VIT®

Vellore Institute of Technology

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

SCHOOL OF ELECTRONICS ENGINEERING

B. Tech BiomedicalEngineering

Curriculum

(*2017-2018 admitted students*)

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 ELECTRONICS ENGINEERING

To be a leader by imparting in-depth knowledge in Electronics Engineering, nurturing engineers, technologists and researchers of highest competence, who would engage in sustainable development to cater the global needs of industry and society.

MISSION STATEMENT OF THE SCHOOL OF ELECTRONICS ENGINEERING

- Create and maintain an environment to excel in teaching, learning and applied research in the fields of electronics, communication engineering and allied disciplines which pioneer for sustainable growth.
- Equip our students with necessary knowledge and skills which enable them to be lifelong learners to solve practical problems and to improve the quality of human life.

B. Tech Biomedical Engineering

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems

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

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

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

5. Graduates will be successful in pursuing higher studies in engineering or management

6. Graduates will pursue career paths in teaching or research

B. Tech Biomedical Engineering

PROGRAMME OUTCOMES (POs)

PO_01: Having an ability to apply mathematics and science in engineering applications.

PO_02: Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyse complex engineering problems.

PO_03: Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment

PO_04: Having an ability to design and conduct experiments, as well as to analyse and interpret data, and synthesis of information

PO_05: Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice

PO_06: Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems

PO_07: Having adaptive thinking and adaptability in relation to environmental context and sustainable development

PO_08: Having a clear understanding of professional and ethical responsibility

PO_09: Having cross cultural competency exhibited by working as a member or in teams

PO_10: Having a good working knowledge of communicating in English – communication with engineering community and society

PO_11: Having a good cognitive load management skills related to project management and finance

PO_12: Having interest and recognise the need for independent and lifelong learning

B. Tech Biomedical Engineering

PROGRAMME SPECIFIC OUTCOMES (PSOs)

On the completion of B.Tech Biomedical Engineering degree, Students will be able to

PSO1. Design and develop biomedical engineering devices and systems.

PSO2. Solve complex and multi-disciplinary real-world challenges in the field of diagnostics, acquisition, imaging, and analysis of bio signals.

PSO3: Use modern tools and techniques to solve contemporary problems in the field of biomedical engineering.

B. Tech Biomedical Engineering

CREDIT STRUCTURE

ategory	Credits
University core (UC)	70
Programme core (PC)	59
Programme elective (PE)	39
University elective (UE)	12
Total credits	**180**

UNIVERSITY CORE – 70 CREDITS

S. No	Course Code	Course Title	L	T	P	J	C
1	CHY1002	Environmental Science	3	0	0	0	3
2	CSE1001	Problem Solving and Programming	0	0	6	0	3
3	CSE1002	Problem Solving and Object Oriented Programming	0	0	6	0	3
4	ECE3999	Tech Answers for Real world Problems (TARP)	1	0	0	8	3
5	ECE4098	Comprehensive Examination	0	0	0	0	2
6	ECE4099	Co-op (Capstone Project + Industry Internship)	0	0	0	0	20
7	ENG1011	English for Engineers	0	0	4	0	2
8	HUM1021	Ethics and Values	2	0	0	0	2
9	MAT1011	Calculus for Engineers	3	0	2	0	4
10	MAT2001	Statistics for Engineers	2	2	2	0	4
11	MGT1022	Lean Start-up Management	1	0	0	4	2
12	PHY1001	Engineering Physics	3	0	2	0	4
13	PHY1999	Introduction to Innovative Projects	1	0	0	4	2
14	CHY1001	Engineering Chemistry	3	0	3	0	4
15	EXC4097	Personality Development (extra &co curricular activities)	0	0	0	0	2
16	FLC4097	Foreign Language (basket)	2	0	0	0	2
17	STS4097	Soft Skills [6x1 credit each]	0	0	0	0	6
18	ECE3099	Industry Internship	0	0	0	0	2

Programme Core – 60 Credits

S. No	Course Code	Course Title	L	T	P	J	C
1	MAT1001	Fundamentals of mathematics (Bridge courses)	3	2	0	0	NA
2	BIT1001	Introduction to Life Sciences (Bridge courses)	4	0	0	0	NA
3	BIT1012	Human Anatomy and Physiology	3	0	2	0	4
4	BIT1013	Semiconductor devices and circuits	2	0	2	4	4
5	ECE1004	Signals and Systems	2	0	0	4	3
6	ECE1010	Fundamentals of Electric and Magnetic Circuits	2	2	2	0	4
7	ECE1011	Medical Physics and Biomedical Instrumentation	3	0	2	0	4
8	ECE1014	Sensors and Measurements	2	0	2	0	3
9	ECE2006	Digital Signal Processing	2	0	2	4	4
10	ECE2012	Control Systems Engineering	2	0	0	4	3
11	ECE2015	Integrated Circuits	2	0	2	4	4
12	ECE2020	Digital Electronics	2	0	2	4	4
13	ECE3020	Diagnostic and Therapeutic Equipment	3	0	0	0	3
14	ECE3023	Microcontrollers and its applications	2	0	2	0	3
15	ECE3024	Analog and Digital Communication	2	0	2	0	3
16	ECE3025	Image Processing	1	0	2	0	2
17	MAT2002	Applications of Differential & Difference Equations	3	0	2	0	4
18	MAT3004	Applied Linear Algebra	3	2	0	0	4
19	MAT3005	Applied Numerical Methods	3	2	0	0	4

Programme Electives - 38 Credits

S.No	Course Code	Course Title	L	T	P	J	C
1	BIT1016	Biochemical analysis and techniques	3	0	2	0	4
2	BIT1018	Medical Optics	3	0	0	0	3
3	BIT1025	Hospital Management	2	0	0	0	2
4	BIT2022	Biomaterials & Artificial Organs	3	0	0	0	3
5	BIT2024	Biomechanics	2	0	0	4	3
6	BIT3015	Biofluid Dynamics	3	0	0	0	3
7	CSE2003	Data Structures and Algorithm	2	0	2	4	4
8	CSE2004	Data Base Management Systems	2	0	2	4	4
9	ECE2017	Physiological System Modeling	2	0	2	0	3
10	ECE2018	Medical Informatics	3	0	0	0	3
11	ECE2021	Medical Imaging Equipment	3	0	0	0	3
12	ECE2022	Graphical System Design for Biomedical Engineers	0	0	4	4	3
13	ECE3009	Neural Networks & Fuzzy Control	3	0	0	4	4
14	ECE3027	Bio-Signal Processing	2	0	2	0	3
15	ECE3028	BioMEMS& Systems on-chip	2	0	0	4	3
16	ECE4020	Telemedicine	3	0	0	0	3
17	ECE4023	Biometric Systems	3	0	0	0	3
18	ECE4024	Embedded Systems in Medical Applications	2	0	0	4	3

University Core (UC)

Course code	Course Title	L	T	P	J	C
CHY1701	Engineering Chemistry	3	0	2	0	4
Pre-requisite		Syllabus version				
		1.1				

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 absorbing properties of polymeric materials

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.	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	
2	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	1 h 30 min

2. 3.	Water Quality Monitoring: Assessment of total dissolved oxygen in different water samples by Winkler's method Estimation of sulphate/chloride in drinking water by conductivity method	3 h
4/5.	Material Analysis: Quantitative colorimetric determination of divalent metal ions of Ni/Fe/Cu using conventional and smart phone digital-imaging methods	3h
6.	Analysis of Iron in carbon steel by potentiometry	1 h 30 min
7.	Construction and working of an Zn-Cu electrochemical cell	1 h 30 min
8.	Determination of viscosity-average molecular weight of different natural/synthetic polymers	1 h 30 min
9.	Arduino microcontroller based sensor for monitoring pH/temperature/conductivity in samples.	1 h 30 min
	Total Laboratory Hours	17 hours

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

Course code	Course Title	L	T	P	J	C
CHY1002	Environmental Sciences	3	0	0	0	3
Pre-requisite		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: Students will be able to

1. Students will **recognize** the environmental issues in a problem oriented interdisciplinary perspectives
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.

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	No. 46	Date	24.08.2017

Course code	Course Title	L	T	P	J	C
CSE1001	PROBLEM SOLVING AND PROGRAMMING	0	0	6	0	3
Pre-requisite	NIL	Syllabus version				
		1.0				

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	3 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.	Operators and Expressions in Python	4 Hours
5.	Algorithmic Approach 1: Sequential	2 Hours
6.	Algorithmic Approach 2: Selection (if, elif, if.. else, nested if else	2 Hours
7.	Algorithmic Approach 3: Iteration (while and for)	4 Hours
8.	Strings and its Operations	2 Hours
9.	Regular Expressions	2 Hours
10.	List and its operations.	2 Hours
11.	Dictionaries: operations	2 Hours
12.	Tuples and its operations	2 Hours
13.	Set and its operations	2 Hours
14.	Functions, Recursions	2 Hours
15.	Sorting Techniques (Bubble/Selection/Insertion)	4 Hours
16.	Searching Techniques : Sequential Search and Binary Search	3 Hours
17.	Files and its Operations	4 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		No. 38	Date	23-10-2015

Course Code	Course Title	L	T	P	J	C
CSE1002	PROBLEM SOLVING AND OBJECT ORIENTED PROGRAMMING	0	0	6	0	3
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

1. To emphasize the benefits of object oriented concepts.
2.To enable 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/inputs and to use generic programming constructs to accommodate different datatypes.
6.Validate the program against file inputs towards solving the problem..

Module:1	Structured Programming	12 hours

Structured Programming conditional and looping statements - arrays - functions - pointers - dynamic memory allocation - structure

Module:2	Introduction to object oriented approach	10 hours

Introduction to object oriented approach: Why object oriented programming? - Characteristics of object oriented language: classes and objects - encapsulation - data abstraction - inheritance - polymorphism - Merits and Demerits of object oriented programming. UML - class diagram of OOP - Inline function default argument function - Exception handling (Standard) - reference: independent reference function returning reference pass by reference.

Module:3	Classes and objects	14 hours

Classes and objects: Definition of classes access specifier class versus structure constructor destructor copy constructor and its importance array of objects dynamic objects - friend function-friend class

Module:4	Polymorphism and Inheritance	26 hours

Polymorphism and Inheritance: Polymorphism - compile time polymorphism function over-loading operator overloading. Inheritance - types of inheritance - constructors and destructors in inheritance constraints of multiple inheritance - virtual base class - run time polymorphism-function overriding

Module:5	Exception handling and Templates	18 hours

Exception handling and Templates Exception handling(user-defined exception) - Function tem-

plate , Class template Template with inheritance , STL Container, Algorithm, Iterator - vector, list, stack, map		
Module:6	**IO Streams and Files**	**10 hours**
IOstreams and Files IOstreams, Manipulators - overloading Inserters( ) and Extractors( ), Sequential and Random files writing and reading objects into/from files		
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		
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.	10 hours
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.	15 hours
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.	10 hours
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	15 hours

	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	15 hours
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.	15 hours
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.	10 hours
	Total Laboratory Hours	90 hours

Mode of assessment: Project/Activity			
Recommended by Board of Studies	29-10-2015		
Approved by Academic Council	No. 39	Date	17-12-2015

ECE3099	Industrial Internship	L	T	P	J	C
		0	0	0	0	2
Pre-requisite	Completion of minimum of Two semesters					

Course Objectives:

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

Course code	Technical Answers for Real World Problems (TARP)	L	T	P	J	C
ECE3999		1	0	0	8	3
Pre-requisite	PHY1999 and 115 Credits Earned	Syllabus version				
		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

Module:1 **15 hours**

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

Course Code	Course Title	L	T	P	J	C
ECE4099	Capstone Project	0	0	0	0	20
Pre-requisite	As per the academic regulations	Syllabus version				
		1.0				

Course Objectives:

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

Course code	Course title	L	T	P	J	C	
ENG1011	English for Engineers	0	0	4	0	2	
Pre-requisite	Cleared EPT / Effective English	Syllabus version					
		v. 2.2					

Course Objectives:

1. To facilitate effective language skills for academic purposes and real-life situations.
2. To enhance students' language and communication with focus on placement skills development.
3. To aid students apply language and communication skills in professional reading and reporting.

Expected Course Outcome:

1. Apply language skills with ease in academic and real-life situations.
2. Build up a job winning digital foot print and learn to face interviews confidently.
3. Develop good interpreting and reporting skills to aid them in research.
4. Comprehend language and communication skills in academic and social contexts.
5. Acquire vocabulary and learn strategies for error-free communication.

Module:1	**Listening**	**4 hours**
Casual and Academic		
Module:2	**Speaking**	**4 hours**
Socializing Skills - Introducing Oneself- His / Her Goals & SWOT		
Module:3	**Reading**	**2 hours**
Skimming and Scanning		
Module:4	**Writing**	**2 hours**
Error-free sentences, Paragraphs		
Module:5	**Listening**	**4 hours**
News (Authentic Material): Analyzing General and Domain Specific Information		
Module:6	**Speaking**	**4 hours**
Group Discussion on factual, controversial and abstract issues		
Module:7	**Reading:**	**2 hours**
Extensive Reading		
Module:8	**Writing**	**2 hours**
Email Etiquette with focus on Content and Audience		
Module:9	**Listening**	**4 hours**
Speeches : General and Domain Specific Information		
Module:10	**Speaking**	**4 hours**
Developing Persuasive Skills - Turncoat and Debate		

Module:11	**Reading**	**2 hours**
Intensive Reading		
Module:12	**Writing**	**2 hours**
Data Transcoding		
Module:13	**Cross Cultural Communication**	**4 hours**
Understanding Inter and Cross-Cultural Communication Nuances		
Module:14	**Speaking**	**4 hours**
Public Speaking/Extempore /Monologues		
Module:15	**Reading for research**	**2 hours**
Reading Scientific/Technical Articles		
Module:16	**Writing**	**2 hours**
Creating a Digital/Online Profile – LinkedIn (Résumé/Video Profile)		
Module:17	**Speaking:**	**4 hours**
Mock Job/Placement Interviews		
Module:18	**Writing**	**2 hours**
Report Writing		
Module:19	**Speaking**	**4 hours**
Presentation using Digital Tools		
Module:20	**Vocabulary**	**2 hours**
Crossword Puzzles/Word games		
	Total Lecture hours:	**60 hours**

Text Book (s)	
1.	Clive Oxenden 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 –
	Feb 2013, Oxford University Press, UK
2	
	Clive Oxenden and Christina Latham-Koenig,New English File: Advanced Students
	Book Paperback – Feb 2012, Oxford University Press, UK
3	Michael Vince,Language Practice for Advanced - Students Book, Feb. 2014, 4th Edition, Macmillan Education, Oxford, UnitedKingdom
Reference Books	

1.	Steven Brown, Dorolyn Smith, Active Listening 3, 2011, 3rd Edition, Cambridge University Press,
	UK
2.	Tony Lynch, Study Listening, 2013, 2nd Edition, Cambridge University Press, UK
3.	Liz Hamp-Lyons, Ben Heasley, Study Writing, 2010, 2nd Edition, Cambridge University Press, UK
	Kenneth Anderson, Joan Maclean, Tony Lynch, Study Speaking, 2013, 2nd Edition, Cambridge
4.	University Press, UK
5.	Eric H. Glendinning, Beverly Holmstrom, Study Reading, 2012, 2nd Edition Cambridge University
	Press, UK
6.	Michael Swan, Practical English Usage (Practical English Usage), Jun 2017, 4th edition, Oxford
	University Press, UK
7.	Michael McCarthy, Felicity O'Dell, English Vocabulary in Use Advanced (South Asian Edition),
	May 2015, Cambridge University Press, UK
8.	Michael Swan, Catherine Walter, Oxford English Grammar Course Advanced, Feb 2012,
	4th Edition, Oxford University Press, UK
9.	Heather Silyn-Roberts, Writing for Science and Engineering: Papers, Presentations and Reports,
	Jun 2016, 2nd Edition, Butterworth-Heinemann, UK

Mode of Evaluation: Assignment and FAT- Mini Project, Flipped Class Room, Lecture, PPT's, Role play, Assignments Class/Virtual Presentations, Report and beyond the classroom activities

List of Challenging Experiments (Indicative)		
1.	Create a Digital or Online Profile or a Digital Footprint	6 hours
2.	Prepare a video resume	8 hours
3.	Analyse a documentary critically	4 hours
4.	Turn Coat- Speaking for and against the topic / Activities through VIT Community Radio	6 hours
5	Present a topic using 'Prezi'	6 hours
6	Analyse a case on cross cultural communication critically	6 hours
7	Create a list of words relating to your domain	4 hours
8	Listen to a conversation of native speakers of English and answer the following questions	6 hours

9	Read an article and critically analyse the text in about 150 words	6 hours
10	Read an autobiography and role play the character in class by taking an excerpt from the book	8 hours
	Total Practical Hours	**60 hours**

Mode of evaluation: Mini Project, Flipped Class Room, Lecture, PPT's, Role play, Assignments Class/Virtual Presentations, Report and beyond the classroom activities			
Recommended by Board of Studies	22-07-2017		
Approved by Academic Council	No. 47	Date	24.08.2017

Course code	Course title	L	T	P	J	C
HUM1021	ETHICS AND VALUES	2	0	0	0	2
Pre-requisite	Nil	Syllabus version				
		1.1				

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. Follow sound morals and ethical values scrupulously to prove as good citizens
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 websites

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.
3. Pagliaro, L.A. and Pagliaro, A.M, "Handbook of Child and Adolescent Drug and Substance 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	No. 46	Date	24-08-2017

Course Code	Course Title	L	T	P	J	C
MAT-1011	**Calculus for Engineers**	3	0	2	0	4
Pre-requisite	**MAT1001**	**Syllabus Version**				
		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 Outcomes:

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

1. apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions
2. understand basic 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 with or without constraints
4. evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates.
5. understand gradient, directional derivatives, divergence, curl and Greens', Stokes, Gauss theorems
6. demonstrate MATLAB code for challenging problems in engineering

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	No. 37	Date	16-06-2015

Course Code	Course title	L	T	P	J	C
MAT2001	Statistics for Engineers	3	0	2	0	4
Prerequisites	MAT1011 – Calculus for Engineers	Syllabus Version				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. Compute and interpret descriptive statistics using numerical and graphical techniques.
2. Understand the basic concepts of random variables and find an appropriate distribution for analysing data specific to an experiment.
3. Apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data.
4. Make appropriate decisions using statistical inference that is the central to experimental research.
5. Use statistical methodology and tools in reliability engineering problems.
6. 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, Prentice Hall India (2011).
4. 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)		
	Introduction: Understanding Data types; importing/exporting data.	2 hours
	Computing Summary Statistics /plotting and visualizing data using Tabulation and Graphical Representations.	2 hours
	Applying correlation and simple linear regression model to real dataset; computing and interpreting the coefficient of determination.	2 hours
	Applying multiple linear regression model to real dataset; computing and interpreting the multiple coefficient of determination.	2 hours
	Fitting the following probability distributions: Binomial distribution	2 hours
	Normal distribution, Poisson distribution	2 hours
	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
	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
	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	Date:	05-10-2017

Course code	Course title	L	T	P	J	C
MGT1022	Lean Start up Management	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
   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	37	Date	16-06-2015

Course code	Course title	L	T	P	J	C
PHY1701	Engineering Physics	3	0	2	0	4
Pre-requisite	None	Syllabus version				
		V.2.1				

Course Objectives:

To enable the students to understand the basics of the latest advancements in Physics viz., Quantum Mechanics, Nanotechnology, Lasers, Electro Magnetic Theory and Fiber Optics.

Expected Course Outcome: Students will be able to

1. Comprehend the dual nature of radiation and matter.
2. Compute Schrodinger's equations to solve finite and infinite potential problems.
3. Analyze quantum ideas at the nanoscale.
4. Apply quantum ideas for understanding the operation and working principle of optoelectronic devices.
5. Recall the Maxwell's equations in differential and integral form.
6. Design the various types of optical fibers for different Engineering applications.
7. Explain concept of Lorentz Transformation for Engineering applications.
8. 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 and Optoelectronic Devices	10 hours

Light propagation through fibers, Acceptance angle, Numerical Aperture, Types of fibers - step index, graded index, single mode & multimode, Attenuation, Dispersion-intermodal and

intramodal. Sources-LED & Laser Diode, Detectors-Photodetectors- PN & PIN - Applications of fiber optics in communication- Endoscopy.		
Module:7	**Special Theory of Relativity**	**5 hours**
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
5.	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.
	Ajoy Ghatak and K. Thyagarajan, Introduction to Fiber Optics, 2010, Cambridge University Press.

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

List of Experiments

1.	Determination of Planck's constant using electroluminescence process	2 hrs
2.	Electron diffraction	2 hrs
3.	Determination of wavelength of laser source (He -Ne laser and diode lasers of different wavelengths) using diffraction technique	2 hrs
4.	Determination of size of fine particle using laser diffraction	2 hrs
5.	Determination of the track width (periodicity) in a written CD	2 hrs
6.	Optical Fiber communication (source + optical fiber + detector)	2 hrs
7.	Analysis of crystallite size and strain in a nano -crystalline film using X-ray diffraction	2 hrs
8.	Numerical solutions of Schrödinger equation (e.g. particle in a box problem) (can be given as an assignment)	2 hrs
9.	Laser coherence length measurement	2 hrs
10.	Proof for transverse nature of E.M. waves	2 hrs
11.	Quantum confinement and Heisenberg's uncertainty principle	2 hrs
12.	Determination of angle of prism and refractive index for various colour –	2 hrs

	Spectrometer			
13.	Determination of divergence of a laser beam			2 hrs
14.	Determination of crystalline size for nanomaterial (Computer simulation)			2 hrs
15.	Demonstration of phase velocity and group velocity (Computer simulation)			2 hrs
			Total Laboratory Hours	30 hrs
Mode of evaluation: CAT / FAT				
Recommended by Board of Studies	04-06-2019			
Approved by Academic Council	No. 55	Date	13-06-2019	

Course code	Course title	L	T	P	J	C
PHY1999	Introduction to Innovative Projects	1	0	0	4	2
Pre-requisite	None	Syllabus version				
		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. Comprehend the various types of thinking skills.
2. Explain the innovative and creative ideas.
3. Analyze a suitable solution for socially relevant issues

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	No. 39	Date	17-12-2015

Course code	Course title	L	T	P	J	C
STS1001	Introduction to Soft skills	3	0	0	0	1
Pre-requisite	None	Syllabus version				
		1				

Course Objectives:

1. To enhance the ability to plan better and work as a team effectively
2. To boost the learning ability and to acquire analytical and research skills
3. To educate the habits required to achieve success

Expected Course Outcome:

- Enabling students to know themselves and interact better with self and environment

Module:1	Lessons on excellence	10 hours

Ethics and integrity : Importance of ethics in life, Intuitionism vs Consequentialism, Non-consequentialism, Virtue ethics vs situation ethics, Integrity - listen to conscience, Stand up for what is right. **Change management:** Who moved my cheese?, Tolerance of change and uncertainty, Joining the bandwagon, Adapting change for growth - overcoming inhibition
How to pick up skills faster?: Knowledge vs skill, Skill introspection, Skill acquisition, "10,000 hours rule" and the converse .**Habit formation:** Know your habits, How habits work? - The scientific approach, How habits work? - The psychological approach, Habits and professional success, "The Habit Loop", Domino effect, Unlearning a bad habit
Analytic and research skills: Focused and targeted information seeking, How to make Google work for you, Data assimilation

Module:2	Team skills	11 hours

Goal setting: SMART goals, Action plans, Obstacles -Failure management. **Motivation :** Rewards and other motivational factors, Maslow's hierarchy of needs, Internal and external motivation. **Facilitation:** Planning and sequencing, Challenge by choice, Full Value Contract (FVC), Experiential learning cycle, Facilitating the Debrief . **Introspection:** Identify your USP, Recognize your strengths and weakness, Nurture strengths, Fixing weakness, Overcoming your complex, Confidence building. **Trust and collaboration.** Virtual Team building, Flexibility, Delegating, Shouldering responsibilities

Module:3	Emotional Intelligence	12 hours

Transactional Analysis: Introduction**,** Contracting, Ego states**,** Life positions. **Brain storming:** Individual Brainstorming, Group Brainstorming, Stepladder Technique, Brain writing, Crawford's Slip writing approach, Reverse brainstorming, Star bursting, Charlette procedure, Round robin brainstorming. **Psychometric Analysis :**Skill Test, Personality Test . **Rebus Puzzles/Problem Solving:** More than one answer, Unique ways

Module:4	Adaptability	12 hours

Theatrix: Motion Picture, Drama, Role Play, Different kinds of expressions. **Creative expression** Writing, Graphic Arts, Music, Art and Dance ,**Flexibility of thought:** The 5'P' framework (Profiling, prioritizing, problem analysis, problem solving, planning). **Adapt to changes(tolerance of change and uncertainty):**Adaptability Curve , Survivor syndrome

	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Chip Heath, How to Change Things When Change Is Hard (Hardcover**)**,2010,First Edition,Crown Business.
2.	Karen Kindrachuk, Introspection**,** 2010, 1st Edition.
3.	Karen Hough, The Improvisation Edge: Secrets to Building Trust and Radical Collaboration at Work, 2011, Berrett-Koehler Publishers
Reference Books	
1.	Gideon Mellenbergh, A Conceptual Introduction to Psychometrics: Development, Analysis and Application of Psychological and Educational Tests,2011, Boom Eleven International.
2.	Phil Lapworth, An Introduction to Transactional Analysis, 2011, Sage Publications (CA)

14. **Mode of Evaluation**: FAT, Assignments, Projects, Case studies, Role plays,3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45th AC	Date	15/06/2017

Course code	Course title	L	T	P	J	C
STS1002	Introduction to Business Communication	3	0	0	0	1
Pre-requisite	None	Syllabus version				
		2				

Course Objectives:

1. To provide an overview of Prerequisites to Business Communication
2. To enhance the problem solving skills and improve the basic mathematical skills
3. To organize the thoughts and develop effective writing skills

Expected Course Outcome:

1. Enabling students enhance knowledge of relevant topics and evaluate the information

Module:1	Study skills	10 hours

Memory techniques: Relation between memory and brain, Story line technique, Learning by mistake, Image-name association, Sharing knowledge, Visualization. **Concept map:**Mind Map, Algorithm Mapping, Top down and Bottom Up Approach. **Time management skills:** Prioritization - Time Busters, Procrastination, Scheduling, Multitasking, Monitoring Working under pressure and adhering to deadlines

Module:2	Emotional Intelligence (Self Esteem)	6 hours

Empathy: Affective Empathy and Cognitive Empathy . **Sympathy :** Level of sympathy (Spatial proximity, Social Proximity, Compassion fatigue)

Module:3	Business Etiquette	9 hours

Social and Cultural Etiquette: Value, Manners, Customs, Language, Tradition. **Writing Company Blogs :** Building a blog, Developing brand message, FAQs', Assessing Competition **Internal Communications:** Open and objective Communication, Two way dialogue, Understanding the audience. **Planning:** Identifying, Gathering Information, Analysis, Determining, Selecting plan, Progress check, Types of planning .**Writing press release and meeting notes:**Write a short, catchy headline, Get to the Point –summarize your subject in the first paragraph, Body – Make it relevant to your audience

Module:4	Quantitative Ability	4 hours

Numeracy concepts: Fractions, Decimals, Bodmas, Simplifications, HCF, LCM, Tests of divisibility. **Beginning to Think without Ink:** Problems solving using techniques such as: Percentage, Proportionality, Support of answer choices, Substitution of convenient values, Bottom-up approach etc. **Math Magic:** Puzzles and brain teasers involving mathematical concepts **Speed Calculations:** Square roots, Cube roots, Squaring numbers, Vedic maths techniques

Module:5	Reasoning Ability	3 hours

Interpreting Diagramming and sequencing information: Picture analogy, Odd picture, Picture sequence, Picture formation, Mirror image and water image. **Logical Links:** Logic based questions-based on numbers and alphabets

Module:6	Verbal Ability	3 hours

S**trengthening Grammar Fundamentals :** Parts of speech, Tenses, Verbs(Gerunds and infinitives): **Reinforcements of Grammar concepts :** Subject Verb Agreement, Active and Passive Voice, Reported Speech

Module:7	**Communication and Attitude**	**10 hours**

Writing : Writing formal & informal letters, How to write a blog & knowing the format, Effective ways of writing a blog, How to write an articles & knowing the format, Effective ways of writing an articles, Designing a brochures, **Speaking skills:** How to present a JAM, Public speaking, **Self managing:** Concepts of self management and self motivation, Greet and Know, Choice of words, Giving feedback, Taking criticism

	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	FACE, Aptipedia, Aptitude Encyclopedia, 2016, First Edition, Wiley Publications, Delhi.
2.	ETHNUS, Aptimithra, 2013, First Edition, McGraw-Hill Education Pvt. Ltd.
Reference Books	
1.	Alan Bond and Nancy Schuman, 300+ Successful Business Letters for All Occasions, 2010, Third Edition, Barron's Educational Series, New York.
2.	Josh Kaufman, The First 20 Hours: How to Learn Anything ... Fast , 2014, First Edition, Penguin Books, USA.

15. **Mode of Evaluation**: FAT, Assignments, Projects, Case studies, Role plays,
3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45th AC	Date	15/06/2017

Course code	Course title	L	T	P	J	C
STS2001	Reasoning Skill Enhancement	3	0	0	0	1
Pre-requisite	None	Syllabus version				
		2				

Course Objectives:

- To strengthen the social network by the effective use of social media and social interactions.
- To identify own true potential and build a very good personal branding
- To enhance the Analytical and reasoning skills.

Expected Course Outcome:

1. Understanding the various strategies of conflict resolution among peers and supervisors and respond appropriately

Module:1	Social Interaction and Social Media	6 hours

Effective use of social media: Types of social media, Moderating personal information, Social media for job/profession, Communicating diplomatically, **Networking on social media: m**aximizing network with social media, How to advertise on social media , **Event management:** Event management methods, Effective techniques for better event management, **Influencing:** How to win friends and influence people, Building relationships, Persistence and resilience, Tools for talking when stakes are high, **Conflict resolution:** Definition and strategies ,Styles of conflict resolution

Module:2	Non Verbal Communication	6 hours

Proximecs: Types of proximecs**,** Rapport building ,**Reports and Data Transcoding:** Types of reports, **Negotiation Skill :** Effective negotiation strategies, **Conflict Resolution:** Types of conflicts

Module:3	Interpersonal Skill	8 hours

Social Interaction : Interpersonal Communication,Peer Communication, Bonding,Types of social interaction, **Responsibility:** Types of responsibilities**,** Moral and personal responsibilities, **Networking :**Competition, Collaboration, Content sharing, **Personal Branding :**Image Building, Grooming, Using social media for branding, **Delegation and compliance:** Assignment and responsibility, Grant of authority, Creation of accountability

Module:4	Quantitative Ability	10 hours

Number properties: Number of factors, Factorials, Remainder Theorem, Unit digit position, Tens digit position, **Averages:** Averages, Weighted Average, **Progressions:** Arithmetic Progression, Geometric Progression, Harmonic Progression, **Percentages:** Increase & Decrease or successive increase , **Ratios :** Types of ratios and proportions

Module:5	Reasoning Ability	8 hours

Analytical Reasoning: Data Arrangement(Linear and circular & Cross Variable Relationship), Blood Relations, Ordering/ranking/grouping, Puzzletest, Selection Decision table

Module:6	Verbal Ability	7 hours

Vocabulary Building: Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings,

Idioms, Sentence completion, Analogies			
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	FACE, Aptipedia Aptitude Encyclopedia, 2016, First Edition, Wiley Publications, Delhi.
2.	ETHNUS, Aptimithra, 2013, First Edition, McGraw-Hill Education Pvt.Ltd.
3.	Mark G. Frank, David Matsumoto, Hyi Sung Hwang, Nonverbal Communication: Science and Applications, 2012, 1st Edition, Sage Publications, New York.
Reference Books	
1.	Arun Sharma, Quantitative aptitude, 2016, 7th edition, Mcgraw Hill Education Pvt. Ltd.
2.	Kerry Patterson, Joseph Grenny, Ron McMillan, Al Switzler, Crucial Conversations: Tools for Talking When Stakes are High, 2001,1st edition McGraw Hill Contemporary, Bangalore.
3.	Dale Carnegie, How to Win Friends and Influence People, Latest Edition,2016. Gallery Books, New York.

16. **Mode of evaluation:** FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45th AC	Date	15/06/2017

Course code	Course title	L	T	P	J	C
STS2002	Introduction to Etiquette	3	0	0	0	1
Pre-requisite	None	Syllabus version				
		2				

Course Objectives:

1. To analyze social psychological phenomena in terms of impression management.
2. To control or influence other people's perceptions.
3. To enhance the problem solving skills

Expected Course Outcome:

Creating in the students an understanding of decision making models and generating alternatives using appropriate expressions.

Module:1	Impression Management	8 hours

Types and techniques

Importance of impression management, Types of impression management, Techniques and case studies, Making a good first impression in an interview (TEDOS technique) , How to recover from a bad impressions/experience, Making a good first impression online

Non-verbal communication and body language

Dressing, Appearance and Grooming, Facial expression and Gestures, Body language (Kinesics), Keywords to be used, Voice elements (tone, pitch and pace)

Module:2	Thinking Skills	4 hours

Introduction to problem solving process : Steps to solve the problem, Simplex process **, Introduction to decision making and decision making process :** Steps involved from identification to implementation**,** Decision making model

Module:3	Beyond Structure	4 hours

Art of questioning: How to frame questions, Blooms questioning pyramid, Purpose of questions, **Etiquette:** Business, Telephone etiquette, Cafeteria etiquette, Elevator etiquette, Email etiquette, Social media etiquette

Module:4	Quantitative Ability	9 hours

Profit and Loss : Cost Price & Selling Price, Margins & Markup, **Interest Calculations:** Simple Interest, Compound Interest, Recurring, **Mixtures and solutions :**Ratio & Averages, Proportions, **Time and Work:** Pipes & Cisterns, Man Day concept, Division Wages, **Time Speed and Distance:**Average speed, Relative speed, Boats and streams. **Proportions & Variations**

Module:5	Reasoning Ability	11 hours

Logical Reasoning: Sequence and series, Coding and decoding, Directions **, Visual Reasoning :** Abstract Reasoning, Input Type Diagrammatic Reasoning, Spatial reasoning, Cubes **Data Analysis And Interpretation** DI-Tables/Charts/Text

Module:6	Verbal Ability	9 hours

Grammar : Spot the Errors, Sentence Correction, Gap Filling Exercise, Sentence Improvisations, Misc. Grammar Exercise			
	Total Lecture hours:	**45 hours**	
Text Book(s)			
1.	Micheal Kallet, Think Smarter: Critical Thinking to Improve Problem-Solving and Decision-Making Skills, April 7, 2014, 1st Edition, Wiley, New Jersey.		
2.	MK Sehgal, Business Communication, 2008, 1st Edition, Excel Books, India.		
3.	FACE, Aptipedia Aptitude Encyclopedia, 2016, First Edition, Wiley Publications, Delhi.		
4.	ETHNUS, Aptimithra, 2013, First edition, McGraw-Hill Education Pvt. Ltd, Banglore.		
Reference Books			
1.	Andrew J. DuBrin, Impression Management in the Workplace: Research, Theory and Practice, 2010, 1st edition, Routledge.		
2.	Arun Sharma, Manorama Sharma, Quantitative aptitude, 2016, 7th edition, McGraw Hill Education Pvt. Ltd, Banglore.		
3.	M. Neil Browne, Stuart M. Keeley, Asking the right questions, 2014, 11th Edition, Pearson, London.		
17.			
18. **Mode of Evaluation**: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)			
Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45th AC	Date	15/06/2017

Course code	Course title	L	T	P	J	C
STS3001	Preparedness for external opportunities	3	0	0	0	1
Pre-requisite	None	Syllabus version				
		2				

Course Objectives:

1. To effectively tackle the interview process, and leave a positive impression with your prospective employer by reinforcing your strength, experience and appropriateness for the job.
2. To check if candidates have the adequate writing skills that are needed in an organization.
3. To enhance the problem solving skills.

Expected Course Outcome:

1. Enabling students acquire skills for preparing for interviews, presentations and higher education

Module:1	Interview Skills	3 hours

Types of interview: Structured and unstructured interview orientation, Closed questions and hypothetical questions, Interviewers' perspective, Questions to ask/not ask during an interview
Techniques to face remote interviews: Video interview, Recorded feedback , Phone interview preparation
Mock Interview : Tips to customize preparation for personal interview, Practice rounds

Module:2	Resume Skills	2 hours

Resume Template : Structure of a standard resume**,** Content, color, font
Use of power verbs: Introduction to Power verbs and Write up
Types of resume: Quiz on types of resume
Customizing resume : Frequent mistakes in customizing resume, Layout - Understanding different company's requirement, Digitizing career portfolio

Module:3	Presentation Skills	6 hours

Preparing presentation : tips to prepare PowerPoint presentation**,** Outlining the content, Passing the Elevator Test
Organizing materials: Blue sky thinking, Introduction , body and conclusion, Use of Font, Use of Color, Strategic presentation
Maintaining and preparing visual aids: Importance and types of visual aids, Animation to captivate your audience, Design of posters
Dealing with questions: Setting out the ground rules, Dealing with interruptions, Staying in control of the questions, Handling difficult questions

Module:4	Quantative Ability	14 hours

Permutation-Combinations : Counting, Grouping, Linear Arrangement, Circular Arrangements
Probability: Conditional Probability, Independent and Dependent Events
Geometry and Mensuration: Properties of Polygon, 2D & 3D Figures, Area & Volumes
Trigonometry: Heights and distances, Simple trigonometric functions
Logarithms: Introduction, Basic rules
Functions: Introduction, Basic rules
Quadratic Equations: Understanding Quadratic Equations, Rules & probabilities of Quadratic Equations
Set Theory: Basic concepts of Venn Diagram

Module:5	**Reasoning Ability**	**7 hours**
Logical reasoning : Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic **Data Analysis and Interpretation:** Data Sufficiency Data interpretation-Advanced Interpretation tables, pie charts & bar chats		
Module:6	**Verbal Ability**	**8 hours**
Comprehension and Logic: Reading comprehension Para Jumbles Critical Reasoning : Premise and Conclusion, Assumption & Inference, Strengthening & Weakening an Argument		
Module:7	**Writing Skills**	**5 hours**
Note making What is note making, Different ways of note making **Report writing** What is report writing, How to write a report, Writing a report & work sheet **Product description** Designing a product, Understanding it's features, Writing a product description **Research paper** Research and its importance, Writing sample research paper		

	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Michael Farra, Quick Resume & Cover letter Book, 2011, 1st Edition, JIST Editors, Saint Paul.
2.	Daniel Flage, An Introduction to Critical Thinking, 2002, 1st Edition, Pearson, London.
Reference Books	
1.	FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2.	ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt. Ltd.

19. **Mode of Evaluation:** FAT, Assignments, Projects, Case studies, Role plays,
3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45th AC	Date	15/06/2017

Course code	Course title	L	T	P	J	C
STS3005	Code Mithra	3	0	0	0	1
Pre-requisite	None	Syllabus version				
		2				

Course Objectives:

1. To develop logics which will help them to create programs, applications in C.
2. To learn how to design a graphical user interface (GUI) with Java Swing.
3. To present an introduction to database management systems, with an emphasis on how to organize, maintain and retrieve - efficiently, and effectively.

Expected Course Outcome:

Enabling students to write coding in C,C++,Java and DBMS concepts

Module:1	**C Programming**	**15 hours**

Introduction to C, Execution and Structure of a C Program, Data Types and Operators, Control Statements, Looping, Arrays, Structure, Pointers, Memory Management in C, Functions.

Module:2	**C++ Programming**	**15 hours**

Introduction to C++, Need for OOP, Class & Objects, Create C++ & Java class and show the similarity Encapsulation, Access Specifiers, Relationship, Polymorphism, Exception Handling, Abstract Classes, Interfaces.

Module:3	**JAVA**	**10 hours**

Introduction to Java, Data Types and Operators, Control Statements, Looping, Arrays, Need for OOP, Class & Objects, Create C++ & Java class and show the similarity Encapsulation, Access Specifiers, Relationship, Polymorphism, Exception Handling, Abstract Classes, Interfaces.

Module:4	**Database**	**5 hours**

Introduction to database, DDL, Data Manipulation, SELECT, Joins.

	Total Lecture hours:	**45 hours**	

Reference Books

1.	Data Structures and Algorithms: https://ece.uwaterloo.ca/~dwharder/aads/Lecture_materials/
2.	C Programming: C Programming Absolute Beginner's Guide (3rd Edition) by Greg Perry, Dean Miller
3.	Java: Thinking in Java, 4th Edition
4.	**Websites: www.eguru.ooo**

20. Mode of Evaluation: FAT, Assignments, Projects 3 Assessments with Term End FAT (Computer Based Test)

Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No.45th AC	Date	15/06/2017

PROGRAM CORE

Course Code	Course Title	L	T	P	J	C
MAT1001	FUNDAMENTALS OF MATHEMATICS (Bridge Course)	3	2	0	0	4
Pre-requisite	Nil	Syllabus version				
		v. 1.0				

Course Objectives:

- This fundamental course on Basic Mathematics provides requisite and relevant background necessary to understand the other important engineering mathematics courses. Further this course is a prerequisite for the non- mathematics students to learn further topics of Engineering Mathematics.

Expected Course Outcome:

At the end of this course the students are expected to

1. Solve a system of linear equations by matrix
2. Apply the techniques of differentiation to find maxima and minima, and techniques of integration to evaluate areas and volumes of revolution
3. Understand the concept of ordinary differential equations, and first and second order linear differential equations
4. Have a clear understanding of analytic geometry and vector
5. Apply concepts of mathematical logic and elementary probability to real life problems

Module:1	Matrices	5 hours

Matrices - types of matrices - operations on matrices-determinants - adjoint matrix -inverse of a matrix -solution of a system of linear equations by inversion method–elementary transformations –rank of a matrix - consistency and inconsistency of system of equations

Module:2	Differential Calculus	6 hours

Differentiation of functions of single variable – differentiation techniques physical interpretations - differentiation of implicit function – higher order derivatives – Taylor's series - maxima and minima for functions of a single variable

Module:3	Integral Calculus	6 hours

Partial fractions - Integration- integration techniques- integration by parts definite integrals – properties- evaluation of area and volume by integration

Module:4	Linear Ordinary Differential Equations	6 hours

Differential equations-definition and examples- formation of differential equation- solving differential equations of first order-solving second order homogenous differential equations with constant coefficients.

Module:5	Analytic geometry	5 hours

Analytic geometry of three dimensions-direction cosines and direction ratios-plane, straight line and

sphere			
Module:6	**Vector Algebra**	**7 hours**	
Vectors–operations on vectors-angle between two vectors-projection of one vector on another vector– equations of plane, straight line and sphere in vector forms-shortest distance between two skew lines-equation of a tangent plane to a sphere.			
Module:7	**Logic and Probability**	**8 hours**	
Mathematical logic – propositions – truth table – connectives– tautology – contradiction. Permutations and combinations – probability – classical approach – addition law- conditional probability - multiplicative law- Baye's theorem and applications.			
Module:8	**Contemporary Issues**	**2 hours**	
	Total Lecture hours:	**45 hours**	
Tutorial	• A minimum of 10 problems to be worked out by students in every Tutorial Class. • Another 5 problems per Tutorial Class to be given as home work. Mode: Individual Exercises, Team Exercises, Online Quizzes, Online Discussion Forums	**30 hours**	
Text Book(s)			
1.	K. A. Stroud and Dexter J. Booth, Engineering Mathematics, 2013, 7th Edition, Palgrave Macmillan.		
Reference Books			
1.	B. S. Grewal, Elementary Engineering Mathematics, 2015, 43rd edition, Khanna Publications.		
2.	Seymour Lipschutz and Marc Lipson, Discrete Mathematics, 2010, 3rd Edition, Tata McGraw - Hill.		
3.	Seymour Lipschutz and John Schiller, Introduction to Probability and Statistics, 2011, 2nd Edition, Tata McGraw -Hill.		
Mode of Evaluation: Digital Assignments(Solutions by using soft skill), Quiz, Continuous Assessments, Final Assessment Test			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
BIT1001	INTRODUCTION TO LIFE SCIENCES (Bridge Course)	4	0	0	0	4
Pre-requisite	Nil	Syllabus version				
		v. 1.0				

Course Objectives:

- To understand the basic concepts of life sciences, evolution, and biotechnology

Expected Course Outcome:

Students will gain knowledge on

1. Comprehend the basic concepts of cell and its organelles, biomolecules and nucleic acids.
2. Recognize the basic physiological function about endocrine, digestive and circulatory system.
3. Differentiate the mechanism about the kidney function and urine formation.
4. Explore the functional usage about the body fluids and its circulatory pathways in human body.
5. Perceive the basic of the body mechanics, locomotion, bones and joints involved in its movement.
6. Estimate the breathing mechanism, gaseous exchange, human neural system and its conduction of nerve impulse.
7. Ability to understand the necessary information about the human body mechanism with its physiological functions.

Module:1	Diversity in the Living World	10 hours

Origin of life, Characteristics of Life, Linnaean and Whittaker' classification, Plant Kingdom-Classification, Structure, types and modifications of root, stem and leaf. Animal Kingdom-Classification and taxonomical aids.

Module:2	Cell Structure and Functions	7 hours

Structures of prokaryotic and Eukaryotic cells, levels of organization, cellular organelles and functions, nuclear components. Major cell types,concepts of cell theory, Cell Cycle and Cell Division.

Module:3	Chemistry of Life	7 hours

Bio-macromolecules, central Dogma of Molecular Biology, nucleic acids, proteins, carbohydrates, lipids , fats, Vitamins and Minerals; cellular metabolism.

Module:4	Microorganisms	6 hours

Microbial World, Classification. structure and types of bacteria, virus, micro algae and fungi, Microbial Growth, beneficial and harmful microorganisms

Module:5	Plant physiology	6 hours

Plant cell growth and differentiation, germination, photosynthesis, respiration, transpiration, transport

of food, nutrients and water, Phyto-hormones, concept of totipotency.			
Module:6	**Animal/human physiology**	**6 hours**	
Circulatory System, Excretory System, Immune system, Nervous system, Digestive system. Sensory organs.			
Module:7	**Genetics**	**6 hours**	
Mendelian Genetics, Laws of Inheritance, Mono, di hybrid crosses, polygenic inheritance, Multiple alleles, Linkage and Crossing Over, Eugenics			
Module:8	**Biotechnology**	**6 hours**	
History of important discoveries in biotechnology. rDNA technology, Gene cloning and applications- Dolly, Polly, ANDi, Bt Cotton, Applications in Health care and Agriculture; Ethical Issues.			
Module:9	**Ecology and evolution**	**6 hours**	
Theories of Evolution. Lamarckism, Darwinism, Speciation, Ecology , Niches, Food chain and Food Web, Migration; Pollution			
Module:10	**Contemporary Issues**	**2 hours**	
	Total Lecture hours:	**60 hours**	
Text Book(s):			
1.	Campbell,N.A. Reece,J.B., and Simon, E.J., Essential Biology with Physiology, 2015, 6th Edition, Campbell Biology Websites Series.		
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course title	L	T	P	J	C
BIT1012	HUMAN ANATOMY AND PHYSIOLOGY	3	0	2	0	4
Prerequisite	Nil	Syllabus version				
		v. 1.0				

Course Objectives:

1. To define the basic concepts of anatomical and physiological terminologies relating to cell, blood components and joints with their functions.
2. To explore the chemical coordination of human endocrine systems, hormones and its functions in male and female reproductive organs.
3. To identify the basics of anatomical and physiological functions of cardiovascular system, blood pressure with factors affecting it, Human Respiratory system, mechanism of breathing and gaseous exchange.
4. To discuss about the human Nervous system, physiology and terminologies involved in it, Functions of brain, vision, hearing, taste and smell, Urinary System, functions of kidney and urine formation Functions and absorption property of digestive system and its movement.

Expected Course Outcome:

The student will be able to

1. Comprehend the basic concepts of human cell and its organelles, general physiological concepts, primary tissues and organ systems of the human body
2. Ability to understand the basic physiological function about endocrine, digestive and circulatory system.
3. Comprehend the mechanism about the kidney function and urine formation.
4. Comprehend the concepts about the body fluids and its circulatory pathways in human body.
5. Comprehend the basic concepts on the human body mechanics, locomotion, bones and joints involved in its movement.
6. Comprehend the breathing mechanism, gaseous exchange, human neural system and its conduction of nerve impulse.
7. Ability to understand the necessary information about the human body mechanism with its physiological functions

Module:1	Introduction	6 hours

Introduction to Human anatomy and physiology- Anatomical and medical terminology- Structure of the human cell- Four primary tissues- organs and organ systems- Physiology of homeostasis- Osteology and joints- Muscles.

Module:2	Blood and Body fluids	6 hours

Body fluids- Composition and functions of blood-Plasma proteins- Red blood cells- White blood cells and platelets- Blood groups and blood clotting.

Module:3	**Endocrine and reproductive systems**	**6 hours**
Concept of hormone- Types of hormones and hormone receptors- Adenohypophysis and neurohypophysis-Thyroid gland-Para thyroid gland-Islets of Langerhans-Adrenal modules and adrenal cortex- Male reproductive organs and functions of androgens- Female reproductive organs- functions of estrogen and progesterone		
Module:4	**Cardiovascular system**	**6 hours**
Structure of the heart and blood vessels- Conducting system of the heart and electrocardiogram-Arterial blood pressure- Factors maintaining blood pressure- factors regulating blood pressure.		
Module:5	**Respiratory system**	**6 hours**
Organs of respiratory system. Structure of lungs- Mechanics of respiration lung. Lung volume and capacities- Transport of Oxygen in the blood- Transport of carbon -di -oxide in the blood- Regulation of respiration- Hypoxia- Dyspnoea.		
Module:6	**Nervous System and special senses**	**6 hours**
Structure of neuron- Resting membrane potential and action potential- Neuromuscular junction- Synaptic transmission-Brain and spinal cord- Reflex arc and reflex action- Functions of the parts of the brain- Vision, hearing- taste and smell.		
Module:7	**Urinary system and Digestive system**	**7 hours**
Structures of malpighian corpuscles- Proximal convoluted tubule- loop of Henle and Distal convoluted tubule- Functions of the kidney- Innervations of urinary bladder. Organs of digestive systems-Salivary secretion- gastric secretion and pancreatic secretion- Bile secretion and functions of liver- Absorption of food substances- Movements of digestive tract.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours	**45 hours**

Text Book	
1.	Anne Waugh, Allison Grant, Ross and Wilson, "Anatomy and Physiology in Health and Illness", 2014, 12th edition, Churchill Livingstone, London.
Reference Books	
1.	Gerard J Tortora, Bryan Derrickson, "Anatomy & Physiology workbook", 2014, 1st edition, New Delhi, India.
2.	Guyton and Hall, "Textbook of Medical Physiology", 2013, 1st edition, Elsevier, India
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT	

List of Challenging Experiments (Indicative)		
1.	Identify the given human appendicular bone and determine its sides. Understand the characteristics of the bones of human body and movements of joints.	6 hours
2.	Identify the given vertebral bone for its location and understand the feature of each vertebral segment.	6 hours
3.	Find the blood group of sample A, B, C and D by using appropriate reagents, to know about the agglutination process, antigens and antibody reaction.	6 hours

4.	Measure the heart rate, pulse rate and blood pressure of a person (after climbing up 3 floors, and after 15 minutes of relaxation), using ECG machine and BP apparatus to know about the physiological control of HR and BP during rest and activity.			6 hours
5.	Perform Rinnie's and Weber's test for two of your friends and identify if they have air conductivity better than bone or vice versa.			6 hours
Total Laboratory Hours				30 hours
Mode of Evaluation: Continuous Assessments and FAT				
Recommended by Board of Studies		21-08-2017		
Approved by Academic Council		No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
BIT1013	SEMICONDUCTOR DEVICES AND CIRCUITS	2	0	2	4	4
Prerequisite	PHY1001/PHY1701-Engineering Physics	Syllabus version				
		v. 1.0				

Course Objectives:

1. To provide understanding of the mechanisms of current flow in semi-conductors
2. To yield understanding about the basic operations of diodes and transistor
3. Gain a comprehensive understanding of the MOSFET
4. Understand the concept of frequency response of amplifiers and different types of feedback

Expected Course Outcome:

The student will be able to

1. Understand the basic materials and properties of semiconductors
2. Demonstrate the control Applications using semiconductor devices
3. Identify the fabrication methods of integrated circuits.
4. Ability to use the devices to build circuits for different applications.
5. Analyze regulating circuits and implement the same in various conditions
6. Classify and analyze the various circuit configurations of Transistor and MOSFETs
7. Apply fundamentals of semiconductor devices in electronics projects
8. Apply concepts of semiconductor devices to design and analyze circuits

Module:1	Semiconductor Fundamentals	5 hours

Formation of energy bands - Fermi level - energy-band models - direct and indirect band gap - electrons and holes – doping - intrinsic and extrinsic semiconductors - elemental and compound semiconductor – generation - recombination and injection of carriers - Drift and Diffusion of carriers - basic governing equations in semiconductors - Transport Equations.

Module:2	Diodes	4 hours

PN Junctions - Formation of Junction - Physical operation of diode - Contact potential and Space Charge phenomena - I-V Characteristics - Zener diode - Physical operation of special diode (Tunnel diode, LED and Photo Diode)

Module:3	Bipolar Junction Transistor	3 hours

Device structure and physical operation, current – voltage characteristics

Module:4	DC Analysis of BJT Circuits	5 hours

DC Analysis of BJT Circuits - CB, CE and CC Configuration - Biasing BJT Circuits CB, CE and CC Configuration - Biasing BJT Circuits

Module:5	**Metal-Oxide-Semiconductor Capacitor and FET**	**3 hours**
MOS Capacitor: Device Structure and mode of operation - C-V Characteristics - Threshold Voltage.		
Module:6	**MOSFET**	**5 hours**
Device Structure and physical operation - I-V Characteristics - C-V characteristics - Types of MOSFET (enhancement mode and depletion mode) - CMOS device structure – characteristics - gates and inverters - Introduction to FinFET and Tunnel(FET).		
Module:7	**Applications of Semiconductor Devices and Circuits**	**3 hours**
Regulated Power supply- wave shaping circuits- amplifier circuits.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book	
1.	Adel S. Sedra, Kenneth C. Smith &Arun N. Chandorkar, Microelectronic Theory and Applications, 2013, 6th edition, Oxford University Press, Chennai.
Reference Book	
1.	Simon M. Sze and Ming–Kwei Lee, Semiconductor Devices: Physics and Technology, 2016 3rd edition, John Wiley and sons, New Jersey.
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT.	

List of Challenging Experiments (Indicative)		
1.	Design a voltage regulator that will maintain an output voltage of 20 V across a 1-kΩ load with an input that will vary between 30 and 50 V.	6 hours
2.	Design a circuit to observe the action of a Transistor as an electronic switch and measure the voltage across the transistor when it is ON and when it is OFF.	6 hours
3.	Conduct an experiment to determine the forward bias and reverse bias characteristics of PN junction diode. Also determine the static resistance, dynamic resistance and reverse resistance from the obtained characteristics.	6 hours
4.	Construct the positive clamper and negative clamper circuit and obtain the corresponding waveform, if the input is a sine waveform and a square waveform of amplitude 10V.	6 hours
5.	Construct the positive and negative clipper circuit and obtain the corresponding output if the input is sine wave of 12 V (p-p).	6 hours
Total Laboratory Hours		30 hours
Mode of Evaluation: Continuous Assessments and FAT		
List of J Component Projects (Indicative)		
1	Design a car parking guard circuit using infrared sensor to help the person in the driving seat, in such a way that it gives an alarm if there is any obstacle.	
2	Design a battery charging circuit using silicon controlled rectifier, to prove that SCR can be used in half wave and full wave rectifiers, invertor circuits and power control circuits.	
3	Design a thermistor temperature sensor alarm circuit where an alarm raises whenever the temperature crosses a certain limit.	

4	Design a water level indicator which employs a simple mechanism to detect and indicate the water level in an overhead tank.			
5	Design a temperature controlled DC fan circuit to switch on the fan connected to DC motor when the temperature is greater than a threshold value.			
Mode of Evaluation: Review I, II, III.				
Recommended by Board of Studies		21-08-2017		
Approved by Academic Council		No. 47	Date	5-10-2017

Course Code	Course title	L	T	P	J	C
ECE1004	SIGNALS AND SYSTEMS	2	0	0	4	3
Pre-requisite	MAT1011 – Calculus for Engineers	Syllabus version				
		v. 2.0				

Course Objectives:

1. To introduce the students to fundamental signals like unit impulse, unit step, ramp and exponentials and various operations on the signals.
2. To acquaint students to static, linear, time invariant, causal and stable systems.
3. To introduce the students to different forms and properties for the analysis of signals passed through varied systems including convolution correlation.
4. To analyse the system using Laplace and Z Transform

Expected Course Outcome:

The students will be able to

1. Differentiate between various types of signals and understand the implication of operations of signals
2. Understand the system like causal, dynamic, linear, time invariant and stable system also students will be able to perform impulse response of both continuous time and discrete time system.
3. Perform the transformation from time domain to frequency domain and understand the distribution of energy as a function of frequency.
4. Apply Fourier transform for discrete time signals and understand the difference between CTFT and DTFT.
5. Usefulness of convolution for analysing the LTI systems and understand the concepts of power spectral density through correlation.
6. Solve differential and difference equations with initial conditions using Laplace and Z transforms.
7. Design a system based on the concepts of system properties.

Module:1	Introduction to Signals	3 hours

Continuous-time and Discrete-time Signals: Representation of signals, Signal classification, Types of signals, Operations on signals - Scaling, Shifting, Transformation of independent variables, Sampling.

Module:2	Systems Concepts	3 hours

Continuous-time and Discrete-time Systems: Classification of systems - Static and dynamic, Linear and non-linear, Time-variant and time-invariant, Causal and non-causal, Stable and unstable, Impulse response and step response of systems.

Module:3	Fourier Analysis of Continuous-time Signals	4 hours

Introduction to Fourier series, Gibbs Phenomenon, Continuous-Time Fourier Transform (CTFT), Properties, Magnitude and phase response, Parseval's theorem, Inverse Fourier transform.

Module:4	**Fourier Analysis of Discrete-time Signals**	**4 hours**
Discrete-time Fourier transform, Properties, Inverse discrete-time Fourier transform, Comparison between CTFT and DTFT.		
Module:5	**Convolution and Correlation**	**4 hours**
Continuous-time convolution, Convolution sum, Correlation between signals: Cross correlation, Autocorrelation, Energy spectral density, Power spectral density.		
Module:6	**System Analysis using Laplace transform**	**5 hours**
Relation between Laplace and Fourier transforms, Properties, Inverse Laplace transform, Solution of differential equations using Laplace transform, Region of convergence, Stability analysis.		
Module:7	**System Analysis using z-Transform**	**5 hours**
Z-transform, Properties, s-plane to z-plane mapping, Inverse z-transform, Solution to difference equations using z-transform, Region of convergence, Stability analysis.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture:	**30 hours**

Text Book(s)

1.	P. Rama Krishna Rao and Shankar Prakriya, "Signals and Systems", 2013, 2nd edition, Mc-Graw Hill, New delhi, India.

Reference Books

1.	Alan. V. Oppenheim, Alan. S. Willsk,S. Hamid Nawab, "Signals and systems", 2013, 2nd edition-Pearson Education Limited, Noida, India.
2.	B. P. Lathi, "Signal processing and linear systems", 2011, reprint, Oxford university press, New York, USA.
3.	Simon Haykin, Barry VanVeen, "Signals and systems", 2011, reprint, 2nd edition, Wiley, India.

Mode of Evaluation: Continuous Assessment Test –I (CAT-I), Continuous Assessment Test –II (CAT-II), Digital Assignments/ Quiz / Completion of MOOC, Final Assessment Test (FAT).

Typical Projects

1. EMG Muscle Sensor based DC Motor Control
2. Speech recognition based home automation system
3. Cell phone signal enhancing router
4. Speaker recognition Security system
5. Analysis of ECG signal to measure the heart rate
6. Stability analysis of Automotive control system using Laplace transform / z –transform

Mode of evaluation: Review I, II and III.

Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE1010	FUNDAMENTALS OF ELECTRIC AND MAGNETIC CIRCUITS	2	2	2	0	4
Prerequisite	Nil	Syllabus version				
		v.1.1				

Course Objectives:

1. To acquaint students with the basic concepts of DC and AC circuits using node and mesh analysis methods.
2. To impart the basics of the forced and natural response of first and second order systems, and to formulate and analyse the circuits using the circuit theorems.
3. To recall the importance and basics of AC circuits and to analyse the AC circuits using theorems.
4. To describe the operation of magnetic circuits and various DC machines and their applications for special purposes.

Expected Course Outcome:

The student will be able to

1. To comprehend the basic concepts and properties of electrical circuits and its classification.
2. Ability to analyse DC and AC circuits using node and mesh analysis methods.
3. Excel in computing the forced and natural response of first and second order systems.
4. Ability to analyse the circuits using the circuit theorems
5. To comprehend the basics of AC circuits and to analyse the AC circuits using theorems.
6. To conceive the operation of magnetic circuits and various DC machines and their applications for special purposes.
7. To compare the theorems, analyse and validate the circuit for a given application.

Module:1	Basics of Electrical Engineering	2 hours

Fundamental laws of electrical engineering-circuit parameters-definitions- Classification of devices of an electrical circuit-Basic devices: resistors, diode, capacitors and inductors.

Module:2	DC Circuits	3 hours

Independent and dependent sources- ideal and practical Kirchhoff's Current Law- Kirchhoff's Voltage Law – nodal and mesh analysis of linear resistive networks containing linear independent and dependent sources.

Module:3	DC Transients	4 hours

Circuit elements R, L, C- Response (forced & natural) of first order circuits (RL & RC)- Response of second order circuit (RLC)

Module:4	**Circuits Theorems**	**6 hours**	
Star/Delta transformation – Superposition theorem – Thevenin's theorem – Norton's theorem, Maximum power transfer theorem – Reciprocity Theorem			
Module:5	**AC Circuits-I**	**4 hours**	
Introduction to AC – RMS Values- average value - *j* operator – phasors and phasor relationship and diagrams for R,L and C – Solution of RL,RC,RLC circuits – power – active and reactive- power factor- 3-Φ circuits			
Module:6	**AC Circuits-II**	**4 hours**	
Sinusoidal AC sources-steady state analysis- Capacitance-phasor representation-impedance-admittance-Mesh and node method for AC circuits-power and reactive power-power factor-Resonance-Series and parallel- Q factor- bandwidth of resonant circuit			
Module:7	**Magnetic circuit and Machines**	**5 hours**	
Laws of magnetic force-Definitions concerning Magnetic circuit- Simple and composite magnetic circuits- Magnetization curves- Magnetic hysteresis- area of hysteresis loop and eddy current losses- Self and mutual Inductance- Working principle- classification- types- construction of transformer- Ideal transformer- e.m.f equation- voltage transformation ratio- phasor diagram- equivalent circuit of transformer- Principle of DC machine- construction- classification and operation of DC motor- AC machines			
Module:8	**Contemporary issues:**	**2 hours**	
	Total Lecture hours:	**30 hours**	
Tutorial	**Total**	**30 hours**	

A minimum of 5 problems to be worked out by students in every Tutorial Class.
Another 5 problems per Tutorial Class to be given as home work.
At least one open ended design problem to be given.

Mode: Individual Exercises, Team Exercises, Quizzes.

Text Book:

1.	B.L.Theraja, A.K.Theraja, "Electrical Technology", 2014, 1st volume, 24th Edition, S. Chand Publication, New Delhi.

Reference Books:

1.	William Hayt & Kemmerly J.E, "Engineering circuit analysis", 2013, 8th Edition, Tata McGraw Hills, Noida.
2.	Richard. C. Darf, "Introduction to Electric Circuits", 2012, 7th edition, John-Wiley and sons, New Jersey.
3.	Vincent Dell Toro, "Electrical Engineering Fundamentals", 2014, 2nd Edition, Prentice Hall India, New Delhi.

Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT

List of Challenging Experiments (Indicative)

1.	After analyzing the transient characteristics (time constant, rise time and fall time) of an RC circuit excited by pulse input using Multisim, construct a RC filter circuit for a full wave rectifier application.	6 hours
2.	Construct a second order RLC series circuit in Multisim and measure the response for a unit step input. Calculate the damping ratio of the circuit from the measured response and fine tune the values of circuit elements in order to achieve a damping ratio of 0.5.	6 hours
3.	For the given circuit, find the Thevenin's equivalent resistance measured	6 hours

	across the open circuited load terminals, build the Thevenin's equivalent circuit and find the current through the load.	
4.	For the given circuit, find the Norton equivalent resistance measured across the open circuited load terminals, build the Norton's equivalent circuit and find the current through the load.	6 hours
5.	Consider a practical inductor (RL series circuit) and a capacitor connected in parallel. Determine the resonant frequency and plot the frequency response. From the frequency response, identify the filter characteristics.	6 hours
Total Laboratory Hours		30 hours
Mode of Evaluation: Continuous Assessments and FAT		
Recommended by Board of Studies	21-08-2017	
Approved by Academic Council	No. 47	Date 5-10-2017

Course code	Course Title	L	T	P	J	C
ECE1011	MEDICAL PHYSICS AND BIOMEDICAL INSTRUMENTATION	3	0	2	0	4
Prerequisite	PHY1001/PHY1701- Engineering Physics	Syllabus version				
		v. 1.0				

Course Objectives:

1. Introduction to the techniques used for measurement of various physiological parameters and discuss the effects electromagnetic radiations on human body
2. Detailed study of medical ultrasound and provide an overview of its components
3. Describe different types of electrodes used in bio-potential recording and types of cardiovascular measurements
4. Discuss respiratory, neuromuscular and nervous measurement system

Expected Course Outcome:

The student will be able to

1. Develop the systems concerned with measuring various non-electrical quantities in human system.
2. Use of radionuclides in medicine, cause of radiation, maximum permissible occupational doses-protective measures
3. Components of ultrasound, acoustical characteristics of human body, piezo electric receivers
4. Understand the conduction techniques of bioelectric signals and the various types of electrodes for the bio potential measurement.
5. Blood pressure measurement, Blood flow measurement
6. Spirometry, CO2 analyzer and Oxygen analyzer
7. Ability to design and conduct experiments, as well as to analyze and interpret data

Module:1	The Electromagnetic Radiation	6 hours

Interaction of photons and charged particles with matter- Photoelectric effect- Compton scattering-Coherent scattering-Infrared radiation and its biological applications-UV radiation and its applications-damaging effects of UV light. Radiometry and photometry- Electrical impedance and Biological Impedance.

Module:2	Nuclear Radiation and its effects on the body	6 hours

Radionuclides used in medicine and biology-LD50-Cause of radiation death-Radiation carcinogenesis-Cataract-Genetic effects-Permissible exposures-Maximum permissible occupational doses- Protective measures.

Module:3	Medical Ultrasound	6 hours

Production-properties and propagation of ultrasonic waves-Bioacoustics-Acoustical characteristics of human body-Ultrasonic Dosimetry-Destructive and nondestructive tests-Cavitation-Piezo electric receivers, thermoelectric probe-Lithotrophy-High power ultrasound in therapy.

Module:4	Bio Potential Electrodes and Bio-amplifiers	8 hours

Origin of bio potential and its propagation-Electrode-electrolyte interface-Electrode–skin interface, Half-cell potential-Impedance-Polarization effects of electrode-Non polarizable electrodes-Types of electrodes - Surface, needle and micro electrodes and their equivalent circuits-Recording problems - Measurement with two

electrodes-Need for bio-amplifier - Single ended bio-amplifier, Differential bio-amplifier –Right leg driven ECG amplifier-Band pass filtering-Isolation amplifiers – Transformer and optical isolation - Isolated DC amplifier and AC carrier amplifier-Chopper amplifier-Power line interference.			
Module:5	**Cardiovascular Measurements**	**5 hours**	
Blood pressure measurement-Blood flow measurement-Heart sound measurement-ECG-VCG			
Module:6	**Respiratory System Measurements**	**6 hours**	
Spirometry-Measurement of functional residual volume-CO_2 analyzer and Oxygen analyzer			
Module:7	**Neuromuscular and Nervous measurement system**	**6 hours**	
EEG-procedure-Signal artifacts-Signal analysis-Evoked potential-EMG-Procedure and signal analysis-Nerve conduction study			
Module:8	**Contemporary issues:**	**2 hours**	
	Total Lecture hours:	**30 hours**	
Text Book			
1.	Abu-Faraj, Ziad O., Handbook of Research on Biomedical Engineering Education and Advance Bioengineering Learning, 2012,Volume 1, IGI Global, Hershey, USA.		
Reference Books			
1.	Leslie Cromwell, "Biomedical Instrumentation and measurement",2012, 1st edition, PHI, New Delhi.		
2	K Thayalan "The Physics of Radiology and Imaging" 2014, 1st edition, Jaypee Medical publishers, India, 2014.		
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT			
List of Challenging Experiments (Indicative)			
1.	Design an ECG amplifier using AD620 instrumentation amplifier with necessary numbers of operational amplifiers. Display the output data on computer screen using USB data acquisition board.		6 hours
2.	EEG signals are usually overlapped with noise signals. Design a band pass filter to eliminate or attenuate the artifacts without losing significant component of EEG signals		6 hours
3.	How pulsed Doppler can be used to detect blood flow. Using ultrasonic sensor (HCSR04) distance module design a blood flowmeter and dsplay the recording on the computer screen.		6 hours
4.	Measurement of strength of arm muscle is of high clinical importance especially for athletes. How can we measure the strength of the arm muscle using EMG? Design a EMG system to access the condition.		6 hours
5.	Wired pulse oximeter is widely used in the hospitals to measure oxygen saturation. Design a wireless pulse oximeter using LED (620nm-940nm) and display the data on computer screen		6 hours
Total Laboratory Hours			30 hours
Mode of Evaluation: Continuous Assessments and FAT			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE1014	SENSORS AND MEASUREMENTS	2	0	2	0	3
Prerequisite	PHY1001/PHY1701- Engineering Physics	Syllabus version				
		v. 1.0				

Course Objectives:

1. To acquaint students basics of measurements system and investigate inductive and magnetic sensors
2. Compare the resistive and capacitive sensors
3. Interpretation of electromagnetic sensors and self-generating sensors
4. Validate signal conditioning of sensors

Expected Course Outcome:

The student will be able to

- Gain the basic idea of measurements and the errors associated with measurement
- Differentiate between the types of sensors available
- Select a suitable sensor for a given application
- Apply the knowledge about the measuring instruments to use them more effectively
- Relate the self-generating sensors with passive sensors
- Comprehend the basics of signal conditioning
- Comprehend the operation and characteristics of special measurement systems

Module:1	Science of Measurement	3 hours

Measurement System – Instrumentation – Classification and Characteristics of Transducers – Static and Dynamic – Errors in Measurements – Calibration – Primary and secondary standards.

Module:2	Resistive and Capacitive Sensors	5 hours

Resistive sensors - Potentiometers, Strain gauges - Pressure resistive temperature detectors (RTD), thermistors – Magnetoresistors - Light dependent resistor (LDR), Resistive hygrometers, Resistive gas sensors - Liquid conductivity sensors - Capacitive sensors- Variable capacitor - Differential capacitor.

Module:3	Inductive and Magnetic Sensors	6 hours

Inductive sensors - Variable reluctance sensors - Eddy current sensors - Linear variabe differential transformers (LVDT) - Variable transformers - Magneto-elastic and magnetostrictive sensors - Super conducting quantum interference devices (SQUID).

Module:4	Electromagnetic Sensors	2 hours

Electromagnetic sensors - Sensors based on Faraday's law - Hall effect sensors.

Module:5	Self-generating Sensors	4 hours

Thermoelectric sensors - Piezo electric sensors - Pyroelectric sensors - Photovoltaic sensors - Electrochemical sensors.

Module:6	Signal Conditioning Elements	4 hours

Deflection bridges – Amplifiers - AC carrier system - Current transmitters - Oscillators and Resonators.

Module:7	Specialized Measurement Systems	

Flow measurement systems: Measurement of velocity - Volume and mass flow rate - Heat transfer effect in measurement systems: Characteristics of thermal sensors - Ultrasonic measurement systems.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book	
1.	Jacob Fraden, "Handbook of modern sensors", 2016, 5th Edition, Springer International Publishing, Switzerland.
Reference Books	
1.	Ramon Pallas-Areny and John G. Webster, "Sensors and Signal Conditioning", 2012, 2nd Edition, John Wiley and Sons Inc, New Jersey.
2.	John. G. Webster and HalitEren, "Measurements, Instrumentation and Sensors Handbook: spatial, mechanical, thermal and radiation measurements", 2014, 2nd edition, CRC Press, Florida.
3.	Winncy Y. Du, "Resistive, Capacitive, Inductive, and Magnetic Sensor Technologies", 2015, 1st Edition, CRC Press Taylor & Francis Group, New York.

Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT

List of Challenging Experiments (Indicative)

1.	Measure the emf voltage in a thermocouple element by keeping its reference electrode in room temperature and its other electrode in boiling water. The expected emf from thermocouple is relatively small (mV), so use an instrumentation amplifier with high input impedance to amplify the emf. Connect a digital voltage meter to the amplifier output, and measure the generated emf. The signal is amplified by a factor of 106. What is the temperature of the boiling water?	5 hours
2.	An LVDT's core motion range is −5mm to +5 mm. Its linearity over this range is ±0.3%, and its sensitivity is 23.8 mV · mm^{-1}. If it is used to track a work piece motion from −3.2 to +3.4 mm, find the sensor's expected output voltage and the error in position determination due to nonlinearity. Assume a linear transfer function $V_{out} = a\ V_{in}$	5 hours
3.	Mention which sensor can able to investigate the effect of an external, constant magnetic field, on a current moving through a semiconductor? Plot and comment on the relationship between sensor voltages versus load current. What is the sign and density of the charge carriers in the sensor element?	5 hours
4.	Measure the room temperature with the Pt 100 sensor and then keeping the sensor in boiling water, measure the resistance variations. Illustrate the resistance variation from room temperature to boiling point. From the response curve calculate sensitivity and nonlinearity of the sensor. Explain why the circuit only measures the resistance in the Pt 100 sensor, and not any contribution in the connection cables	5 hours
5.	Determine ten different beam loading values that will be used in lab to end load a cantilever beam using a platform and weights. Load values should increase by 100 gram intervals. Calculate the stress levels generated at the strain gage location for each load.	5 hours
6.	The capacitive level sensor is chosen to measure a water level ($\varepsilon_r = 80$) that can rise 300 mm high. If the capacitance reading is 503.4 pF, what is the water level? The width of the sensor's planar electrodes b is 20 mm, and the distance between the two plates d is 1 mm. Illustrate the response from 50mm height.	5 hours
Total Laboratory Hours		30 hours

Mode of Evaluation: Continuous Assessments and FAT

Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course Code	Course title	L	T	P	J	C
ECE2006	DIGITAL SIGNAL PROCESSING	2	0	2	4	4
Pre-requisite	ECE1004 – Signals and Systems	Syllabus version				
		v.1.1				

Course Objectives:

1. To summarize and analyze the concepts of signals, systems in time and frequency domain with the corresponding transformations.
2. To instruct students the design of analog and digital IIR, FIR filters.
3. To introduce students the diverse structures for realizing digital filters.
4. To teach students the usage of appropriate tools for realizing signal processing modules

Expected Course Outcome:

The students will be able to

1. Comprehend, classify and analyze the signals, systems, also, transform the time domain signals and response of the system to frequency domain
2. Ability to simplify the Fourier transform computations using fast algorithms
3. Comprehend the various analog filter design techniques and their digitization.
4. Ability to design the digital filters.
5. Ability to realize the digital filters using delay elements, summer, etc.
6. Ability to realize the lattice filters using delay elements, ladders, summers, etc
7. Ability to analyse and exploit the real-time signal processing applications
8. To design and implement systems using the imbibed signal processing concepts

Module:1	**Frequency Analysis of Signals and Systems-I**	**2 hours**

Review of Discrete -Time Signals and Systems – Classification, Convolution- z- transform: ROC-stability/causality analysis, DTFT: Frequency response-System analysis.

Module:2	**Frequency Analysis of Signals and Systems-II**	**5 hours**

Frequency domain sampling- Sampling rate conversion - Aperiodic correlation estimation-Cepstrum processing-Band limited discrete time signals- Phase and group delay- DFT-Properties. Frequency analysis of signals using DFT-FFT Algorithm-Radix-2 FFT algorithms-Applications of FFT

Module:3	**Theory and Design of Analog Filters**	**5 hours**

Design techniques for analog low pass filter -Butterworth and Chebyshev approximations, frequency transformation, Properties -Constant group delay and zero phase filters

Module:4	**Design of IIR Digital Filters**	**4 hours**

IIR filter design: Bilinear and Impulse Invariant Techniques- Spectral transformation of Digital filters.

Module:5	**Design of FIR Digital Filters**	**5 hours**

FIR Filter Design: Design characteristics of FIR filters with linear- phase – Frequency response of linear phase FIR filters – Design of FIR filters using window functions (Rectangular, Hamming, Hanning, Blackmann, and

Kaiser).		
Module:6	**Realization of Digital Filters**	**3 hours**
Direct, Cascade, Parallel, State space representations, Basic FIR and IIR digital filter structures		
Module:7	**Realization of Lattice filter structures**	**4 hours**
All pass filters, IIR tapped cascaded lattice structures, FIR cascaded lattice structures, Parallel all pass realization of IIR transfer function.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	J. G. Proakis, D.G. Manolakis and D.Sharma, "Digital Signal Processing Principles, Algorithms and Applications", 2012, 4th edition, Pearson Education, Noida, India.
2.	S.K.Mitra, Digital Signal Processing, 2013, 4th edition, TMH, New Delhi, India.

Reference Books

1.	Richard G Lyons and D.Lee Fugal, "The Essential Guide to Digital Signal Processing", 2014, Prentice Hall, New Jersey, US.
2.	Oppenhiem V.A.V and Schaffer R.W, "Discrete – time Signal Processing", 2013, 3rd edition, Prentice Hall, New Jersey, US.
3.	Lyons, "Understanding Digital Signal Processing", 2013, Pearson Edition, Noida, India.
4.	Emmanuel C. Ifeachor, "Digital Signal Processing A Practical Approach", 2011, 2nd edition reprint, Prentice Hall, New Jersey, US.

Mode of Evaluation: Continuous Assessment Test –I (CAT-I), Continuous Assessment Test –II (CAT-II), Digital Assignments/ Quiz / Completion of MOOC, Final Assessment Test (FAT).

List of Challenging Experiments (Indicative)

1	Introduction to MATLAB 2015A, Code Composer Studio and Digital Signal Processor.	6 hours
2	Basics of Digital Signal processing: Time domain and Frequency domain signal analysis for standard signals- Convolution, Correlation, Stability analysis, Spectral Estimation through DTFT and DFT, Radix-N- Algorithms.	6 hours
3	Signal Processing Techniques for Speech Applications-simulation, optimization and implementation.	6 hours
4	Signal processing methods for Music Signals- simulation, optimization and implementation.	6 hours
5	Signal processing mechanisms for Bio-Signals - simulation, optimization and implementation.	6 hours
Total Laboratory Hours		30 hours

Mode of Evaluation: Continuous Assessment of Challenging experiments / Final Assessment Test (FAT).

Typical Projects

1. Voice biometric speaker recognition
2. Hearing aid system
3. Identification of Musical Instruments
4. Simulation of cochlear implant in MATLAB
5. Speaker recognition system based on MFCC
6. Voice conversion
7. Disease detection based on ECG

8. Implementation of 5-Band Audio Equalizer in Matlab 9. Watermarking in audio signal 10. Musical tone generator using Matlab 11. Hearing aid system for impaired People using Matlab 12. Noise Cancellation using adaptive filters. 13. Implementation of speech recognition system 14. Disease detection based on Speech signal 15. Disease detection based on EEG.			
Mode of evaluation: Review I, II and III.			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE2012	CONTROL SYSTEMS ENGINEERING	2	0	0	4	3
Prerequisite	ECE1004-Signals and Systems MAT2002-Applications of Differential and Difference Equations	Syllabus version				
		v.1.0				

Course Objectives:

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

Expected Course Outcome:

The Students will be able to

- Calculate the transfer function from the block diagram
- Determine the stability of linear systems
- Investigate the mathematical models of the electrical and mechanical physical systems and their equivalence
- Describe various controllers and motors.
- Design PID controllers from design specifications
- Apply frequency domain methods to determine stability
- Formulate state-space models

Module:1	Introduction to Control Systems	2 hours

Basic block diagram of control system - Control schemes - Open loop and closed loop - Applications and scope.

Module:2	Mathematical Modeling of Physical Systems	5 hours

Differential equation - Difference equation and State variable representations - Mathematical modeling of electrical and mechanical systems - Equivalence between the elements of different types of systems - Transfer function - Block diagram - Manipulation of block diagrams - Open loop transfer function and closed loop transfer function - Signal flow graph.

Module:3	Components of Control Systems	3 hours

Controllers - P, PI, PID controllers - Actuators - DC Servo motor -AC Servo motor - Stepper motor - Synchronous.

Module:4	Time Domain Response	5 hours

Steady state and transient response - Time domain specifications - Types of test inputs -Response of first order and second order systems - Steady state error - Error constants - Generalized error coefficient.

Module:5	Characterization of Systems	3 hours

Stability - Concept and definition, Poles, Zeros, Order and Type of systems - R-H criteria - Root locus analysis.

Module:6	**Frequency Domain Response**	**6 hours**
Frequency response - Performance specifications in the frequency domain - Phase margin and gain margin - Bode plot -Polar plot and Nyquist plot - Stability analysis in frequency domain.		
Module:7	**Compensator and Controller Design**	**4 hours**
Realization of basic compensators - Cascade compensation in time domain and frequency domain - Feedback compensation - Design of lag, lead, lag-lead series compensator - Linear models of physiological systems - Regulation of cardiac output and frequency response of glucose insulin regulation.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book	
1.	Norman S. Nise, "Control Systems Engineering", 2011, 6th Edition, John Wiley & Sons, New York.
Reference Books	
1.	R.C. Dorf and R.H. Bishop, "Modern Control Systems", 2011, 12th Edition, Pearson Education, Inc., London.
2.	K. Ogata, "Modern Control Engineering", 2015, 5th Edition, Pearson Education, London.
3.	Farid Golnaraghi and Benjamin C Kuo, "Automatic Control Systems", 2017, 10th Edition, McGraw Hill Education, New York.
4.	I.J. Nagarthand and M. Gopal, "Control Systems Engineering", 2011, 5th Edition, New Age International, Chennai.

Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT

List of Challenging Projects (Indicative)

1. Design a Medical Alert System in the form of a wearable device that monitors rapid shifts in blood pressure and acceleration to automatically detect when a user has fallen.
2. Design an Electronic Walking Stick for visually impaired individuals who have a big problem when they walk on the street or stairs using white cane, but have sharp haptic sensitivity. The electronic walking stick will help the blind persons by providing more convenient means of life.
3. Design a Self-Balancing Spoon by which people suffering from Parkinson's disease can eat food comfortably without any spillage.
4. Design an Automatic Street Light Control System by exploring the methodology to sense the vehicle or human being without falls detection which may occur due to animals and the protocol for dimming light without wasting energy.
5. Design an Automatic Irrigation system which measures the moisture of the soil and automatically turns on or off the water supply system.

Mode of Evaluation: Review I, II and III

Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE2015	INTEGRATED CIRCUITS	2	0	2	4	4
Prerequisite	BIT1013- Semiconductor Devices and Circuits	Syllabus version				
		v.1.1				

Course Objectives:

1. Describe the linear and non-linear applications of op-amps
2. Discuss filters, ADC and DAC
3. Introduce the concepts of voltage regulator
4. Compare the concepts of waveform generation and introduce some special function ICs

Expected Course Outcome:

The student will be able to

1. Design linear and nonlinear applications of op – amps
2. Choose appropriate A/D and D/A converters for signal processing applications.
3. Generate waveforms using op – amp circuits
4. Gain knowledge about PLL
5. Design oscillators and filters using functional ICs
6. Analyze special function ICs
7. Develop skills to develop simple filter circuits and various amplifiers
8. Identify the method to apply various signal conditioning circuits

Module:1	Basic Op-amp circuits	5 hours

Op-Amp Fundamentals -Practical Limitations of op-amp circuits-Frequency compensation and stability Gain bandwidth product- Voltage Follower - Design of Instrumentation amplifier- VCVS, CCVS and VCCS- Voltage to Current converter –Computer Aided Analysis of Circuits using Pspice, dual opamp TL082 as a general purpose JFET input opamp.

Module:2	Active Filters	4 hours

Introduction to filtering - frequency response-characteristics and terminology-active versus passive filters-low pass filter-first order low pass active filter- second order active filter model-second order low pass filter characteristics-Sallen-key unity gain filter-Sallen-key equal component filter- higher order filters- high pass active filter- band pass filter-single op-amp band pass filter- multistage band pass filter state variable filter- state variable filters-all pass filters -switched capacitor filters-design of biomedical signal conditioning circuits.

Module:3	Non-Linear circuits	4 hours

Log / antilog amplifiers-comparator - zero crossing detector - sample and hold circuit - precision diode half wave and full wave rectifiers - active peak detector - clipper and clamper - square and triangular waveform generators-Phase changers - sinusoidal oscillators- Computer Aided Analysis of Circuits using Multisim.

Module:4	Timer and PLL	4 hours

555 timer - monostable and astable operation - applications - 556 voltage controlled oscillator - function generator ICs-functional block diagram - principle of operation - building block of PLL - characteristics - derivations of expressions for lock and capture ranges -frequency synthesis- application of PLL in biomedical

systems - analog multiplier and phase detection -wide band width precision analog multiplier MPY 634 and its applications.		
Module:5	**A-D and D-A Converters**	**4 hours**
Digital to analog converters - binary weighed and R-2R ladder types – parallel input multiplying type DAC7821 analog to digital converters - continuous - counter ramp-successive approximation-single slope-dual slope -flash type ADC-tracking ADC- DAC/ADC performance characteristics and comparison.		
Module:6	**Voltage Regulators**	**3 hours**
IC Voltage regulators – Three terminal fixed and adjustable voltage regulators – IC 723 general purpose regulator – Monolithic switching regulator - Switching Regulators - DC-DC converters - Low Drop Out (LDO) Regulators.		
Module:7	**Special Function ICs**	**4 hours**
Switched capacitor filter IC MF10 - Frequency to Voltage and Voltage to Frequency converters - Audio Power amplifier - Video Amplifier - Isolation Amplifier - Opto-couplers and fibre optic IC.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Books		
1.	Ramakant.A.Gayakwad, “Op-Amps and Linear Integrated Circuits”, 2015, 4th edition, Pearson education-India, Bangalore.	
2.	Roy Choudhury and Shail Jain, “Linear Integrated Circuits”, 2011, 1st edition, Wiley Eastern Ltd, India.	
Reference Books		
1.	Coughlin and Driscoll, “Operational-Amplifiers and Linear Integrated Circuits”, 2011, 6th edition, Pearson education-India, Bangalore.	
2.	Sergio Franco, “Design with operational amplifier and analog integrated circuits”, 2014, 3rd edition, Tata McGraw Hill, Noida.	
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT		
List of Challenging Experiments: (Indicative)		
1.	Design Butterworth 2nd order active LPF and HPF with cut-off frequency of 1.5KHz.	6 hours
2.	Construct an Instrumentation amplifier in differential mode and realize the output of one of the sensor connected to the circuit	6 hours
3.	Design and test a high-Q band pass self-tuned filter for a given centre frequency	6 hours
4.	Design and test a notch filter to eliminate 50 Hz power line noise in the medical equipment like ECG Machine	6 hours
5.	Designing with 12 bit parallel input multiplying DAC 7821	6 hours
Total Laboratory Hours		30 hours
Mode of Evaluation: Continuous Assessments and FAT		
List of Projects: (Indicative)		

1. Design a motion detector using IC 555 timer circuit, which automatically switches on an alarm when someone comes close to it (Detection of theft or an unauthorized person entering a restricted area)
2. Design an automatic headlight switcher circuit using IC 555 which reacts like the human eye to outside light levels and independently turns the light on and off when needed.
3. Design a dual audio signal tracer circuit, to trouble shoot for audio signal in radio and other

electronically circuitry.

4. Design a low cost hearing aid using IC 741. Audio signal are sensed by the condenser microphone and amplified by IC741.
5. Design a sequential time for DC motor control for industrial applications which requires rotation of the motors in forward and reverse directions for desired periods.

Mode of Evaluation: Review I, II, III.			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE2020	DIGITAL ELECTRONICS	2	0	2	4	4
Prerequisite	BIT1013- Semiconductor Devices and Circuits	Syllabus version				
		v.1.0				

Course Objectives:

1. Identify fundamentals of Logic families and types of logic gates
2. Develop the combinational circuits and sequential circuits
3. Investigate state machine techniques for logical design circuits and compare memory devices
4. Validate various types programmable logic circuits

Expected Course Outcome:

The student will be able to

1. Comprehend the basics of logic families
2. Describe the knowledge about logic gates
3. Examine the combinational circuits
4. Analyse the design of Sequential circuits
5. Formulate the state machine analysis for logical design
6. Differentiate the classification memory devices
7. Appraise the PLC's for logic circuit design
8. Design the logic gates and memory devices

Module:1	Logic Families	3 hours

Introduction to different logic families- Operational characteristics of BJT in saturation and cut-off regions- Operational characteristics of MOSFET as switch- TTL inverter - circuit description and operation-CMOS inverter - circuit description and operation-Structure and operations of TTL and CMOS gates- Electrical characteristics of logic gates – logic levels and noise margins- fan-out- propagation delay- transition time- power consumption and power-delay product.

Module:2	Logic Gates	5 hours

Logic gates – Truth tables – NOT, AND, OR, NOR, NAND, XOR, XNOR - Boolean Laws and theorems – Solving Boolean expressions- Truth Tables and Logic circuits – The Karnaugh Map – half adder-full adder- Multiplexers and De multiplexers - Decoders and encoders.

Module:3	Combinatorial Circuits	5 hours

Use of TTL-74XX Series & CMOS 40XX Series ICs- TTL ICs - Code Converters- Decoders- De multiplexers- Encoders- Priority Encoders- Multiplexers & their applications- Priority Generators- Arithmetic Circuit ICs- Parallel Binary Adder/Subtractor Using 2's Complement System- Magnitude Comparator Circuits

Module:4	Sequential Circuits	5 hours

Commonly Available 74XX & CMOS 40XX Series ICs - RS, JK.JK Master-Slave- D and T Type Flip-Flops & their Conversions- Synchronous and asynchronous counters- Decade counters-Shift Registers & application examples.

Module:5	**State Machine Design Approach**	**4 hours**
State machine design-ASM charts-state minimization- State assignment- Synthesis using D-FF and JK-FF - Asynchronous state machines- Design Examples.		
Module:6	**Memory**	**2 hours**
Read-only memory - Read/write memory - SRAM and DRAM- Non-Volatile Memories - EEPROM, Flash and FRAM.		
Module:7	**Programmable Logic Devices**	**4 hours**
PLAs- PALs and their applications- Sequential PLDs and their applications- State-machine design with sequential PLDs- Overview of Complex Programmable Logic Devices (CPLDs)- Introduction to field programmable gate arrays (FPGAs).		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book		
1.	J.F.Wakerly, "Digital Design Principles and Practices", 2017, 5th edition, Pearson Education, London.	
2.	William L Fletcher, "Engineering Approach to Digital Design", 2015, 1st edition, Pearson Education India, Bangalore.	
Reference Books		
1.	Donald P. Leach, Albert Paul Malvino, "Digital Principles and Applications", 2012, 8th edition, Tata McGraw Hill, Noida.	
2.	Thomas L Floyd, "Digital Fundamentals", 2011, 10th edition, Pearson Education Inc, London.	
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT		
List of Challenging Experiments (Indicative)		
1.	(a). Enter the circuit diagrams and truth tables of all the circuits you will test. These include the NAND, NOR, and INVERT/NOT. (b). Design a circuit to perform the EXCLUSIVE OR (XOR) function using only NAND and/or NOR gates. Simplify the circuit so that you use the smallest possible number of NAND and/or NOR gates (c). Check the circuit does perform the EXLUSIVE OR using truth tables or Boolean algebra	6 hours
2.	(a).Design a 4 kHz clock using the 555-timer chip. Make the low level 1/4 of the output period (a 75% duty cycle: 25% low, 75% high). (b). How large a capacitor would you need to substitute in order to modify your clock to run at 1 Hz (e.g. for visual observation of LEDs), keeping all other components fixed?	6 hours
3.	JK flip-flop with J=K=1 and CLR=1 is driven at the clock input by 1 kHz pulses. Draw the waveforms for the clock and the Q output vs. time using the same time scale. Make sure to include enough periods of the clock signal to see all the behavior of the flip-flop's output.	6 hours
4.	(a). Check your power supply before connecting to the circuit board. The Tektronix PS 280/3 has a fixed 5 V output that you should use to power digital circuits. The logic chips will burn out at around 6 V. If the supply voltage drops when you connect to the circuit, do not increase V. (b). Input logical values can be set by connecting wires from the gate inputs to either 0 V (logical 0) or 5 V (logical 1). Use one long rail on your prototyping board for 0V and one for 5V. Note: Disconnecting an input from the 5 V rail is not the same as connecting it to 0V. If it is disconnected, the input can float up	6 hours

	to 5 V on its own. (c). The logic level of the output can be observed using a light emitting diode (LED), which is connected from the output to ground. The LED lights up when the output is +5 V and is off when the output is 0 V. To limit the amount of current though the diode, place a resistor in series with it. What value of resistor should you use to limit the current to 20 mA? Record your calculation. (d). Record the measured truth tables for the NAND (7400), NOR (7402), and INVERT (7404) gates, using the LED indicators for your measurements.	
5.	Connect a NAND gate so that it performs the INVERT function. Do this for a NOR gate also. This trick will be convenient in simplifying complex circuits. Record you circuit and measured truth table.	6 hours
Total Laboratory Hours		30 hours

Mode of Evaluation: Continuous Assessments and FAT

List of Projects (Indicative)

1. Design a fingerprint attendance system circuit, using a Fingerprint Sensor module to authenticate a true person or employee by taking their finger input in the system. Employ 4 push buttons to enrol, Delete, UP/Down. ENROLL and DEL key has triple features.
2. Design a Touchless heart rate, pulse rate monitoring and image recognition app to detect changes in face's reflectivity for automobilist safety, based on cutting-edge research and science conducted at the MIT Media Lab, thereby allowing the app to calculate a person's heart rate.
3. Design an Obstacle Avoiding Robot Car Using an Ultrasonic Sensor by interfacing three ultrasonic sensors with arduino uno. Run an algorithm according to which you are going to manipulate your desire distance for obstacle detection then you are going to control your motor rotation direction for movement of your bot. 50cm (Front), 15cm (Each Side).
4. Design and implement a Digital code lock System using Arduino. Employ a LCD display which is used to interface with the project to output lock status to be used in places where we need more security.
5. Design a Luggage Security System using GSM to inform about the status of the luggage to the owner, by making of an integrated IR Transmitter Receiver circuit and IR diodes which sense any object about certain range. Make the algorithm tailor-made to the specific requirements of the user.

Mode of Evaluation: Review I, II, III.

Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE3020	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT	3	0	0	0	3
Prerequisite	ECE1011-Medical Physics and Biomedical Instrumentation	Syllabus version				
		v.1.1				

Course Objectives:

1. Discuss various bio-potential recordings and eplain various functional blocks present is cardiac care units and equipment their care and safety
2. Describe functional details of diathermy equipment and various assistive devices
3. Discuss working of hemodialyser and other respiratory devices
4. Describe various stimulators their function and uses

Expected Course Outcome:

The student will be able to

1. Develop measurement systems by selecting different types of, electrodes, signal conditioning circuits for acquiring and recording various bio-potential
2. Describe and explain specific parts in Cardiac care units
3. Comprehend the importance of diathermy units
4. Describe important working mechanisms of assist devices
5. Comprehend the operational conditions of hemodialyser
6. Develop the knowledge of respiratory aides and various types of Medical stimulators, and recently developed equipment

Module:1	**Bio-potential Recording**	**8 hours**
ECG- EEG- EMG- PCG- EOG- lead system and recording methods- typical waveform – frequency Spectrum - abnormal waveforms - Evoked response.		
Module:2	**Cardiac Devices**	**7 hours**
Pace makers - Different types- Batteries for pace makers- DC defibrillators - Asynchronous and synchronous types - Patient monitoring system - Principles of bio telemetry.		
Module:3	**Diathermy**	**5 hours**
Physiological effects of HF radiation - Depth of Penetration - Short wave - Ultrasonic and microwave diathermy - Surgical diathermy		
Module:4	**Assist Devices**	**5 hours**
Heart lung machine-Condition to be satisfied by the H/L System - Different types of Oxygenators - Pumps -Pulsatile and Continuous Types - Monitoring Process.		
Module:5	**Hemodialyzer**	**5 hours**
Hemodialyzer - Indication and Principle of Hemodialysis – Membrane – Dialysate - Different types of hemodialyzers - Monitoring Systems -Wearable Artificial Kidney - Implanting Type.		
Module:6	**Respiratory Aides**	**6 hours**
Respiratory aids- Intermittent positive pressure - Breathing Apparatus Operating Sequence- Electronic IPPB unit		

with monitoring for all respiratory parameters.			
Module:7	**Stimulator**	**6 hours**	
Galvanic - Faradic stimulators - Interferential therapy - Electrical safety- Leakage current - Micro and macro electric shock - GFI units - Electrical safety Analyser.			
Module:8	**Contemporary issues:**	**3 hours**	
	Total Lecture hours:	**45 hours**	
Text Book			
1.	Khandpur R.S, "Handbook of Biomedical Instrumentation", 2014, 3rd edition, Tata McGraw Hill Publication, New Delhi.		
Reference Books			
1.	Shakti Chatterjee, Aubert Miller, "Biomedical Instrumentation Systems", 2010, 1st edition, Delmar Cencage Learning, Clifton Park, New York.		
2.	Leslie Cromwell, Fred J.Weibell and Erich A.Pfeiffer, "Biomedical Instrumentation", 2011, 1st edition, Prentice Hall- India, New Delhi.		
3.	Webster J.G, "Medical Instrumentation application and design", 2011, 4th edition, John Wiley and sons, New York.		
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course Code	Course Title	L	T	P	J	C
ECE3023	MICROCONTROLLERS AND ITS APPLICATIONS	2	0	2	0	3
Prerequisite:	ECE2020- Digital Electronics	Syllabus version				
		v.1.0				

Course Objectives:

1. Analysis of timing and memory requirements.
2. Learn the design aspects of I/O and Memory Interfacing circuits
3. Discuss the energy efficient microcontroller and programming with low power modes for battery optimizations
4. Comprehensive knowledge of interfacing internal peripherals with external sensors and devices.

Expected Outcomes:

The student will be able to

- Understand theory of noise and the various methods involved in modulation techniques
- Interpret the concepts in digital communication and differentiate various digital modulation techniques.
- Recognize all the standards required for the digital data communication
- Apply and integrate various pulsed modulation in digital communication systems.
- Convergent in proposing suitable error controlling and correction algorithms
- Understand and Incorporte mutli user radio and multiple access schemes.

Module:1	Introduction to Intel 8051 Microcontroller	3 hours

Introduction to Microprocessors and Microcontrollers, Von Neumann / Harvard architecture, CISC vs RISC, Overview of 8051 and features in Instruction Set, Addressing Modes, Multiplexing Address/Data, Register / Special Function Registers (SFR) Mapping, Interrupts, Priority and Vector Locations GPIO Ports, Timers and its operating modes, Serial Communication –SPI and UART.

Module:2	8051 Programming	3 hours

Introduction to IDE – Assembler and Compiler Directives, Programmer, Development and Debugging tools, Introduction to Embedded C Programming, Creating Projects and Workspaces, Working with multiple modules Linking and Relocating modules,

Module:3	TI – MSP430 – 16 bit Energy Efficient Microcontroller	5 hours

Overview of MSP430 portfolio- MSP30 architecture – CPU - Functional Block Diagram – RISC Instruction Set – Memory mapped IO – Clock Generator, Active and Various Low Power Modes

Module:4	Programming with TI MSP430	5 hours

Overview of TI Code Composer Studio, Development and Debugging methods, Watch Variables and Break Points, Creating Projects and Workspaces, Include Files and their register mapping definitions

General Purpose Input and Output (GPIO), Interface issues between 3V and 5V Systems, Load considerations, Timers, Capture Mode, Pulse Width Modulation (PWM), Serial Communication – SPI, I2C, UART and USB modules

Module:6	Analog Peripherals of TI MSP430	4 hours

Analog to Digital Conversion, ADC Conversion Techniques, Advanced ADC configuration, Comparators and its

operating modes, Digital to Analog Conversion			
Module:7	**Interfacing Techniques**	**4 hours**	
Interfacing output devices – LEDs, 7 Segment Displays, Alphanumeric LCDs, Buzzer, DC Motors / Stepper Motors, Interfacing input devices- switches , matrix keypads, Working with ADC and DAC			
Module:8	**Contemporary Issues**	**2 hours**	
	Total Lecture:	**30 hours**	

Text Books:	
1	Muhammad Ali Mazidi, Janice G. Mazidi, Rolin D. McKinlay, 2014, 1st edition, 8051 Microcontroller and Embedded Systems, Pearson, India.
2	Steven F Barrett, Daniel J Pack. "Microcontroller Programming and Interfacing Texas Instruments MSP 430", 2011, 1st edition, Morgan & Claypool Publisher, New York.
3	John Davies, "MSP Microcontroller Basics", 2012, 1st edition, Newnes Publisher, New York.
Reference Books:	
1	Douglas V Hall, "Microprocessors and Interfacing Programming and Hardware", 2011, 1st edition, Tata McGrawHill, New Delhi.

Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT

List of Challenging Experiments: (Indicative)

1	Design a simple embedded system which can blink an LED for N times if a button is pressed.	6 hours
2	Design a microcontroller based system to interface the temperature sensor and to display the temperature in the LCD display.	6 hours
3	Design a PWM based motor control system	6 hours
4	Design a system to read a sensor value and to communicate to a personal computer.	6 hours
5	Design a digital clock using RTC and microcontroller.	6 hours
Total Laboratory Hours		30 Hours

Mode of Evaluation: Continuous Assessment and FAT

Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE3024	ANALOG AND DIGITAL COMMUNICATION	2	0	2	0	3
Prerequisite	ECE2015-Integrated Circuits					

Course Objectives:

1. To make students understand analog and digital communication techniques
2. To teach data and pulse communication techniques
3. To introduce source and Error control coding
4. To provide knowledge on multi-user radio communication

Expected Course Outcome:

The student will be able to

1. Understand theory of noise and the various methods involved in modulation techniques
2. Interpret the concepts in digital communication and differentiate various digital modulation techniques.
3. Recognize all the standards required for the digital data communication
4. Apply and integrate various pulsed modulation in digital communication systems.
5. Convergent in proposing suitable error controlling and correction algorithms
6. Understand and Incorporate mutli user radio and mutiple access schemes.

Module:1	Analog Communication	5 hours

Noise: Source of Noise - External Noise- Internal Noise - Noise Calculation. Introduction to Communication Systems: Modulation – Types - Need for Modulation. Theory of Amplitude Modulation - Evolution and Description of SSB Techniques - Theory of Frequency and Phase Modulation – Comparison of various Analog Communication System (AM, FM, PM)

Module:2	Digital Communication	5 hours

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) Minimum Shift Keying (MSK) –Phase Shift Keying (PSK) – BPSK – QPSK – 8 PSK – 16 PSK - Quadrature Amplitude Modulation (QAM) – 8 QAM – 16 QAM – Bandwidth Efficiency– Comparison of various Digital Communication System (ASK – FSK – PSK – QAM)

Module:3	Data Communication	5 hours

History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Error Detection and Correction Techniques - Data communication Hardware - Serial and parallel interfaces

Module:4	Pulse Communication	4 hours

Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM)

Module:5	Source and Error Control Coding	4 hours

Entropy -Source encoding theorem - Shannon fano coding - Huffman coding - mutual information - Channel capacity - Channel coding theorem - Error Control Coding - Linear block codes - Cyclic codes -Convolution codes - Viterbi decoding algorithm.

Module:6	**Multi-user Radio Communication**	**3 hours**
Advanced Mobile Phone System (AMPS) - Global System for Mobile Communications (GSM) – Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Hand off		
Module:7	**Multiple Access Schemes**	**2 hours**
Overview - Satellite Communication - Bluetooth.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30hours**

Text Book	
1.	T.L.Singal, "Analog and Digital Communication", 2012, 1st edition, Tata McGraw Hill Education Private Ltd, New York.
Reference Books	
1.	Wayne Tomasi, "Advanced Electronic Communications Systems", 2015, 6th edition, Pearson Publisher, London.
2.	Rappaport T.S, "Wireless Communications: Principles and Practice", 2011, 2nd edition, Pearson Education, Yew York.
3.	Andrew J. Viterbi, Jim K. "Omura, Principles of Digital Communication and Coding", 2013, 1st edition, Dover Publications Ltd, Mineola.
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT	

List of Challenging Experiments (Indicative)		
1.	Modulate a sinusoidal carrier wave by a speech message signal using different analog modulation schemes like DSB-SC, DSB-FC and SSB. Plot the amplitude spectrum of the message and transmitted signals. Implement the demodulation process. Plot the amplitude spectrum after mixing and low pass filtering. Compare the bandwidth and power requirements of the modulation schemes used.	8 hours
2.	Consider three different speech signals. Use FDM to multiplex a communication channel by allocating different frequency ranges to different messages. The width and allocation of the frequency bands are to be properly chosen so that they don't overlap and thus, signals from different users will not interfere one another. Implement FDM by DSB-SC, in which the amplitude of a sinusoidal carrier is changed by the message. At the receiver side, the original message is recovered by demodulation, where the received signal is multiplied by a cosine with the same frequency as used by the modulator, and then low pass filtered. Plot the amplitude spectrum of transmitted, received and recovered signals.	4 hour
3.	Consider the bit sequence of length 10,000. Modulate it with BASK, BPSK and BFSK. Transmit the signals through AWGN channel. Vary the SNR. Compare the probability of error of all these modulation techniques. Plot the signal space diagrams of various modulations considered. Analyse the impact of noise for different SNR values using signal space diagrams.	4 hour
4.	Consider the bit sequence of length 10,000. Modulate it with BPSK, QPSK and 8-PSK. Transmit the signal through AWGN channel. Vary the SNR. Compare the probability of error of all these modulation techniques. Plot the signal space diagrams of various modulations considered. Analyse the impact of noise for different SNR values using signal space diagrams.	4 hour
5.	Consider the bit sequence of length 10,000. Modulate it with binary PAM. Transmit the signal through AWGN channel. Vary the SNR. Compare the	6 hours

	theoretical and simulated probability of error. If the distance between the constellation points is increased, what is the corresponding effect in terms of probability of error? What is the effect of increasing the modulation order on the system performance?			
6.	Write a code to build a (3, 1, 3) repetition encoder. Map the encoder output to BPSK symbols. Transmit the symbols through AWGN channel. Investigate the error correction capability of the (3, 1, 3) repetition code by comparing its BER performance to that without using error correction code. If the repetition is done for 5 times, what is the impact on the BER?			4 hour
Total Laboratory Hours				30 hours
Mode of Evaluation: Continuous Assessments and FAT				
Recommended by Board of Studies	21-08-2017			
Approved by Academic Council	No. 47	Date		5-10-2017

Course code	Course Title	L	T	P	J	C
ECE3025	IMAGE PROCESSING	1	0	2	0	2
Prerequisite	ECE2006-Digital Signal Processing	Syllabus version				
		v.1.1				

Course Objectives:

1. To define digital image fundamentals and enhancement techniques
2. To impart the principles of filtering techniques in spatial and frequency domain
3. To discuss the various image restoration and compression techniques
4. To discover the principles segmentation techniques, feature extraction from images and classification

Expected Course Outcome:

The student will be able to

1. Comprehend image sampling and DFT
2. Process the given images to enhance them in spatial and frequency domains
3. Restore degraded images using frequency domain filters such as adaptive and Wiener filters
4. Perform image segmentation and morphological operations on a given image
5. Write algorithms for image compression
6. Extract image features, identify and classify them
7. Develop algorithms for specific applications

Module:1	Digital Image Fundamentals	2 hours

Introduction – Origin – Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels

Module:2	Image enhancement in spatial domain	2 hours

Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering

Module:3	Filtering in frequency domain	2 hours

Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.

Module:4	Image Restoration	2 hours

Noise models– Mean Filters – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

Module:5	Image Segmentation and Morphological operations	2 hours

Detection of Discontinuities–Edge Linking and Boundary detection – Region based segmentation-Morphological processing- Erosion and dilation.

Module:6	Image Compression	2 hours

Fundamentals – Image Compression models – Error Free Compression – Variable Length Coding – Bit-Plane

Coding – Lossless Predictive Coding – Lossy Compression – Lossy Predictive Coding – Compression -Image formats.			
Module:7	**Feature Extraction**		**1 hours**
Image Morphology, Boundary descriptors, Regional descriptors			
Module:8	**Contemporary issues:**		**2 hours**
	Total Lecture hours:		**15 hours**
Text Book			
1.	Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", 2016, 3rd edition, Pearson Education, Noida.		
Reference Books			
1.	Anil Jain K. "Fundamentals of Digital Image Processing", 2011, 1st edition, Prentice Hall India Learning Pvt. Ltd, Delhi.		
2.	Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", 2011, 1st edition, Prentice Hall India Learning Pvt. Ltd, Delhi.		
3.	Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", 2011, 2nd edition, McGraw Hill Pvt. Ltd., New York.		
4.	William K Pratt, "Digital Image Processing", 2013, 1st edition, CRC Press, Florida.		
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT			
List of Challenging Experiments (Indicative)			
1.	Read the given x-ray image using Matlab software and perform contrast enhancement and remove the noise using spatial low pass filters. Compare their performance.		6 hours
2.	Read the CT image of the given lungs image, perform intensity enhancement, and extract the nodules in the lungs using Matlab software.		6 hours
3.	Segment the white matter, gray matter and CSF from the given MRI image using Matlab software.		6 hours
4.	Process the given endoscopic images and extract the tumor detected using Matlab software.		6 hours
5.	Extract the blood vessels from the given retinal image using Matlab software.		6 hours
Total Laboratory Hours			30 hours
Mode of Evaluation: Continuous Assessments and FAT			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course title	L	T	P	J	C
MAT2002	Applications of Differential and Difference Equations	3	0	2	0	4
Pre-requisite	MAT1011 - Calculus for Engineers	Syllabus Version				
		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 Outcomes:

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	No. 47	Date	05-10-2017	

Course Code	Course title	L	T	P	J	C
MAT3004	**Applied Linear Algebra**	3	2	0	0	4
Pre-requisite	**MAT2002 Applications of Differential and Difference Equations**	**Syllabus Version**				
		1.0				

Course Objectives

1. understanding basic concepts of linear algebra to illustrate its power and utility through applications to computer science and Engineering.
2. apply the concepts of vector spaces, linear transformations, matrices and inner product spaces in engineering.
3. solve problems in cryptography, computer graphics and wavelet transforms

Expected Course Outcomes

At the end of this course the students are expected to learn

1. the abstract concepts of matrices and system of linear equations using decomposition methods
2. the basic notion of vector spaces and subspaces
3. apply the concept of vector spaces using linear transforms which is used in computer graphics and inner product spaces
4. applications of inner product spaces in cryptography
5. Use of wavelet in image processing.

Module:1	**System of Linear Equations**:	**6 hours**

Gaussian elimination and Gauss Jordan methods - Elementary matrices- permutation matrix - inverse matrices - System of linear equations - - LU factorizations.

Module:2	**Vector Spaces**	**6 hours**

The Euclidean space R^n and vector space- subspace –linear combination-span-linearly dependent-independent- bases - dimensions-finite dimensional vector space.

Module:3	**Subspace Properties**:	**6 hours**

Row and column spaces -Rank and nullity – Bases for subspace – invertibility- Application in interpolation.

Module:4	**Linear Transformations and applications**	**7 hours**

Linear transformations – Basic properties-invertible linear transformation - matrices of linear transformations - vector space of linear transformations – change of bases – similarity

Module:5	**Inner Product Spaces:**	**6 hours**

Dot products and inner products – the lengths and angles of vectors – matrix representations of

inner products- Gram-Schmidt orthogonalisation		
Module:6	**Applications of Inner Product Spaces**:	**6 hours**
QR factorization- Projection - orthogonal projections – relations of fundamental subspaces – Least Square solutions in Computer Codes		
Module:7	**Applications of Linear equations** :	**6 hours**
An Introduction to coding - Classical Cryptosystems –Plain Text, Cipher Text, Encryption, Decryption and Introduction to Wavelets (only approx. of Wavelet from Raw data)		
Module:8	**Contemporary Issues:**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours:	**45 hours**
Tutorial	• A minimum of 10 problems to be worked out by students in every Tutorial Class • Another 5 problems per Tutorial Class to be given as home work.	**30 hours**

Text Book(s)

1. Linear Algebra, Jin Ho Kwak and Sungpyo Hong, Second edition Springer(2004). (Topics in the Chapters 1,3,4 &5)
2. Introductory Linear Algebra- An applied first course, Bernard Kolman and David, R. Hill, 9th Edition Pearson Education, 2011.

Reference Books

1. Elementary Linear Algebra, Stephen Andrilli and David Hecker, 5th Edition, Academic Press(2016)
2. Applied Abstract Algebra, Rudolf Lidl, Guter Pilz, 2nd Edition, Springer 2004.
3. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003
4. Introduction to Linear Algebra, Gilbert Strang, 5th Edition, Cengage Learning (2015).

Mode of Evaluation

Digital Assignments, Continuous Assessments, Final Assessment Test

Recommended by Board of Studies	25-02-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

Course Code	Course title	L	T	P	J	C
MAT-3005	Applied Numerical Methods	3	2	0	0	4
Pre-requisite	MAT2002 – Applications of Differential and Difference Equations	Syllabus Version				
		1.0				

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 Outcomes

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 Equations**	**6 hours**
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	• A minimum of 10 problems to be worked out by students in every Tutorial Class. • 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., 6th Edition, 2012.
2. Applied Numerical Analysis, C. F. Gerald and P.V. Wheatley, Addition-Wesley, 7th 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 J. Morris, Wiley India Edn., 2007.
3. Numerical Methods for Engineers with Programming and Software Applications, Steven C. Chapra and Ra P. Canale, 7th Edition, Tata McGraw Hill, 2014.
4. Numerical Analysis, R.L. Burden and J. D. Faires, 4th Edition, Brooks Cole, 2012.
5. 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	No.47	Date	05-10-2017

PROGRAM ELECTIVES

Course code	Course Title	L	T	P	J	C
BIT1016	BIOCHEMICAL ANALYSIS AND TECHNIQUES	3	0	2	0	4
Prerequisite	Nil	Syllabus version				
		v.1.1				

Course objectives:

1. To describe the students with basic concepts of biomolecules, their structural classification and its metabolism.
2. To define the biology of enzymes, hormones, its classification with properties, composition and functions of blood and urine.
3. To investigate on clinical analytical methods used in biochemical techniques like hemocytometer, urine analysis and organ function tests – Liver, kidney, thyroid, pancreas and gastric system.
4. To interpret on analytical techniques like microscopy, chromatography, electrophoresis, blood gas analyzers and analytical applications of spectrophotometry, fluorometry, atomic absorption and atomic emission spectroscopy.

Expected course outcome:

The student will be able to

1. Comprehend the basic concepts of biomolecules and its functional classification
2. Ability to understand the metabolism of carbohydrates, proteins and fats with its factors affecting and deficiency disorders.
3. Comprehend the mechanism of enzymes and its classification with its modes of action.
4. Ability to understand the concepts and types of hormones, its physiological actions and immune system
5. Comprehend the knowledge on composition and functions of blood, formation of urine, composition of urine – creatinine, urea, albumin and sugar.
6. Ability to understand the instrumentation and principle concepts of Hemocytometer, organ function tests, microscopy and various analytical techniques.
7. Ability to understand the knowledge about analytical techniques and its significant usage in medicine.

Module:1	Biomolecules	5 hours

Carbohydrates – General classification - Structure and functions - Lipids structure and function - storage lipids - Structure of proteins and amino acids – Conformation – Classification - Denaturation.

Module:2	Metabolism	6 hours

Carbohydrate - Blood glucose regulation - Hypo and hyperglycemia - Diabetus mellitus-types - Clinical features - Metabolic changes – Glycosuria – GTT – Aminoacids – Phenylketonuria - Lipids and Lipoproteins- Cholesterol- Factors affecting the level - Plasma lipoprotein – Types - Hyper and hypo-lipo proteinemias - Risk factor - Atheroscelorosis and fatty liver.

Module:3	Introduction to enzymes and hormones	6 hours

Classification – chemistry - Nomenclature properties and mode of action of enzymes - Factor affecting enzyme activity - Concepts and types of hormones - Hormone actions – Pituitary – Thyroid –Parathyroid - Endocrine pancreas - Blood glucose regulation - Sex hormones and their functions - Immune system.

Module:4	**Blood and urine identification factors**	**6 hours**
Blood and urine - Composition and functions - Types and functions of RBC - WBC and platelet - Urine profile (creatinine – urea – albumin - sugar) - Color of urine - Specific gravity.		
Module:5	**Clinical analytical methods**	**6 hours**
Hemocytometer - Orine analysis - Organ function tests - Liver function tests - Kidney function tests - Thyroid function tests - Adrenal function tests - Pancreatic function tests - Gastric function tests.		
Module:6	**Biological and physiochemical parameters**	**6 hours**
Water quality assessment for biological and physiochemical parameters - Buffers and saline solutions - Body fluids - pH Isoelectronic/Isotonic point- Concept and determination".		
Module:7	**Analytical techniques**	**8 hours**
Microscopy - Principles of phase contrast - Interference and polarized light microscopy - Principle and applications of Chromatography – Electrophoresis - Flame photometry – Auto analyzers -Blood gas analyzers – Principle - Instrumentation and analytical applications for spectrophotometry – Fluorometry - Atomic absorption spectroscopy - Inductively coupled plasma - Atomic emission spectroscopy.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book		
1.	David L. Nelson and Michael M. Cox (University of Wisconsin-Madison), "Lehninger Principles of Biochemistry", 2017, 7th edition, Wisconsin.	
Reference Books		
1.	Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J Kennelly and P. Anthony Weil, "Harpers Illustrated Biochemistry", 2015, 30th edition, McGraw Hill Education, Columbus, USA.	
2.	Satyanarayana, "Biochemistry", 2017, 5th edition, Elsevier, Amsterdam.	
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT		
List of Challenging Experiments (Indicative)		
1.	A 29-year old Canadian woman was referred to a general internal medicine clinic for evaluation of a low serum albumin level. With a given serum sample, identify and estimate the role of albumin in serum (BCG method).	6 hours
2.	A 50-year old female was brought to an emergency department because of conscious disturbance on the previous night. The patient denied a history of diabetes mellitus and any use of medication. With a given sample of serum, estimate the amount of glucose in serum (GOD Method).	6 hours
3.	Increase in plasma protein concentration is generally due to an increase in total globulins and the concentration of albumin remains same or decreases. A decrease in total protein concentration is due to fall in albumin and sometimes globulin. In such conditions, how will you employ Biuret method to estimate the total protein in serum? Also report the normal range of protein in serum.	6 hours
4.	Bile salts malabsorption has been shown to induce diarrhea in various conditions. The underlying mechanisms of induction of diarrhea by bile salts are not fully known and may involve decrease in NaCl absorption as well as increased Cl- secretion in the intestine. Explain the methods to identify bile salts in bile juice.	6 hours
5.	A 35-year old woman became severely depressed after the sudden death of her husband. Two months later, she was brought to an emergency room because of extreme weakness and lethargy. She appeared thin and pale. Questioning revealed that she had not eaten for several weeks. Although much feared by clinicians, the ability to produce ketones has allowed humans to withstand prolonged period of	6 hours

	starvation. In such cases, identify the role of ketone bodies in urine and its analysis with a given urine sample (Rothera's test).	
Total Laboratory Hours		30 hours
Mode of Evaluation: Continuous Assessment and FAT		
Recommended by Board of Studies	21-08-2017	
Approved by Academic Council	No. 47	Date 5-10-2017

Course code	Course Title	L	T	P	J	C
BIT1018	MEDICAL OPTICS	3	0	0	0	3
Prerequisite	Nil	Syllabus version				
		v.2.1				

Course Objectives:

1. To discuss the physical properties of optical fiber, fabrication methods employed to manufacture them.
2. To describe the principles of transmission of light signal and its interaction with biological tissues for medical application
3. To investigate the application of optical, fluorescence and atomic force microscopy used for the diagnosis of diseases
4. To familiarize with the application of laser in the field of Ophthalmology and Dermatology

Expected Course Outcome:

The student will be able to

1. Understand the physical properties of optical fiber, fabrication methods employed to manufacture them.
2. Select the coupling instrumentation needed for transmission of light signal for a given application
3. Build optical instruments used for the diagnosis of diseases in humans
4. Use optical, fluorescence and atomic force microscopy and their applications
5. Develop instrumentation for therapeutic purposes considering interaction of light with biological tissues
6. Comprehend the application of laser in the field of Ophthalmology and Dermatology.

Module:1	**Introduction to Optics and Optical fibers**	**7 hours**

Introduction to Optical Fibers - Fiber Fabrication techniques-vapor phase oxidation - Outside Vapor-phase oxidation - Modified chemical vapor deposition and Plasma-activated chemical vapor deposition -Transmission Losses - Attenuation - Material absorption-Extrinsic and Intrinsic - Scattering losses- Mie Scattering - Rayleigh Scattering –SBS – SRS - Fiber bending loss-Micro and Macro bending losses.

Module:2	**Connectors, Splices and Couplers**	**6 hours**

Introduction to fiber Splices- Fusion splice - Mechanical splice – Snug tube splice - Loose tube splice - Multiple splice - Protection of splice -Connectors: - SMA – STC - Bionic etc, - Coupling – Passive – Stan - TEE types

Module:3	**Fiber optics Applications in Healthcare**	**6 hours**

Fiber optic endoscopes and its types - Laparoscopes, colonoscopes, Bronchoscopes, Arthroscopes - equipmental setup - Mechanism and applications.

Module:4	**Microscopy and its applications**	**6 hours**

Principle - modes of operation- properties - advantages-disadvantages and its applications of Optical Microscopy- Fluorescence microscopy and Atomic Force Microscopy.

Module:5	**Laser Safety and Tissue Interactions**	**6 hours**

Type of laser- tissue interaction and Laser safety- Photocoagulation Photothermal Ablation - Photochemical ablation- Photodisruption - Photochemcial interaction.

Module:6	**Lasers in Opthalmology**	**6 hours**

Introduction to Eye - Tissue Interactions - Different Corneal Refractive surgeries – Glaucoma - Lens and Retinal surgeries - Laser Treatment of choroidal Neovascularization.			
Module:7	**Lasers in Dermatology**	**6 hours**	
Structure of Skin - Modes of action of Laser Light - Human Skin and Laser interaction - Factors and effects of laser light on skin lesions - Types of skin diseases and types of lasers used in Dermatology.			
Module:8	**Contemporary issues**	**2 hours**	
	Total Lecture hours:	**45 hours**	
Text Books			
1.	Kirill Kulilov, "Laser Interaction with Biological Material: Mathematical Modeling (Biological and Medical Physics, Biomedical Engineering)", 2014, 1st edition, Springer International Publishing Switzerland.		
2.	Gerd Keiser, "Optical fibre communication", 2011, 4th edition, McGraw- Hill, New York.		
Reference Books			
1.	Peter.B.Cotton and Williams , "Practical Gastrointestinal Endoscopy: The Fundamentals", 2011 6th edition, Wiley Blackwell, New Jersey.		
2.	Fundamentals of Light Microscopy and electronic Imaging, Douglas B. Murphy., 2011, 1st edition, John Wiley & Sons, New Jersey.		
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
BIT1025	HOSPITAL MANAGEMENT	2	0	0	0	2
Prerequisite	Nil	Syllabus version				
		v.2.0				

Course Objectives:

1. With an objective of imbibing a professional approach amongst students towards hospital management.
2. The subject encompasses management principles, staffing and marketing processes, discussing their significance and role in effective and efficient management of health care organizations.

Expected Course Outcome:

The student will be able to

1. Understand the basic principles in hospital system management.
2. Apply the system development life cycle concepts.
3. Comprehend the disposal and hospital waste management mechanisms.
4. Analyse the electrical and fire safety measures.
5. Understand the principles of material management in a hospital.
6. Analyse the financial and legal aspects in hospital management.

Module:1	Principle of Hospital Management	4 hours

Importance of management and Hospital-Management control systems-Forecasting techniques decision-making process-Staffing pattern in hospitals-Selection-Recruiting process-Training of staff-Organizational structures.

Module:2	Computers in Hospital Management	4 hours

System Development life cycle-Reasons to use computers in hospital-Main categories of information systems in hospitals-EPR-E health care.

Module:3	Sterilization and waste management	4 hours

Disease Transmission - Disinfection methods – Sterilization - steam sterilizing (Auto claving) - Microwave (Non-burn treatment technology).-Disposal methods - Incinerator - Hazardous waste- Radioactive waste-Liquid waste destruction landfill-Air pollution and Emission control- Instrumentation and monitoring-Crematories.

Module:4	Electrical and fire safety	4 hours

Sources of shocks, macro & micro shocks-Hazards, monitoring and interrupting the Operation from leakage current- Elements of fire-causes of fire-Action to be taken in case of fire in a hospital.

Module:5	Assessing Quality Health Care	4 hours

Patient Safety Organization-Governmental & Independent-Measuring Quality care-Evaluation of hospital services – Six sigma way-Quality assurance in hospitals – Patient Orientation for total patient satisfaction-5S techniques

Module:6	Material Management	4 hours

Classification of Materials-Purchase Management- Purchase system (Centralized, Decentralized, Local purchase)-Purchase Procedures:-Selection of Suppliers-Tendering procedures-Analyzing bids-Price negotiations-Issue of purchase orders-Rate Contracts-Follow up action.			
Module:7	**Finance and Legal Aspects in a Hospital**	**4 hours**	
Introduction to principal and methods of budgeting-internal and external auditing-Medico legal aspects-Preventive Steps for Doctors/Hospitals to Avoid Litigation-Consent Form-Life Support Dying Declaration-Death Certificate-Post Mortem			
Module:8	**Contemporary issues:**	**2 hours**	
	Total Lecture hours:	**30 hours**	
Text Book			
1.	K. V. Ramani, "Hospital Management: Text and Cases", 2013, 1st edition, Pearson Education, New Delhi, India.		
Reference Books			
1.	G. D Kunders, "Hospitals - Facilities Planning & Management", 2017,1st edition, Tata McGraw Hill Education, New Delhi, India		
2	Sharon Bell Buchbinder, Nancy H. Shanks, "Introduction to Health Care Management", 2011, 1st edition, Jones & Bartlett Publishers, Boston, USA.		
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
BIT2022	BIOMATERIALS AND ARTIFICIAL ORGANS	3	0	0	0	3
Prerequisite	BIT1012- Human anatomy and physiology	Syllabus version				
		v.1.0				

Course objectives:

1. To define the basic concepts of materials used for biomedical applications – Metals, polymers, ceramics, bioresorbable/biodegradable materials, biomaterial response to host reactions, its systemic toxicity, testing of blood and material interactions, in-vitro and in-vivo testing of biomaterials.
2. To discuss the basic concepts about substitutive medicine, overview of organ replacement, design consideration and evaluation of artificial organs.
3. To determine the design of artificial heart/mechanical circulatory assist devices, heart valve prosthesis, gaseous exchange devices and artificial lungs
4. To describe about artificial kidney, artificial pancreas, artificial blood and artificial liver with its mechanism and applications.

Expected Course Outcome:

The student will be able to

1. Comprehend the basic concepts of biomaterials utilised in biomedical applications with its wide range of properties.
2. Ability to understand the biomaterial-host response, and their various testing methods to evaluate the biomaterials used in medicine.
3. Comprehend the knowledge about the need for artificial organs with its desired design consideration, organ replacement and steps required to evaluate the device.
4. Comprehend the basics and concepts of artificial heart, artificial lungs, liver, blood and kidney.
5. Ability to understand the material components involved in designing the different artificial organs
6. Comprehend the knowledge about the standards of biomaterials used in biomedical applications.

Module:1	Materials for biomedical applications	6 hours

Properties of materials - Classes of materials used in medicine – Metals – Polymers - Hydrogels -bioresorbable and biodegradable materials – Ceramics - Natural materials - Composites thin films – Grafts - Coating medical fabrics and biologically functional materials - Smart materials - Pyrolytic carbon for long term medical implants - Textured and porous materials non-fouling surfaces.

Module:2	Biomaterials reactions to host and its testing	6 hours

Host reactions to biomaterials – Inflammation - Wound healing and foreign body response - Systemic toxicity and hypersensitivity - Blood coagulation and blood-material interactions – Tumorigenesis - Implant associated infection - Testing of biomaterials – *in-vitro* & *in-vivo* assessment of tissue compatibility - Testing of blood material interactions - Degradation of materials in the biological environment - Effects of the biological environment on metals - Polymers and ceramics.

Module:3	Design of artificial organs	4 hours

Substitutive medicine - Biomaterial concentration - Outlook for organ replacement - Design consideration - Evaluation of artificial organs.

Module:4	**Artificial heart and circulatory assist devices**	**5 hours**
Design of artificial heart - History of artificial heart - Types of valve prostheses - Thrombus deposition – Durability - Mechanical circulatory assistance - Two main categories - Intra-aortic balloon pump - Percutaneous cardio-pulmonary bypass.		
Module:5	**Artificial lungs and blood gas exchange devices**	**6 hours**
Gas exchange systems - Cardio pulmonary bypass - Comparison of artificial lungs and natural lungs - Oxygen transport - Carbon-dioxide transport - Coupling of oxygen & carbon-dioxide exchange - Shear induced transport - Augmentation and devices for improved gas transport.		
Module:6	**Artificial kidney & artificial pancreas**	**6 hours**
Artificial kidney - Renal transplantation - Mass transfer in dialysis – Membranes – Hemofiltration - Adequacy of dialysis - Peritoneal dialysis equipment - Artificial pancreas - Insulin therapy - Therapeutic options in diabetes - Insulin administration system - Insulin production system.		
Module:7	**Artificial blood & artificial liver**	**6 hours**
Introduction to principal and methods of budgeting - Internal and external auditing - Medico legal aspects - Preventive steps for doctors/hospitals to avoid litigation - Consent form - Life support dying declaration - Death certificate - High risk post mortem.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	M.Lysaght., T.J. Webster., "Biomaterials and Artificial organs", 2013, 1st edition, Woodhead Publishing, Cambridge.
Reference Books	
1.	Joseph D. Bronzino, "Tissue Engineering and Artificial Organs", The Biomedical Engineering Handbook, 2016, 3rd edition, CRC Press, Florida.
2	S.Amato, B.Ezzell, "Regulatory affairs for biomaterials and medical devices", 2014, 1st edition, Woodhead Publishing, Cambridge.

Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course Code	Course Title	L	T	P	J	C
BIT2024	BIOMECHANICS	2	0	0	4	3
Prerequisite:	BIT1012- Human Anatomy & Physiology	Syllabus version				
		2.0				

Course Objectives:

- To discover the principles of mechanics that are applied in human movement studies and recall the structure and function of human bones and joints
- To recall about the material properties of bone, ligament, tendon, muscle and recognize various posture and gait
- To recall the structure and function of heart and lungs to relate the mechanics involved in circulation and breathing
- To incorporate the knowledge of biomechanics in the field of sports and ergonomics

Expected Course Outcome:

The student will be able to

1. Ability to apply the principles of mechanics in human movement studies
2. Comprehend the structure and function of human bones and joints
3. Comprehend human posture and gait
4. Ability to differentiate the material properties of bone, ligament, tendon and muscle
5. Comprehend the structure and function of heart and lungs
6. Ability to analyse the mechanics of circulatory and respiratory systems
7. Ability to solve the problems of sports and ergonomics with biomechanical solutions

Module:1	Introduction to Mechanics	5 hours

Biomechanics – Basic Concepts: Kinematics – Descriptions of Motion, Kinetics – Introduction to Forces – Introduction to Statics and Dynamics – Translatory Motion in Linear and Concurrent Force Systems – Additional Linear Force Considerations – Rotatory and Translatory Forces and Motion – Torque – Moment of Force – Muscle Forces – Lever Systems – Force Components – FEM – FEA.

Module:2	Joint Structure and Function	4 hours

Materials used in Human joints – General Properties of Connective Tissue – Complexities of Human Joint Design – Joint Function – General Changes with Disease – Injury – Immobilization – Exercise – Overuse.

Module:3	Tissue Biomechanics – Hard	4 hours

Material components of the body: Bone – Elastic properties – Bone shortening – Energy storage in elastic media – Viscoelasticity in bone – Bone fractures – Biomechanics of bone – Posture and Gait – Normal and Pathological**.**

Module:4	Tissue Biomechanics – Soft	4 hours

Material components of the body: Ligaments – Tendons – Cartilage – Elastic properties – Energy storage in elastic media –Viscoelasticity in muscles – Total muscle tension – Muscle fatigue.

Module:5	Cardio - Pulmonary Mechanics	4 hours

Structure of heart – Heart valves – Mechanical modeling of vasculatures and stent – Structure of the lung –

Physics of breathing – Alveoli – Mechanical model of breathing and breathing parameters –Methods for determining lung pressure and volume – Airway resistance and conductance.		
Module:6	**Application in Sport and Ergonomics**	**4 hours**
Qualitative analysis of Squat technique – Exercise specificity, injury risk, injury mechanisms –Posture balance, methods to adapt good posture – Occupational injuries and their prevention –Equipment and other engineering constraints.		
Module:7	**Computational Biomechanics**	**3 hours**
Software used for designing/ modeling and analysis – Basics involved in designing.		
Module:8	**Contemporary issues**	**2 hours**
Lecture Hours		**30 hours**

Text Books:	
1.	Y.C. Fung, "Bio-Mechanics- Mechanical Properties of Tissues", 2011, 1st Edition, Springer-Verlag, New York.
2.	Susan J Hall, "Basic Biomechanics", 2011, 1st Edition, Tata McGraw-Hill, New Delhi.
3.	Marcelo Epstein, "The Elements of Continuum Biomechanics", ISBN: 978-1-119-99923-2, 2012, 1st Edition, Wiley, New York.
Reference Book:	
1.	Jay D. Humphrey, Sherry De Lange, "An Introduction to Biomechanics: Solids and Fluids, Analysis and Design", 2015, 2nd Edition, Springer, New York.

Mode of Evaluation: CAT, Digital Assignment, Quiz, Additional learning (if any) and FAT.

List of Projects: (Indicative)

1. Place markers on certain locations of your body capture images of the same. Check if you have bilaterally equivalent posture. You should do it by using minimal number of markers. Objective: To understand the normal posture, shift of Log in case of abnormality.

2. Take your foot print while walking; it should contain at least two gait cycles. Now measure the gait parameters. Compare between right and left.

Objective: To understand the implication of a particular posture on gait parameter.

3. Create a 3D model of any synovial joint and explain its kinematics.

Objective: To understand all the possible movements and the range of motion around a joint.

4. Create a 3D model of any mechanical heart valve.

Objective: To understand the design requirements and constraints for a heart valve.

5. Create a 3D model of any soft tissue (ligament, tendon, muscle, meniscus, intervertebral disc).

Objective: To understand the material requirements for designing a soft tissue

Mode of Evaluation: Review I, II, III

Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course Code	Course Title	L	T	P	J	C
BIT3015	BIO-FLUID DYNAMICS	3	0	0	0	3
Prerequisite:	Nil	Syllabus version				
		v.2.1				

Course Objectives:

1. To recall the fluid mechanic principles that would govern the properties of bio fluids and identify the mechanical equivalent of bio viscoelastic fluids
2. To describe the properties of blood and discover the dynamics involved in circulatory system
3. To estimate the fluid dynamics of synovial and cerebro spinal fluid during physiological and pathological conditions
4. To discover the dynamics of alveolar mechanism during physiological and pathological conditions

Expected Course Outcome:

The student will be able to

1. Ability to apply the fluid mechanics principles in bio fluid studies
2. Ability to derive mechanical equivalent design for bio viscoelastic fluid
3. Comprehend the physical, chemical and rheological properties of blood
4. Comprehend and analyse structure and dynamics of blood vessels and circulation
5. Comprehend and analyse dynamics related to cerebro spinal fluid
6. Comprehend alveolar mechanics and flow of air in lungs
7. Comprehend synovial fluid and its dynamics

Module:1	Basic Bio-fluid Mechanics	6 hours

Newton's laws – Stress – Strain – Elasticity – Hooks-law – Viscosity – Newtonian fluid – Non-Newtonian fluid – Viscoelastic fluids – Vascular tree – Relationship between diameter, velocity and pressure of blood flow – Resistance against flow.

Module:2	Bio-Viscoelastic Fluid Mechanics	7 hours

Viscoelasticity – Viscoelastic models – Maxwell-Voigt and Kelvin Models – Response to Harmonic variation – Use of viscoelastic models – Bio-Viscoelastic fluids: Protoplasm – Mucus – Saliva –Synovial fluids.

Module:3	Flow Properties of Blood	8 hours

Physical – Chemical and Rheological properties of blood – Apparent and relative viscosity –Bloodviscosity variation – Effect of shear rate, haematocrit, temperature, protein contents of blood –Casson's equation – Problems associated with extracorporeal blood flow – Rheology of Blood in micro-vessels – Fahraeus-Lindquist effect and inverse effect – Distribution of suspended particles in a narrow rigid tube – Nature of red blood cells in tightly fitting tubes – Hematocrit in very narrow tube.

Module:4	Cardiac Mechanics	7 hours

Cardiovascular system – Mechanical properties of blood vessels – Arteries – Arterioles – Capillaries and veins – Blood flow: Laminar and Turbulent – Physics of cardiovascular diseases – Prosthetic heart valves and replacements.

Module:5	**Bio-fluid Dynamic of Human Brain**	**4 hours**
Cerebro Spinal Fluid – Cerebral blood flow – Blood brain barrier – Brain diseases.		
Module:6	**Respiratory Mechanics**	**5 hours**
Alveoli mechanics – Interaction of Blood and Lung P-V curve of Lung – Breathing mechanism – Airway resistance – Physics of Lung diseases.		
Module:7	**Orthopedic Mechanics**	**6 hours**
Synovial joint – Synovial fluid – Diseases affecting synovium		
Module:8	**Contemporary Issues:**	**2 hours**
	Total Lecture:	**45 hours**

Text Book:	
1.	David A. Rubenstein, Weiyin, Mary D. Frame, "Biofluid Mechanics- An Introduction to fluid Mechanics, Macrocirculation and Microcirculation", 2015, 1st Edition, Academic Press, Massachusetts, New York.
Reference Books:	
1.	Silver Frederick H., "Biomaterials, Medical Devices & Tissue Engineering", 2014, 1st Edition, Chapman & Hall publishing, London.

Mode of Evaluation: CAT, Digital Assignment, Quiz, and FAT			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
CSE2003	DATA STRUCTURES AND ALGORITHMS	2	0	2	4	4
Pre-requisite	NIL	Syllabus version				
		v1.0				

Course Objectives:

1. To impart the basic concepts of data structures and algorithms.
2. To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
3. To provide an insight into the intrinsic nature of the problem and to develop software systems of varying complexity.

Expected Course Outcome:

1. Evaluating and providing suitable techniques for solving a problem using basic properties of Data Structures.
2. Analyse the performance of algorithms using asymptotic notations.
3. Demonstrate knowledge of basic data structures and legal operations on them.
4. Illustrate different types of algorithmic approaches to problem solving and assess the trade-offs involved.
5. Analyse basic graph algorithms, operations and applications through a structured (well-defined) algorithmic approach.
6. Categorize the feasibility and limitations of solutions to real-world problems.
7. Provide efficient algorithmic solution to real-world problems.

Module:1	**Introduction to Data structures and Algorithms**	**1 hour**

Overview and importance of algorithms and data structures, Stages of algorithm development for solving a problem: Describing the problem, Identifying a suitable technique, Design of an Algorithm, Proof of Correctness of the Algorithm, Computing the time complexity of the Algorithm.

Module:2	**Analysis of Algorithms**	**3 hours**

Asymptotic notations and their significance, Running time of an algorithm, Time-complexity of an algorithm, Performance analysis of an algorithm, Analysis of iterative and recursive algorithms, Master theorem (without proof).

Module:3	**Data Structures**	**7 hours**

Importance of data structures, Arrays, Stacks, Queues, Linked list, Trees, Hashing table, Binary Search Tree, Heaps.

Module:4	**Algorithm Design Paradigms**	**8 hours**

Divide and Conquer, Brute force, Greedy, Recursive Backtracking and Dynamic programming.

Module:5	**Graph Algorithms**	**4 hours**

Breadth First Search (BFS), Depth First Search (DFS), Minimum Spanning Tree (MST), Single Source Shortest Paths.

Module:6	**Computational Complexity classes**	**5 hours**

Tractable and Intractable Problems, Decidable and Undecidable problems, Computational complexity Classes: P, NP and NP complete - Cooks Theorem (without proof),3-CNF-SAT Problem, Reduction of 3-CNF-SAT to Clique Problem, Reduction of 3-CNF-SAT to Subset sum problem.			
Module:7	**Recent Trends**	**2 hours**	
Algorithms related to Search Engines			
	Total Lecture hours:	**30 hours**	

Text Book(s)	
1.	Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009.
Reference Books	
1.	Sanjoy Dasgupta, C.Papadimitriou and U.Vazirani , Algorithms , Tata McGraw-Hill, 2008.
2.	A. V. Aho, J.E. Hopcroft and J. D. Ullman, Data Strucures and Algorithms ,Pearson India, Ist Edition, 2002
3.	A. V. Aho, J.E. Hopcroft and J. D. Ullman, The Design and Analysis of Computer Algorithms ,Pearson,1st edition, 2006.
4.	Sara Baase , Allen Van Gelder, Computer Algorithms, Introduction to Design and Analysis, 3rd edition, Wesley Longman Publishing, 1999.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	Extract the features based on various color models and apply on image and video retrieval	
2.	Arrays, loops and Lists	2 hours
3.	Stacks and Queues	2 hours
4.	Searching and Sorting	3 hours
5.	Linked List and operations	4 hours
6.	Brute force technique	2 hours
7.	Greedy Technique	2 hours
8.	Backtracking	2 hours
9.	Dynamic Programming	2 hours
10.	Trees and Tree Operations	3 hours
11.	BFS and DFS	2 hours
12.	Minimum Spanning Tree	2 hours
Total Laboratory Hours		26 hours
Mode of assessment: Project/Activity		

Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

Course code	Course Tile	L	T	P	J	C
CSE2004	DATABASE MANAGEMENT SYSTEM	2	0	2	4	4
Pre-requisite	NIL	Syllabus version				
		v1.0				

Course Objectives:

1. To understand the concept of DBMS and ER Modeling.
2. To explain the normalization, Query optimization and relational algebra.
3. To apply the concurrency control, recovery, security and indexing for the real time data.

Expected Course Outcome:

1. Explain the basic concept and role of DBMS in an organization.
2. Illustrate the design principles for database design, ER model and normalization.
3. Demonstrate the basics of query evaluation and heuristic query optimization techniques.
4. Apply Concurrency control and recovery mechanisms for the desirable database problem.
5. Compare the basic database storage structure and access techniques including B Tree, B+Trees and hashing.
6. Review the fundamental view on unstructured data and its management.
7. Design and implement the database system with the fundamental concepts of DBMS.

Module:1	DATABASE SYSTEMS CONCEPTS AND ARCHITECTURE	5 hours

History and motivation for database systems -characteristics of database approach - Actors on the scene - Workers behind the scene - Advantages of using DBMS approach– Data Models, Schemas, and Instances– Three-Schema Architecture and Data Independence– The Database System Environment– Centralized and Client/Server Architectures for DBMSs– Classification of database management systems.

Module:2	DATA MODELING	4 hours

Entity Relationship Model : Types of Attributes, Relationship, Structural Constraints - Relational Model, Relational model Constraints - Mapping ER model to a relational schema - Integrity constraints

Module:3	SCHEMA REFINEMENT	6 hours

Guidelines for Relational Schema – Functional dependency; Normalization, Boyce Codd Normal Form, Multi-valued dependency and Fourth Normal form; Join dependency and Fifth Normal form.

Module:4	QUERY PROCESSING AND TRANSACTION PROCESSING	5 hours

Translating SQL Queries into Relational Algebra - heuristic query optimization - Introduction to Transaction Processing - Transaction and System concepts – Desirable properties of Transactions - Characterizing schedules based on recoverability - Characterizing schedules based on serializability

Module:5	CONCURRENCY CONTROL AND RECOVERY TECHNIQUES	4 hours

Two-Phase Locking Techniques for Concurrency Control – Concurrency Control based on timestamp – Recovery Concepts – Recovery based on deferred update – Recovery techniques based on immediate update - Shadow Paging.

Module:6	**PHYSICAL DATABASE DESIGN**	**3 hours**	
Indexing: Single level indexing, multi-level indexing, dynamic multilevel Indexing			
Module:7	**RECENT TRENDS - NOSQL DATABASE MANAGEMENT**	**3 hours**	
Introduction, Need of NoSQL, CAP Theorem, different NoSQL data models: Key-value stores, Column families, Document databases, Graph databases			
	Total Lecture hours:	**30 hours**	

Text Book(s)	
1.	R. Elmasri S. B. Navathe, Fundamentals of Database Systems, Addison Wesley, 7th Edition, 2015
2.	Raghu Ramakrishnan,Database Management Systems,Mcgraw-Hill,4th edition,2015.
Reference Books	
1.	A. Silberschatz, H. F. Korth S. Sudershan, Database System Concepts, McGraw Hill, 6th Edition 2010.
2.	Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management,6th Edition,2012.
3.	Pramod J. Sadalage and Marin Fowler, NoSQL Distilled: A brief guide to merging world of Polyglot persistence, Addison Wesley, 2012.
4.	Shashank Tiwari ,Professional NoSql,Wiley ,2011

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	DDL and DML	3 hours
2.	Single row and aggregate functions	3 hours
3.	Joins and Sub queries	3 hours
4.	Anonymous blocks and control structures	3 hours
5.	Iterations	3 hours
6.	Cursors	3 hours
7.	Functions and Procedures	3 hours
8.	Exception Handling and triggers	3 hours
9.	DBA Concepts	3 hours
10.	XML, DTD, XQuery Representations	3 hours
Total Laboratory Hours		30 hours
Mode of assessment: Project/Activity		

Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

Course code	Course title	L	T	P	J	C
ECE2017	PHYSIOLOGICAL SYSTEM MODELING	2	0	2	0	3
Prerequisite	ECE2012-Control Systems Engineering	Syllabus version				
		v.2.0				

Course Objectives:

1. To introduce the basic system concepts and differences between an engineering and physiological control systems.
2. To acquaint students with different mathematical techniques applied in analysing a system and the various types of nonlinear modelling approaches.
3. To teach neuronal membrane dynamics and to understand the procedures for testing, validation and interpretation of physiological models.
4. To study the cardiovascular model and apply the modelling methods to multi input and multi output systems.

Expected Course Outcome:

The student will be able to

1. Understand the basic system concepts and differences between an engineering and physiological control systems.
2. Apply different mathematical techniques to analyze a system.
3. Comprehend the various nonlinear modelling approaches.
4. Understand the neuronal membrane dynamics.
5. Apply the procedures for testing, validation and interpretation of physiological models.
6. Comprehend the cardiovascular model.
7. Analyse the modelling methods to multi input and multi output systems.

Module:1	System Modeling in Physiology	5 hours

The problem of system modeling in physiology - Need for modeling - Conceptual and mathematical models – Modeling - experiments and simulation - Feedback control systems - Difference between engineering and physiological control systems.

Module:2	Physiological Modeling	5 hours

Deductive and Inductive modeling - Characteristics of a reliable physiological model - Modeling a simple reflex - Mathematical modeling.

Module:3	Nonlinear Modeling	4 hours

System Identification, Model Specification, Model estimation. Types of nonlinear modeling approaches. Non parametric modeling. Volterra and Wiener models. Volterra Kernels. Modeling the vertebrate retina. Analysis of estimation errors.

Module:4	Modeling of Neuronal Systems	4 hours

A general model of the nerve membrane - Action potential and synaptic dynamics - Functional integration in the single neuron - Neuronal systems with point process inputs - Conduction in nerve fibres - Voltage clamp experiment - Hodgkin Huxley (H-H) model - Circuit analog of the H-H nerve membrane model.

Module:5	**Systems Identification in Physiology**	**4 hours**
System characteristics - System parameters - System functional properties - Input characteristics - Experimental considerations - Data preparation - Data consolidation - Model specification and estimation tasks - Model validation and interpretation.		
Module:6	**Modeling of Cardiovascular Systems**	**3 hours**
Cardiovascular systemic and pulmonary circulation - Lumped model of the cardiovascular system - Pulmonary physiology - Respiratory control system.		
Module:7	**Multi Input/ Output Systems**	**3 hours**
Modeling of multi input/ multi output systems -The Two-input case - Applications of Two-input modeling to physiological systems.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book

1.	Michael C.K. Khoo, "Physiological Control Systems: Analysis, Simulation and Estimation," 2011, 1st edition, Prentice Hall of India, New Delhi.

Reference Books

1.	Suresh Devasahayam, "Signal Processing and Physiological Systems Modeling", 2013, 1st edition, Springer, New York.
2.	Joseph D. Bronzino and Donald R. Peterson, "The Biomedical Engineering Handbook", 2015, 4th edition, CRC Press, Florida.

Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT

List of Challenging Experiments (Indicative)

1.	The pupillary light reflex is a classic example of a negative feedback control system. Design a control system model for the light reflex system in the retina.	6 hours
2.	Develop a model for a system where the glucose uptake is dependent on insulin concentration in the plasma and that insulin production rate is dependent on the glucose concentration in the plasma.	6 hours
3.	The Bainbridge reflex is a cardiac reflex that aids in matching of cardiac output (the flow rate at which blood is pumped out of the heart) to venous return (the flow rate at which blood returns to the heart). Design a servomechanism model to adjust the cardiac output to track venous return.	6 hours
4.	Several types of physiological receptors exhibit the property of rate sensitivity. Carbon dioxide receptors have been found in the lungs of humans, birds and reptiles. Design a model in which ventilation may be controlled by the intrapulmonary receptors following denervation of the carotid bodies.	6 hours
5.	The regulation of water balance in the body is intimately connected with the control of sodium excretion. One major mechanism of sodium reabsorption involves the renin-angiotensin-aldosterone system. Design a model to describe the regulation process in the kidney.	6 hours
Total Laboratory Hours		30 hours

Mode of Evaluation: Continuous Assessments and FAT

Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE2018	MEDICAL INFORMATICS	3	0	0	0	3
Prerequisite	Nil	Syllabus version				
		v.2.0				

Course Objectives:

1. To introduce the basic concepts in Biomedical Informatics and its applications in electronic medical record system and medical standards.
2. To acquaint the students to clinical decision support systems.
3. To introduce the basics of bioinformatics, resources in the field and to apply the standards in proper health care delivery.
4. To teach the various bioinformatics tools and explore the databases available in NCBI.

Expected Course Outcome:

The student will be able to

1. Understand the basic concepts in Biomedical Informatics.
2. Comprehend the applications of an electronic medical record system.
3. Apply the various aspects of health informatics and medical standards.
4. Design and develop clinical decision support systems.
5. Understand the basics of bioinformatics and the resources in the field.
6. Explore and apply the various bioinformatics tools and databases available in NCBI.

Module:1	Introduction to Biomedical Informatics	7 hours

The Science and the Pragmatics - Biomedical Data - Their Acquisition, Storage, and Use - Computer Architectures for Health Care and Biomedicine - Overview of hospital information system - Patient history taking mechanisms - Patient data processing - Database Management - Communication of medical data across different hospital units - Networking and Integration of patient data.

Module:2	Computer Architectures and Software Engineering for Health Care and Biomedicine	6 hours

Data from patients - Patient Record, Coding and classification – Standards - Natural Language Processing - Biomedical Imaging Informatics - Biosignal Analysis - Electronic Health Record Systems - Patient-Centered Care Systems - Primary care - Clinical Departmental Systems - Nursing Information Systems.

Module:3	Electronic Patient Record and Standards	6 hours

Electronic Patient Record - Medical data formats – Medical Standards – HL7 – DICOM - LOINC - PACS - Medical Standards for Vocabulary - ICD 10 – DRG - MeSH, UMLS, SNOMED - Healthcare Standards - JCAHO, HIPAA.

Module:4	Biomedical Decision Making	6 hours

Probabilistic Clinical Reasoning - Medical Knowledge and Decision Support - Methods for decision

support - Clinical decision-support systems - Strategies for medical knowledge acquisition - Predictive tools for clinical decision support.		
Module:5	**Bioinformatics**	**6 hours**
Introduction to Bioinformatics- Biological information resources - Genome sequence acquisition and analysis - Retrieval of biological data - Data acquisition – databases - structure and annotation - Data mining and data characteristics.		
Module:6	**Bioinformatics tools**	**6 hours**
NCBI - Human Genome Project – GenBank - Sequence alignment – BLAST – FASTA –CLUSTALW - Phylogenetic analyses.		
Module:7	**Methodology for Information Systems**	**6 hours**
Human-Computer interaction in health care - Costs and Benefits of information systems - Security in medical information systems - Standards in Health care informatics and Telematics - Project management.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	Edward H. Shortliffe and James J. Cimino, "Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Health Informatics)", 2014, 4th edition, Springer, New York.
Reference Book	
1.	Rastogi, "Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery", 2013, 1st edition, Prentice Hall, New Delhi.

Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE2021	MEDICAL IMAGING EQUIPMENT	3	0	0	0	3
Prerequisite	ECE1011-Medical Physics and Biomedical Instrumentation	Syllabus version				
		v.1.0				

Course Objectives:

1. To provide comprehensive understanding of medical image acquisition in different modalities and to acquaint the students with different reconstruction techniques and noise removal.
2. To develop a basic familiarity with all the modules employed in magnetic resonance imaging
3. To familiarize with manipulation of nuclear radiation fields for medical applications To demonstrate knowledge, clinical and technical skills and decision-making capabilities and appropriate usage of nuclear medicine systems with respect to diagnostic imaging
4. To acquaint the students with radiation therapy and the safety measures related to radiation.

Expected Course Outcome:

The student will be able to

1. To comprehend the acquisition techniques involved in different modalities of medical imaging
2. To conceive the historical evolution of the imaging methods pertaining to computed tomography and to excel with different reconstruction techniques and programming techniques for noise removal.
3. To comprehend the principle of operation of modules employed in magnetic resonance imaging
4. Familiar with all the modules employed in magnetic resonance imaging
5. To manipulate of nuclear radiation fields for diagnostics to be skillful in image generation
6. To excel with radiation therapy and the safety measures related to radiation.

Module:1	Medical X-Ray Equipment	7 hours

Nature of X-Rays - X-ray Absorption - Tissue Contrast. X-Ray Equipment – X-ray Tube, collimator, Bucky Grid, power supply. Digital Radiography - discrete digital detectors, storage phosphor and film Scanning. X-Ray Image intensifier tubes - Fluoroscopy – Digital Fluoroscopy. Angiography, Cine angiography. Digital Subtraction Angiography. Mammography.

Module:2	Computed Tomography	7 hours

Principles of Tomography - First to Fifth generation scanners – Image reconstruction Technique - Back projection and Iterative method. Spiral CT Scanning - Ultra fast CT Scanners- X-Ray Sources – Collimation – X-Ray Detectors – Viewing System.

Module:3	Magnetic Resonance Imaging	6 hours

Fundamentals of Magnetic Resonance- Interaction of nuclei with static Magnetic Field and Radio frequency wave – Rotation and Precession –induction of a magnetic resonance signal – bulk Magnetization – Relaxation Processes T1 and T2.

Module:4	MRI System and its components	5 hours

MRI system- System Magnet, generation of Gradient magnetic Fields, Radio Frequency coils, Shim coils, Electronic components.

Module:5	Nuclear medicine systems	5 hours

Radio isotopes- alpha, beta and gamma radiations. Radio pharmaceuticals. Radiation detectors - Gas Filled, ionization Chambers, proportional counter, GM counter and Scintillation Detectors.			
Module:6	**Recent Trends in Nuclear Medicine Systems**	**6 hours**	
Principles of SPECT and PET - CTAC (CT with attenuation Correction) PET.			
Module:7	**Radiation therapy and radiation safety**	**7 hours**	
Radiation therapy-Linear accelerator, Betatron, cesium and cobalt. Radiation Protection in Medicine –Radiation Protection principles, Radiation measuring instruments-Dosimeter, film Badges, Thermo luminescent dosimeters – Electronic dosimeter- ICRP regulation Practical reduction of dose to staff and visitors.			
Module:8	**Contemporary issues:**	**2 hours**	
	Total Lecture hours:	**45 hours**	
Text Book			
1.	Gopal B.Saha, “Physics and Radiobiology of Nuclear Medicine”, 2013, 4th edition, Springer-Verlag, New York.		
Reference Books			
1.	Russell K. Hobbie, Bradley J. Roth, “Intermediate Physics for Medicine and Biology”, 2015, 1st edition, Springer International Publishing, Switzerland.		
2.	Paul Suetens, “Fundamentals of Medical Imaging”, 2017, 3rd edition, Cambridge University Press, Cambridge, New York.		
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE2022	GRAPHICAL SYSTEM DESIGN FOR BIOMEDICAL ENGINEERS	0	0	4	4	3
Prerequisite	ECE1014-Sensors and Measurements	Syllabus version				
		v.1.0				

Course Objectives:

1. To expose students to methods and techniques used in LabVIEW programming
2. To provide students with skills necessary to perform basic tasks in LabVIEW
3. To make students learn how best to utilize LabVIEW and its programming environment

Expected Course Outcome:

The student will be able to

1. Demonstrate the methods and techniques used in virtual instrumentation
2. Develop systems to acquire biomedical signals using various data acquisition cards
3. Design systems to be interfaced and monitored by Graphical Dashboards
4. Incorporate sensors for real-time measurement and acquire real-time data for medical applications.
5. Formulate and evaluate methods to control medical devices using LabVIEW

Text Book

1. Sanjay Gupta, Joseph John, Virtual Instrumentation using LABVIEW, 2011, 2nd Edition, McGraw Hill.

Reference Books

1. LabVIEW user manual- National Instruments
2. LabVIEW data acquisition basics manual – National Instruments

List of Challenging Experiments (Indicative)

1.	Acquire a finite measurement and provide options for exporting the measurement to the disk.	6 hours
2.	Acquire ECG data and plot the waveform and determine the heart rate.	8 hours
3.	Acquire EMG signals from different hand muscles and plot the signals. Compare the response for a single movement of hand.	8 hours
4.	Using PPG sensor record the pulse waveform and determine the heart rate.	8 hours
5.	Design a respiration monitor to measure respiration rate of a subject.	6 hours
6.	Using the appropriate sensors and electrodes, acquire any two physiological parameters (ECG and PPG) of a subject and display them.	6 hours
7.	Record heart sounds using PCG sensor and display the signal. Determine the heart rate.	6 hours
8.	Using accelerometer detect the tremor in hands. Determine the velocity.	6 hours
9.	Design a motor controlled wheel chair that moves with voice signal.	6 hours
Total Laboratory Hours		60 hours

Mode of Evaluation: Continuous Assessments and FAT

List of Projects:

1. Design a Virtual Instrument for critical care monitoring
2. Design a system using IMAQ and LabVIEW for the study of eye motion
3. Develop a Cardiorespiratory monitoring system to monitor ECG, PCG and respiration.
4. Acquire respiration signals using respiration for breathing disorder pattern analysis, during Sleep.
5. Using accelerometer, design and develop a system to estimate and analyze the impact

. during fall.			
Mode of Evaluation: Review I,II and III			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course Code	Course title	L	T	P	J	C
ECE3009	NEURAL NETWORKS AND FUZZY CONTROL	3	0	0	4	4
Pre-requisite	ECE2006 - Digital Signal Processing	Syllabus version				
		v.1.0				

Course Objectives:

1. To summarize basic learning laws and architectures of neural networks.
2. To describe supervised and unsupervised learning laws of Neural Networks.
3. To introduce Fuzzy Logic, Fuzzy relations and Fuzzy mathematics for designing a Fuzzy logic controller.
4. To discuss neuro fuzzy approaches like ANFIS and CANFIS.

Expected Course Outcome:

1. The students will be able to
2. To translate biological motivations into various characteristics of artificial neural networks
3. To comprehend and analyze basic learning laws of neural networks and activation functions used.
4. To interpret associative memories for storing and recalling the input patterns
5. To learn and implement supervised and unsupervised learning algorithms for various applications.
6. To learn fuzzification and de-fuzzification methods for developing Fuzzy inference systems
7. To apply and integrate various neuro-fuzzy techniques for designing intelligent systems using ANFIS and CANFIS.
8. To design a model using neural networks and fuzzy logic for various applications.

Module:1	Introduction to Artificial Neural Networks	3 hours

Artificial neural networks and their biological motivation, terminology, models of neuron, topology, characteristics of artificial neural networks, types of activation functions.

Module:2	Learning methods	7 hours

Error correction learning, Hebbian learning, perceptron – XOR problem– perceptron learning rule convergence theorem – adaline.

Module:3	Supervised Learning	9 hours

Introduction to ANN architecture, multilayer perceptron, back propagation learning algorithm, momentum factor, radial basis function network. Associative memory: Auto association, hetero association, recall and cross talk. Recurrent neural networks - Hopfield neural network.

Module:4	Unsupervised Learning	9 hours

Introduction, competitive learning neural networks, max net, Mexican hat, hamming net, Kohonen self organizing feature map, counter propagation, learning vector quantization, adaptive resonance theory, performance of SOM.

Module:5	**Fuzzy Sets and Fuzzy Relations**	**4 hours**
Introduction, classical sets and fuzzy sets, classical relations and fuzzy relations, membership function.		
Module:6	**Fuzzy Inference Systems**	**6 hours**
Fuzzification, fuzzy arithmetic, numbers, extension principle, fuzzy inference system, defuzzification, fuzzy rule based systems, fuzzy nonlinear simulation, fuzzy decision making, fuzzy optimization.		
Module:7	**Neuro-Fuzzy Systems**	**5 hours**
Introduction, ANFIS, ANFIS as universal approximator, CANFIS.		
Module:8	**Contemporary issues**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	J.S.R. Jang, C.T. Sun, E. Mizutani, "Neuro Fuzzy and Soft Computing - A computational Approach to Learning and Machine Intelligence", 2012, 1st edition, PHI learning Private Limited, New Delhi.
2.	Timothy J. Ross, Fuzzy Logic with Engineering Applications, 2016, 4th edition, John Wiley and sons, USA

Reference Books

1.	Jacek. M. Zurada, "Introduction to Artificial Neural Systems", 2014, 11th edition, Jaico Publishing House, Mumbai.
2.	Simon Haykin, "Neural Networks and Learning Machines", 2016, 3rd edition, Pearson Education Inc. India
3.	Samir Roy, Udit Chakraborthy, "Introduction to Soft Computing Neuro - Fuzzy and Genetic Algorithms", 2013, 1st edition, Pearson education, Noida.

Mode of Evaluation: Continuous Assessment Test –I (CAT-I), Continuous Assessment Test –II (CAT-II), Digital Assignments/ Quiz / Completion of MOOC, Final Assessment Test (FAT).

Typical Projects

1. Adaptive filtering for Medical (ECG) signals.
2. Adaptive Neuro Fuzzy Inference System
3. Automation of Traffic signal using Raspberry Pi
4. Cardiac Image Diagnostic System
5. Cryptographic System using Neural Networks
6. Design and Development of Biometric Recognition and Matching System
7. Digital Audio Watermark Embedding System
8. Electrical load forecasting using Neural Networks
9. Electronic Music System using ANN
10. Face Identification System using ANN
11. Feature Extraction of EEG Signals
12. Image Decryption using Neural Networks
13. Internal Fault identification using Artificial Neural Network
14. Signature Forgery and Handwriting Detection System

15. Smart Driver Assist System using Raspberry Pi 16. Speaker Recognition using Soft Computing 17. Speech Separation Using ICA Based Neural Networks			
Mode of evaluation : Continuous Assessment of Challenging experiments & Final Assessment Test (FAT)			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

ECE3027	BIO-SIGNAL PROCESSING	2	0	2	0	3
Prerequisite:	ECE2006- Digital Signal Processing	**Syllabus version**				
		v.1.1				

Course Objectives:

1. Identify fundamentals of biomedical signals and its spectral analysis
2. Investigate the cardiological signal and neurological signal processing
3. Develop adaptive filtering techniques for cancelling noise and investigate wavelets involved in classification of biosignals
4. Interpret various types of feature reduction analysis.

Expected Course Outcome:

The student will be able to

1. Examine the basic signal processing for bio-signals
2. Illustrate the knowledge about spectral analysis
3. Comprehend cardialogical signal processing methods
4. Formulate an algorithm for bio-signal processing
5. Describe an adaptive algorithms for biosignals
6. Comprehend the classification of bio signals using wavelets
7. Demonstrate the feature reduction methods for different bio signals

Module:1	**Signals and Systems**	**3 hours**

Characteristics of dynamic biomedical signals – Noises-random – Structured and Physiological noises – Filters – IIR and FIR filters.

Module:2	**Spectrum**	**4 hours**

Spectrum – Power Spectral Density function – Cross Spectral Density and Coherence function – Cepstrum and Homomorphic filtering – Estimation of mean of finite time signals.

Module:3	**Time Series Analysis**	**4 hours**

Time series analysis – Linear prediction models – Process order estimation – Lattice representation – Non-stationary process – Fixed segmentation – Adaptive segmentation – Application in EEG, PCG signals – Time varying analysis of Heart-rate variability – Model based ECG simulator.

Module:4	**Spectrum Estimation**	**4 hours**

Spectral estimation – Blackman Tukey method – Periodogram – Model based estimation – Application in heart rate variability, PCG signals.

Module:5	**Adaptive Filtering**	**3 hours**

Filtering – LMS adaptive filter – Adaptive noise canceling in ECG – Improved adaptive filtering in FECG.

Module:6	**Wavelet Detection and Bio-signal Classification**	**5 hours**

Wavelet detection in ECG – Structural features – Matched filtering – Adaptive wavelet detection – Detection of overlapping wavelets – Signal classification and recognition – Statistical signal classification – Linear

discriminant function – Direct feature selection and ordering.		
<		
Module:7	**Time Frequency and Multivariate Analysis**	**5 hours**
Back propagation neural network based classification – Application in Normal versus Ectopic ECG beats – Time frequency representation – Spectrogram – Wigner distribution – Time-Scale representation – Scalogram – Wavelet analysis – Data reduction techniques – ECG data compression – ECG characterization – Feature extraction – Wavelet packets – Multivariate component analysis –PCA – ICA.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture:	**30 hours**

Text Book:	
1.	Rangaraj.M.Rangayyan, "Biomedical Signal Processing", 2014, 1st edition, IEEE press, New York.
Reference Book:	
1.	N. Vyas, "Biomedical Signal Processing", 2011, 1st edition, University Science Press, New Delhi.
Mode of Evaluation: CAT, Digital Assignment, Quiz, Additional learning (if any) and FAT	

List of Challenging Experiments: (Indicative)		
1.	Acquire two ECG samples from same and two different individuals. Perform correlation between the samples. Tabulate and interpret the results.	6 hours
2.	Acquire the ECG signal and add 60 Hz sine wave to it. Plot the PSD to show the noise on the mixed signal. Design an appropriate filter to remove the noise and plot the PSD of the filtered signal to show that noise is removed. Explain the design aspect of the filter.	6 hours
3.	Consider the ECG, EMG, and EEG Signals. Apply different compression techniques like TP, AZTEC and CORTES on them and compute the compression ratio. Now reconstruct the compressed signal with the original and identify the percentage of data lost.	6 hours
4.	Process a bio-signal and extract any feature from it. Explain the preprocessing and the feature extraction methods used.	6 hours
5.	Record your own speech in three different media and compare the speech signals. Estimate the h(n) of your two medias (different mobiles) by assuming one of them as your x(n). Use a linear approach in obtaining the result 1 and use deconvolution to obtain the result 2 and compare both the results.	6 hours
	Total Laboratory Hours	30 hours
Mode of Evaluation: Continuous Assessments and FAT		

Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE3028	BIOMEMS AND SYSTEM ON-CHIP	2	0	0	4	3
Prerequisite	ECE2015-Integrated Circuits	Syllabus version				
		v.1.1				

Course Objectives:

1. To introduce the students with the historical background of evolution of MEMS and acquaint with the various modern micromachining techniques.
2. To optimize various detection techniques and applications of biosensors.
3. The fundamentals of microfluidics and lab-on-chip with various applications of BioMEMS and implantable devices.
4. To infer the scaling effects in miniaturizing devices with the recent trends in BioMEMS applications

Expected Course Outcome:

The student will be able to

1. Inception of historical background of evolution of MEMS and Microsystems to the students.
2. Demonstration of basic properties of silicon and acquainted with the various modern micromachining techniques.
3. Differentiate the various detection techniques and applications of biosensors.
4. Exposure to fundamentals of microfluidics and lab-on-chip.
5. Acquaintance with various applications of BioMEMS and implantable devices and acquainted with the recent trends in BioMEMS applications.
6. Hands-on exposure to scaling effects in miniaturizing devices.
7. Design and simulation of microfabricated biochips.

Module:1	**Introduction**	**4 hours**
Historical background of Micro Electro Mechanical Systems-Types of MEMS devices-MEMS in automotive and aeronautical industry-Microsystems-Integrated MEMS and Microsystems.		
Module:2	**Materials AND Processes**	**4 hours**
Materials used in MEMS-Properties of silicon-Fabrication techniques-Lithography, Etching-Wafer bonding-Bulk and Surface micromachining-Ion implantation-Thin film deposition		
Module:3	**Biosensors**	**4 hours**
Types of biosensors-Detection techniques-Optical-Electrical,-Mechanical-SPR based. Specific examples: glucose sensor and urea sensor.		
Module:4	**Microfluidics and Biochips**	**4 hours**
Fundamentals of Microfluidics-Lab-on-a-chip devices-Silicon and glass micromachining for micro total analysis systems-Surface chemistry in polymer microfluidic system- Biochips and their applications in medical treatment.		
Module:5	**Applications of BioMEMS**	**4 hours**
MEMS devices for diagnostics-Drug delivery, Implantable devices- Shape memory implants- MEMS for		

neurosurgery-Micro needles.			
Module:6	**Scaling**	**4 hours**	
Scaling in Geometry-Scaling in Rigid-Body Dynamics-Scaling in Electrostatic Forces-Scaling in Electromagnetic Forces-Scaling in Electricity-Scaling in Fluid Mechanics-Scaling in Heat Transfer.			
Module:7	**Recent trends in BioMEMS**	**4 hours**	
Drug delivery systems and MEMS-Application models-Blood pressure sensors-Biochip-Micro needles-Microelectrodes-Neural prosthesis and catheter end sensors.			
Module:8	**Contemporary issues:**	**2 hours**	
	Total Lecture hours:	**30 hours**	
Text Books:			
1.	Marc J. Madou, "Fundamentals of Microfabrication: The Science of Miniaturization", 2012, 2nd edition, CRC Press, Florida, USA.		
2.	Edwin Oosterbroek and Albert van den Berg, "Lab-on-a-Chip: Miniaturized Systems for (Bio) Chemical Analysis and Synthesis", 2011, 1st edition, Elsevier Science, Amsterdam, Netherlands.		
Reference Books:			
1.	Gary S. May and Simon Sze, "Fundamentals of semiconductor fabrication", 2010, 1st edition John Wiley & Sons, New Jersey, USA.		
2.	L'Hocine Yahia, "Shape Memory Implants", 2012,1st edition, Springer-Verlag Berlin and Heidelberg, Germany		
Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT			
List of Projects: (Indicative)			
1. Non-invasive blood glucose measurement is need of the hour. Near infrared based measurement of blood measurement has shown promising results. Design a glucose measurement system using NIR LED (660nm-920nm) and discuss the advantages and disadvantages of the developed system.			
2. Design a contact less digital thermometer using Omron D6T MEMS thermal sensor for wireless temperature sensing applications			
3. Conventional Stethoscope sound level is low and difficult to analyze. Using Zigbee and microsensor, design a wireless stethoscope			
4. Design a touch key pad for visually impaired person using AT42QT MEMS sensors developed by microsensor technology			
5. Design a 5mA power supply unit for iontophoresis based transdermal drug delivery system.			
Mode of Evaluation: Review I,II, III			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE4020	TELEMEDICINE	3	0	0	0	3
Prerequisite	ECE3024 - Analog and Digital Communication	Syllabus version				
		v.2.1				

Course Objectives:

1. To impart the key principles for telemedicine and health.
2. To make student understand tele medical technology.
3. To enable the students with the knowledge of tele medical standards, mobile telemedicine and its applications
4. Explain basic parts of Tele radiology Systems like Image Acquisition System, Display System, Communication Network, Interpretation

Expected Course Outcome:

The student will be able to:

1. Comprehensive coverage of Telemedicine concepts and their applications
2. Recognize the key policy drivers for telehealth
3. Demonstrate multimedia technologies in telemedicine
4. Examine protocols behind encryption techniques for secure transmission of data.
5. Distinguish ethical and legal aspects of telemedicine.
6. Interpret the fundamental parts of teleradiology system.

Module:1	Telemedicine and Health	5 hours

History and Evolution of telemedicine - Functional diagram of telemedicine system – Telemedicine - Tele health - Tele care - Organs of telemedicine - Global and Indian scenario.

Module:2	Ethical and Legal aspects of Telemedicine	4 hours

Ethical and legal aspects of Telemedicine – Confidentiality - Social and legal issues - Safety and regulatory issues - Advances in Telemedicine.

Module:3	Telemedical Technology	8 hours

Principles of Multimedia - Text, Audio, Video, data - Data communications and networks - PSTN – POTS – ANT – ISDN – Internet - Air/ wireless communications: GSM satellite - and Micro wave - Modulation techniques, Types of Antenna - Integration and operational issues - Communication infrastructure for telemedicine – LAN and WAN technology - Satellite communication. Mobile hand held devices and mobile communication - Internet technology and telemedicine using world wide web (www) - Video and audio conferencing - Clinical data – Local and centralized.

Module:4	Telemedical Standards	7 hours

Data Security and Standards - Encryption - Cryptography - Mechanisms of encryption - Phases of Encryption - Protocols: TCP/IP, ISO – OSI - Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T.120, H.324 (Video phone based PSTN) - Video Conferencing - Real - time Telemedicine integrating doctors / Hospitals - Clinical laboratory data - Radiological data - and other clinically significant biomedical data - Administration of centralized medical data - security and confidentially of medical records and access control - Cyber laws related to telemedicine

Module:5	**Mobile Telemedicine**	**7 hours**
Tele radiology: Definition, Basic parts of tele radiology system - Image Acquisition system - Display system - Tele pathology - Multimedia databases - Color images of sufficient resolution - Dynamic range - Spatial resolution - Compression methods - Interactive control of color.		
Module:6	**Information System**	**6 hours**
Medical information storage and management for telemedicine - Patient information medical history - Test reports - Medical images diagnosis and treatment - Hospital information system – Doctors – Paramedics - Facilities available -Pharmaceutical information system.		
Module:7	**Telemedical Applications**	**6 hours**
Telemedicine access to health care services – Health education and self-care - Introduction to robotics surgery - Tele surgery - Tele cardiology, Tele oncology - Telemedicine in neurosciences - Electronic Documentation - e - health services security and interoperability - Telemedicine access to health care services – health education and self-care - Business aspects - Project planning and costing - Usage of telemedicine.		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	Sherry Emery, Telemedicine in Hospitals: Issues in Implementation, 2015, 1st edition, Routledge, Tayor and Francis Group, New York.
Reference Books	
1.	Bernard Fong, A.C.M. Fong, C.K. Li, Telemedicine Technologies: Information Technologies in Medicine and Telehealth, 2011, 1st edition, John Wiley & Sons Ltd, New York.
2.	Gulla, Vincenzo, Telehealth Networks for Hospital Services: New Methodologies, Medical Information Science Reference, 2013, 1st edition, Hershey.
3.	Halit Eren, John G. Webster, Telemedicine and Electronic Medicine, 2015, 1st edition, CRC Press, Bocaraton.

Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT			
Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course code	Course Title	L	T	P	J	C
ECE4023	BIOMETRIC SYSTEMS	3	0	0	0	3
Prerequisite	ECE3025-Image Processing	Syllabus version				
		v.1.1				

Course Objectives:

1. To introduce the general principles of design of biometric systems and the underlying trade-offs. personal privacy and security implications of biometrics based identification technology. Introduction to fingerprint biometric
2. To familiarize with Face recognition and Hand Geometry, feature extraction, pattern classification. Authentication Methods and their algorithms
3. To acquire knowledge about various parameters involved in Iris and Voice recognition. Authentication Methods and their algorithms.
4. Introduction to multimodal Biometric system and its functional blocks and futuristic biometric systems

Expected Course Outcome:

The student will be able to

1. Demonstrate knowledge engineering principles underlying biometric systems.
2. Describe and explain Finger print feature processing and techniques, computer enhancement and modelling.
3. Face recognition, how to perform Feature Extraction, classification of features, training of algorithm using neural network
4. Competing iris Scan technologies, various steps involved in voice scan, challenges related to iris and voice scan
5. Perceive various areas of physiological and Behavioural Biometrics
6. Demonstration of innovative multimodal Biometric system and Statistical Measures of Biometrics

Module:1	Introduction to biometrics	6 hours

Introduction and back ground – Biometric technologies – Passive biometrics – Active biometrics - Biometric systems – Enrollment – Templates – Algorithm – Verification – Biometric applications – biometric characteristics- Authentication technologies –Need for strong authentication – Protecting privacy and biometrics and policy – Biometric applications – Biometric characteristics

Module:2	Fingerprint technology	7 hours

History of fingerprint pattern recognition - General description of fingerprints - Finger print feature processing techniques - Fingerprint sensors using RF imaging techniques – Fingerprint quality assessment – Computer enhancement and modeling of fingerprint images – Fingerprint enhancement– Feature extraction – Fingerprint classification – Fingerprint matching

Module:3	Face recognition and Hand Geometry	7 hours

Introduction to face recognition _ Neural networks for face recognition – face recognition from correspondence maps – Hand geometry – Scanning – Feature Extraction - Adaptive Classifiers - Visual-Based Feature Extraction and Pattern Classification - Feature extraction – Types of algorithm –Biometric fusion.

Module:4	**Iris, Voice recognition**	**6 hours**
Iris scan - Features – Components – Operation (Steps) – Competing iris Scan technologies – Strength and weakness. Voice Scan - Features – Components – Operation (Steps) – Competing voice Scan (facial) technologies–Strength and weakness.		
Module:5	**Physiological and Behavioural Biometrics**	**6 hours**
Retina scan – AFIS (Automatic Finger Print Identification Systems) – Behavioral biometrics – Signature scan- Keystroke scan biometrics application – Biometric Solution Matrix – Bio privacy – Comparison of privacy factor in different biometrics technologies.		
Module:6	**Multimodal Biometrics**	**6 hours**
Introduction to multimodal Biometric system – Integration strategies – Architecture – Level of fusion – Combination strategy –Training and adaptability – Examples of multimodal biometric systems – Performance evaluation- Statistical Measures of Biometrics – FAR – FRR – FTE – EER – Memory requirement and allocation.		
Module:7	**Biometric Authentication**	**5 hours**
Introduction - Biometric Authentication Methods - Biometric Authentication Systems – Biometric authentication by fingerprint -Biometric Authentication by Face Recognition - Expectation-Maximization theory - Support Vector Machines. Biometric authentication by fingerprint –Biometric authentication by hand geometry- Securing and trusting a Biometric transaction – Matching location – local host - authentication server – Match On Card (MOC) – Multi-Biometrics and Two-Factor authentication		
Module:8	**Contemporary issues:**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book	
1.	Arun A. Ross, Karthik Nandakumar, Anil K. Jain , "Introduction to Biometrics", 2011, 1st edition, Springer, New York, USA.
Reference Books	
1.	Haizhou Li, Liyuan Li, Kar-Ann Toh**,** Advanced Topics in Biometrics, 2012, 1st edition, World Scientific Publisher, Singapore.

Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT

Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017

Course Code	Course Title	L	T	P	J	C
ECE4024	EMBEDDED SYSTEMS IN MEDICAL APPLICATIONS	2	0	0	4	3
Prerequisite:	ECE3023-Microcontrollers and its Applications	Syllabus version				
		v.1.0				

Course Objectives:

- To introduce students to RTOS concepts, processes, tasks, threads and scheduling
- Collect the knowledge of architecture of ARM cortex M4
- Discuss the embedded system advanced modes and various peripherals.
- Develop a system with interfacing sensors, actuators for portable medical gadgets

Expected Course Outcome:

The student will be able to:

1. Understand the architectural blocks in 32 bit microcontrollers and deploy them as suitable solution for medical projects
2. Become aware of interrupts in embedded systems
3. Get an overview of available embedded networking mechanisms and work with IoT
4. Manage parallel processes with different priority and real time constraints without the aid of an operating system
5. Able to give a detailed description of limitations of the specific system
6. Independently design and implement an embedded system based on an eight bit microcontroller
7. Design real time embedded systems using the concepts of RTOS.

Module:1	Introduction to Embedded Systems	3 hours

Characteristics of embedded computing applications, concepts of real time systems, embedded design life cycle – Tools used in Design Process – Challenges in Embedded system design, different architectures, caches, virtual memory.

Module:2	Operating Systems (OS) Overview	4 hours

Need for Operating Systems, Operating System concepts, processes, tasks and threads, scheduling, memory management, clocks and timers, inter-task synchronization, bus drivers, power management and optimization

Module:3	ARM Cortex M4 Architecture	5 hours

Overview of ARM Cortex M3 and M4 (Core v7) and its architecture, Peripherals and Bus structure, Advantages of ARM Cortex M4, ARM and Thumb Instruction Set, Floating Point Unit (FPU), IEE Standards, FPU implementation in ARM Cortex M4, Nested Vectored Interrupt Controller (NVIC), Interrupt Latency, Programmable Clocks, Memory Map, Bit banding

Module:4	Embedded System Advanced Modes and Peripherals	4 hours

Real Time Clock, Calendar and Alarms, Direct Memory Access (DMA) Controller, Hibernation Modes, Ultra low Power Timer and ADC modes, Device Security Zones, JTAG Programming, Driver API Libraries, Cortex Microcontroller System Interface Standard (CMSIS) Programming Compliance and Portability

Module:5	**Embedded Networking**	**4 hours**
Need for Networking, Wired and Wireless Networking, Various Wireless networking Protocols, Emphasis on Low Power consumption for Wireless Protocols, Low Power RF, Proprietary and Standard protocols – SimpliciTI, Zigbee, WiFi, Bluetooth Low Energy (BLE), 6LowPAN		
Module:6	**Internet of Things (IoT)**	**4 hours**
Introduction to Internet of Things (IoT), Review of CC3200 heterogeneous Cores and its architecture, Block Diagram, User API, Power Challenges, Introduction to Wireless LAN (WLAN), Parameters, Station Modes – Access Point/Station and their configuration settings,		
Module:7	**Sensors with Cloud and Internet connectivity**	**4 hours**
Streaming sensor data to Internet, Control of IO ports on Sensor hardware from Internet, Headless systems programming and configuring, Working with MAC Addresses , Cloud Dashboards and Monitoring		
Module:8	**Contemporary Issues:**	**2 hours**
	Total Lecture:	**30 hours**

Text Books:	
1	Johanathan W Valvano, "Introduction to ARM Cortex M3- Microcontrollers", 2012, 1st edition, Jonathan Valvano Publishing, USA.
2	Raj Kamal, "Embedded Systems Architecture, Programming and Design", 2011, 2nd edition, Tata McGraw Hill, New Delhi.
Reference Books:	
1	Ivan Cibrario Berlalotti, Garbride Manduchi, "Real-Time Embedded System: Open Source Operating Systems perspective", 2012, 1st edition, CRC Press,USA.
2	Diagnostic, Patient Monitoring and Therapy Applications Guide, 2010,Texas Instruments.
3	Datasheet, Technical Documents and Application Notes http://www.ti.com/product.
4	Datasheet, Technical Documents and Application Notes http://www.ti.com/product/CC3200

Mode of Evaluation: CAT, Digital Assignment, Quiz and FAT

List of Projects:

1. Develop an embedded bed monitoring system capable of sensing temperature, pressure, pulse rate, ECG for the patient and that can decide the necessary actuations.
2. Develop an EMG based robotic arm in which the arm activities can be controlled by acquiring the EMG signal of a person.
3. Develop an embedded wireless communication system in which a coordinator collect the bioparameters from nodes and uplink the data to the cloud.
4. Design and develop a ultrasound based blood flow monitoring system.

Mode of Evaluation: Review I, II and III

Recommended by Board of Studies	21-08-2017		
Approved by Academic Council	No. 47	Date	5-10-2017