4018.2	3	3	3	3	3	-	-	1	2	-	-	3	3	3	3
EEE4018.3	3	3	3	3	3	-	-	1	2	-	-	3	3	3	3
EEE4018.4	3	3	3	3	3	-	-	1	2	-	-	3	3	3	3
EEE4018.5	3	3	3	3	3	-	-	1	2	-	-	3	3	3	3
EEE4018.6	3	3	3	3	3	-	-	1	2	-	-	3	3	2	3
EEE4018.7	3	3	3	3	3	-	-	1	2	-	-	3	3	3	3
EEE4018.8	3	3	3	3	3	-	-	1	2	-	-	3	3	3	3
	3	3	3	3	3	-	-	-	2	-	-	3	3	3	3

EEE4019	Advanced Digital Design with FPGAs	L	T	P	J	C
		2	0	0	4	3
Pre-requisite	**EEE3002**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To learn complex digital systems using Hardware Description Language.
2. To learn field programmable gate array (FPGA) technologies and utilize associated computer aided design (CAD) tools to synthesize and analyze digital systems.

Expected Course Outcome:

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

1. Design and recognize the trade-offs involved in digital design flows for system
2. Compile and synthesize Verilog HDL.
3. Analyze and synthesize digital modules and circuits for a wide application range.
4. Design state machines to control complex systems.
5. Verify Verilog test bench to test Verilog modules.
6. Build a synchronous DSP system in Verilog and verify its performance.
7. Design a floating point arithmetic using the IEEE-754 Standard.
8. Design a component or a product applying all the relevant standards with realistic constraints

Module:1	**Introduction to FPGAs**	**3 Hours**

Basic Programmable Logic architectures, Complex Programmable Logic Devices (CPLDs), Field Programmable Gate Arrays (FPGAs), Design Flow, Design Tools.

Module:2	**Introduction to Verilog HDL**	**5 Hours**

Review of Verilog HDL, Modeling styles: Behavioral, Dataflow, and Structural Modeling, gate delays, switch-level Modeling, Hierarchal structural modeling.

Module:3	**Implementing Logic using MSI Combinational Logic Blocks**	**4 Hours**

Multiplexer, DeMultiplexer, Encoder, Decoder, ROM, PAL, PLA.

Module:4	**Verilog Modelling of Sequential Circuits**	**4 Hours**

Flip-Flops, Shift Registers, Counters, Finite State Machine Modelling.

Module:5	**Verification**	**3 Hours**

Functional verification, simulation types, Test Bench design, value change dump (VCD) files.

Module:6	**Design**	**6 Hours**

Adders and Substractors, Multiplication Digital Signal Processing modules: FIR and IIR Filters, Bus structures, Synchronous & Asynchronous data transfer, UART baud rate generator, A simple CPU design.

Module:7	**Floating point arithmetic circuits**	**3 Hours**

Adders, Subtractors, Multipliers

Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**30 Hours**

Text Book(s)

1. Michael D Ciletti, "Advanced Digital Design with the Verilog HDL" Prentice Hall, 2nd Edition, 2011.
2. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis" Pearson, Second Edition, 2009.

Reference Books

1. Stephen Brown & Zvonko Vranesic, "Fundamentals of digital Logic with Verilog Design" TATA Mc Graw Hill Ltd. 3rd Edition 2014.
2. Ming-Bo Lin., Digital System Designs and Practices Using Verilog HDL and FPGAs. Wiley, 2008.
3. Woods, R., McAllister, J., Yi, Y. and Lightbody, G. FPGA-based implementation of signal processing systems. John Wiley & Sons, 2017.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4019.1	3	2	2	2	1	-	-	-	2	-	-	3	1	2	1
EEE4019.2	3	2	3	2	3	-	-	-	2	-	-	3	3	2	3
EEE4019.3	3	3	2	2	1	-	-	-	2	-	-	3	3	2	3
EEE4019.4	3	3	3	2	3	-	-	-	2	-	-	3	3	2	3
EEE4019.5	3	3	1	3	3	-	-	-	3	-	-	3	2	1	1
EEE4019.6	3	3	3	3	3	-	-	-	2	-	-	3	2	1	3
EEE4019.7	3	3	3	3	3	-	-	-	2	-	-	3	3	2	3
EEE4019.8	3	3	3	3	3	-	-	-	2	-	-	3	3	2	3
	3	3	3	3	3	-	-	-	2	-	-	3	3	2	3

EEE4020	Embedded System Design		L	T	P	J	C
			2	0	0	4	3
Pre-requisite	EEE4001	**Syllabus version**					
Anti-requisite	NIL	v. 1.0					

Course Objectives:

1. To give an emphasis on the characteristics and hardware architecture of embedded system and real time operating systems.
2. To provide essential knowledge on various communication protocols and understanding of Mealy and Moore machines.
3. To provide the essential knowledge in the embedded modeling and design of finite state machines.

Expected Course Outcome:

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

1. Understand the characteristics and concepts of embedded system.
2. Understand the architecture of hardware embedded system
3. Compare the concepts of RTOS with general purpose OS.
4. Design hardware components/architecture for embedded system applications.
5. Interpret the wired and wireless communication protocols.
6. Design state space model using Moore and Mealy technique
7. Analyze the embedded system modelling with state transition and FSM.
8. Design a component or a product applying all the relevant standards with realistic constraints

Module:1	Introduction to Embedded systems:	3 Hours

Embedded system- Definition, Categories, Requirements. Challenges and issues in embedded software development, Trends in embedded software development, Applications of embedded systems.

Module:2	Hardware architecture of embedded system:	4 Hours

Processor, Memory, Memory models, Latches and Buffers, crystal, Timers, reset circuit, Watchdog timer, chip select logic circuit, ADC and DAC, Display units, Communication interfaces, Introduction to emulators.

Module:3	Real time operating system (RTOS) with Kernel:	4 Hours

RTOS vs General purpose OS, Kernel Architecture and Functionalities - Task management, Process Scheduling, Resource management (Semaphores and Mutex), Task Synchronization. Embedded software development Life cycle.

Module:4	Serial Bus for embedded systems:	5 Hours

I2C- Features, Arbitration, Bit Transfer Waveform and exceptions. CAN- Layered Architecture of CAN, properties, Data Rates, Frame types. USB- Physical interface, Enumeration process in USB, Types of packets, Types of transfers.

Module:5	Wireless Applications:	4 Hours

Introduction to wireless networking –Basics. Bluetooth – Overview, power levels, Device communication, Base band, Packet format, packet heading, packet types and packet timing. Overview of IEEE 802.15.4 standard feature, Device types and Frame format. ZigBee –

Architecture objectives, Network model, ZigBee stack block diagram, Network layer. ZigBee Vs Bluetooth.			
Module:6	**Introduction to Moore and Mealy models**		**4 Hours**
Design of a Level to Pulse converter implementing Moore and Mealy FSM- Block diagram, definition of the state, building state transition diagram to state table, Relative trade-offs. State space models of sequential machines- Introduction.			
Module:7	**Embedded System Modelling:**		**4 Hours**
Finite State Machine (FSM) - Rules for designing FSM, Design examples implementing state and state transition diagram for vending machine, ATM, digital lock.			
Module:8	**Contemporary issues:**		**2 Hours**
	Total Lecture hours:		**30 Hours**
Text Book(s)			
1. David.E. Simon, "An Embedded Software primer", Pearson Education Inc., 2012. 2. Tammy Noergaard, "Embedded systems architecture: a comprehensive guide for engineers and programmers" Berlin: Elsevier, 2014.			
Reference Books			
1. Xiacong Fan, "Real-time embedded systems: Design principles and engineering practices", Amsterdam [Netherlands]: Newnes, 2015. 2. Frank Vahid and Tony Givargis, "Embedded System Design: A Unified Hardware/Software Approach", Wiley; Student edition, 2010.			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4020.1	3	3	-	-	-	-	-	-	-	-	-	3	-	-	2
EEE4020.2	3	3	-	-	-	-	-	-	-	-	-	3	-	-	2
EEE4020.3	3	3	-	-	-	-	-	-	-	-	3	3	-	-	2
EEE4020.4	3	3	3	-	3	-	-	-	-	-	3	3	3	2	2
EEE4020.5	3	3	2	-	3	-	-	-	-	-	3	3	2	3	3
EEE4020.6	3	3	3	-	3	-	-	-	-	-	3	3	3	3	
EEE4020.7	3	3	3	-	3	-	-	-	-	-	3	3	3	3	3
EEE4020.8	3	3	3	-	3	-	-	-	-	-	3	3	3	3	3
	3	3	3		3						3	3	3	3	2

EEE4022	**Analog VLSI Design**		**L**	**T**	**P**	**J**	**C**
			3	**0**	**0**	**0**	**3**
Pre-requisite	**EEE3002**	**Syllabus version**					
Anti-requisite	NIL	v. 1.0					

Course Objectives:

1. To understand about various types of Analog systems, CMOS amplifiers and oscillators.
2. To understand Applications of MOSFET in Analog devices.

Expected Course Outcome:

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

1. Understand the characteristics of MOS and sizing of transistors
2. Analyze MOS based amplifier circuits with various configurations
3. Apply differential amplifiers using MOS for various applications
4. Explore Operational Amplifiers for linear ICs using CMOS
5. Design oscillators using MOS devices
6. Study the concepts of Phase-Locked Loops

Module:1	**Introduction to Analog VLSI design**:	**4 Hours**
Basic MOS device, I/V characteristics, small-signal model, long-channel and short channel devices.		
Module:2	**Single-Stage MOS Amplifier:**	**7 Hours**
Common source with resistive load, diode-connected load, current source load, Source follower, common gate, cascade amplifier.		
Module:3	**Differential Amplifiers:**	**8 Hours**
Single ended and differential operation, basic differential pair analysis, common mode response, differential pair with MOS loads and Frequency response of Amplifier.		
Module:4	**Current Mirrors:**	**5 Hours**
Basic current mirrors, cascade current mirrors, Active current mirrors- small signal analysis and common mode properties.		
Module:5	**Operational Amplifiers:**	**7 Hours**
Basic CMOS Op-Amp, One stage Op-amps, Two-stage Op-Amps, Gain Boosting, Noise in Op-Amp.		
Module:6	**Oscillators:**	**7 Hours**
Ring Oscillators, LC Oscillators, Voltage-Controlled Oscillators.		
Module:7	**Phase-Locked Loops:**	**5 Hours**
Basic PLL, Charge-Pump PLLs, Non-ideal effects in PLLs.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)

1.	Tony Chan Carusone David A. Johns Kenneth W. Martin, "Computer System Architecture", John Wiley & Sons, Inc, Second Edition, 2012.
2.	Behzad Razavi, "Design of Analog CMOS integrated circuits", Tata McGraw Hill, Second Edition, 2003.
Reference Books	
1. Jacob Baker, "CMOS circuit design", Wiley-IEEE press, Third Edition, 2010	

Mode of valuation:	CAT I & II – 30%, DA I & II – 20%, Quiz – 10%, FAT – 40%		
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4022.1	3	2	1	-	1	-	-	-	-	-	1	1	2	3	1
EEE4022.2	3	3	3	1	1	-	-	-	1	-	-	1	2	3	3
EEE4022.3	3	3	3	1	1	-	-	-	-	-	1	1	2	3	3
EEE4022.4	3	2	1	-	1	-	-	-	1	-	1	1	2	2	3
EEE4022.5	3	3	3	1	1	-	-	-	-	-	-	1	2	3	2
EEE4022.6	3	2	3	-	1	-	-	-	1	-	-	1	2	3	2
	3	3	3	1	1	-	-	-	1	-	1	1	2	3	3

EEE4024	Computer Architecture & Organization	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	**EEE3002**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To gain an understanding of computer data representation and manipulation.
2. To understand the basic organization for data storage and access across various media.

Expected Course Outcome:

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

1. Interpret the data flow between various modules of the computer and data representation in various formats.
2. Analyze the performance of processor and their interconnections.
3. Perform the various arithmetic tasks and familiarize the various multiplication algorithms.
4. Acquaint the knowledge about floating point and decimal arithmetic's.
5. Design the various register transfer functions and develop programs for various CPU organizations.
6. Realize the various mapping techniques and familiarize the various data transfer mechanism.
7. Describe the functionality and issues of parallel and vector processing. .

Module:1	**Fundamental Concepts**	**4 Hours**

Introduction- Generation of Computer, Computer families and developments, Functional units, Basic operational concepts, Data Representation-Fixed point and Floating point numbers.

Module:2	**Introduction to computer architecture**	**5 Hours**

CPU organization by Vou-Newmann model, CPU transistor count-Moore's law, Performance analysis of CPU, Typical Mother board, interconnection of components.

Module:3	**Computer Arithmetic**	**7 Hours**

Fixed-Point Arithmetic, Addition, Subtraction, Multiplication and Division, Combinational and Sequential ALUs, Carry look ahead adder, Robertson algorithm, booth's algorithm, Modified booth's Algorithm.

Module:4	**Floating point and Decimal Arithmetic**	**3 Hours**

Floating Point Arithmetic, Decimal Arithmetic unit-Decimal Arithmetic operations.

Module:5	**Introduction to CPU Design**	**9 Hours**

Function of CPU, Register Classification and organization, ALU and control unit, instruction set with examples, addressing modes, stack organization, Register Transfer, Bus and memory transfers, Input - Output and Interrupt. Micro programmed control CPU design.

Module:6	**Memory System Design and I/O Organization**	**7 Hours**

Basic concepts semiconductors, RAM memories, Read-only memories- Cache memory and related mapping- Virtual memories. Introduction to buses and connecting I/O devices to CPU and

memory-Programmed controlled I/O transfer- Interrupt controlled I/O transfer-DMA Controller.		
Module:7	**Pipeline and Vector Processing**	**8 Hours**
Introduction to pipelining and pipeline hazards-design issues of pipeline architecture-Instruction level parallelism and advanced issues-parallel processing concepts-Vector Processing, Array Processors, CISC, and RISC & VLIW.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)

1. William Stallings, "Computer Organization and Architecture", Prentice Hall, Tenth Edition, 2016.
2. Car Hamacher, Zvonks Vranesic, SafeaZaky, "Computer Organization", McGraw Hill, Fifth Edition, 2011.

Reference Books

1. David A. Patterson & John L. Hennessy, "Computer Architecture: A Quantitative Approach", Elsevier, Fifth Edition, 2012.

Mode of valuation:	CAT I & II – 30%, DA I & II – 20%, Quiz – 10%, FAT – 40%		
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4024.1	2	1	-	-	-	-	-	1	1	1	-	-	-	-	-
EEE4024.2	3	2	1	1	-	-	-	1	1	1	-	-	-	-	-
EEE4024.3	3	2	-	1	2	-	-	1	1	1	-	-	1	-	2
EEE4024.4	2	1	-	-	2	-	-	1	1	1	-	2	1	-	2
EEE4024.5	3	2	-	-	-	-	-	2	2	1	-	1	2	-	-
EEE4024.6	3	2	-	-	-	-	-	2	2	1	-	1	2	-	-
EEE4024.7	2	1	-	-	-	-	-	1	1	1	-	1	-	-	-
	3	2	1	1	2	-	-	2	2	1	-	2	2	-	2

EEE4026	Digital Control Systems	L	T	P	J	C
		2	0	0	4	3
Pre-requisite	**EEE3001**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. The aim of this course is to understand the discretization of continuous system
2. To understand the discrete state space modelling of physical systems and to exploit the properties such as controllability, observability.
3. Synthesis the digital controller.

Expected Course Outcome:

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

1. Visualise discrete and continuous system
2. Analyze the response of the discrete system.
3. Analyze the stability of the discrete system.
4. Infer controllability/ observability of a system
5. Analyse and design digital PID controllers
6. Discuss and analyze State variable methods
7. Understand the mechanization of control algorithms
8. Design a component or a product applying all the relevant standards with realistic constraints

Module:1	**Introduction:**	**4 Hours**

Overview of design approaches, continuous versus digital control, sampling process, Sample and hold device, A/D, D/A conversion. Calculus of difference equations. Z-transform. Pulse transfer function

Module:2	**Stability Analysis of discrete systems:**	**2 Hours**

location of poles, Jury's stability criterion, stability analysis through bilinear transforms.

Module:3	**State variable analysis :**	**4 Hours**

State equations of discrete data systems – State transition equations – Relationship between state equation and transfer functions - Characteristic equations – Eigen value – Eigen vector.

Module:4	**State Space Model Transformation:**	**4 Hours**

Diagonalization of Matrix – Jordan canonical form – Methods of computing state transition matrix – State diagram – Decomposition of discrete data transfer function. Controllability and observability of linier time invariant discrete data systems.

Module:5	**Design of Digital Control Systems - Classical Method:**	**6 Hours**

Digital PID controllers and frequency domain compensation design.

Module:6	**Design of Digital Control Systems – State Feedback Design:**	**5 Hours**

State variable methods - Pole placement design, Observer design and the discrete linear regulator problem.

Module:7	**Microprocessor Based Digital Control Implementation:**	**3 Hours**
Selection of processors – Mechanization of control algorithms. Iterative computation via parallel, direct, canonical, cascade realization. Case studies.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**30 Hours**

Text Book(s)

1. K. Ogata, "Discrete-time control systems", Pearson, 2015.
2. G. F. Franklin, J. D. Powell and M Workman, 'Digital Control of Dynamic Systems' PHI (Pearson), 2008.

Reference Books

1. G. F. Franklin, J. D. Powell and A. E. Naeini, 'Feedback Control of Dynamic Systems' PHI (Pearson), 2015.
2. Loan D. Landau, Gianluca Zito, 'Digital Control Systems, Design, Identification and Implementation' Springer, 2007.
3. D. Ibrahim, 'Micro-controller based Applied Digital Control' John Wiley & Sons Ltd., 2006
4. .M.Gopal, "Digital Control Engineering", New Age Publishers, 2008.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4026.1	3	3	2	3	3	-	-	1	2	2	-	3	3	2	2
EEE4026.2	3	3	3	3	3	-	-	1	2	2	-	3	3	3	3
EEE4026.3	3	3	3	3	3	-	-	1	2	2	-	3	3	3	3
EEE4026.4	3	3	3	3	3	-	-	1	2	2	-	3	3	3	3
EEE4026.5	3	3	3	3	3	-	-	1	2	2	-	3	3	3	3
EEE4026.6	3	3	3	3	3	-	-	1	2	2	-	3	3	2	3
EEE4026.7	3	3	3	3	3	-	-	1	2	2	-	3	3	3	3
EEE4026.8	3	3	3	3	3	-	-	1	2	2	-	3	3	3	3
	3	3	3	3	3	-	-	1	2	2	-	3	3	3	3

EEE4027	**Robotics and Control**		**L**	**T**	**P**	**J**	**C**
			2	**0**	**0**	**4**	**3**
Pre-requisite	**EEE3001**	**Syllabus version**					
Anti-requisite	NIL	v. 1.0					

Course Objectives:

1. To develop the student's knowledge in various robot structures and their workspace.
2. To develop student's skills in performing spatial transformations associated with rigid body motions & some knowledge and analysis skills associated with trajectory planning.
3. To develop student's skills in performing kinematic analysis of robotic systems and some knowledge and skills associated with robot control

Expected Course Outcome:

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

1. Select different types of sensors and actuators for robotic systems
2. Apply spatial transformation to obtain the forward kinematic equation of robot manipulators.
3. Analyse forward and inverse kinematics for simple robot manipulators.
4. Derive Jacobian matrix and identify singularities.
5. Identify the dynamics of the robotic manipulator using Euler Lagrangian approach
6. Generate joint trajectories for motion planning.
7. Implement the multivariable controller for setpoint tracking and disturbance rejection
8. Design a component or a product applying all the relevant standards with realistic constraints

Module:1	**Introduction**	**2 Hours**

Brief History, Types of robots, Degrees of freedom of robots, Robot configurations and concept of workspace, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.

Module:2	**Rigid Motion and Homogeneous transformation**	**5 Hours**

Position definitions. Coordinate frames. Different orientation descriptions. Free vectors. Translations rotations and relative motion, Composition of rotation, rotation with respect to fixed frame and current frame, parameterisation of rotation, Euler Angele, roll, pitch, yaw, axis/angle representation, Homogeneous transformation

Module:3	**Forward Kinematics**	**4 Hours**

Link coordinate frames. Denavit-Hartenberg convention. Assignment, of coordinate frame, Joint and end effector Cartesian space. Calculation of DH parameters and forward kinematic equation of different configuration of manipulator, Planner elbow manipulator, Cylindrical three link, SCARA, Spherical Wrist and other configuration.

Module:4	**Velocity Kinematics:**	**4 Hours**

Forward kinematics transformations of position Translational and rotational velocities. Velocity Transformations. Singularity, The Manipulator Jacobian.

Module:5	**Robot Dynamics**	**4 Hours**

Lagrangian formulation, general expression for kinetic and potential energy of n-link manipulator, Newton-Euler equations of motion. Derivation of equations of motion for simple cases: two-link manipulators.

Module:6	**Trajectory Planning& Programming**	**5 Hours**

Trajectory planning and avoidance of obstacles.Trajectory for point to point motion,Cubic polynomial trajectory,Quintic polynomial, LSPB(Linear segment with parabolic blend)Minimum

time trajectory, Trajectories for Paths Specified by Via Points. Robot languages, computer control and Robot software			
Module:7	**Independent Joint Control:**	**4 Hours**	
Actuator dynamics, Set point tracking Feed forward control, Drive Train dynamics. Introduction to force control and multivariable control.			
Module:8	**Contemporary issues:**	**2 Hours**	
Text Book(s)			
1.	M.W. Spong, S. Hutchinson, and M. Vidyasagar, Robot Modeling and Control, Wiley, 2nd revise edition, 2012		
2.	J.J. Craig, Introduction to Robotics: Mechanics and Control, Pearson Education, 4th Edition, 2017		
3.	M.P. Groover, et.al., Industrial Robots: Technology, Programming and applications, McGraw Hill, 2nd indian edition, 2012.		
Reference Books			
1.	Robot Manipulators : Modeling, Performance Analysis and Control. by Etienne Dombre; Wisama Khalil, Somerset : Wiley, 2013.		
2.	M O Tokhi, A K M Azad,Flexible robot manipulator :modelling,simulation and control 2nd edition, 2017.		
3.	Ashitava Ghosal.Robotic fundamental Concept and Analysis,Oxford University Press 11th impression 2015.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4027.1	3	2	1	1	-	-	-	2	1	1	-	1	-	-	-
EEE4027.2	3	2	1	1	1	-	-	2	1	1	-	1	2	2	2
EEE4027.3	3	3	2	2	-	-	-	2	1	1	-	1	2	2	-
EEE4027.4	3	2	1	1	1	-	-	2	1	1	-	1	2	2	2
EEE4027.5	3	2	1	1	2	-	-	-	1	1	-	-	2	2	2
EEE4027.6	3	2	1	2	3	-	-	-	1	1	-	1	2	2	2
EEE4027.7	3	2	1	2	3	-	-	-	1	1	-	1	2	2	2
EEE4027.8	3	3	2	3	3	-	-	2	3	3	1	2	2	2	3
	3	3	2	2	3	-	-	2	2	2	1	2	2	2	3

VIT Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

EEE4028	**VLSI Design**		**L**	**T**	**P**	**J**	**C**
			3	**0**	**2**	**0**	**4**
Pre-requisite	**EEE3002**	**Syllabus version**					
Anti-requisite	NIL	v. 2.0					

Course Objectives:

1. To provide an understanding of the digital VLSI concepts, circuit design, principles.
2. To provide introduction to architecture and design concepts underlying modern complex VLSI.
3. To provide students with the background needed to design, develop, and test digital circuits using VHSIC Hardware Description Language (VHDL) and Verilog HDL.
4. To provide the students to design the digital circuits using transistors for complex systems.

Expected Course Outcome:

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

1. Analyze and identify the methodologies for fabricating the ICs.
2. Synthesize and design arithmetic circuits using HDL.
3. Design logic circuits using CMOS and its equivalent layout for fabrication.
4. Analyze the characteristics of CMOS to reduce the delay and power dissipation in logic circuits.
5. Identify transistor configurations for better performance in logic circuits.
6. Design memory devices using transistors.
7. Identify and design arithmetic circuits for various applications.
8. Design and Conduct experiments, as well as analyze and interpret data

Module:1	**Overview of VLSI Design Methodology**	**4 Hours**

The VLSI design process, Architectural design, logical design, Physical design, layout styles, Full custom, Semi custom approaches.

Module:2	**Introduction to Verilog HDL**	**6 Hours**

Introduction Verilog HDL, Gate level, data flow, behavioral modeling, Data types and Operators, Blocking and non-blocking assignment statements. Test benches.

Module:3	**Introduction to MOS Devices**	**6 Hours**

Introduction to MOS Transistor Theory: nMOS, pMOS Enhancement Transistor, MOSFET as a Switch, Threshold voltage, MOS Device Design Equations, Body effect, Second order effects. MOS Transistor Circuit Model. Stick Diagram, Layout Design Rules.

Module:4	**Circuit Characterization And Performance Estimation**	**6 Hours**

DC Characteristics of CMOS Inverter, Switching Characteristics of CMOS Inverter, Transistor Sizing Analytical Delay model- Rise Time, Fall Time. Gate Delays, RC Delay Models, Logical Effort. Power Dissipation: Static- Dynamic-Short Circuit Power Dissipation

Module:5	**Combinational logic Circuits**	**6 Hours**

Introduction, Static CMOS Design- Complex Logic Gates, Ratioed Logic, Pass-Transistor Logic, Transmission gate Logic, Dynamic CMOS Logic Design: Dynamic Logic Design Considerations. Speed and Power Dissipation of Dynamic logic, Signal integrity issues, Cascading Dynamic gates.

Module:6	**Sequential Logic Circuits**	**6 Hours**

Static and Dynamic Latches and Registers, Timing issues, pipelining		
Module:7	**Designing arithmetic circuits**	**9 Hours**
Adders-Ripple carry, Carry-Look ahead, Multiplier using Array based-Ripple carry adder, Carry-Save adder, Multiplier using Tree based-Wallace Tree, Dadda Tree, Booth Multiplier, Squarer. Modeling of arithmetic circuits using HDL: Pipelined Multiplier and Accumulator, FIR filter design. Verilog Coding for arithmetic circuits.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

List of Challenging Experiments (Indicative)		
1.	Four bit adder using different approaches for delay and Area reduction	2 Hours
2.	Four Bit Wallace tree multiplier	2 Hours
3.	Four bit dada tree multiplier	2 Hours
4.	Four bit squarer design	2 Hours
5.	Multiplier and Accumulator design	2 Hours
6.	FIR filter design	2 Hours
7.	CMOS switch level implementation of Complex Boolean functions	2 Hours
8.	CMOS switch level implementation of adder and subtractor	2 Hours
9.	Implementation of Boolean function using various transistors	2 Hours
10.	Positive and negative edge triggered register design	2 Hours
	Total Laboratory Hours	**30 hours**

Text Book(s)

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated circuits: A design perspective". Second Edition, Prentice Hall of India, 2013.
2. Neil H.E.Weste, David Money Harris, "CMOS VLSI DESIGN: a circuits and systems perspective", Fourth edition, Pearson 2015.

Reference Books

1. Samir Palnitkar, "Verilog HDL", Prentice Hall, 2010.
2. Sung-Ma Kong, Yusuf Leblebici and Chulwoo Kim, "CMOS digital integrated circuits: analysis and design", 4th edition, McGraw-Hill Education, 2015.

Mode of Evaluation:	CAT I & II – 30%, DA I & II – 20%, Quiz – 10%, FAT – 40%		
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4028.1	3	2	1	1	1							2			
EEE4028.2	3	2	1	2	2			2	2	2		2	2	2	2
EEE4028.3	3	1	1									1	2	1	1
EEE4028.4	3	3	2	1	1			1	1	1		1	1		1
EEE4028.5	3	3	2	1	1			1	1	1		1	1		1
EEE4028.6	3	3	2									1	1		1
EEE4028.7	3	2	1	2	2			2	2	2		2	2	2	2
EEE4028.8	3	3	3	3	3			2	2	3			2	1	2
	3	3	2	1	2	-	-	2	2	-	-	1	2	2	2

EEE4029	Advanced Microcontrollers	L	T	P	J	C
		2	0	0	4	3
Pre-requisite	**EEE4001**	**Syllabus version**				
Anti-requisite		v. 1.0				

Course Objectives:

1. To give an emphasis on the features of ARM Processors & PIC Microcontroller
2. To provide essential knowledge on various operating modes, I/O ports,
   a. Timers/Counters, control register and the various types of interrupts of those microcontroller.

Expected Course Outcome:

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

1. Describe the architecture of ARM processor
2. Analyse the Peripherals of ARM processor
3. Develop the Program for processor peripherals
4. Apply the knowledge to utilize the ARM processor for real time applications
5. Comprehend the architecture of PIC18FXX microcontroller
6. Develop the program for PIC18FXX microcontroller
7. Utilize the MPLAB software to simulate PIC18FXX microcontroller programs
8. Design a component or a product applying all the relevant standards with realistic constraints

Module	Title	Hours
Module:1	**Architecture of LPC 21XX**	**3 Hours**
Features, overview of LPC 21XX architecture, Various registers of 21XX, ports of LPC 21XX.		
Module:2	**Functional Blocks of LPC 21XX**	**4 Hours**
Timers, ADC and DAC, Serial communication and Interrupt.		
Module:3	**Programming of LPC21XX Functional Blocks**	**6 Hours**
Programming of LPC 21XX: GPIO, Timer, ADC, DAC, UART and Interrupt.		
Module:4	**Case Studies**	**3 Hours**
FAN speed control using temperature sensor, generation of delay, multitasking using interrupt.		
Module:5	**Architecture of PIC 18FXX**	**3 Hours**
Microcontroller Architecture—PIC18F Family, Programming Model and Its registers.		
Module:6	**Instruction Set & Functional Blocks of PIC 18FXX**	**6 Hours**
Data Transfer, Arithmetic, and Branch Instructions, Introduction to Logic, Bit Manipulation, and Multiply-Divide Operations, Stack and Subroutines. Input/output (I/O) Ports, Interrupts and Timers.		
Module:7	**Application Programs**	**3 Hours**
MPLAB introduction, solving real time problems using PIC 18FXX.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**30 Hours**

Text Book(s)

1. Andrew N Sloss , Dominic Symes , Chris Wright, " ARM System Developer's Guide: Designing and Optimizing System Software ", Morgan Kaufmann Publishers, 1st edition, 2009.

2.	Muhammad Ali Mazidi , Rolin D. McKinlay, Danny Causey, "PIC Microcontroller and Embedded Systems Using Assembly and C for PIC 18", Prentice Hall, 2nd Edition, 2009.
Reference Books	
1.	David Seal, "ARM Architecture Reference Manual ", Addison Wesley, 2nd Edition, 2007
2.	Peatman, "Designing with PIC Microcontroller", Pearson Education, 1st Edition, 2011.
3.	P.V Guruprasad, "Arm Architecture System on Chip and More ", Apress, 2013.
4.	http://www.nxp.com/documents/user_manual/UM10114.pdf.

Mode of Evaluation:	CAT I & II – 30%, DA I & II – 20%, Quiz – 10%, FAT – 40%		
Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4029.1	3	2	2	1	1	-	-	-	1	-	-	2	1	1	1
EEE4029.2	3	3	2	1	1	-	-	-	1	-	-	2	1	3	1
EEE4029.3	3	3	3	1	1	-	-	-	1	-	-	2	1	1	1
EEE4029.4	3	2	2	1	1	-	-	-	1	-	-	2	1	1	1
EEE4029.5	3	2	2	1	1	-	-	-	1	-	-	2	2	1	1
EEE4029.6	3	3	3	2	2	-	-	-	1	-	-	2	1	1	2
EEE4029.7	3	2	2	2	2	-	-	-	1	-	-	2	1	1	2
EEE4029.8	3	3	3	3	3	-	-	-	1	-	-	2	1	1	2
	3	3	3	3	3	-	-	-	1	-	-	2	2	3	3

EEE4030	**System on Chip Design**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**4**	**4**
Pre-requisite	**NIL**	**Syllabus version**				
Anti-requisite	NIL	v. 2.1				

Course Objectives:

1. To provide an overview on the present day design technology for System-On-Chip
2. To understand how various domains integrate with each other such as hardware and software, analogue and digital constructions.

Expected Course Outcome:

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

1. Understand the basics of SoC.
2. Solve the design issues in processors
3. Interpret the complex SoC system.
4. Develop the RTL coding for SoC designs.
5. Design and verify the various configurations of SoC system.
6. Acquire the knowledge of physical design flow.
7. Analyze the various routing issues in SoCs.
8. Design a component or a product applying all the relevant standards with realistic constraints

Module:1	**Introduction to SoCs**	**3 Hours**
Technology trends, design challenges, Overview of SoC Design Flow.		
Module:2	**SoC Design**	**7 Hours**
Hardware System Structure, Software structure, Semiconductor Economics, Major issues in SoC Design. Design for Integration. Accelerating Processor for traditional software task. System design multiple processors.		
Module:3	**System Level Design**	**5 Hours**
Complex SoC system architecture, Processor centric SoC organization, Communication Design – Hardware and Software interconnects, Non-processor building block in SoC design.		
Module:4	**RTL Synthesis**	**8 Hours**
Review of Verilog - RTL Coding and RTL Synthesis RTL coding guidelines, Synthesizable coding style, FSM Coding style, Memory Modeling.		
Module:5	**SoC Verification**	**10 Hours**
Verification technology options, Verification methodology. System level verification, block-level verification. Timing verification.		
Module:6	**Physical Design**	**7 Hours**
Partitioning, Floor Planning, Placement, Routing, Goals of routing - Global routing –Maze routing, Detailed routing, Over the Cell Routing, Physical verification and design sign-off.		
Module:7	**Routing**	**3 Hours**
Clock routing, Power and Ground routing, Clock tree synthesis.		
Module:8	**Contemporary issues:**	**2 Hours**

	Total Lecture hours:	**45 Hours**

Text Book(s)

1. Chris Rowen , "Engineering the Complex SOC: Fast, Flexible Design with Configurable Processors", Pearson, 2004.
2. Rochit Rajsuman, 'System-on-a-Chip: Design and Test', Artech House, 2006.

Reference Books

1. Prakash Rashinkar, Peter Paterson, Leena Singh, "System on a chip verification: Methodology and Verification", Kluwer Academic Publishers, 2013
2. Himanshu Bhatnagar, "Advanced ASIC Chip Synthesis", Kluwer Academic Publishers, 2nd Edition, 2002.
3. Rao Tummala, Madhavan Swaminathan , "Introduction to System-On-Package: Miniaturization of the entire system", McGraw-Hill, 1st Edition, 2008.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date:	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4030.1	3	2	2	1	1	-	-	-	1	-	-	2	2	1	1
EEE4030.2	3	3	2	1	1	-	-	-	1	-	-	2	2	3	1
EEE4030.3	3	2	2	1	1	-	-	-	1	-	-	2	2	1	1
EEE4030.4	3	2	3	1	1	-	-	-	1	-	-	2	2	1	3
EEE4030.5	3	2	3	1	1	-	-	-	1	-	-	2	2	1	3
EEE4030.6	2	2	2	1	1	-	-	-	1	-	-	2	2	1	1
EEE4030.7	3	3	2	1	1	-	-	-	1	-	-	2	2	3	1
EEE4030.8	3	3	3	1	1	-	-	-	1	-	-	2	2	1	3
	3	3	3	1	1	-	-	-	1	-	-	2	2	3	3

EEE4034	**Wireless Sensor Networks**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**4**	**4**
Pre-requisite	**EEE4021**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. To explore the basic fundamentals in wireless sensor technology.
2. To expose the students to the recent advances in various wireless networks.
3. To discover various routing mechanism and the storage requirement for networking of sensors.

Expected Course Outcome:

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

1. Understand the fundamentals and basic features of wireless sensor networks.
2. Analyze the localization and tracking techniques of wireless sensor networks
3. Acquire the knowledge about Medium access and sleep based control strategies for wireless channels
4. Realize the various routing protocols, energy minimization and security issues in sensor networks.
5. Understand the fundamentals of sensor tasking and control
6. Discuss the data storage management, retrieval and solve security challenges
7. Know the importance of wireless sensors security and reliability
8. Design a component or a product applying all the relevant standards with realistic constraints

Module:1	**Introduction**:	**8 Hours**

Basic sensor network architectural elements, Advantages of Sensor Networks, Applications - Technological Trends- Storage, search and Retrieval - Network Deployment - Structured versus randomized deployment - Network topology- Connectivity in geometric random graphs - Connectivity using power control-Coverage metrics- Mobile deployment

Module:2	**Localization and Tracking** :	**6 Hours**

Localization and Tracking – Localization approaches -Network-wide localization - Theoretical analysis of localization techniques-Tracking Methods

Module:3	**Medium Access and Sleep Based Topology Control:**	**6 Hours**

Medium Access and Sleep Based Topology Control - Contention-Free Medium Access -Contention-Based Medium Access -Wireless MAC Protocols - Characteristics of MAC Protocols in Sensor Networks -Hybrid MAC Protocols-Sleep based topology control

Module:4	**Routing:**	**7 Hours**

Routing–Energy aware routing – Unicast geographic routing, routing on a curve, energy minimizing broadcast, energy aware routing to a region, Attribute based routing – directed diffusion, rumor routing, geographic hash tables.

Module:5	**Sensor Tasking and Control:**	**5 Hours**

Sensor Tasking and Control – Task driven sensing, roles of sensor nodes and utilities, information based sensor tasking – IDSQ, cluster leader based protocol, sensor tasking in tracking relations, joint routing and information aggregation – multi step information directed routing, sensor group

management.		
Module:6	**Data-centric networking**:	**5 Hours**
Data-centric networking– Data-centric routing -Data-gathering with compression - Querying - Data-centric storage and retrieval- The database perspective on sensor networks-sensor group management.		
Module:7	**Transport reliability and Security:**	**5 Hours**
Transport reliability and Security - Basic mechanisms and tunable parameters- Reliability guarantees -Security Attacks in Sensor Networks - Protocols and Mechanisms for Security- Case Studies.		
Module:8	**Contemporary issues:**	**2 Hours**
	Total Lecture hours:	**45 Hours**

Text Book(s)

1.	BhaskarKrishnamachari, "Networking Wireless Sensors", Cambridge University Press, 2011.
2.	Ian Fuat Akyildiz, "Wireless sensor networks", Chichester [u.a.] : Wiley, 2011.

Reference Books

1.	Daniel Minoli, TaiebZnati,KazemSohra, 'Wireless Sensor Networks: Technology, Protocols, and Applications' John wiley& sons, 2007.
2.	Feng Zhao, Leonidas. J.Guibas, 'Wireless Sensor Networks', Morgan Kaufamann Publishers, 2008.
3.	Ivan Stojmenovi, 'Handbook of Sensor Networks: Algorithms and Architectures', Hoboken: John Wiley & Sons, 2005.
4.	Raghavendra, C. S., Sivalingam, Krishna M., Znati, Taie, Wireless Sensor Networks, Kluwer Academic publishers, 2007.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4034.1	3	1	1	1	1	-	-	-	1	-	-	1	2	1	1
EEE4034.2	1	3	1	1	1	-	-	-	1	-	-	1	2	3	1
EEE4034.3	3	1	1	1	1	-	-	-	1	-	-	1	2	1	1
EEE4034.4	3	1	1	1	1	-	-	-	1	-	-	1	2	1	1
EEE4034.5	3	1	1	1	1	-	-	-	1	-	-	1	2	1	1
EEE4034.6	1	3	1	3	1	-	-	-	1	-	-	1	2	2	1
EEE4034.7	3	1	1	1	1	-	-	-	1	-	-	1	2	1	1
EEE4034.8	1	1	3	3	3	-	-	-	1	-	-	1	2	1	1
	3	3	3	3	3	-	-	-	3	3	-	1	2	1	1

VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

EEE4035	**Virtual Instrumentation**	**L**	**T**	**P**	**J**	**C**
		0	**0**	**2**	**4**	**2**
Pre-requisite	**EEE4021**	**Syllabus version**				
Anti-requisite	NIL	v. 1.0				

Course Objectives:

1. Understanding Virtual Instrument concepts
2. Developing Virtual Instruments for practical works.
3. Analog and digital measurement principles
4. Data Acquisition operation

Expected Course Outcome:

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

1. Analyse the analog and digital signals acquired from devices.
2. Design a component or a product applying all the relevant standards with realistic constraints

List of Challenging Experiments (Indicative)

1	Basic arithmetic and boolean operations.
2	Program using SUBVI concept.
3	Wave forms & Graphs
4	Iterative data processing using (FOR,WHILE Loops, Formula Node.)
5	Case Structures.
6	Introduction to various tool boxes
7	Array and string operations.
8	Analog signals interfacing using DAQ.
9	Digital signals interfacing using DAQ.
10	NI ELVIS.

Text Book(s)

1.	Robert H Bishop, “LabVIEW”, Pearson,2016.

Reference Books

1	Gary W. Johnson, Richard Jenning, “LabVIEW Graphical Programming”, 4th /e, Tata McGraw Hill, New York, 2006.
2.	LabVIEW. Core 3, Exercises-manual by National instruments,2013.
3.	Ronald W Larsen, “LabVIEW for Engineers, Prentice Hall, 2011.
4.	S Sumathi, **“**LabVIEW based advanced instrumentation systems**”,** Springer, 2007.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Recommended by Board of Studies	**05/03/2016**		
Approved by Academic Council	**40th AC**	Date	**18/03/2016**

EEE4037	**Rapid Prototyping with FPGAs**	**L**	**T**	**P**	**J**	**C**
		0	**0**	**4**	**0**	**2**
Pre-requisite	**NIL**	**Syllabus version**				
Anti-requisite		v.1.0				

Course Objectives:

1. This course exposes students to hands-on experience in the design and test of a wide variety of prototype electric and electronic systems hardware
2. Engineering design by applying a combination of human creativity and modern computational tools to the synthesis of a simple component or system.

Expected Course Outcome:

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

1. Design and Conduct experiments, as well as analyze and interpret data

List of Experiments

1	Accumulator design in Verilog
2	MAC design in Verilog
3	HDL programming- Adder, Subtractor,Multplexer, Demultiplexer
4	Code converter
5	Shift register/Universal shift register
6	Upcounter/Downcounters
7	FIR filter
8	Array multiplier
9	Rapid Prototyping of Power Electronics Converters for Photovoltaic System Application Using Xilinx System Generator
10	Design Principles for Rapid Prototyping Forces Sensors Using 3-D Printing
11	Rapid Control Prototyping of Active Vibration Control Systems in Automotive Applications
12	Rapid Prototyping of a Low-Cost Solar Array Simulator Using an Off-the-Shelf DC Power Supply
13	Rapid Prototyping of Miniature Capsule Robots
Total Laboratory Hours	**60 hours**

Reference Books

1. Chee Kai Chua, Kah Fai Leong, Chu Sing Lim Rapid Prototyping: Principles and Applications ,3rd Edition, Kindle Edition
2. Miltiadis Boboulas, CAD-CAM & Rapid prototyping Application Evaluation, Bookboon
3. R. C. Cofer Benjamin Harding , Rapid System Prototyping with FPGAs

Recommended by Board of Studies	**10-05-2017**		
Approved by Academic Council	**53^{th} AC**	Date	**13-12-2018**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4037.1	3	3	3	2	3	-	-	-	1	-	-	1	3	1	3
EEE4037.2	3	3	3	2	3	-	-	-	1	-	-	1	3	1	3

EEE4038	Testing and Calibration Systems		L	T	P	J	C
			0	0	2	0	1
Pre-requisite	**EEE4021/EEE2004**	**Syllabus version**					
Anti-requisite	NIL	v. 1.0					

Course Objectives:

1. To explore the basic concepts and terminology of testing and calibration systems.

Expected Course Outcome:

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

1. Design and Conduct experiments, as well as analyze and interpret data

List of Experiments

1	Perform a comparative experimental study on Calibration of a Pressure Gauge Using a Dead Weight Pressure Gauge Calibrator and the Digital Pressure Calibrator.
2	Evaluate the errors and estimate the uncertainties during pressure measurement. Perform an experimental study on calibration of pressure gauge to overcome the same.
3	Perform an experimental study on calibration of rotameter. Evaluate the same by estimation of uncertainties during flow measurement.
4	Perform uncertainty calculations for the given Voltmeter and ammeter and calibrate the same using multifunctional calibrator system. Validate the meters for a given electrical circuit.
5	Conduct a verification and validation of a three-phase wattmeter and a single-phase wattmeter. Perform uncertainty calculations for the same
6	Configure and calibrate the given K-type thermocouple for measuring temperature of a kettle between 25°C to 250°C. Perform uncertainty analysis.
7	Perform a calibration and uncertainty analysis for a given thermistor for measuring temperature of a system between 25°C to 150°C.
8	Conduct a verification and validation of a hygrometer for measuring humidity. Perform measurement uncertainty for the same.
9	Perform an experiment for RTD and Thermocouple probe calibration.
10	Conduct an experiment for torque transducer calibration and check the errors
Total Laboratory Hours	**30 hours**

Reference Books

1. Calibration Handbook of Measuring Instruments by Alessandro Brunelli ,Ist Edition,ISA.
2. ction to Measuration and Calibration by Paul.D.Q. Campbell Industrial Press Inc
3. Sensors and Signal Conditioning by Ramon Pallas-Areny/John.G.Webster , Second Edition, Wiley India.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	**13-10-2018**		
Approved by Academic Council	**53rd AC**	Date	**13-12-2018**

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
EEE4038.1	3	3	3	3	3	-	-	-	1	-	-	1	3	3	3
	3	3	3	3	3	-	-	-	1	-	-	1	3	3	3

MEE1006	Applied Mechanics and Thermal Engineering	L	T	P	J	C
		2	0	2	0	3
Pre-requisite	NIL	`Syllabus version				
		2.1				

Course Objectives:

1. To make the students to understand the principles of solid mechanics.
2. To make the students to understand the basic concepts of mechanical vibrations.
3. To familiarize the students with the properties of fluids and the applications of fluid mechanics.
4. To make the students to understand the principles of thermodynamics and to get broad knowledge in its applications.
5. To provide the students a gist of the theory behind the refrigeration and air conditioning system.
6. To make the students to understand the principles of heat transfer.

Expected Course Outcome:

Student will be able to

1. Evaluate the allowable loads and associated allowable stresses before mechanical failure in different types of structures.
2. Assess the vibrations associated with various mechanical systems.
3. Apply the fundamental laws of thermodynamics for the analysis of wide range of thermodynamic systems.
4. Explain basic concepts of fluid mechanics and their applications.
5. Demonstrate and analyze various refrigeration and air conditioning systems.
6. Evaluate heat transfer through different modes.

Module 1	**Solid Mechanics**		**5 hour**

Concept of stress and strain-Normal and shear stress -relationship between stress and strain-Elasticity- poisson's ratio-shear force and bending moment diagrams for simply supported, cantilever and overhanging beams - Analysis of forces in truss members

Module 2	**Mechanical Vibrations**		**5 hour**

Single degree of freedom systems- Un-damped and damped- Natural frequency- transverse vibration of shafts- critical speed by Rayleigh's and Dunkerley's method.Forced vibration-Harmonic excitation-Magnification factor- Vibration isolation-Torsional vibration-Holzer's analysis.

Module 3	**Fluid Mechanics**		**4 hour**

Properties of fluid- Uniform and steady flow- Euler's and Bernoulli's Equations- pressure losses along the flow. Flow measurement- Venturi meter and Orifice meters, Pipes in series and parallel. Introduction to Turbines and pumps - classification of turbines - specific speed and speed governance. Classification of pumps- characteristics and efficiency.

Module 4	**Thermodynamic systems**		**3 hour**

Basic concepts of Thermodynamics - First law of thermodynamics– Second law of thermodynamics - applications. Working Principle of four stroke and two stroke engines - Open and closed cycle gas turbines

Module 5	**Steam Boilers and Turbines**		**3 hour**
Formation of steam – Thermal power plant – Boilers -Modern features of high-pressure boilers - Mountings and accessories - Steam turbines: Impulse and reaction principle.			
Module 6	**Compressors, Refrigeration and Air conditioning**		**5 hour**
Air Compressors- Principle of operation of reciprocating, centrifugal and axial flow compressors - Basic functions of refrigeration- Vapour Compression and Vapour absorption systems-Principle of air conditioning system- Types and comparison.			
Module 7	**Heat Transfer**		**3 hour**
Fundamentals of heat transfer-conduction, convection and radiation - Free convection and forced convection - Applications like cooling of electronic components, electric motor and transformers			
Module 8	**Contemporary Discussion**		**2 hour**
	Total hours	**30 hour**	
Mode: Flipped Class Room, [Lecture to be videotaped], Use of physical cut section models to lecture, Visit to Industry, Min of 2 lectures by industry experts.			

Practical Experiments

1. Evaluation of Engineering Stress / Strain Diagram on Steel rod, Thin and Twisted Bars under tension.
2. Compression test on Bricks, Concrete blocks.
3. Natural frequency of longitudinal vibration of spring mass system.
4. Determination of torsional vibration frequency of a single rotor system
5. Undamped free vibration of equivalent spring mass system
6. Damped vibration of equivalent spring mass system
7. Flow through Venturimeter
8. Flow through Orifice Meter
9. Verification of Bernoulli's Apparatus
10. Performance test on air-conditioning system
11. Performance test on vapour compression refrigeration system
12. Heat transfer in natural/forced convection
13. Heat transfer through a composite wall.

Mode of Evaluation	Continuous Assessment includes CAT I, CAT II, Assignments/Quizzes, FAT

Text Book(s)

1.	R.K. Rajput, (2010), Thermal Engineering, Lakshmi Publications

Reference Books

1.	Rogers and Mayhew, 'Engineering Thermodynamics – Work and Heat Transfer', Addision Wesley, New Delhi, 1999.
2.	B.K. Sarkar, 'Thermal Enginerring', Tata McGraw Hill, New Delhi, 1998.
3.	Ahmadal Ameen 'Refrigeration and Airconditioning' Prentice Hall of India Ltd, 2006.
4.	P.K. Nag, 'Heat Transfer', Tata McGraw Hill 2002.

5.	R.K. Rajput, (2006), Strength of materials (Mechanics of solids), S. Chand & Company Ltd.			
6.	P.K. Nag, ‘Basic and Applied Engineering Thermodynamics’, Tata McGraw Hill, New Delhi,2010.			
7.	B.K. Sachdeva, ‘Fundamentals of Engineering Heat and Mass Transfer (SI Units)’, New Age International (P) Limited (2009).			
8.	C.P. Arora ‘Refrigeration and Air Conditioning’, Tata McGraw Hill (2001).			
	Recommended by Board of Studies		**17.08.2017**	
	Approved by Academic Council No.	**47th AC**	Date	**05.10.2017**

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
MEE1006.1	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-
MEE1006.2	2	1	1	1	-	-	-	-	1	-	-	-	-	-	-
MEE1006.3	2	1	1	1	-	-	-	-	1	-	-	-	-	-	-
MEE1006.4	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-
MEE1006.5	2	1	1	1	-	-	-	-	1	-	-	-	-	-	-
MEE1006.6	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-

ECE3501	IoT Fundamentals	L	T	P	J	C
	Job Role: SSC/Q8210	2	0	2	4	4
Pre-requisite	NIL	**Syllabus version**				
		v.1.0				

Course Objectives:

1. To impart knowledge on the infrastructure, sensor technologies and networking technologies of IoT.
2. To analyse, design and develop IoT solutions.
3. To explore the entrepreneurial aspect of the Internet of Things
4. To apply the concept of Internet of Things in the real world scenarios

Expected Course Outcome:

After successfully completing the course the student should be able to

1. Identify the main component of IoT
2. Program the controller and sensor as part of IoT
3. Assess different Internet of Things technologies and their applications

Module	Title	Hours
Module:1	**Introduction:**	**2 hour**
IT-ITeS/BPM Industry – An Introduction, the relevance of the IT-ITeS sector, **Future Skills – An Introduction,** General overview of the Future Skills sub-sector		
Module:2	**Internet of Things - An Introduction:**	**3 hours**
Evolution of IoT and the trends, Impact of IoT on businesses and society, Existing IoT use cases and applications across industries.		
Module:3	**IoT Security and Privacy:**	**6 hours**
Security and privacy risks, analyze security risks, Technologies and methods that mitigate security, Privacy standards and regulations, Social and privacy impacts		
Module:4	**IoT Solutions**	**6 hours**
IoT use case development, Need and Goals for IoT solution, Adoption of IoT solutions, Planning for IoT Solution: Evaluate costs, competition, technology challenges and internal resource considerations, Need for stakeholder buy-in		
Module:5	**Prototyping the Pilot execution:**	**5 hours**
Prototype developing Stages, deploy real-time UI/UX visualizations, Methods and metrics to analyze and convey business outcomes, feedback and data obtained from execution.		
Module:6	**Scalability of IoT Solutions:**	**5 hours**
Roadmap for developing complete IoT solutions, Strategies for implementation, key Milestone, Scalability of IoT Solutions, Methods, platforms and tools. Web and Mobile Interfaces		
Module:7	**Build and Maintain Relationships at the Workplace, Team Empowerment**	**3 hours**

Total Lecture hours:		**30 hours**
Text Book(s)		
1.	Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A hands-on Approach", University Press, 2015.	
2.	Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things", Wiley,Nov 2013, (1 st edition)	
3.	Claire Rowland, Elizabeth Goodman, Martin Charlier, Ann Light, Algred Lui," Designing Connected Products: UX for the consumer internet of things", O'Reilly, (1 st edition),2015	
Reference Books		
1.	Rethinking the Internet of things: A Scalable Approach to Connecting Everything by Francis daCosta, Apress, 2014	
2.	Learning Internet of Things by Peter Waher, Packt Publishing, 2015	
3.	Designing the Internet of Things, by Adrian Mcewen, Hakin Cassimally , Wiley India Private Limited	
4.	Cloud Computing, Thomas Erl, Pearson Education, 2014	
5.	Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, William Stallings, Addison-Wesley Professional; 1 edition	
6.	https://nsdcindia.org/sites/default/files/MC_SSCQ8210_V1.0_IoT- Domain%20Specialist_09.04.2019.pdf	

List of Experiments

1. Measure the light intensity in the room and output data to the web API.
2. Control your home power outlet from anywhere using raspberry pi.
3. Build a web based application to automate door that unlocks itself using facial recognition.
4. Drinking water monitoring and analytics, consists of IoT device, cloud, and mobile and web app.
5. Smart Parking System
6. IoT based Healthcare application
7. Real-time environmental monitoring and weather prediction
8. Traffic pattern prediction
9. Smart Street light
10. Plant health monitoring

Total Laboratory Hours			30 hours
Recommended by Board of Studies			
Approved by Academic Council		Date	

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ECE3501.1	3	2	2	2	1	-	-	-	2	-	-	1	3	2	3
ECE3501.2	3	3	2	2	2	-	-	-	2	-	-	1	3	2	2
ECE3501.3	3	3	3	3	2	-	-	-	2	-	-	1	2	2	2
	3	3	2	2	2	-	-	-	2	-	-	1	3	2	2

VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

ECE3502	**IoT Domain Analyst**	**L**	**T**	**P**	**J**	**C**
	Job Role: SSC/Q8210	**2**	**0**	**2**	**4**	**4**
Pre-requisite		**Syllabus version**				
		v.1.0				

Course Objectives:

1. To impart knowledge on the infrastructure, sensor technologies and networking technologies of IoT.
2. To analyse, design and develop IoT solutions.
3. To explore the entrepreneurial aspect of the Internet of Things
4. To apply the concept of Internet of Things in the real world scenarios

Expected Course Outcome:

After successfully completing the course the student should be able to

1. Identify the main component of IoT
2. Program the controller and sensor as part of IoT
3. Assess different Internet of Things technologies and their applications

Module:1	**IoT Solution Models:**	**3 hour**
Models applied in IoT solutions, Semantic models for data models, Application of semantic models, information models, information models to structure data, relationships between data categories.		
Module:2	**Data Models :**	**3 hours**
Tags to organize data, tag data to pre-process large datasets, predictive models for forecasting, Application of predictive models.		
Module:3	**Simulation Scenarios:**	**4 hours**
Models to simulate real-world scenarios, Application of the models, stages of data lifecycle, reuse existing IoT solutions, reusability plan.		
Module:4	**Use Case Development**	**4 hours**
Approaches to gather business requirements, defining problem statements, business requirements for use case development, Assets for development of IoT solutions.		
Module:5	**Value engineering and Analysis:**	**4 hours**
Principles and phases of Value Engineering and Analysis, Frameworks for Value Engineering in IoT solutions, cost-function analysis of IoT solution components, action plans to incorporate Value Engineering, Data modelling requirements, Development models: Waterfall, Agile, Spiral, V models, monetization models for IoT use cases - ‘Outcomes As A Service’ model.		
Module:6	**Data Analytics for IoT Solutions:**	**6 hours**
Data generation, Data gathering, Data Pre-processing, data analyzation, application of analytics, vertical-specific algorithms, Exploratory Data Analysis.		
Module:7	**Deployment of Analytics Solutions**	**6 hours**
Anomaly Detection and Data Clustering, Predictive Analytics and Streaming Analytics, cloud/edge methods, integrating analytics models, performance of analytical models, Templates for data insights, deriving insights.		
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A hands-on Approach", University Press, 2015.
2.	Adrian McEwen & Hakim Cassimally, "Designing the Internet of Things", Wiley,Nov 2013, (1 st edition)
3.	Claire Rowland, Elizabeth Goodman, Martin Charlier, Ann Light, Algred Lui," Designing Connected Products: UX for the consumer internet of things", O'Reilly, (1 st edition),2015
Reference Books	
1.	Rethinking the Internet of things: A Scalable Approach to Connecting Everything by Francis daCosta, Apress, 2014
2.	Learning Internet of Things by Peter Waher, Packt Publishing, 2015
3.	Designing the Internet of Things, by Adrian Mcewen, Hakin Cassimally , Wiley India Private Limited
4.	Cloud Computing, Thomas Erl, Pearson Education, 2014
5.	Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud, William Stallings, Addison-Wesley Professional; 1 edition
6.	https://nsdcindia.org/sites/default/files/MC_SSCQ8210_V1.0 IoT- Domain %20 Specialist_09.04.2019.pdf

List of Experiments

1. Measure the light intensity in the room and output data to the web API.
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4. Drinking water monitoring and analytics, consists of IoT device, cloud, and mobile and web app.
5. Smart Parking System
6. IoT based Healthcare application
7. Real-time environmental monitoring and weather prediction
8. Traffic pattern prediction
9. Smart Street light
10. Plant health monitoring

		Total Laboratory Hours	30 hours
Recommended by Board of Studies			
Approved by Academic Council		Date	

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
ECE3502.1	3	2	2	2	2	-	-	-	2	-	-	1	3	2	3
ECE3502.2	3	3	2	2	2	-	-	-	2	-	-	1	3	2	2
ECE3502.3	3	3	3	3	2	-	-	-	2	-	-	1	2	2	2
ECE3502.4	3	3	2	2	2	-	-	-	2	-	-	1	3	2	2