



VIT[®]

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

School of Computer Science and Engineering

CURRICULUM AND SYLLABI

(2018-2019)

B.Tech (CSE) - Specialization in Bio-Informatics



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School of Computer Science and Engineering

PEOs - B.Tech (CSE) - Specialization in Bio-Informatics

1. Advance knowledge through quality research in important emerging areas in the discipline and to build strong relationship with industry, academia and society.
2. Able to analyze, design and implement optimized solutions for the real-world problems and become engineering professional, innovator, product developer or entrepreneur.
3. Develop an ability to adapt, work as a team to implement trans-disciplinary and multi-disciplinary projects using the cutting edge tools and technologies.
4. Graduates will be ethical and socially responsible and be able to pursue higher education/research in reputed institutions.

Signature of HoD



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School of Computer Science and Engineering

Student Learning Outcomes (SLO)

B.Tech(CSE) / B.Tech(CSE with Bio-Inf.) / B.Tech (CSE with Inf. Sec.)

1. Having an ability to apply mathematics and science in engineering applications.
2. Having a clear understanding of the subject related concepts and of contemporary issues
3. Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient)
4. Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)
5. Having design thinking capability
6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints
7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)
8. Having Virtual Collaborating ability
9. Having problem solving ability- solving social issues and engineering problems.
10. Having a clear understanding of professional and ethical responsibility
11. Having interest in lifelong learning
12. Having adaptive thinking and adaptability
13. Having cross cultural competency exhibited by working in teams
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data
15. Having an ability to use the social media effectively for productive use
16. Having a good working knowledge of communicating in English
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice
18. Having critical thinking and innovative skills
19. Having a good cognitive load management [discriminate and filter the available data] skills
20. Having a good digital footprint



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School of Computer Science and Engineering

PSOs - B.Tech(CSE) - Specialization in Bio-Informatics

1. The ability to formulate mathematical models and problem-solving skills through programming techniques for addressing real-time problems using appropriate data structures and algorithms.
2. The ability to design hardware and software through system programming skills based on the knowledge acquired in the system software and hardware courses.
3. The ability to interpret relationships among living things and analyze the biological problems, from molecular to ecosystem level, solving them using basic biological concepts, algorithms, and tools available in computer science and to facilitate the biological database system.

Signature of HoD



Programme Core	Programme Elective	University Core	University Elective	Total Credits
58	40	70	12	180

Course Code	Course Title	Course Type	L	T	P	J	C
PROGRAMME CORE							
BIT1004	Cell Biology and Biochemistry	ETL	3	0	2	0	4
BIT2001	Analytical Bioinformatics	ETL	3	0	2	0	4
CSE1003	Digital Logic and Design	ETL	3	0	2	0	4
CSE1005	Software Design and Development	ETLP	2	0	2	4	4
CSE2001	Computer Architecture and Organization	TH	3	0	0	0	3
CSE2003	Data Structures and Algorithms	ETLP	2	0	2	4	4
CSE2004	Database Management Systems	ETLP	2	0	2	4	4
CSE2005	Operating Systems	ETLP	2	0	2	4	4
CSE2006	Microprocessor and Interfacing	ETLP	2	0	2	4	4
CSE3002	Internet and Web Programming	ETLP	2	0	2	4	4
CSE4001	Parallel and Distributed Computing	ETLP	2	0	2	4	4
EEE1001	Basic Electrical and Electronics Engineering	ETL	2	0	2	0	3
MAT1014	Discrete Mathematics and Graph Theory	TH	3	1	0	0	4
MAT2002	Applications of Differential and Difference Equations	ETL	3	0	2	0	4
MAT3004	Applied Linear Algebra	TH	3	1	0	0	4
Course Code	Course Title	Course Type	L	T	P	J	C
PROGRAMME ELECTIVE							
BIT1031	System Biology	TH	3	0	0	0	3
BIT2002	Biological Database	ETP	3	0	0	4	4
BIT2003	Genomics and Proteomics	ETP	3	0	0	4	4
BIT3001	Computational Biology	ETP	3	0	0	4	4
BIT3002	Molecular Modelling and Drug Design	ETP	3	0	0	4	4
BIT3003	Molecular Evolution and Phylogeny	TH	3	0	0	0	3
CSE1004	Network and Communication	ETL	3	0	2	0	4
CSE1007	Java Programming	ETL	3	0	2	0	4
CSE2002	Theory of Computation and Compiler Design	TH	4	0	0	0	4
CSE3006	Embedded System Design	ETP	3	0	0	4	4
CSE3009	Internet of Things	ETP	3	0	0	4	4



Course Code	Course Title	Course Type	L	T	P	J	C
CSE3011	Robotics and its Applications	ETP	3	0	0	4	4
CSE3013	Artificial Intelligence	ETP	3	0	0	4	4
CSE3016	Computer Graphics and Multimedia	ETLP	2	0	2	4	4
CSE3018	Content Based Image and Video Retrieval	ETLP	2	0	2	4	4
CSE3019	Data Mining	ETLP	2	0	2	4	4
CSE3020	Data Visualization	ETLP	2	0	2	4	4
CSE3021	Social and Information Networks	ETP	3	0	0	4	4
CSE3024	Web Mining	ETL	3	0	2	0	4
CSE3025	Large Scale Data Processing	ETLP	2	0	2	4	4
CSE3029	Game Programming	ETLP	2	0	2	4	4
CSE4003	Cyber Security	ETP	3	0	0	4	4
CSE4004	Digital Forensics	ETL	3	0	2	0	4
CSE4011	Virtualization	ETP	3	0	0	4	4
CSE4014	High Performance Computing	ETP	3	0	0	4	4
CSE4015	Human Computer Interaction	ETP	3	0	0	4	4
CSE4019	Image Processing	ETP	3	0	0	4	4
CSE4020	Machine Learning	ETLP	2	0	2	4	4
CSE4022	Natural Language Processing	ETP	3	0	0	4	4
CSE4027	Mobile Programming	ETLP	2	0	2	4	4
CSE4028	Object Oriented Software Development	ETLP	2	0	2	4	4
Course Code	Course Title	Course Type	L	T	P	J	C
UNIVERSITY CORE							
CHY1002	Environmental Sciences	TH	3	0	0	0	3
CHY1701	Engineering Chemistry	ETL	3	0	2	0	4
CSE1001	Problem Solving and Programming	LO	0	0	6	0	3
CSE1002	Problem Solving and Object Oriented Programming	LO	0	0	6	0	3
CSE3099	Industrial Internship	PJT	0	0	0	0	2
CSE3999	Technical Answers for Real World Problems (TARP)	ETP	1	0	0	8	3
CSE4098	Comprehensive Examination	PJT	0	0	0	0	2
CSE4099	Capstone Project	PJT	0	0	0	0	20
ENG1011	English for Engineers	LO	0	0	4	0	2
HUM1021	Ethics and Values	TH	2	0	0	0	2
MAT1011	Calculus for Engineers	ETL	3	0	2	0	4
MAT2001	Statistics for Engineers	ETL	2	1	2	0	4
MGT1022	Lean Start-up Management	ETP	1	0	0	4	2
PHY1701	Engineering Physics	ETL	3	0	2	0	4
PHY1999	Introduction to Innovative Projects	ETP	1	0	0	4	2
BIT1003	Biology for Engineers	ETL	3	0	2	0	4



UNIVERSITY ELECTIVE							
Course Code	Course Title	Course Type	L	T	P	J	C
EXC4097	Co-Extra Curricular Basket	CDB	0	0	0	0	2
Course Code	Course Title	Course Type	L	T	P	J	C
FLC4097	Foreign Language Course Basket	CDB	0	0	0	0	2
STS4097	Soft Skills B.Tech. / B.Des.	CDB	0	0	0	0	6
Course Code	Course Title	Course Type	L	T	P	J	C
BRIDGE COURSE							
BIT1001	Introduction to Life Sciences	TH	4	0	0	0	4
ENG1002	Effective English	LO	0	0	4	0	2
Course Code	Course Title	Course Type	L	T	P	J	C
NON CREDIT COURSE							

BIT1004	Cell biology and Biochemistry	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	NIL	Syllabus version				
		1.1				
Course Objectives:						
1. Analyze cell structure and its functions 2. Illustrate the structure and functions of biomolecules 3. Distinguish the concept of central dogma, cell cycle and cell signalling						
Expected Course Outcome:						
1. Define and recall the cell structure and functions 2. Classify the cell constituents and biomolecules 3. Demonstrate the characteristic features, properties and types of macromolecules 4. Formulate the basic concepts of enzymes and its regulations 5. Elaborate the principles and regulations of replication, transcription and translation mechanism 6. Appraise the skills of cell cycle events and signal transduction process in cell, tissue and organ level						
Student Learning Outcomes (SLO): 2,7						
2. Having a clear understanding of the subject related concepts and of contemporary issues 7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)						
Module:1	Cell structure and Functions	6 hours				
Prokaryotic and eukaryotic cell structure; biomembrane, Transport across cell membranes – passive diffusion, facilitated diffusion, co-transport and active transport. Cell organelles, cytoskeleton structure and functions.						
Module:2	Biomolecules	6 hours				
Types of macro molecules, metabolites and products. Properties of water. Cellular carbohydrates, lipids and their classification.						
Module:3	Proteins	6 hours				
Classification and properties of amino acids. Peptides and structure of proteins.						
Module:4	Enzymes	7 hours				
Classification, catalysis, properties, cofactors, coenzymes and inhibitors. Thermodynamics and kinetics - Michaelis-Menten equation. Regulatory enzymes.						
Module:5	Nucleic acids	4 hours				
DNA and RNAs. Nucleoside and nucleotides. Structure, function and properties of nucleic acids.						
Module:6	Central dogma	7 hours				

Transcription, translation and protein synthesis in organisms. Replication of DNA. Gene and chromosomal mutations.		
Module:7	Cell cycle and signal transduction	7 hours
Mitosis and meiosis. Cell cycle control system, regulation of check points by mitogens, cyclins and cdks. Cell signaling and transport: Autocrine, paracrine and endocrine signaling molecules, secondary signaling molecules and signal transduction.		
Module:8	Contemporary issues:	2 hours
Industrial expert lecture		
Total Lecture hours:		45 hours
Text Book(s)		
1.	Harvey Lodish , Arnold Berk , Chris A. Kaiser , Monty Krieger, Anthony Bretscher , Hidde Ploegh, Angelika Amon ,Matthew P. Scott. 2012. Molecular Cell Biology 7 th edition. W.H. Freeman. USA.	
Reference Books		
1.	Victor Rodwell, David Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil. 2015.	
2.	Harpers Illustrated Biochemistry 30 th Edition. McGraw-Hill education, USA.	
3.	Geoffrey M. Cooper and Robert E. Hausman. 2013. The Cell: A Molecular Approach. 6 th edition. Sinauer Associates, Inc. USA.	
4.	Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts and Peter Walter. 2014. Molecular Biology of the Cell. 6 th edition. Garland Science, USA.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	Preparation of reagents, buffers and basic calculations.	3 hours
2.	Quantitative estimation of reducing sugars in samples.	3 hours
3.	Quantitative estimation of non-reducing sugars.	3 hours
4.	Quantitative estimation of proteins.	3 hours
5.	Functioning of microscopes; studying the diversity of cells using permanent slides.	3 hours
6.	Subjecting cells to different pH, concentrations and analyzing the structural changes occurring due to osmosis.	3 hours
7.	Growing root tips of different plants and comparing the chromosome number by fixing at metaphase stage.	3 hours
8.	Comparison of various stages of Meiosis I and Meiosis II during microsporogenesis of <i>Rheo discolor</i> .	3 hours
9.	Extraction of genomic DNA from a microbe/plant/animal cell.	3 hours
10	Quantification of DNA/RNA	3 hours
Total Laboratory Hours		30 hours

Mode of evaluation: Written examinations, assignments and quizzes			
Recommended by Board of Studies	03-08-2017		
Approved by Academic Council	No. 46	Date	23-08-2017

BIT2001	Analytical Bioinformatics	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		1.1				
Course Objectives:						
<ol style="list-style-type: none"> 1. Adapt basic knowledge on various techniques and areas of applications in bioinformatics. 2. Analyze common problem in bioinformatics, alignment techniques, ethical issues, public data sources, and evolutionary modelling. 3. Discover the practical use of tools for specific bioinformatic areas. 						
Expected Course Outcome:						
<ol style="list-style-type: none"> 1. Apply knowledge of bioinformatics in a practical project. 2. Develop the ability for critical assessment of scientific research publications in bioinformatics. 3. Build an understanding of the research process in general, such as research methods, scientific writing, and research ethics. 4. Evaluate the main databases at the NCBI and EBI resources 5. Compare the databases, tools, repositories and be able to use each one to extract specific information 6. Demonstrate the selected tools at NCBI and EBI to run simple analyses on genomic sequences. 						
Student Learning Outcomes (SLO): 2, 7						
2. Having a clear understanding of the subject related concepts and of contemporary issues						
7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)						
Module:1	Introduction to bioinformatics	3 hours				
Scope and applications of bioinformatics, Alignment of pairs of sequences; Introduction-Definition of sequence alignment, Methods - Dot matrix sequence comparison						
Module:2	Pairwise sequence alignment	6 hours				
Dynamic programming algorithm for sequence alignment – Global Alignment: Needleman-Wunsch, Local Alignment: Smith-Waterman , Gap penalty, Assessing the significance of an alignment						
Module:3	Multiple sequence alignment	6 hours				
Dynamic programming, progressive methods, Iterative methods, MSA using CLUSTAL W, PILEUP and CLUSTAL X, purpose and applications of multiple sequence alignment						
Module:4	Scoring matrices	6 hours				
Similarity searches-PAM and BLOSUM matrix, Dayhoff mutation matrix , construction of PAM and BLOSUM matrix. Differences between PAM & BLOSUM						
Module:5	Database search methods	7 hours				
Database searching for similar sequences. Sequence similarity search, FASTA sequence database similarity search, BLAST sequence database similarity search, other methods of comparing database of sequences and patterns.						

Module:6	Neural Networks	7 hours	
The Theory -Introduction – Priors & likelihoods - Learning algorithms: backpropagation - Neural Networks: Applications - Sequence encoding & output interpretation- Sequence correlations & neural networks			
Module:7	Hidden Markov Models	8 hours	
The Theory - Introduction -Prior information & initialization -Likelihood & basic algorithms -Learning algorithms -Applications of HMMs: general aspects -Protein applications			
Module:8	Contemporary issues:	2 hours	
Industry Expert Lecture			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Bioinformatics: Sequence and Genome Analysis David W. Mount, David Mount		
	2. Bioinformatics: the Machine Learning Approach – Pierre Baldi and Søren Brunak Publisher: MIT Press.		
Reference Books			
1.	Hooman H Rashidi, Lukas K Buehler. Bioinformatics Basics. - 2000.		
	2. Per Jambeck, Cynthia Gibas. Developing Bioinformatics Computer Skills. Computers – 2001.		
	3. Bioinformatics Methods and Protocols: Methods and Protocols. edited by Stephen Misener, Stephen A Krawetz - Science – 1999.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	Retrieval of Data from Biological Database		3 hours
2.	Protein Sequence Retrieval – Uniprot		3 hours
3.	Retrieve all the mitochondrial nucleotide sequence and the GenBank details of the organism Indian muntjac using Entrez.		3 hours
4.	Global Pairwise Alignment		3 hours
5.	Smith-Waterman Algorithm - Local Alignment of Sequences		3 hours
6.	DotPlot esr1_human.		3 hours
7.	Detecting Repeats		3 hours
8.	Create a dotplot of gcr_human		3 hours
9.	BLAST Procedure		3 hours
10.	Multiple Sequence Alignment		3 hours
Total Laboratory Hours			30 hours
Mode of evaluation:			

Recommended by Board of Studies	03-08-2017		
Approved by Academic Council	No. 46	Date	23-08-2017

CSE1003	DIGITAL LOGIC AND DESIGN	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	NIL	Syllabus version				
		v1.0				
Course Objectives:						
1. Introduce the concept of digital and binary systems. 2. Analyze and Design combinational and sequential logic circuits. 3. Reinforce theory and techniques taught in the classroom through experiments in the laboratory.						
Expected Course Outcome:						
1. Comprehend the different types of number system. 2. Evaluate and simplify logic functions using Boolean Algebra and K-map. 3. Design minimal combinational logic circuits. 4. Analyze the operation of medium complexity standard combinational circuits like the encoder, decoder, multiplexer, demultiplexer. 5. Analyze and Design the Basic Sequential Logic Circuits 6. Outline the construction of Basic Arithmetic and Logic Circuits 7. Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyze the results.						
Student Learning Outcomes (SLO): 1,2,5,14						
1. Ability to apply mathematics and science in engineering applications. 2. Having a clear understanding of the subject related concepts and of contemporary issues 5. Having design thinking capability 14. Ability to design and conduct experiments, as well as to analyze and interpret data.						
Module:1	INTRODUCTION	3 hours				
Number System - Base Conversion - Binary Codes - Complements(Binary and Decimal)						
Module:2	BOOLEAN ALGEBRA	8 hours				
Boolean algebra - Properties of Boolean algebra - Boolean functions - Canonical and Standard forms - Logic gates - Universal gates – Karnaugh map - Don't care conditions - Tabulation Method						
Module:3	COMBINATIONAL CIRCUIT - I	4 hours				
Adder - Subtractor - Code Converter - Analyzing a Combinational Circuit						
Module:4	COMBINATIONAL CIRCUIT –II	6 hours				
Binary Parallel Adder- Look ahead carry - Magnitude Comparator - Decoders – Encoders - Multiplexers –Demultiplexers.						
Module:5	SEQUENTIAL CIRCUITS – I	6 hours				
Flip Flops - Sequential Circuit: Design and Analysis - Finite State Machine: Moore and Mealy model - Sequence Detector.						
Module:6	SEQUENTIAL CIRCUITS – II	7 hours				
Registers - Shift Registers - Counters - Ripple and Synchronous Counters - Modulo counters - Ring and Johnson counters						
Module:7	ARITHMETIC LOGIC UNIT	9 hours				
Bus Organization - ALU - Design of ALU - Status Register - Design of Shifter - Processor Unit - Design of specific Arithmetic Circuits Accumulator - Design of Accumulator.						
Module:8	Contemporary Issues: RECENT TRENDS	2 hours				

		Total Lecture hours:		45 hours
Text Book(s)				
1.	M. Morris Mano and Michael D.Ciletti– Digital Design: With an introduction to Verilog HDL, Pearson Education – 5th Edition- 2014. ISBN:9789332535763.			
Reference Books				
1.	Peterson, L.L. and Davie, B.S., 2007. Computer networks: a systems approach. Elsevier.			
2.	Thomas L Floyd. 2015. Digital Fundamentals. Pearson Education. ISBN: 9780132737968			
3.	Malvino, A.P. and Leach, D.P. and Goutam Saha. 2014. Digital Principles and Applications (SIE). Tata McGraw Hill. ISBN: 9789339203405.			
4.	Morris Mano, M. and Michael D.Ciletti. 2014. Digital Design: With an introduction to Verilog HDL. Pearson Education. ISBN:9789332535763			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
List of Challenging Experiments (Indicative)				
1.	Realization of Logic gates using discrete components, verification of truth table for logic gates, realization of basic gates using NAND and NOR gates			4.5 hours
	Implementation of Logic Circuits by verification of Boolean laws and verification of De Morgans law			3 hours
	Adder and Subtractor circuit realization by implementation of Half-Adder and Full-Adder, and by implementation of Half-Subtractor and Full-Subtractor			4.5 hours
	Combinational circuit design i. Design of Decoder and Encoder ii. Design of Multiplexer and De multiplexer iii. Design of Magnitude Comparator iv. Design of Code Converter			4.5 hours
	Sequential circuit design i. Design of Mealy and Moore circuit ii. Implementation of Shift registers iii. Design of 4-bit Counter iv. Design of Ring Counter			4.5 hours
	Implementation of different circuits to solve real world problems: A digitally controlled locker works based on a control switch and two keys which are entered by the user. Each key has a 2-bit binary representation. If the control switch is pressed, the locking system will pass the difference of two keys into the controller unit. Otherwise, the locking system will pass the sum of the two numbers to the controller unit. Design a circuit to determine the input to the controller unit.			4.5 hours
	Implementation of different circuits to solve real world problems: A bank queuing system has a capacity of 5 customers which serves on first come first served basis. A display unit is used to display the number of customers waiting in the queue. Whenever a customer leaves the queue, the count is reduced by one and the count is increased by one if a customer joins a queue. Two sensors (control signals) are used to sense customers leaving and joining the queue respectively. Design a circuit that displays the number of customers waiting in the queue in binary format using LEDs. Binary 1 is represented by LED glow and 0 otherwise.			4.5 hours
Total Laboratory Hours				30 hours
Mode of assessment: Project/Activity				
Recommended by Board of Studies		28-02-2017		
Approved by Academic Council		No. 46	Date	24-08-2017

CSE1005	SOFTWARE DESIGN AND DEVELOPMENT	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	Nil	Syllabus version				
		V1.0				
Course Objectives (COs):						
1. To provide basic elements of software engineering principles, design and development. 2. To apply the basic theoretical software design principles to a group software development project. 3. To impart the knowledge in UML artifacts for requirements gathering, analysis as well as design phases using an object-oriented methodology.						
Expected Course Outcome (COs):						
1. Comprehend the principles of the engineering processes in software development life cycle. 2. Implement the software development processes activities from requirements to implementation. 3. Manage software projects through activities of planning and scheduling. 4. Familiarize themselves with the situations and motivations that call for using a range of design principles. 5. Apply good design and modern software development tools to work on the software projects. 6. Work in a team of on a small-to-medium-size software development project.						
Student Learning Outcomes (SLO):						
6,13,17 6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints 13. Having cross cultural competency exhibited by working in teams 17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice						
Module:1	INTRODUCTION TO SOFTWARE ENGINEERING					3 hours
Software Engg. – Process, project and product – Process models: Classical and evolutionary.						
Module:2	INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT					3 hours
Planning – Scheduling – milestones – deliverables – risk assessment.						
Module:3	REQUIREMENTS MODELING					5 hours
Requirements Elicitation – functional requirement – nonfunctional requirements – basics of object, class, instance – use case model – activity diagram-SRS standards.						
Module:4	INTRODUCTION TO DESIGN					4 hours
Introduction to Design: Basics of Design: Object oriented concepts – abstraction – modularity – cohesion – coupling – design principles.						
Module:5	STRUCTURAL DESIGN					4 hours
Structural Design : Architecture design – Data flow diagrams – User interface design – applications of DFD						
Module:6	OBJECT BASED DESIGN					4 hours
Object Based Design: Introduction to sequence – state-class diagrams – Basics of components and design patterns – MVC pattern with applications – Basics of Software Architecture – Software Design Document (SDD) standards.						

Module:7	IMPLEMENTATION, DEPLOYMENT AND MAINTENANCE	5 hours	
Mapping Design (Models) to Code – Testing - Usability – Deployment – Configuration Management – Maintenance			
Module:8	RECENT TRENDS	2 hours	
Recent Trends in Software Design			
		Total Lecture hours:	30 hours
Text Book(s)			
1.	Roger Pressman, Software Engineering: A Practitioner's Approach, 7th Edition, McGraw-Hill, 2010.		
2.	Carol Britton and Jill Doake, A Student Guide to Object-Oriented Development (Oxford: Elsevier, 2005)		
Reference Books			
1.	Ian Sommerville, Software Engineering, 9th Edition, Addison-Wesley, 2016 2) Pankaj Jalote, A Concise Introduction to Software Engineering, Springer, 2008		
2.	Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design patterns: Elements of Reusable object-oriented software”, Addison-Wesley, 1995.		
3.	Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd ed, Pearson Education, 2004.		
Mode of Evaluation: CAT 1, CAT 2 & FAT			
List of Challenging Experiments (Indicative)			
1.	Planning for the software development – Planning & Scheduling	3 hours	
2.	Data flow diagram for specific application.	3 hours	
3.	Entity Relationship Diagram, Context flow diagram, DFD (Structural Modelling and Functional Modelling)	3 hours	
4.	Use case model for specific application- Software requirements Specification – IEEE Standards.	3 hours	
5.	Activity diagram and its specifications	3 hours	
6.	Class diagram for specific application.	3 hours	
7.	Sequence diagram for specific application.	4 hours	
8.	Software Design Document with IEEE standards for specific applications.	4 hours	
9.	Implementation of a module in the design with tools and technology.	4 hours	
		Total Laboratory Hours	30 hours
Mode of evaluation: Review 1, Review 2 & FAT			
Recommended by Board of Studies		04-04-2014	
Approved by Academic Council		No. 37	Date 16-06-2015

CSE2001	COMPUTER ARCHITECTURE AND ORGANIZATION	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	CSE1003 Digital Logic Design	Syllabus version				
		v1.0				
Course Objectives:						
<ol style="list-style-type: none"> To acquaint students with the basic concepts of fundamental component, architecture, register organization and performance metrics of a computer. To impart the knowledge of data representation in binary and understand implementation of arithmetic algorithms in a typical computer. To teach students how to describe machine capabilities and design an effective data path design for instruction execution. To introduce students to syntax and semantics of machine level programming. To make students understand the importance of memory systems, IO interfacing techniques and external storage and their performance metrics for a typical computer. And explore various alternate techniques for improving the performance of a processor. 						
Expected Course Outcome:						
<ol style="list-style-type: none"> Differentiate Von Neumann, Harvard, and CISC and RISC architectures. Analyze the performance of machines with different capabilities. Illustrate binary format for numerical and characters. Validate efficient algorithm for arithmetic operations. Construct machine level program for given expression on n-address machine. Analyze and calculate memory traffic for a program execution. Design an efficient data path for an instruction format for a given architecture. Explain the importance of hierarchical memory organization. Able to construct larger memories. Analyze and suggest efficient cache mapping technique and replacement algorithms for given design requirements. Demonstrate hamming code for error detection and correction. Understand the need for an interface. Compare and contrast memory mapping and IO mapping techniques. Describe and Differentiate different modes of data transfer. Appraise the synchronous and asynchronous bus for performance and arbitration. Understand the structure and read write mechanisms for different storage systems. Illustrate and suggest appropriate use of RAID levels. Assess the performance of IO and external storage systems. Classify parallel machine models. Illustrate typical 6-stage pipeline for overlapped execution. Analyze the hazards and solutions. 						
Student Learning Outcomes (SLO): 1,2,5						
<ol style="list-style-type: none"> Having an ability to apply mathematics and science in engineering applications Having a clear understanding of the subject related concepts and of contemporary issues Having design thinking capability 						
Module:1	Introduction and overview of computer architecture	3 hours				
Introduction to computer systems - Overview of Organization and Architecture -Functional components of a computer -Registers and register files-Interconnection of components- Organization of the von Neumann machine and Harvard architecture-Performance of processor						
Module:2	Data Representation And Computer Arithmetic	6 hours				
Fixed point representation of numbers-algorithms for arithmetic operations: multiplication (Booths, Modified Booths) - division (restoring and non-restoring) - Floating point representation with IEEE standards and algorithms for common arithmetic operations- Representation of non-numeric data (character codes).						

Module:3	Fundamentals of Computer Architecture	11 hours
Introduction to ISA (Instruction Set Architecture)-Instruction formats- Instruction types and addressing modes- Instruction execution (Phases of instruction cycle)- Assembly language programming-Subroutine call and return mechanisms-Single cycle Data path design-Introduction to multi cycle data path-Multi cycle Instruction execution.		
Module:4	Memory System Organization and Architecture	9 hours
Memory systems hierarchy-Main memory organization-Types of Main memory-memory interleaving and its characteristics and performance- Cache memories: address mapping-line size-replacement and policies- coherence- Virtual memory systems- TLB- Reliability of memory systems- error detecting and error correcting systems.		
Module:5	Interfacing and Communication	7 hours
I/O fundamentals: handshaking, buffering-I/O techniques: programmed I/O, interrupt-driven I/O, DMA- Interrupt structures: vectored and prioritized-interrupt overhead- Buses: Syn-chronous and asynchronous- Arbitration.		
Module:6	Device Subsystems	4 hours
External storage systems-organization and structure of disk drives: Electronic- magnetic and optical technologies- RAID Levels- I/O Performance		
Module:7	Performance Enhancements	4 hours
Classification of models - Flynn's taxonomy of parallel machine models (SISD, SIMD, MISD, MIMD)- Introduction to Pipelining- Pipelined data path-Introduction to hazards		
Module:8	Contemporary issues: Recent Trends	1 hour
Multiprocessor architecture: Overview of Shared Memory architecture, Distributed architecture.		
Total Lecture hours:		45 hours
Text Book(s)		
1.	David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface 5th edition, Morgan Kaufmann, 2013.	
2.	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer organization, Mc Graw Hill, Fifth edition, Reprint 2011.	
Reference Books		
1.	W. Stallings, Computer organization and architecture, Prentice-Hall, 8th edition, 2013	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
Recommended by Board of Studies	04-04-2014	
Approved by Academic Council	No. 37	Date 16-06-2015

CSE2003	DATA STRUCTURES AND ALGORITHMS				L	T	P	J	C
		2	0	2	4	4			
Pre-requisite	NIL	Syllabus version							
		v1.0							
Course Objectives:									
<ol style="list-style-type: none"> 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:									
<ol style="list-style-type: none"> 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. 									
Student Learning Outcomes (SLO): 1,6,9									
<ol style="list-style-type: none"> 1. Having an ability to apply mathematics and science in engineering applications. 6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints 9. Having problem solving ability- solving social issues and engineering 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 Structures and Algorithms ,Pearson India, 1st 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 hours
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			3 hours
12.	Minimum Spanning Tree			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

CSE2004	DATABASE MANAGEMENT SYSTEM				L	T	P	J	C
					2	0	2	4	4
Pre-requisite	NIL				Syllabus version				
					v1.0				
Course Objectives:									
<ol style="list-style-type: none"> To understand the concept of DBMS and ER Modeling. To explain the normalization, Query optimization and relational algebra. To apply the concurrency control, recovery, security and indexing for the real time data. 									
Expected Course Outcome:									
<ol style="list-style-type: none"> Explain the basic concept and role of DBMS in an organization. Illustrate the design principles for database design, ER model and normalization. Demonstrate the basics of query evaluation and heuristic query optimization techniques. Apply Concurrency control and recovery mechanisms for the desirable database problem. Compare the basic database storage structure and access techniques including B Tree, B+ Tress and hashing. Review the fundamental view on unstructured data and its management. Design and implement the database system with the fundamental concepts of DBMS. 									
Student Learning Outcomes (SLO):					1,5,7				
<ol style="list-style-type: none"> Having an ability to apply mathematics and science in engineering applications Having design thinking capability Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning) 									
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, 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

CSE2005	OPERATING SYSTEMS				L	T	P	J	C
					2	0	2	4	4
Pre-requisite	NIL				Syllabus version				
					v1.0				
Course Objectives:									
<ol style="list-style-type: none"> To introduce the concept of Operating system concepts and designs and provide the skills required to implement the services. To describe the trade-offs between conflicting objectives in large scale system design. To develop the knowledge for application of the various design issues and services. 									
Expected Course Outcome:									
<ol style="list-style-type: none"> Interpret the evolution of OS functionality, structures and layers. Apply various types of system calls and to find the stages of various process states. Design a model scheduling algorithm to compute various scheduling criteria. Apply and analyze communication between inter process and synchronization techniques. Implement page replacement algorithms, memory management problems and segmentation. Differentiate the file systems for applying different allocation and access techniques. Representing virtualization and Demonstrating the various Operating system tasks and the principle algorithms for enumerating those tasks. 									
Student Learning Outcomes (SLO): 2, 14, 17									
<ol style="list-style-type: none"> Having a clear understanding of the subject related concepts and of contemporary issues. Having an ability to design and conduct experiments, as well as to analyze and interpret data. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice. 									
Module:1	Introduction				2 hours				
Introduction to OS: - Functionality of OS - OS Design issues - Structuring methods (monolithic, layered, modular, micro-kernel models) - Abstractions, processes, and resources - influence of security, networking, multimedia.									
Module:2	OS Principles				3 hours				
System Calls System/Application Call Interface - Protection User/Kernel modes - Interrupts Processes and Threads - Structures (Process Control Block, Ready List etc).									
Module:3	Scheduling				5 hours				
Processes Scheduling - CPU Scheduling - Pre-emptive non-pre-emptive - Resource allocation and management - Deadlocks Deadlock Handling Mechanisms.									
Module:4	Concurrency				4 hours				
Inter-process communication Synchronization - Implementing Synchronization Primitives Semaphores - Monitors - Multiprocessors and Locking - Scalable Locks - Lock-free Coordination.									
Module:5	Memory management				5 hours				
Main Memory management Memory allocation strategies Caching -Virtual Memory Hardware TLB - Virtual Memory OS techniques Paging Segmentation Page Faults Page Replacement Thrashing Working Set.									
Module:6	Virtualization				4 hours				
Virtual Machines Virtualization (Hardware/Software, Server, Service, Network) Hypervisors -OS - Container Virtualization - Cost of virtualization.									
Module:7	File systems				3 hours				

File system interface - file system implementation File system recovery Journaling - Soft updates LFS - Distributed file system.			
Module:8 Security Protection and trends		4 hours	
Security and Protection - Mechanism Vs Policies Access and authentication - models of protection Memory Protection Disk Scheduling - OS performance, Scaling OS - Mobile OS: Recent Trends: - Future directions in Mobile OS / Multi-core Optimization /Power efficient Scheduling			
		Total Lecture hours:	30 hours
Text Book(s)			
1.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne-Operating System Concepts, Wiley (2012).		
Reference Books			
1.	Ramez Elmasri, A Carrick, David Levine, Operating Systems, A Spiral Approach - McGrawHill Science Engineering Math (2009).		
2.	Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau, Operating Systems, Three Easy Pieces, Arpaci-Dusseau Books, Inc (2015).		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	Write a boot loader - to load a particular OS say TinyOS/ KolibriOS image - code to access from BIOS to loading the OS - involves little assembly code may use QEMU/virtual machines for emulation of hardware.		3 hours
2.	Allocate/free memory to processes in whole pages, find max allocatable pages, incorporate address translation into the program.		3 hours
3.	Create an interrupt to handle a system call and continue the previously running process after servicing the interrupt.		3 hours
4.	Write a Disk driver for the SATA interface. Take care to check readiness of the controller, locked buffer cache, accept interrupts from OS during the period, interrupting the OS again once done and clearing buffers.		3 hours
5.	Demonstrate the use of locks in conjunction with the IDE driver.		3 hours
6.	Run an experiment to determine the context switch time from one process to another and one kernel thread to another. Compare the findings.		3 hours
7.	Determine the latency of individual integer access times in main memory, L1 Cache and L2 Cache. Plot the results in log of memory accessed vs average latency.		3 hours
8.	Compare the overhead of a system call with a procedure call. What is the cost of a minimal system call?		3 hours
9.	Compare the task creation times. Execute a process and kernel thread, determine the time taken to create and run the threads.		3 hours
10.	Determine the file read time for sequential and random access based of varying sizes of the files. Take care not to read from cached data - used the raw device interface. Draw a graph log/log plot of size of file vs average per-block time.		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

CSE2006	MICROPROCESSOR AND INTERFACING	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	CSE1003-Digital Logic Design, CSE2001-Computer Architecture and Organization	Syllabus version				
		v1.0				
Course Objectives:						
<ol style="list-style-type: none"> 1. Students will gain knowledge on architecture, accessing data and instruction from memory for processing. 2. Ability to do programs with instruction set and control the external devices through I/O interface 3. Generate a system model for real world problems with data acquisition, processing and decision making with aid of micro controllers and advanced processors. 						
Expected Course Outcome:						
<ol style="list-style-type: none"> 1. Recall the basics of processor, its ways of addressing data for operation by instruction set. 2. Execute basic and advanced assembly language programs. 3. Learn the ways to interface I/O devices with processor for task sharing. 4. Recall the basics of co-processor and its ways to handle float values by its instruction set. 5. Recognize the functionality of micro controller, latest version processors and its applications. 6. Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyze the results. 						
Student Learning Outcomes (SLO): 2, 5, 9						
<ol style="list-style-type: none"> 3. Having a clear understanding of the subject related concepts and of contemporary issues 5. Having design thinking capability 9. Having problem solving ability- solving social issues and engineering problems 						
Module:1	INTRODUCTION TO 8086 MICROPROCESSOR					6 hours
Introduction to 8086, Pin diagram, Architecture, addressing mode and Instruction set						
Module:2	INTRODUCTION TO ALP					5 hours
Tools- Assembler Directives, Editor, assembler, debugger, simulator and emulator. E.g., ALP Programs-Arithmetic Operations and Number System Conversions, Programs using Loops, If then else, for loop structures						
Module:3	Advanced ALP					2 hours
Interrupt programming using DOS BIOS function calls, File Management						
Module:4	Introduction to Peripheral Interfacing-I					5 hours
PPI 8255, Timer 8253, Interrupt controller-8259						
Module:5	Introduction to Peripheral Interfacing-II					4 hours
IC 8251 UART, Data converters (A/D and D/A Converter), seven segment display and key- board interfacing						
Module:6	Co-Processor					4 hours
Introduction to 8087, Architecture, Instruction set and ALP Programming						
Module:7	Introduction to Arduino Boards					2 hours
Introduction to Microcontroller- Quark SOC processor, programming, Arduino Boards using GPIO (LED, LCD, Keypad, Motor control and sensor), System design application and case study.						

Module:8	Contemporary issues	2 hours	
Architecture of one of the advanced processors such as Multicore, Snapdragon, ARM processor in iPad			
		Total Lecture hours:	30 hours
Text Book(s)			
1.	A.K. Ray and K.M. Bhurchandi Advanced Microprocessors and Peripherals, third Edition, Tata McGraw Hill, 2012.		
2.	Barry B Bray , The Intel Microprocessor 8086/8088, 80186,80286, 80386 and 80486 Arcitecture, programming and interfacing, PHI, 8th Edition, 2009.		
Reference Books			
1.	Douglas V. Hall, SSSP Rao Microprocessors and Interfacing Programming and Hardware. Tata McGraw Hill, Third edition, 2012.		
2.	Mohamed Rafiquazzaman, Microprocessor and Microcomputer based system design, Universal Book stall, New Delhi, Second edition, 1995		
3.	K Uday Kumar, B S Umashankar, Advanced Micro processors IBM-PC Assembly Language Programming, Tata McGraw Hill, 2002.		
4.	Massimo Banzi, Getting Started with Arduino , First Edition, pub. O'Reilly, 2008.		
5.	John Uffenbeck and 8088 Family. 1997. The 80x86 Family: Design, Programming, and Interfacing (2nd ed.). Prentice Hall PTR, Upper Saddle River, NJ, USA.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	Arithmetic operations 8/16 bit using different addressing modes.	2.5 hours	
2.	Finding the factorial of an 8 /16 bit number.	2.5 hours	
3.	(a) Solving nCr and nPr (b) Compute nCr and nPr using recursive procedure. Assume that n and r are non-negative integers	2.5 hours	
4.	Assembly language program to display Fibonacci series	2.5 hours	
5.	Sorting in ascending and descending order	2.5 hours	
6.	(a) Search a given number or a word in an array of given numbers. (b) Search a key element in a list of n 16-bit numbers using the Binary search algorithm.	2.5 hours	
7.	To find the smallest and biggest numbers in a given array.	2.5 hours	
8.	ALP for number system conversions.	2.5 hours	
9.	(a) String operations(String length, reverse, comparison, concatenation, palindrome)	2.5 hours	
10.	ALP for Password checking	2.5 hours	
11.	Convert a 16-bit binary value (assumed to be an unsigned integer) to BCD and display it from left to right and right to left for specified number of times	2.5 hours	
12.	ALP to interface Stepper motor using 8086/ Intel Galileo Board	2.5 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

CSE3002	INTERNET AND WEB PROGRAMMING	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	CSE2004-Database Management System	Syllabus version				
		v1.0				
Course Objectives:						
<ol style="list-style-type: none"> To comprehend and analyze the basic concepts of web programming and internet protocols. To describe how the client-server model of Internet programming works. To demonstrate the uses of scripting languages and their limitations. 						
Expected Course Outcome:						
After successfully completing the course the student should be able to						
<ol style="list-style-type: none"> Differentiate web protocols and web architecture. Apply JavaScript, HTML and CSS effectively to create interactive and dynamic websites. Implement client side scripting using JavaScript. Develop applications using Java. Implement server side script using PHP, JSP and Servlets. Develop XML based web applications. Develop application using recent environment like Node JS, Angular JS, JSON and AJAX. 						
Student Learning Outcomes (SLO): 2, 5, 6, 17						
<ol style="list-style-type: none"> Having a clear understanding of the subject related concepts and of contemporary issues. Having design thinking capability Having an ability to design a component or a product applying all the relevant standards and with realistic constraints Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice 						
Module:1	INTRODUCTION TO INTERNET	2 hours				
Internet Overview- Networks - Web Protocols — Web Organization and Addressing - Web Browsers and Web Servers -Security and Vulnerability-Web System Architecture – URL - Domain Name – Client-side and server-side scripting.						
Module:2	WEB DESIGNING	4 hours				
HTML5 – Form elements, Input types and Media elements, CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Multiple Column Layout, User Interface.						
Module:3	CLIENT-SIDE PROCESSING AND SCRIPTING	7 hours				
JavaScript Introduction –Functions – Arrays – DOM, Built-in Objects, Regular Expression, Exceptions, Event handling, Validation- AJAX - JQuery.						
Module:4	SERVER SIDE PROCESSING AND SCRIPTING - PHP	5 hours				
Introduction to PHP – Operators – Conditionals – Looping – Functions – Arrays- Date and Time Functions – String functions - File Handling - File Uploading – Email Basics - Email with attachments.						
Module:5	PHP SESSION MANAGEMENT and DATABASE CONNECTIVITY	3 hours				
Sessions-Cookies-MySQL Basics – Querying single and multiple MySQL Databases with PHP – PHP Data Objects.						
Module:6	XML	4 hours				
XML Basics – XSL, XSLT, XML Schema-JSON.						

Module:7	APPLICATION DEVELOPMENT USING NODE JS	4 hours	
Introduction to Node.js- Installing Node.js - Using Events, Listeners, Timers, and Callbacks in Node.js – Introduction to Mongo DB- Accessing MongoDB from Node.js.			
Module:8	Industry Expert Talk	1 hour	
		Total Lecture hours:	30 hours
Text Book(s)			
1.	Paul Deitel, Harvey Deitel, Abbey Deitel, Internet & World Wide Web - How to Program, 5th edition, Pearson Education, 2012.		
2.	Kogent Learning Solutions Inc, Web Technologies Black Book, Dream Tech press, 2013.		
3.	Brad Dayley, Brendan Dayley, and Caleb Dayley , Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications, 2nd Edition, Pearson Education, 2018		
Reference Books			
1.	Lindsay Bassett, Introduction to JavaScript Object Notation, 1st Edition, O'Reilly Media, 2015		
2.	Fritz Schneider, Thomas Powell , JavaScript – The Complete Reference, 3rd Edition, Mc-Graw Hill, 2017		
3.	Steven Holzener , PHP – The Complete Reference, 1st Edition, Mc-Graw Hill, 2017		
4.	Sandeep Kumar Patel, Developing Responsive Web Applications with AJAX and JQuery, Packt Publications, 2014		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	HTML basic tags, HTML forms, table, list, HTML frames and CSS internal, external and inline		4 hours
2.	JavaScript validation, DOM and Ajax		6 hours
3.	Java, Servlet and JSP		8 hours
4.	PHP : Forms and File handling, Session Management and Cookies, Databases		8 hours
5.	XML		4 hours
Total Laboratory Hours			30 hours
Mode of assessment: Project/Activity			
Recommended by Board of Studies		19-11-2018	
Approved by Academic Council		No. 53	Date 13-12-2018

CSE4001	PARALLEL AND DISTRIBUTED COMPUTING	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	NIL	Syllabus version				
		v1.0				
Course Objectives:						
<ol style="list-style-type: none"> To introduce the fundamentals of parallel and distributed computing architectures and paradigms. To understand the technologies, system architecture, and communication architecture that propelled the growth of parallel and distributed computing systems. To develop and execute basic parallel and distributed application using basic programming models and tools. 						
Expected Course Outcome:						
Students who complete this course successfully are expected to:						
<ol style="list-style-type: none"> Design and implement distributed computing systems. Asses models for distributed systems. Design and implement distributed algorithms. Experiment with mechanisms such as client/server and P2P algorithms, remote procedure calls (RPC/RMI), and consistency. Analyse the requirements for programming parallel systems and critically evaluate the strengths and weaknesses of parallel programming models. Differentiate between the major classes of parallel processing systems. Analyse the efficiency of a parallel processing system and evaluate the types of application for which parallel programming is useful. 						
Student Learning Outcomes (SLO): 2, 5, 14, 17						
<ol style="list-style-type: none"> Having a clear understanding of the subject related concepts and of contemporary issues. Having design thinking capability. Having an ability to design and conduct experiments, as well as to analyze and interpret data. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice. 						
Module:1	Parallelism Fundamentals	2 hours				
Motivation – Key Concepts and Challenges – Overview of Parallel computing – Flynn’s Taxonomy – Multi-Core Processors – Shared vs Distributed memory.						
Module:2	Parallel Architectures	3 hours				
Introduction to OpenMP Programming – Instruction Level Support for Parallel Programming – SIMD – Vector Processing – GPUs.						
Module:3	Parallel Algorithm and Design	5 hours				
Preliminaries – Decomposition Techniques – Characteristics of Tasks and Interactions – Mapping Techniques for Load balancing – Parallel Algorithm Models.						
Module:4	Introduction To Distributed Systems	4 hours				
Introduction – Characterization of Distributed Systems – Distributed Shared Memory – Message Passing – Programming Using the Message Passing Paradigm – Group Communication – Case Study (RPC and Java RMI).						
Module:5	Coordination	6 hours				
Time and Global States – Synchronizing Physical Clocks – Logical Time and Logical Clock – Coordination and Agreement – Distributed Mutual Exclusion – Election Algorithms – Consensus and Related Problems.						
Module:6	Distributed Transactions	6 hours				

Transaction And Concurrency Control – Nested Transactions – Locks – Optimistic Concurrency Control – Timestamp Ordering Distributed Transactions – Flat and Nested – Atomic – Two Phase Commit Protocol – Concurrency Control.			
Module:7	Distributed System Architecture and its Variants	2 hours	
Distributed File System: Architecture – Processes – Communication Distributed Web-based System: Architecture – Processes – Communication. Overview of Distributed Computing Platforms.			
Module:8	Recent Trends	2 hours	
Total Lecture hours:		30 hours	
Text Book(s)			
1.	George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, “Distributed Systems: Concepts and Design”, 5th Edition, Pearson / Addison – Wesley, 2012		
2.	Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, “Introduction to Parallel Computing”, Pearson, 2nd Edition, 2008.		
Reference Books			
1.	Andrew S. Tanenbaum and Maarten Van Steen, “Distributed Systems: Principles and Paradigms”, Pearson, 2nd Edition, 2006		
2.	Pradeep K. Sinha, “Distributed Operating System: Concepts and Design”, PHI Learning Pvt. Ltd., 2007		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	OpenMP – Basic programs such as Vector addition, Dot Product	2 hours	
2.	OpenMP – Loop work-sharing and sections work-sharing	2 hours	
3.	OpenMP – Combined parallel loop reduction and Orphaned parallel loop reduction	2 hours	
4.	OpenMP – Matrix multiply (specify run of a GPU card, large scale data ... Complexity of the problem need to be specified)	3 hours	
5.	MPI – Basics of MPI	3 hours	
6.	MPI – Communication between MPI process	3 hours	
7.	MPI – Advanced communication between MPI process	3 hours	
8.	MPI – Collective operation with ‘synchronization’	3 hours	
9.	MPI – Collective operation with ‘data movement’	3 hours	
10.	MPI – Collective operation with ‘collective computation’	3 hours	
11.	MPI – Non-blocking operation	3 hours	
Total Laboratory Hours			30 hours
Mode of assessment: Project/Activity			
Recommended by Board of Studies		19-11-2018	
Approved by Academic Council		No. 53	Date 13-12-2018

EEE1001	Basic Electrical and Electronics Engineering				L	T	P	J	C
					2	0	2	0	3
Pre-requisite	NIL				Syllabus version				
					v. 1.0				
Course Objectives:									
1. To understand the various laws and theorems applied to solve electric circuits and networks 2. To provide the students with an overview of the most important concepts in Electrical and Electronics Engineering which is the basic need for every engineer									
Expected Course Outcome:									
1. Solve basic electrical circuit problems using various laws and theorems 2. Analyze AC power circuits and networks, its measurement and safety concerns 3. Classify and compare various types of electrical machines 4. Design and implement various digital circuits 5. Analyze the characteristics of semiconductor devices and comprehend the various modulation techniques in communication engineering 6. Design and conduct experiments to analyze and interpret data									
Student Learning Outcomes (SLO): 1,2,9									
1. Having an ability to apply mathematics and science in engineering applications 2. Having a clear understanding of the subject related concepts and of contemporary issues 9. Having problem solving ability- solving social issues and engineering problems									
Module:1	DC circuits				5 hours				
Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Thevenin's and Maximum power transfer theorem									
Module:2	AC circuits				6 hours				
Alternating voltages and currents, AC values, Single Phase RL, RC, RLC Series circuits, Power in AC circuits-Power Factor- Three Phase Systems – Star and Delta Connection- Three Phase Power Measurement – Electrical Safety –Fuses and Earthing, Residential wiring									
Module:3	Electrical Machines				7 hours				
Construction, Working Principle and applications of DC Machines, Transformers, Single phase and Three-phase Induction motors, Special Machines-Stepper motor, Servo Motor and BLDC motor									
Module:4	Digital Systems				5 hours				
Basic logic circuit concepts, Representation of Numerical Data in Binary Form- Combinational logic circuits, Synthesis of logic circuits									
Module:5	Semiconductor devices and Circuits				7 hours				
Conduction in Semiconductor materials, PN junction diodes, Zener diodes, BJTs, MOSFETs, Rectifiers, Feedback Amplifiers using transistors. Communication Engineering: Modulation and Demodulation - Amplitude and Frequency Modulation									
	Total Lecture hours:				30 hours				
Text Book(s)									
1.	1. John Bird, 'Electrical circuit theory and technology ', Newnes publications, 4 t h Edition, 2010.								
Reference Books									
1.	Allan R. Hambley, 'Electrical Engineering -Principles & Applications' Pearson Education, First Impression, 6/e, 2013								
2.	Simon Haykin, 'Communication Systems', John Wiley & Sons, 5 t h Edition, 2009.								

3.	Charles K Alexander, Mathew N O Sadiku, 'Fundamentals of Electric Circuits', Tata McGraw Hill, 2012.		
4.	Batarseh, 'Power Electronics Circuits', Wiley, 2003		
5.	H. Hayt, J.E. Kemmerly and S. M. Durbin, 'Engineering Circuit Analysis', 6/e, Tata McGraw Hill, New Delhi, 2011.		
7.	Fitzgerald, Higgabogan, Grabel, 'Basic Electrical Engineering', 5t h edn, McGraw Hill, 2009.		
8.	S.L.Uppal, 'Electrical Wiring Estimating and Costing ', Khanna publishers, NewDelhi, 2008.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	Thevenin's and Maximum Power Transfer Theorems – Impedance matching of source and load	3 hours	
2.	Sinusoidal steady state Response of RLC circuits	3 hours	
3.	Three phase power measurement for ac loads	3 hours	
4.	Staircase wiring circuit layout for multi storey building	3 hours	
5.	Fabricate and test a PCB layout for a rectifier circuit	3 hours	
6.	Half and full adder circuits.	3 hours	
7.	Full wave Rectifier circuits used in DC power supplies. Study the characteristics of the semiconductor device used	3 hours	
8.	Regulated power supply using zener diode. Study the characteristics of the Zener diode used	3 hours	
9.	Lamp dimmer circuit (Darlington pair circuit using transistors) used in cars. Study the characteristics of the transistor used	3 hours	
10.	Characteristics of MOSFET	3 hours	
Total Laboratory Hours			30 hours
Mode of assessment: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		29/05/2015	
Approved by Academic Council		37th AC	Date 16/06/2015

MAT1014	Discrete Mathematics and Graph Theory		L	T	P	J	C
			3	1	0	0	4
Pre-requisite	Nil		Syllabus Version				
			1.0				
Course Objectives:							
<ol style="list-style-type: none"> 1. To address the challenge of the relevance of lattice theory, coding theory and algebraic structures to computer science and engineering problems. 2. To use number theory, in particular congruence theory to cryptography and computer science problems. 3. To understand the concepts of graph theory and related algorithm concepts. 							
Expected Course Outcome:							
At the end of this course, students are expected to							
<ol style="list-style-type: none"> 1. form truth tables, proving results by truth tables, finding normal forms, 2. learn proof techniques and concepts of inference theory 3. understand the concepts of groups and application of group codes, use Boolean algebra for minimizing Boolean expressions. 4. learn basic concepts of graph theory, shortest path algorithms, concepts of trees and minimum spanning tree and graph colouring, chromatic number of a graph. 5. Solve Science and Engineering problems using Graph theory. 							
Student Learning Outcomes (SLO):							
			1, 2, 7				
<ol style="list-style-type: none"> 1. Having an ability to apply knowledge of mathematics in Science and Engineering 2. Having a clear understanding of the subject related concepts and of contemporary issues 7. Having computational thinking 							
Module:1	Mathematical Logic and Statement Calculus		6 hours				
Introduction-Statements and Notation-Connectives-Tautologies-Two State Devices and Statement logic -Equivalence - Implications-Normal forms - The Theory of Inference for the Statement Calculus.							
Module:2	Predicate Calculus		4 hours				
The Predicate Calculus - Inference Theory of the Predicate Calculus.							
Module:3	Algebraic Structures		5 hours				
Semigroups and Monoids - Groups – Subgroups – Lagrange’s Theorem Homomorphism – Properties-Group Codes.							
Module:4	Lattices		5 hours				
Partially Ordered Relations -Lattices as Posets – Hasse Digram – Properties of Lattices.							
Module:5	Boolean algebra		5 hours				
Boolean algebra - Boolean Functions-Representation and Minimization of Boolean Functions – Karnaugh map – McCluskey algorithm.							
Module:6	Fundamentals of Graphs		6 hours				
Basic Concepts of Graph Theory – Planar and Complete graph - Matrix representation of Graphs – Graph Isomorphism – Connectivity–Cut sets-Euler and Hamilton Paths–Shortest Path algorithms.							
Module:7	Trees, Fundamental circuits , Cut sets,		12 hours				

Graph colouring, covering, Partitioning			
Trees – properties of trees – distance and centres in tree –Spanning trees – Spanning tree algorithms- Tree traversals- Fundamental circuits and cut-sets. Bipartite graphs - Chromatic number – Chromatic partitioning – Chromatic polynomial - matching – Covering– Four Colour problem.			
Module:8	Contemporary Issues		2 hours
Industry Expert Lecture			
		Total Lecture hours:	45 hours
Tutorial	<ul style="list-style-type: none"> • 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. 		15 hours
Mode of Evaluation			
Individual Exercises, Team Exercises, Online Quizzes, Online, Discussion Forums			
Text Book(s)			
<ol style="list-style-type: none"> 1. Discrete Mathematical Structures with Applications to Computer Science, J .P. Trembley and R. Manohar, Tata McGraw Hill-35th reprint, 2017. 2. Graph theory with application to Engineering and Computer Science, Narasing Deo, Prentice Hall India 2016. 			
Reference Books			
<ol style="list-style-type: none"> 1. Discrete Mathematics and its applications, Kenneth H. Rosen, 8th Edition, Tata McGraw Hill, 2019. 2. Discrete Mathematical Structures, Kolman, R.C.Busby and S.C.Ross, 6th Edition, PHI, 2018. 3. Discrete Mathematics, Richard Johnsonbaugh, 8th Edition, Prentice Hall, 2017. 4. Discrete Mathematics, S. Lipschutz and M. Lipson, McGraw Hill Education (India) 2017. 5. Elements of Discrete Mathematics–A Computer Oriented Approach, C.L.Liu, Tata McGraw Hill, Special Indian Edition, 2017. 6. Introduction to Graph Theory, D. B. West, 3rd Edition, Prentice-Hall, Englewood Cliffs, NJ, 2015. 			
Mode of Evaluation			
Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test			
Recommended by Board of Studies		03-06-2019	
Approved by Academic Council		No.55	Date 13-06-2019

MAT2002	Applications of Differential and Difference Equations	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	MAT1011 - Calculus for Engineers	Syllabus Version				
		v1.0				
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 Sturm-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						
Student Learning Outcomes (SLO):						
		1, 2, 9				
1. Having an ability to apply mathematics and science in engineering applications						
2. Having a clear understanding of the subject related concepts and of contemporary issues						
9. Having problem solving ability- solving social issues and 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	Sturm Liouville's problems and power series	6 hours				

Solutions			
The Sturm-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, 10 th Edition, John Wiley India, 2015		
Reference Books			
1.	Higher Engineering Mathematics, B. S. Grewal, 43 rd Edition, Khanna Publishers, India, 2015		
2.	Advanced Engineering Mathematics by Michael D. Greenberg, 2 nd 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	3 hours	
8.	Applying the Frobenius method to solve differential equations arising in engineering applications	3 hours	
9.	Visualising Bessel and Legendre polynomials	3 hours	
10.	Evaluating Fourier series-Harmonic series	3 hours	
11.	Applying Z-Transforms to functions encountered in engineering	3 hours	
12.	Solving Difference equations arising in engineering applications	3 hours	
Total Laboratory Hours			30 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

MAT3004	Applied Linear Algebra		L	T	P	J	C
			3	1	0	0	4
Pre-requisite	MAT2002 Applications of Differential and Difference Equations	Syllabus Version					
		v1.0					
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.							
Student Learning Outcomes(SLO) 1,2,7							
1. Having an ability to apply knowledge of Mathematics in Science and Engineering							
2. Having a clear understanding of the subject related concepts and of contemporary issues							
7. Having computational thinking							
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	<ul style="list-style-type: none"> • 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. 	15 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, 9 th 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, 2 nd Edition, Springer 2004.		
3. Contemporary linear algebra, Howard Anton, Robert C Busby, Wiley 2003		
4. Introduction to Linear Algebra, Gilbert Strang, 5 th 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

PROGRAMME ELECTIVE

BIT1031	SYSTEMS BIOLOGY	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	BIT1005	Syllabus version				
		1.0				
Course Objectives:						
<ol style="list-style-type: none"> 1. Understand biological systems as a system, structure and dynamics of cellular and organism function. 2. Develop knowledge on biological interaction networks and genome-level cellular metabolism. 3. Apply mathematics, statistics and computing in an integrated way to analyse biological systems. 						
Expected Course Outcome:						
<ol style="list-style-type: none"> 1. Adapt the biological knowledge with data analysis 2. Evaluate and handle various bioinformatics tools 3. Build group and compare data, to gain information about single molecules compared to similar molecules 4. Explain how genomic, transcriptomic and proteomic techniques work, and discuss their strengths and limitations. 5. Interpret the results of biological studies by making use of bioinformatic techniques. 6. Develop basic scripts and pipelines for automating and repeating analyses 						
Student Learning Outcomes (SLO): 6,7,18						
6 Having an ability to design a component or a product applying all the relevant standards and with realistic constraints						
7 Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)						
18 Having critical thinking and innovative skills						
Module:1	System-level Understanding of Biological Systems	6 hours				
Introduction - system level understanding of biological systems - Biological systems: Example. Advanced measurement systems - cell lineage and its application						
Module:2	Modeling the Activity of Single Genes	6 hours				
Modeling the activity of single genes - Chemical reactions- Physical chemistry, The Basics of Transcription, a probabilistic model of a prokaryotic gene and its regulation						
Module:3	Modeling biochemical networks	6 hours				
Atomic - level simulation and modeling of bio-macromolecules - molecular dynamics – the force field, molecular dynamics methods – Monte Carlo methods						

Module:4	Kinetic Models	6 hours	
Kinetic models of excitable membranes and synaptic interactions - Kinetic models of ion channels –Voltage-dependent Ion channels – Ligand gated synaptic ion channels			
Module:5	Stochastic Models	6 hours	
Stochastic simulation of cell signaling pathways – Limitations of deterministic models. A novel stochastic simulator, Multistate molecules, signalling complex and allostery			
Module:6	Virtual Biology Laboratory	6 hours	
Modeling large biological systems from functional genomic data: Parameter estimation, cellular simulation, towards a virtual biology laboratory, computational cell biology, the stochastic approach			
Module:7	Simulation of the Whole Cell	7 hours	
Computer simulation of the whole cell, computer simulation of the cell, human erythrocyte model and its application, software for modeling and simulation, E-cell, and V-cell.			
Module:8	Contemporary issues:	2 hours	
Lecture by Industrial Expert			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Hiroaki Kitano. Foundations of Systems Biology. (Editor), MIT Press, 20012.		
2.	Computational Modeling of Genetic and Biochemical Networks, James M. Bower, Hamid Bolouri, MIT Press, 2000.3.		
3.	Gene Regulation and Metabolism: Postgenomic Computational Approaches, Julio Collado- Vides (Editor), Ralf Hofestadt (Editor),MIT Press,2002		
Reference Books			
1.	Lars Skyttner General Systems Theory. Science. 2001.		
2.	Dynamical Systems and Their Applications in Biology by Fields Institute for Research in Mathematical Sciences. Science. 2003.		
Mode of evaluation:			
Recommended by Board of Studies		03-08-2017	
Approved by Academic Council		No. 46	Date 23-08-2017

BIT2002	BIOLOGICAL DATABASES	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	BIT 1005	Syllabus version				
		1.0				
Course objectives (CoB):						
<ol style="list-style-type: none"> 1. Develop basic knowledge on the available online biological databases. 2. Experiment with of all kinds of nucleotide and protein databases and the best use of it throughout their course. 3. Discover the area of interest from the available database information 						
Course Outcomes (CO):						
<ol style="list-style-type: none"> 1. Analyze nucleotide and protein sequence from various databases. 2. Build an extensive knowledge of model organisms and to browse genome databases to retrieve useful information's which will be helpful for their research work. 3. Distinguish the intersection of life and information sciences, information theory, gene expression, and database queries 4. Apply existing software effectively to extract information from large databases and to use this information in computer modeling. 5. Demonstrate critical thinking and research methods in Bioinformatics to understand computational and experimental data. 6. Evaluate sequence, structural, and functional analysis of biomolecules. 						
Student Learning Outcomes (SLO):		5,13				
5. Having design thinking capability						
13. Having cross cultural competency exhibited by working in teams						
Module:1	Sequence submission tools	6 hours				
Introduction –Relational database- Motivation of biological database - Central dogma of life - Submission of sequences to the database, sequence formats, conversion of one sequence into another.						
Module:2	Nucleotide sequence databases	6 hours				
European Molecular Biology Laboratory (EMBL) - NCBI GenBank – DNA Data Bank of Japan (DDBJ), Genes and genetic disorders : COSMIC, Clinvar, HUMSAVAR- SNP database (DbSNP).						
Module:3	Protein amino acid sequence databases	6 hours				
Databases – UniProt Knowledgebase : SwissProt/TrEMBL - Protein Information Resource (PIR)						
Module:4	Protein structure databases	7 hours				
History of structural biology - Protein Data Bank (PDB), contents of a PDB file- SCOP : SCOP: Structural Classification of Proteins - CATH : Protein Structure Classification database						

Module:5	Protein function and pathway database	6 hours	
Pfam-protein family database - GO-gene ontology, PROSITE-protein function pattern and profile, ENZYME-Enzyme commission, KEGG Pathway database			
Module:6	Genome and Micro array databases	6 hours	
ENSEMBL Human - UCSC Human Genome Browser Gateway and other vertebrate genome databases. DNA microarray: database and basic tools, Gene Expression Omnibus (GEO) and SAGE databases			
Module:7	Protein-protein interactions	6 hours	
BioGRID: Database of Protein, Chemical, and Genetic Interactions, STRING : functional protein association networks, DIP - Database of Interacting Proteins			
Module:8	Contemporary issues:	2 hours	
Lecture by Industrial experts			
		Total Lecture hours:	45 hours
Text Book(s)			
<ol style="list-style-type: none"> 1. Attwood TK and Parry-Smith DJ (2014) Introduction to bioinformatics, Pearson Education. 2. Baxevanis A., Ouellette F.B.F. (Eds.) Bioinformatics: a practical guide to the analysis of genes and proteins. John Wiley and Sons, New York (1998). 			
Reference Books			
1. Mount D (2014) Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor			
Recommended by Board of Studies		08-03-2018	
Approved by Academic Council		No. 46	Date 23-08-2017

BIT2003	GENOMICS AND PROTEOMICS	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	BIT 1005	Syllabus version				
		1.0				
Course Objectives:						
<ol style="list-style-type: none"> 1. Build basic and applications knowledge on genomics and proteomics 2. Discover the techniques involved in the analysis of genomics and proteomics 3. Analyze genomic and proteomic studies in various biological models. 						
Expected Course Outcome:						
<p>At the end of the course the student should be able to</p> <ol style="list-style-type: none"> 1. Analyze the principle of sequencing and its significance 2. Compare genomics and gene expression profiling 3. Distinguish the principle of functional and structural genomics 4. Identify and isolate principle of proteins and their functional and structural properties 5. Illustrate the basic informations on protein interaction network 6. Apply the genomic and proteomic patterns in industrial and medicinal diagnostics and treatment 						
Student Learning Outcomes (SLO) : 1,2,9						
<ol style="list-style-type: none"> 1. Having an ability to apply mathematics and science in engineering applications 2. Having a clear understanding of the subject related concepts and of contemporary issues 9. Having problem solving ability- solving social issues and engineering problems 						
Module:1	Gene structure and sequencing	8 hours				
Sequence complexity – introns and exons – genome structure in viruses and prokaryotes – organelle genomes and nuclear DNA in eukaryotes – chain terminator sequencing – automated DNA sequencing – high throughput sequencing – alternate DNA sequencing methods.						
Module:2	Comparative genomics and Global expression profiling	8 hours				
Protein evolution by exon shuffling – comparative genomics of prokaryotes and eukaryotes – horizontal and lateral gene transfer – Traditional approaches to expression profiling- global analysis of RNA expression: spotted DNA arrays, printed oligonucleotide chips – data acquisition and analysis – serial analysis of gene expression – massively parallel signature sequencing.						
Module:3	Functional and structural genomics	8 hours				
Functional genomics by systematic gene knockout – genome wide random mutagenesis – use of chemical mutagens and pheno-copy libraries – Determining gene function by sequence comparison						

– X-ray crystallography, NMR and Cryo EM in high throughput structure determination – structure prediction methods – domain fusion method for functional annotation.			
Module:4	Proteome sequencing	5 hours	
Gel electrophoresis (1DE and 2DE), liquid chromatography and mass spectrometers for protein and peptide analysis – routes in proteome analysis - protein digestion techniques - protein identification by mass finger printing			
Module:5	Protein mining	4 hours	
Sequence analysis by tandem mass spectrometry – data bases and algorithms in protein identification.			
Module:6	Protein Expression analysis	4 hours	
Comparative proteomics – use of isotope tags – yeast two hybrid systems – immunoprecipitation and western blot analysis – short gun identification of multiprotein complex – bait and reverse bait analysis			
Module:7	Protein interaction network and modifications	6 hours	
Protein interaction network – sample enrichment for detecting protein modifications – integration of different algorithms to map protein modification- glycoprotein analysis – protein arrays. Intrinsically disordered proteins and their importance in understanding disease processes.			
Module:8	Contemporary Issues:	2 hours	
Lecture by experts			
	Total Lecture hours:	45 hours	
Text Book(s)			
1.	Principles of genome analysis and genomics – SB Primrose and RM Twyman, 3 rd edition, Blackwell publishing, 2003.		
2.	Introduction to proteomics: tools for the new biology – Daniel C Liebler, Humana Press, 2002.		
Reference Books			
1.	Discovering genomics, proteomics and bioinformatics, A Malcolm Campbell and Laurie J Heyer, Cold Spring Harbour Laboratory Press, 2002.		
Recommended by Board of Studies		03-08-2017	
Approved by Academic Council		No. 46	Date 23-08-2017

BIT3001	COMPUTATIONAL BIOLOGY	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	BIT2004	Syllabus version				
		1.0				
Course Objectives:						
<ol style="list-style-type: none"> Students will learn about the computational problems in the emerging areas of Bioinformatics, Computational Biology, and Genomics. The students will gain insights from varied backgrounds of engineering, computer science, and the life sciences 						
Expected Course Outcome:						
<p>At the end of the course, students should be able to:</p> <ol style="list-style-type: none"> 1) Explain mathematical concepts involved in biology 2) Gain basic knowledge of modern molecular biology and genomics 3) Develop an algorithm for analysis of biological sequences. 4) Gain knowledge to identify and develop in silico models appropriate to the different biological projects 5) Apply molecular methods to study genetic variation within and between species 6) Explain and evaluate different phylogenetic optimal criteria 7) Correctly select systems biology tools that will help them in re-constructing and re-defining complex biological processes 						
Student Learning Outcomes (SLO): 2,7,9						
<p>2. Having a clear understanding of the subject related concepts and of contemporary issues</p> <p>7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)</p> <p>9. Having problem solving ability- solving social issues and engineering problems</p>						
Module:1	Introduction	6 hours				
How the genome is studied, maps and sequences, specific techniques, the human genome project, sequence databases. Strings, graphs, and algorithms - Understanding the Basics of NGS: From Mechanism to Variant Calling						
Module:2	Sequence Comparison and Database Search algorithms	6 hours				
Comparing two sequences, global comparison the basic algorithm, database search, pam matrices, blast, fast, other issues, similarity and distance, parameter choice in sequence comparison, string matching and exact sequence comparison.						
Module:3	Fragment Assembly of DNA -I	7 hours				
The ideal case, complications, alternative methods for DNA sequencing, shortest common						

superstring, reconstruction, multicontig, algorithms, representing overlaps, paths originating			
Module:4	Fragment Assembly of DNA-II	7 hours	
Superstrings, shortest superstrings as paths, heuristics, finding overlaps, ordering fragments, alignment and consensus, The Maximum Overlap Graph, Graph formulation of SCS			
Module:5	Physical Mapping of DNA - I	7 hours	
Restriction enzymes - Restriction site mapping, hybridization mapping, models, restriction site models, interval graph models, the consecutive ones property, algorithmic implications			
Module:6	Physical Mapping of DNA - II	5 hours	
An algorithm for the cp problem, an approximation for hybridization mapping with errors, a graph model, a guarantee, computational practice, heuristics for hybridization mapping. Enhanced Double Digest Problem			
Module:7	Phylogenetic tree construction algorithms	5 hours	
Character states and the perfect phylogeny problem, binary character states, two characters, parsimony and compatibility in phylogenies, algorithms for distance matrices, reconstructing additive trees, reconstructing ultrametric trees, agreement between phylogenies.			
Module:8	Contemporary issues:	2 hours	
Lecture by Industrial Expert			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	João Meidanis & João Carlos Setubal PWS Publishing Company, Boston. 1997		
Reference Books			
1.	Konopka, Andrzej K Konopka, M James C Crabbe Compact Handbook Of Computational Biology- Science – 2004.		
2.	Dan Gusfield Algorithms on Strings, Trees, and Sequences: Computer Science and Computational Biolog - Computers - 1997		
3.	Michael S Waterman Introduction to Computational Biology: Maps, Sequences, and Genomes by - Science - 1995		
Recommended by Board of Studies		03-08-2017	
Approved by Academic Council		No. 46	Date 23-08-2017

BIT3002	MOLECULAR MODELING AND DRUG DESIGN	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	BIT 1004 and BIT 2001	Syllabus version				
		1.0				
Course Objectives:						
<ol style="list-style-type: none"> 1. To understand the theoretical background of molecular mechanics force fields and basic background of drug designing concept 2. To understand their application using tools and software's 						
Expected Course Outcome:						
At the end of the course the student should be able to						
<ol style="list-style-type: none"> 1. understand molecular mechanics force fields and concept of drug designs computationally 2. Learn the Quantum mechanics & concepts in molecular modeling 3. Use simple molecular mechanics force field and general features 4. Apply Molecular Structures & Modeling for biological databases 5. Deriving and using 3D pharmacophores 						
Student Learning Outcomes (SLO):		2, 9				
Module:1	Quantum mechanics & concepts in molecular modeling	8 hours				
Introduction – coordinate systems, potential energy surfaces. Introduction to quantum mechanics: Schrodinger wave equation, Born-Oppenheimer approximation. Introduction to computer hardware and software						
Module:2	Biomolecules	7 hours				
Overview of Biomolecules - protein structures and classifications, Protein folding and Ramachandran plot						
Module:3	Force Fields	7 hours				
The simple molecular mechanics force field and general features; bond stretching; angle bending; torsional terms; non-bonded interactions; electrostatic interactions; van der Waals interactions; steepest descent method, conjugate gradient method						
Module:4	Analysis and Properties	6 hours				
Geometry optimization, Vibrational frequencies: potential energy surface, harmonic vs. fundamental frequencies, zero-point vibrational energies (ZPVE's).						
Module:5	Molecular Structures & Modeling	5 hours				

Protein and nucleic acid structures, the molecular basis, stability, molecular complexes. Steps in homology modeling, tools, databases, side chain modeling, loop modeling. Predicting Protein Structures by Threading			
Module:6	Drug design	5 hours	
Deriving and using 3D pharmacophores. Structure-based methods to identify lead compounds: finding lead compounds by searching 3D databases; de novo ligand design			
Module:7	Molecular Docking	5 hours	
Docking - molecular modeling in drug design – structure based drug design, AUTODOCK and HEX. Visualization tools for molecular systems : Visualizing Molecular Dynamics trajectories, VMD, YASARA, PyMOL			
Module:8	Contemporary issues:	2 hours	
Lecture by Industrial Expert			
	Total Lecture hours:	45 hours	
Text Book(s)			
1.	Andrew R. Leach, Molecular Modeling, Principles & Applications, 2 nd ed (Dorling Kindersley(india) (P)Ltd with pearson education Ltd, UK, 2010		
Reference Books			
1.	R.K. Prasad, Quantum Chemistry, 4th ed. (New Age international (P) Ltd, ND, 2010)		
2.	Alan Hinchliffe, Molecular Modelling for Beginners, 2 nd ed, John-Wiley, 2010		
3.	S. C. Rastogi, Namita Mendiratta, Parag Rastogi, Bioinformatics: Methods And Applications: (Genomics, Proteomics and Drug Discovery), 3 rd ed, PHI learning (P) Ltd, 2010		
Recommended by Board of Studies		06-03-2018	
Approved by Academic Council		No.49	Date 15.03.2018

BIT3003	Molecular Evolution and Phylogeny	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	BIT2001	Syllabus version				
		2.0				
Course Objectives:						
<p>1. To demonstrate the basic models for comparative genome research including the analysis of observed DNA base and amino acid mutation patterns.</p> <p>2. To apply the use of mathematical models in phylogenetic reconstruction and statistical methods for the comparison of different models.</p> <p>3. To reconstruct and infer the biological data in a meaningful way complimentary to biological research.</p>						
Expected Course Outcome:						
<p>At the end of this course students will be able to:</p> <p>1. Analyze the present the mathematical models in the study of molecular evolution and to illustrate how to use them in actual data analysis.</p> <p>2. Solve the biological processes that shape evolution at the molecular level and the improved ability to infer from sequence data the story of the evolution of life on earth.</p> <p>3. Explore and analyze nucleotide and protein data and infer evolutionary relationships</p> <p>4. Develop skills to challenge the upcoming NGS big-data content analysis using tree based approach.</p> <p>5. Identify unique data from biology and perform pattern search and bridge ontological information in research.</p>						
Student Learning Outcomes (SLO):		2,20				
2. Having a clear understanding of the subject related concepts and of contemporary issues						
20. Having a good digital footprint						
Module:1	Molecular Archeology	7 hours				
Introduction to molecular evolution, driving forces in evolution, evolutionary changes in nucleotide sequences.						
Module:2	Phylogenetic Trees	7 hours				
Molecular phylogenetics, phylogenetic trees, trees and distances.						
Module:3	Phylogeny Algorithms	7 hours				
Measuring genetic change, Genetic distance-Measuring evolutionary change on tree- kinds of data.						
Module:4	Methods of reconstruction	6 hours				
Distance matrix methods, Maximum parsimony methods, Maximum likelihood methods						
Module:5	Evolutionary Analysis	6 hours				
Models of Molecular evolution, Functional constraints and the rate of substitution patterns of codon usage and base composition.						

Module:6	Molecular Evolution theory	5 hours	
Evolutionary clocks, Neutral theory, Genetic variation within species, Natural selection.			
Module:7	Applications of molecular phylogenetics	5 hours	
Organismal phylogeny, what does evolutionary medicine to offer, host parasite co-speciation.			
Module:8	Contemporary issues:	2 hours	
Lecture by Industrial Expert			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	LindellBromham, An Introduction to Molecular Evolution and Phylogenetics, 2016, 2 nd edition, Oxford University press, UK.		
Reference Books			
1	Graur Dan, Molecular and Genome Evolution, 2016, Sinauer Associates Inc. USA		
2.	Alexei J. Drummond, Remco R. Bouckaert, Bayesian Evolutionary Analysis with BEAST, 2015, Cambridge University Press, England.		
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Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		03-08-2017	
Approved by Academic Council		No. 46	Date 23-08-2017

CSE1004	NETWORK AND COMMUNICATION				L	T	P	J	C
					3	0	2	0	4
Pre-requisite	NIL				Syllabus version				
					v1.0				
Course Objectives:									
1. To build an understanding among students about the fundamental concepts of computer networking, protocols, architectures, and applications.									
2. To help students to acquire knowledge in design, implement and analyze performance of OSI and TCP-IP based Architectures.									
3. To implement new ideas in Networking through assignments.									
Expected Course Outcome:									
1. Interpret the different building blocks of Communication network and its architecture.									
2. Contrast different types of switching networks and analyze the performance of network									
3. Identify and analyze error and flow control mechanisms in data link layer									
4. Design subnetting and analyze the performance of network layer									
5. Construct and examine various routing protocols									
6. Compare various congestion control mechanisms and identify appropriate Transport layer protocol for real time applications									
7. Identify the suitable Application layer protocols for specific applications and its respective security mechanisms									
Student Learning Outcomes (SLO): 2,5,6									
2. Having a clear understanding of the subject related concepts and of contemporary issues									
5. Having design thinking capability									
6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints									
Module:1	Networking Principles and layered architecture				6 hours				
Data Communications and Networking: A Communications Model – Data Communications - Evolution of network, Requirements , Applications, Network Topology (Line configuration, Data Flow), Protocols and Standards, Network Models (OSI, TCP/IP)									
Module:2	Circuit and Packet switching				7 hours				
Switched Communications Networks – Circuit Switching – Packet Switching – Comparison of Circuit Switching and Packet Switching – Implementing Network Software, Networking Parameters(Transmission Impairment, Data Rate and Performance)									
Module:3	Data Link Layer				10 hours				
Error Detection and Correction – Hamming Code , CRC, Checksum- Flow control mechanism – Sliding Window Protocol - GoBack - N - Selective Repeat - Multiple access Aloha - Slotted Aloha - CSMA, CSMA/CD – Multiple Access Networks (IEEE 802.3), Token Ring(IEEE 802.5) and Wireless Networks (IEEE 802.11, 802.15)									
Module:4	Network Layer				6 hours				
IPv4 Address Space – Notations – Classful Addressing – Classless Addressing – Network Address Translation – IPv6 Address Structure – IPv4 and IPv6 header format.									
Module:5	Routing Protocols				4 hours				
Routing-Link State and Distance Vector Routing Protocols- Implementation-Performance Analysis- Packet Tracer.									
Module:6	Transport Layer				7 hours				

TCP and UDP-Congestion Control-Effects of Congestion-Traffic Management-TCP Congestion Control-Congestion Avoidance Mechanisms-Queuing Mechanisms-QoS Parameters			
Module:7	Application Layer	3 hours	
Application layer-Domain Name System-Case Study : FTP-HTTP-SMTP-SNMP			
Module:8	Recent Trends in Network Security	2 hours	
Total Lecture hours: 45 hours			
Text Book(s)			
1.	Computer Networks: A Systems Approach, Larry Peterson and Bruce Davie, 5th Ed, The Morgan Kaufmann Series, Elsevier, 2011.		
2.	Computer Networking: A Top-Down Approach Featuring the Internet, J.F. Kurose and K.W.Ross, 6th Ed., Pearson Education, 2012.		
Reference Books			
1.	Data Communications and Networking, Behrouz A. Forouzan, McGraw Hill Education, 5th Ed., 2012.		
2.	TCP/IP Protocol Suite, Behrouz A. Forouzan, McGraw-Hill Education, 4 Ed., 2009.		
3.	Data and Computer Communications, William Stallings, Pearson Education, 10th Ed, 2013.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1	Demo session of all networking hardware and Functionalities	3 Hours	
2	Network configuration commands using Linux	3 Hours	
3	Error detection and correction mechanisms	3 Hours	
4	Flow control mechanisms	3 Hours	
5	IP addressing Classless addressing	3 Hours	
6	Observing Packets across the network and Performance Analysis of Routing protocols	3 Hours	
7	Socket programming(TCP and UDP) Multi client chatting	3 Hours	
8	Simulation of unicast routing protocols	3 Hours	
9	Simulation of Transport layer Protocols and analysis of congestion control techniques in network	3 Hours	
10	Develop a DNS client server to resolve the given host name or IP address	3 Hours	
Total Laboratory Hours			30 hours
Mode of assessment: Project/Activity			
Recommended by Board of Studies		28-02-2017	
Approved by Academic Council		No. 46	Date 24-08-2017

CSE1007	JAVA PROGRAMMING	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	NIL	Syllabus version				
		v1.0				
Course Objectives:						
<ol style="list-style-type: none"> 1. To impart the core language features of Java and its Application Programming Interfaces (API). 2. To demonstrate the use of threads, exceptions, files and collection frameworks in Java. 3. To familiarize students with GUI based application development and database connectivity. 						
Expected Course Outcome:						
<ol style="list-style-type: none"> 1. Comprehend Java Virtual Machine architecture and Java Programming Fundamentals. 2. Design applications involving Object Oriented Programming concepts such as inheritance, association, aggregation, composition, polymorphism, abstract classes and interfaces. 3. Design and build multi-threaded Java Applications. 4. Build software using concepts such as files, collection frameworks and containers. 5. Design and implement Java Applications for real world problems involving Database Connectivity. 6. Design Graphical User Interface using JavaFX. 7. Design, Develop and Deploy dynamic web applications using Servlets and Java Server Pages. 						
Student Learning Outcomes (SLO): 1, 9, 14						
<ol style="list-style-type: none"> 1. Having an ability to apply mathematics and science in engineering applications 9. Having problem solving ability-solving social issues and engineering problems 14. Having an ability to design and conduct experiments, as well as to analyze and interpret data 						
Module:1	Java Fundamentals	4 hours				
Java Basics: Java Design goal - Features of Java Language - JVM - Bytecode - Java source file structure basic programming constructs Arrays one dimensional and multi-dimensional enhanced for loop String package						
Module:2	Object Oriented Programming	5 hours				
Class Fundamentals - Object Object reference array of objects constructors methods over- loading this reference static block - nested class inner class garbage collection finalize() Wrapper classes Inheritance types - use of super - Polymorphism abstract class interfaces packages and sub packages.						
Module:3	Robustness and Concurrency	6 hours				
Exception Handling - Exceptions Errors - Types of Exception - Control Flow in Exceptions - Use of try, catch, finally, throw, throws in Exception Handling - user defined exceptions - Multithreading Thread creation sharing the workload among threads synchronization inter thread communication deadlock.						
Module:4	Files, Streams and Object serialization	7 hours				
Data structures: Java I/O streams Working with files Serialization and deserialization of objects Lambda expressions, Collection framework List, Map, Set Generics Annotations						
Module:5	GUI Programming and Database Connectivity	7 hours				
GUI programming using JavaFX, exploring events, controls and JavaFX menus Accessing databases using JDBC connectivity.						
Module:6	Servlet	7 hours				

Introduction to servlet - Servlet life cycle - Developing and Deploying Servlets - Exploring Deployment Descriptor (web.xml) - Handling Request and Response - Session Tracking Management.			
Module:7	Java Server Pages	7 hours	
JSP Tags and Expressions - JSP Expression Language (EL) - Using Custom Tag - JSP with Java Bean.			
Module:8	Latest Trends	2 hours	
Industry Expert talk			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Herbert Schildt, The Complete Reference -Java, Tata McGraw-Hill Education, Tenth Edition, 2017.		
2.	Paul J. Deitel, Harvey Deitel ,Java SE8 for Programmers (Deitel Developer Series) 3rd Edition, 2014		
3.	Y. Daniel Liang, Introduction to Java programming-comprehensive version-Tenth Edition, Pearson ltd 2015		
Reference Books			
1.	Paul Deitel Harvey Deitel ,Java, How to Program, Prentice Hall; 9th edition , 2011.		
2.	Cay Horstmann BIG JAVA, 4th edition, John Wiley Sons,2009		
3.	Nicholas S. Williams, Professional Java for Web Applications, Wrox Press, 2014.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	Write a program to demonstrate the use of multidimensional arrays and looping constructs.	2 hours	
2.	Write a program to demonstrate the application of String handling functions.	2 hours	
3.	Write a program to demonstrate the use of Inheritance.	2 hours	
4.	Write a program to demonstrate the application of user-defined packages and sub-packages.	2 hours	
5.	Write a program to demonstrate the use of Java Exception handling methods.	2 hours	
6.	Write a program to demonstrate the use of threads in Java.	2 hours	
7.	Demonstrate with a program the use of File handling methods in Java.	2 hours	
8.	Demonstrate the use of Java collection frameworks in reducing application development time.	2 hours	
9.	Build a GUI application using JavaFX	2 hours	
10.	Write a program to register students data using JDBC with MySQL Database.	2 hours	
11.	Write a program that uses Servlets to perform basic banking tasks.	2 hours	
12.	Write a web application using JSP and demonstrate the use of http request and response methods.	2 hours	
13.	Write a JSP program for an order management system.	2 hours	
14.	Write a JSP program that using JDBC and MySQL database to store the user data.	2 hours	
15.	JSP with Java Bean	2 hours	
Total Laboratory Hours			30 hours
Mode of assessment: Project/Activity			
Recommended by Board of Studies		10-08-2018	
Approved by Academic Council		No. 52	Date 14-09-2018

CSE2002	THEORY OF COMPUTATION AND COMPILER DESIGN	L	T	P	J	C
		4	0	0	4	4
Pre-requisite	NIL	Syllabus version				
		v1.0				
Course Objectives:						
<ol style="list-style-type: none"> 1. Provides required theoretical foundation for a computational model and compiler design 2. Discuss Turing machines as a abstract computational model 3. Compiler algorithms focus more on low level system aspects. 						
Expected Course Outcome:						
On successful completion of the course, the student should be able to:						
<ol style="list-style-type: none"> 1. Design computational models for formal languages 2. Design scanners and parsers using top-down as well as bottom-up paradigms 3. Design symbol tables and use them for type checking and other semantic checks 4. Implement a language translator 5. Use tools such as lex, YACC to automate parts of implementation process 						
Student Learning Outcomes (SLO): 1,9,18						
<ol style="list-style-type: none"> 3. Having an ability to apply mathematics and science in engineering applications 9. Having problem solving ability- solving social issues and engineering problems 18. Having critical thinking and innovative skills. 						
Module:1	Introduction To Languages and Grammers	3 hours				
Overview of a computational model - Languages and grammars – alphabets – Strings - Operations on languages, Introduction to Compilers - Analysis of the Source Program - Phases of a Compiler						
Module:2	Regular Expressions and Finite Automata	9 hours				
Finite automata – DFA – NFA – Equivalence of NFA and DFA (With Proof) - Regular expressions – Conversion between RE and FA (With Proof) Lexical Analysis - Recognition of Tokens - Designing a Lexical Analyzer using finite automata						
Module:3	Myhill-Nerode Theorem	4 hours				
Myhill-Nerode Theorem - Minimization of FA – Decision properties of regular languages – Pumping lemma for Regular languages (With Proof)						
Module:4	CFG, PDAs and Turing Machines	15 hours				
CFG – Chomsky Normal Forms - NPDA – DPDA - Membership algorithm for CFG. Syntax Analysis - Top-Down Parsing - Bottom-Up Parsing - Operator-Precedence Parsing - LR Parsers						
Module:5	Turing Machines	5 hours				
Turing Machines – Recursive and recursively enumerable languages – Linear bounded automata - Chomsky's hierarchy – Halting problem						
Module:6	Intermediate Code Generation	10 hours				
Intermediate Code Generation - Intermediate Languages – Declarations - Assignment Statements - Boolean Expressions - Case Statements – Backpatching - Procedure Calls.						
Module:7	Code Optimization	7 hours				
Code Optimization - Basic Blocks and Flow Graphs – The DAG Representation of Basic Blocks - The Principal Sources of Optimization - Optimization of Basic Blocks - Loops in Flow Graphs - Peephole Optimization - Introduction to Global Data-Flow Analysis						
Module:8	Code Generation	7 hour				
Code Generation – Issues in the Design of a Code Generator - The Target Machine - Run-Time						

Storage Management - Next-Use Information - Register Allocation and Assignment - A Simple Code Generator - Generating Code from DAG			
Recent Trends – Just-in-time compilation with adaptive optimization for dynamic languages			
- Parallelizing Compilers			
Total Lecture Hours			
		Total Lecture hours:	60 hours
Text Book(s)			
1.	Introduction to Automata Theory, Languages, and Computation (3rd Edition), John E Hopcroft, Rajeev Motwani, Jeffery D. Ullman, Pearson education, 2013.		
2.	Principles of Compiler Design, Alferd V. Aho and Jeffery D. Ullman, Addison Wesley, 2006		
Reference Books			
1.	Introduction to Languages and the Theory of Computation, John Martin, McGraw-Hill Higher Education,2010		
2.	Modern Compiler Implementation in Java, 2nd ed., Andrew W. Appel Cambridge University Press, 2012.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		19-11-2018	
Approved by Academic Council		No. 53	Date 13-12-2018

CSE3006	EMBEDDED SYSTEMS DESIGN	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	CSE2006-Microprocessor and Interfacing	Syllabus version				
		v1.0				
Course Objectives:						
<ol style="list-style-type: none"> 1. To expose students to various challenges and constraints of special purpose computing systems in terms of resources and functional requirements. 2. To introduce students to various components of typical embedded systems viz., sensors and actuators, data converters, UART etc., their interfacing, programming environment for developing any smart systems and various serial communication protocols for optimal components interfacing and communication. 3. To make students understand the importance of program modeling, optimization techniques and debugging tools for product development and explore various solutions for real time scheduling issues in terms of resources and deadline. 						
Expected Course Outcome:						
<ol style="list-style-type: none"> 1. Identify the challenges in designing an embedded system using various microcontrollers and interfaces. 2. To differentiate and outline various requirements for conventional computing systems and embedded systems. 3. Summarize the functionality of any special purpose computing system and by proposing smart solutions at prototype level to solve engineering problems. 4. To elucidate the working principle and interfacing of typical components of an embedded system. 5. Design program models, apply various optimization techniques and demonstrate the debugging tools in simulation environment. 6. To analyze the pros and cons of real time scheduling algorithms and suggest appropriate solution for various issues. 7. To evaluate the working principle of serial communication protocols and their appropriate usage. 						
Student Learning Outcomes (SLO): 6, 7, 9						
<ol style="list-style-type: none"> 6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints. 7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning). 9. Having problem solving ability- solving social issues and engineering problems. 						
Module:1	Introduction	5 hours				
Overview of Embedded Systems, Design challenges, Embedded processor technology, Hardware Design, Micro-controller architecture -8051, PIC, and ARM.						
Module:2	Conventional Computing System	4 hours				
Internal architecture of PC laptop server - higher end computing system, Requirement of Conventional Computing, Pros cons of Conventional computing.						
Module:3	Architecture of Special Purpose Computing system	6 hours				
ATM, Handheld devices, Data Compressor, Image Capturing Devices Architecture and Requirements, Challenges Constraints of special purpose computing system.						
Module:4	I/O interfacing techniques	8 hours				
Memory interfacing, A/D, D/A, timers, watch-dog timer, counters, encoder decoder, UART, Sensors and actuators interfacing.						

Module:5	Programming tools	7 hours	
Evolution of embedded programming tools, Modeling programs, Code optimization, Logic analyzers, Programming environment.			
Module:6	Real time operating system	8 hours	
Classification of Real time system, Issues challenges in RTS, Real time scheduling schemes- EDF-RMS Hybrid techniques, eCOS, POSIX, Protothreads.			
Module:7	Embedded Networking protocols	5 hours	
Inter Integrated Circuits (I2C), Controller Area Network, Embedded Ethernet Controller, RS232, Bluetooth, Zigbee, Wifi.			
Module:8	Recent Trends	2 hours	
Total Lecture hours: 45 hours			
Text Book(s)			
1.	Embedded System Design A Unified HW.SW Introduction, by Vahid G Frank and Givargis Tony, John Wiley Sons, 2006.		
2.	Wayne Wolf, Computers as Components Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2008 One or two books.		
3.	Embedded Systems Architecture, Programming and Design, by Raj Kamal, TMH, 2011.		
Reference Books			
1.	Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill, 2009.		
2.	Embedded Systems Lyla, Pearson, 2013.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		04-04-2014	
Approved by Academic Council		No. 37	Date 16-06-2015

CSE3009	INTERNET OF THINGS				L	T	P	J	C
					3	0	0	4	4
Pre-requisite	NIL				Syllabus version				
					v1.0				
Course Objectives:									
<ol style="list-style-type: none"> To apprise students with basic knowledge of IoT that paves a platform to understand physical, logical design and business models To teach a student how to analyze requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms. To explain the students how to code for an IoT application and deploy for real-time scenario. 									
Expected Course Outcome:									
<ol style="list-style-type: none"> Describe various layers of IoT protocol stack and describe protocol functionalities. Evaluate efficiency trade-offs among alternative communication models for an efficient IoT application design. Comprehend advanced IoT applications and technologies from the basics of IoT. Understand working principles of various sensor for different IoT platforms. Estimate the cost of hardware and software for low cost design IoT applications. Compare various application business models of different domains. Solve real-time problems and demonstrate IoT applications in various domains using prototype models. 									
Student Learning Outcomes (SLO): 2, 5, 6									
<ol style="list-style-type: none"> Having a clear understanding of the subject related concepts and of contemporary issues Having design thinking capability Having an ability to design a component or a product applying all the relevant standards and with realistic constraints. 									
Module:1	Introduction To Internet of Things				5 hours				
Definition & Characteristics of IoT - Challenges and Issues - Physical Design of IoT, Logical Design of IoT - IoT Functional Blocks, Security.									
Module:2	Components In Internet of Things				7 hours				
Control Units Communication modules Bluetooth Zigbee Wifi GPS- IOT Protocols (IPv6, 6LoWPAN, RPL, CoAP etc), MQTT, Wired Communication, Power Sources.									
Module:3	Technologies Behind IoT				7 hours				
Four pillars of IOT paradigm, - RFID, Wireless Sensor Networks, SCADA (Supervisory Control and Data Acquisition), M2M - IOT Enabling Technologies - BigData Analytics, Cloud Computing, Embedded Systems.									
Module:4	Programming The Microcontroller For IoT				8 hours				
Working principles of sensors IOT deployment for Raspberry Pi /Arduino /Equivalent platform Reading from Sensors, Communication: Connecting microcontroller with mobile devices, communication through Bluetooth, wifi and USB - Contiki OS- Cooja Simulator.									
Module:5	Resource Management in IoT				4 hours				
Clustering, Clustering for Scalability, Clustering Protocols for IOT.									
Module:6	From The Internet Of Things To The Web Of Things				6 hours				
The Future Web of Things Set up cloud environment Cloud access from sensors Data Analytics for IOT- Case studies- Open Source e-Health sensor platform Be Close Elderly monitoring Other recent projects.									

Module:7	IoT Applications			6 hours
Business models for the internet of things, Smart city, smart mobility and transport, smart buildings and infrastructure, smart health, environment monitoring and surveillance.				
Module:8	Recent Trends			2 hours
Total Lecture hours: 45 hours				
Text Book(s)				
1.	Dieter Uckelmann et.al, Architecting the Internet of Things, Springer, 2011			
2.	Arshdeep Bahga and Vijay Madisetti, Internet of Things A Hand-on Approach, Universities press, 2015			
Reference Books				
1.	Charalampos Doukas , Building Internet of Things with the Arduino, Create space, April 2002			
2.	Dr. Ovidiu Vermesan and Dr. Peter Friess, Internet of Things: From research and innovation to market deployment, River Publishers 2014.			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
Recommended by Board of Studies		04-04-2014		
Approved by Academic Council		No. 37	Date	16-06-2015

CSE3011	ROBOTICS AND ITS APPLICATIONS				L	T	P	J	C
					3	0	0	4	4
Pre-requisite	NIL				Syllabus version				
					v1.0				
Course Objectives:									
<ol style="list-style-type: none"> To introduce basic concepts, parts of robots and types of robots To make the students familiar with various drive systems of robots, sensors and their applications in programming of robots To discuss the applications of robots, and implementations of robots 									
Expected Course Outcome:									
<ol style="list-style-type: none"> Explain the basic concepts of working of robot Analyze the function of sensor in robot and design the robotic arm with various tools Program the robot for a typical application and path planning using robotic vision Understand the various robot programming languages Conduct and design the experiments for various robot operations Use the advanced techniques for robot processing 									
Student Learning Outcomes (SLO): 1, 6, 17									
<ol style="list-style-type: none"> Having an ability to apply mathematics and science in engineering applications Having an ability to design a component or a product applying all the relevant standards and with realistic constraint Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice 									
Module:1	Introduction				3 hours				
Introduction, brief history, types, classification and usage, science and technology of robots, Artificial Intelligence in Robotics, some useful websites, textbooks and research journals									
Module:2	Elements of Robots-Joints, Links, Actuators, and Sensors				7 hours				
Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kind of actuators, stepper-DC-servo-and brushless motors- model of a DC servo motor-types of transmissions-purpose of sensor-internal and external sensor-common sensors-encoders-tachometers-strain gauge based force torque sensor-proximity and distance measuring sensors-and vision									
Module:3	End Effectors				5 hours				
Classification of end effectors-tools as end effectors-drive system for grippers-mechanical adhesive-vacuum magnetic-grippers-hooks and scoops-gripper force analysis-and gripper design-active and passive grippers									
Module:4	Planning and Navigation				6 hours				
Introduction, path planning-overview-road map path planning-cell decomposition path planning-potential field path planning-obstacle avoidance-case studies									
Module:5	Vision system				6 hours				
Robotic vision systems-image representation-object recognition-and categorization-depth measurement- image data compression-visual inspection-software considerations									
Module:6	Robot Programming				7 hours				
Introduction to robot languages-VAL-RAPID-language-basic commands-motion instructions- pick and place operation using industrial robot manual mode-automatic mode-subroutine command based programming-move master command language-introduction-syntax-simple problems									
Module:7	Field and service robots / Industrial				9 hours				

	Robots		
Ariel robots-collision avoidance robots for agriculture-mining-exploration-underwater-civilian- and military applications-nuclear applications-space applications-Industrial robots-artificial intelligence in robots-application of robots in material handling-continuous arc welding-spot welding-spray painting-assembly operation-cleaning-etc			
Module:8	Contemporary issues		2 hours
	Total Lecture hours:		45 hours
Text Book(s)			
1.	Richard D.Klafter.Thomas Achmielewski and Mickael Negin, Robotic Engineering an Integrated approach prentice hall India- newdelhi-2001		
2.	Saeed B.Nikku, Introduction to Robotics, analysis, control and applications Wiley-India 2nd edition-2011		
Reference Books			
1.	Industrial robotic technology-programming and application by M.P.Groover et al, McGrawhill 2008		
2.	Robotics technology and flexible automation by S.R. Deb, TMH2009		
3.	ABB reference manual		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		04-04-2014	
Approved by Academic Council		No. 37	Date 16-06-2015

CSE3013	ARTIFICIAL INTELLIGENCE				L	T	P	J	C
					3	0	0	4	4
Pre-requisite	NIL				Syllabus version				
					v1.0				
Course Objectives:									
<ol style="list-style-type: none"> To impart artificial intelligence principles, techniques and its history To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems To develop intelligent systems by assembling solutions to concrete computational problems 									
Expected Course Outcome:									
<ol style="list-style-type: none"> Evaluate Artificial Intelligence (AI) methods and describe their foundations. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning. Demonstrate knowledge of reasoning and knowledge representation for solving real world problems Analyze and illustrate how search algorithms play vital role in problem solving Illustrate the construction of learning and expert system Discuss current scope and limitations of AI and societal implications. 									
Student Learning Outcomes (SLO): 1, 7, 17									
<ol style="list-style-type: none"> Having an ability to apply mathematics and science in engineering applications Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning) Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice 									
Module:1	Artificial Intelligence and its Issues				9 hours				
Definitions - Importance of AI, Evolution of AI - Applications of AI, Classification of AI systems with respect to environment, Knowledge Inferring systems and Planning, Uncertainty and towards Learning Systems.									
Module:2	Overview to Problem Solving				5 hours				
Problem solving by Search, Problem space - State space, Blind Search - Types, Performance measurement.									
Module:3	Heuristic Search				4 hours				
Types, Game playing mini-max algorithm, Alpha-Beta Pruning									
Module:4	Knowledge Representation and Reasoning				7 hours				
Logical systems Knowledge Based systems, Propositional Logic Constraints, Predicate Logic First Order Logic, Inference in First Order Logic, Ontological Representations and applications									
Module:5	Uncertainty and knowledge Reasoning				7 hours				
Overview Definition of uncertainty, Bayes Rule Inference, Belief Network, Utility Based System, Decision Network									
Module:6	Learning Systems				4 hours				
Forms of Learning Types - Supervised, Unsupervised, Reinforcement Learning, Learning Decision Trees									
Module:7	Expert Systems				7 hours				
Expert Systems - Stages in the development of an Expert System - Probability based Expert Systems - Expert System Tools - Difficulties in Developing Expert Systems - Applications of Expert Systems									

Module:8	Recent Trends	2 hours	
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Russell, S. and Norvig, P. 2015. Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall.		
2.	Poole, D. and Mackworth, A. 2010. Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press.		
Reference Books			
1.	Ric, E., Knight, K and Shankar, B. 2009. Artificial Intelligence, 3rd edition, Tata McGraw Hill.		
2.	Luger, G.F. 2008. Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson.		
3.	Brachman, R. and Levesque, H. 2004. Knowledge Representation and Reasoning, Morgan Kaufmann.		
4.	Alpaydin, E. 2010. Introduction to Machine Learning. 2nd edition, MIT Press.		
5.	Sutton R.S. and Barto, A.G. 1998. Reinforcement Learning: An Introduction, MIT Press.		
6.	Padhy, N.P. 2009. Artificial Intelligence and Intelligent Systems, Oxford University Press.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		04-04-2014	
Approved by Academic Council		No. 37	Date 16-06-2015

CSE3016	COMPUTER GRAPHICS AND MULTIMEDIA	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	Nil	Syllabus version				
		v. 1.0				
Course Objectives:						
<ol style="list-style-type: none"> To comprehend the fundamental concepts of graphics and multimedia. To gain and apply the acquired knowledge pertaining to 2D and 3D concepts in graphics programming. To understand the basic 3D modeling and rendering techniques. To realize the importance of multimedia towards building the virtual environment and communication. 						
Expected Course Outcome:						
<ol style="list-style-type: none"> To enumerate the functionalities of pixels and coordinate systems pertaining to graphics manipulation. Design and demonstrate the 2D and 3D objects using graphics algorithms. Have the ability to model and render 3D objects by comprehending the complexities of illumination in virtual scenes. To realize and grasp the intricacies involved with various AR/VR devices. Appraise and interpret the various multimedia communication standards, applications and basic principles. To implement various graphics algorithms and devise the 2D/3D computer animation. To design and develop 3D objects in the virtual space 						
Student Learning Outcomes (SLO): 2,9,11						
2.Having a clear understanding of the subject related concepts and of contemporary issues.						
9.Having problem solving ability - solving social issues and engineering problems.						
11.Having interest in lifelong learning						
Module:1	BASIC CONCEPTS & TECHNIQUES	3 hours				
Pixels-Replicating Pixels, Pixel Interpolation, Pixel Art Scaling. Bi-linear Interpolation, Vector - Scaling, Magnitude, Normalization, Dot Product, Cartesian and Polar co-ordinate system.						
Module:2	TWO DIMENSIONAL GRAPHICS PRIMITIVES	4 hours				
Bresenham's Line Algorithm, Mid-point circle Algorithm, Liang-Barsky line clipping Algorithm, Weiler and Atherton polygon clipping Algorithm, Halftoning						
Module:3	GEOMETRIC TRANSFORMATIONS & PROJECTIONS	5 hours				
Basic 2D Transforms, Basic 3D Transforms, Composite transformation matrices, Co-ordinate transform, Projections - Orthographic, Axonometric, 1 Point Perspective Projection						
Module:4	MODELING	4 hours				
Fractal models - Lindenmayer system Models, Deterministic self-similar fractals. Viewing - Drawing the Canonical View Volume, Computer Animation methods, Morphing techniques						
Module:5	RENDERING TECHNIQUES	5 hours				
Antialiasing, Texture Mapping- MipMap, Visible surface determination - Back face detection, ZBuffer method, Shading Model - Gouraud and Phong Shading.						
Module:6	AUGMENTED AND VIRTUAL REALITY	4 hours				

Understanding the Human Senses and their relationship to Output / Input Devices - Component Technologies of Head-Mounted Displays. Google Glass and Related Augmenting Displays, Sensors for Tracking Position, Orientation and Motion, Devices to Enable Interaction with Data.

Module:7	MULTIMEDIA COMMUNICATION STANDARDS	3 hours
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JPEG, MPEG-7 standardization process of Multimedia content description, MPEG-21 Multimedia framework, ITU-T standardization process, Audio-visual systems(H.322, H.324), Video coding standards (H.261, H.26L)

Module:8	Contemporary issues (To be handled by experts from industry)	2 hours
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Total Lecture hours:	30 hours
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Text Book(s)

1. K.R. Rao, Zoran S. Bojkovic and Dragorad A. Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Prentice Hall, 2014, ISBN-978-81203-2145-8 2
2. Donald Hearn, Pauline Baker, "Computer Graphics with OPENGL - C Version", 4th Edition, Pearson Education, 201

Reference Books

1. J. Vince, "Mathematics for Computer Graphics, Undergraduate Topics in Computer Science ", DOI 10.1007/978-1-84996-023-6 14, Springer-Verlag
2. F.S.Hill, Computer Graphics using OPENGL, Second edition, Pearson Education, 2009
3. Kamisetty Rao, Zoran Bojkovic, Dragorad Milovanovic, "Introduction to Multimedia Communications: Applications, Middleware, Networking ", Wiley, ISBN: 978-0-471-46742-7
4. James D. Foley, Andries Van Dam, Steven K. Feiner, John F. Hughes, "Computer Graphics- Principles and practice", 2nd Edition, Pearson Education, 2007
5. John F. Hughes, Andries Van Dam, Morgan Mc Guire, David F. Sklar, James D. Foley, Steven K. Feiner and Kurt Akeley, "Computer Graphics: Principles and Practice", 3rd Edition, AddisonWesley Professional, 2013.
6. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR, Steve Aukstakalnis, Addison-Wesley Professional, 2016, ISBN 0134094352, 9780134094359

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

List of Challenging Experiments (Indicative)

1.	Learning of Graphics Programming Environment and usage of Graphics APIs. Modelling and visualization of real-world /artificial scene using 2D graphics primitives	2 hours
2.	Implementation of Line Drawing algorithms	2 hours
3.	Implementation of Circle Drawing algorithm.	2 hours
4.	Implementation of Line clipping algorithms against the given rectangular window.	2 hours
5.	Implement the 2-D transformations functions on 2-D graphic objects. Write a sample program to demonstrate the use of the various 2-D transformation	3 hours
6.	Implement the function for the following 3-D transformation of a 3-D object <ul style="list-style-type: none"> o Translation o Rotation 	3 hours
7.	Write down function to display a 3D object using <ul style="list-style-type: none"> o Orthographic Projection o Perspective Projection 	3 hours

8.	Write an application to demonstrate the use of the 3D transformations and projections.	2 hours
9.	Use a audio processing software and perform the audio editing tasks– Import audio, Select and edit the sound, Create fade-in fade-out effects, Label audio segments, Use noise remove filter, Mix audio, Change stereo to mono tracks, Export audio to different format and save.	2 hours
10.	Use a video processing Software to perform – Trim video clips, crop video, rotate video, join video, add subtitles, and edit video dimension, bit rate, frame rate, sample rate, channel on a video.	3 hours
11.	Application development to Augmented and Virtual Reality - Science and Engineering	3 hours
12.	Create a 3D animation using a 3D modeling software.	3 hours
Total Laboratory Hours		30 hours
Mode of evaluation:		
Recommended by Board of Studies	04-04-2014	
Approved by Academic Council	No. 37	Date 16-06-2015

CSE3018	CONTENT BASED IMAGE AND VIDEO RETRIEVAL	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	NIL	Syllabus version				
		v1.0				
Course Objectives:						
<ol style="list-style-type: none"> To understand the fundamentals of images and key image features for image and video retrieval. To provide the exposure on importance of similarity measures in content-based image and video retrieval. To design the algorithm for content-based image retrieval and classify images using machine learning algorithms. 						
Expected Course Outcome:						
<ol style="list-style-type: none"> Understand the basic feature extraction methods used in Content based Image and Video retrieval to build the robust feature vectors for the Images. Extract the features based on various color models and apply on image and video retrieval. Apply texture and shape features for retrieval using various texture and shape models. Classify videos and image frames based on motion features. Apply similarity metrics to compute the distance between two images or videos. Use high level features using SIFT, SURF, color histograms and wavelets for image and video retrieval. Explore the computer vision tool box for object detection, tracking and processing videos. 						
Student Learning Outcomes (SLO):		2, 7, 14				
<ol style="list-style-type: none"> Having a clear understanding of the subject related concepts and of contemporary issues Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning). Having an ability to design and conduct experiments, as well as to analyze and interpret data. 						
Module:1	Fundamentals of Content-based image and video retrieval	3 hours				
History of CBIVR-Importance of CBIVR -Visual information retrieval system first generation VIR system 2nd generation VIR system a typical CBVIR system architecture - CBIVR techniques Query techniques: Semantic Retrieval - Relevance feedback iterative techniques machine learning techniques.						
Module:2	Image Content descriptors-Key Frame features Color	4 hours				
Color Space Color momentum color histogram color coherence vector-color correlogram Invariant color features						
Module:3	Image Content descriptors Key frame features- Texture, Shape	4 hours				
Tamura features- Wold features-Simultaneous Auto-Regressive (SAR) Model-Wavelet transform features- Shape: Moment invariants Turning angles Fourier descriptors-Spatial information						
Module:4	Motion features	3 hours				
Background foreground extraction - Camera based motion features object based motion features-object features Gabor features						
Module:5	Similarity Measures and Indexing Schemes	4 hours				
Minkowski-form distance Quadratic form distance Mahalanobis distance- Kullback-Leibler (KL) Divergence and Jeffrey-Divergence (JD)						

Module:6	Feature Extraction techniques	5 hours	
Histogram of Oriented Gradients (HOG), Speeded Up Robust Features (SURF), Local Binary Patterns (LBP), Haar wavelets, and color histograms.			
Module:7	Feature Extraction Techniques and Computer Vision Toolboxes	5 hours	
Scalar invariant feature transform Gray level co-occurrence matrix Principal component Analysis Toolboxes: Feature detection, extraction, and matching; object detection and tracking; motion estimation; and video processing.			
Module:8	Recent Trends - Case studies	2 hours	
		Total Lecture hours:	30 hours
Text Book(s)			
1.	Gerald Schaefer - Advances in Intelligent and Soft Computing - Chapter - Content based image retrieval – Springer Book.		
2.	Long, F., Zhang, H., Feng, D. D. (2003). Multimedia information retrieval and management. Technological Fundamentals and Applications.		
3.	Poornima, Y., Hiremath, P. S. (2013). Survey on Content Based Image Retrieval System and Gap Analysis for Visual Art Image Retrieval System. International Journal of Computer Science Issues (IJCSI), 10(3), 23.		
Reference Books			
1.	Research Papers in various journals.		
2.	Duda, R. O., Hart, P. E., Stork, D. G. (2012). Pattern classification. John Wiley Sons.		
3.	HWebb, A. R. (2003). Statistical pattern recognition. John Wiley Sons.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	CBIR using color momentum.	2 hours	
2.	CBIR using color histogram.	4 hours	
3.	CBIR using texture tamura features.	4 hours	
4.	CBIR using shape - moment invariants.	4 hours	
5.	CBIR with similarity measure.	4 hours	
6.	CBIR with GLCM.	4 hours	
7.	Foreground extraction using background subtraction.	4 hours	
8.	Object detection using SIFT and SURF.	4 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

CSE 3019	DATA MINING				L	T	P	J	C
					2	0	2	4	4
Pre-requisite	Nil				Syllabus version				
					v. 1.0				
Course Objectives:									
<ol style="list-style-type: none"> To introduce the concept of Data Mining and Data Preprocessing To develop the knowledge for application of the mining algorithms for association, clustering To explain the algorithms for mining data streams and the features of recommendation systems. 									
Expected Course Outcome:									
<ol style="list-style-type: none"> Interpret the contribution of data warehousing and data mining to the decision-support systems Apply the various classifications techniques to find the similarity between data items Design the model to sample, filter and mine the Streaming data Apply the link analysis and frequent item-set algorithms to identify the entities on the real world data Evaluate and report the results of the recommended systems Analyse the various data mining tasks and the principle algorithms for addressing the tasks Create the working model as a team to solve the challenging data mining problems 									
Student Learning Outcomes (SLO): 2, 7, 14, 17									
2.Having a clear understanding of the subject related concepts and of contemporary issues									
7.Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)									
14.Having an ability to design and conduct experiments, as well as to analyze and interpret data									
17.Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice									
Module:1	INTRODUCTION				3 hours				
Data Mining – Data ware housing-OLAP-Data Preprocessing									
Module:2	CLASSIFICATION TECHNIQUES AND FINDING SIMILAR ITEMS				5 hours				
Classification Techniques: Decision Tree, ID3, K-Nearest Neighbour Classifier, Naive Bayes- Near Neighbour Search – Shingling of Documents - Similarity Preserving – Locality Sensitive Hashing (LSH) –Application and Variance of LSH – Distance Measures – High degrees of similarity									
Module:3	MINING DATA STREAMS				4 hours				
Stream Data model - Sampling Data in a Stream – Filtering Streams – Counting distinct elements in a stream – Estimating Moments – Counting Ones in a window – Decaying windows									
Module:4	LINK ANALYSIS				4 hours				
Page Rank – Link Spam – Hubs and Authorities									
Module:5	FREQUENT ITEM SETS				4 hours				
Market-Basket Model – A-priori Algorithm – Handling larger datasets – Counting Frequent items in a stream – Limited Pass Algorithms									
Module:6	CLUSTERING				4 hours				
Hierarchical Clustering – K-means Algorithm – Clustering in Non-Euclidean spaces, Clustering for Streams and Parallelism									
Module:7	RECOMMENDATION SYSTEMS				4 hours				
Content based – Collaborative Filtering – Dimensionality reduction-Case study									

Module:8	Contemporary issues:	2 hours	
		Total Lecture hours:	30 hours
Text Book(s)			
1.	Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Morgan Kaufmann , 2011		
Reference Books			
1.	Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, Morgan Kaufmann 2011		
2.	J. Leskovec, A. Rajaraman, and Jeffrey D. Ullman. Mining of Massive Datasets. Cambridge University Press, 2014.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	Introduction to exploratory data analysis using R	3 hours	
2.	Demonstrate the Descriptive Statistics for a sample data like mean, median, variance and correlation etc.,	3 hours	
3.	Demonstrate Missing value analysis and different plots using sample data.	3 hours	
4.	Demonstration of apriori algorithm on various data sets with varying confidence (%) and support (%).	3 hours	
5.	Demo on Classification Techniques using sample data Decision Tree, ID3 or CART.	3 hours	
6.	Demonstration of Clustering Techniques K-Mean and Hierarchical.	3 hours	
7.	Simulation of Page Rank Algorithm and Demonstration on Hubs and Authorities.	3 hours	
8.	Demo on Classification Technique using KNN.	3 hours	
9.	Demonstration on Document Similarity Techniques and measurements.	3 hours	
10.	Design and develop a recommendation engine for the given application.	3 hours	
Total Laboratory Hours			30 hours
Mode of evaluation: Project/Activity			
Recommended by Board of Studies		04-04-2014	
Approved by Academic Council		No. 37	Date 16-06-2015

CSE3020	DATA VISUALIZATION		L	T	P	J	C
			2	0	2	4	4
Pre-requisite	Data Mining CSE3019	Syllabus version					
		v. 1.1					
Course Objectives:							
<ol style="list-style-type: none"> 1. To understand the various types of data, apply and evaluate the principles of data visualization. 2. Acquire skills to apply visualization techniques to a problem and its associated dataset. 3. To apply structured approach to create effective visualizations thereby building visualization dashboard to support decision making. 							
Expected Course Outcome:							
<ol style="list-style-type: none"> 1. Identify the different data types, visualization types to bring out the insight. Relate the visualization towards the problem based on the dataset. 2. Identify the different attributes and showcasing them in plots. Identify and create various visualizations for geospatial and table data. 3. Ability to visualize categorical, quantitative and text data. Illustrate the integration of visualization tools with hadoop. 4. Ability to visualize categorical, quantitative and text data. 5. Design visualization dashboard to support the decision-making on large scale data. 6. Match the knowledge gained with the industries latest technologies. 7. Ability to create and interpret plots using R/Python. 							
Student Learning Outcomes (SLO): 4, 7, 12							
<ol style="list-style-type: none"> 4. Having sense making skills of creating unique insights in what is being seen or observed. 7. Having computational thinking. 12. Having adaptive thinking and adaptability 							
Module:1	Introduction to Data Visualization					4 hours	
Overview of data visualization - Data Abstraction -Analysis: Four Levels for Validation- Task Abstraction - Analysis: Four Levels for Validation							
Module:2	Visualization Techniques					5 hours	
Scalar and point techniques Color maps Contouring Height Plots - Vector visualization techniques Vector properties Vector Glyphs Vector Color Coding Stream Objects.							
Module:3	Visual Analytics					3 hours	
Visual Variables- Networks and Trees - Map Color and Other Channels- Manipulate View							
Module:4	Visual Analytics					3 hours	
Arrange Tables Geo Spatial data Reduce Items and Attributes							
Module:5	Visualization Tools and Techniques					5 hours	
Introduction to data visualization tools- Tableau - Visualization using R							
Module:6	Diverse Types Of Visual Analysis					4 hours	
Time- Series data visualization Text data visualization Multivariatedata visualization and case studies							
Module:7	Visualization Dashboard Creations					4 hours	
Dashboard creation using visualization tools for the use cases: Finance-marketing-insurance-healthcare etc.,							
Module:8	Recent Trends					2 hours	
Industry Expert talk							

		Total Lecture hours: 30 hours		
Text Book(s)				
1.	Tamara Munzer, Visualization Analysis and Design -, CRC Press 2014 AlexandruTelea, Data Visualization Principles and Practice CRC Press 2014.			
2	Paul J. Deitel, Harvey Deitel, Java SE8 for Programmers (Deitel Developer Series) 3rd Edition, 2014.			
3	Y. Daniel Liang, Introduction to Java programming-comprehensive version-Tenth Edition, Pearson ltd 2015.			
Reference Books				
1.	Paul Deitel Harvey Deitel ,Java, How to Program, Prentice Hall; 9th edition , 2011.			
2.	Cay Horstmann BIG JAVA, 4th edition,John Wiley Sons,2009			
3.	Nicholas S. Williams, Professional Java for Web Applications, Wrox Press, 2014.			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
List of Challenging Experiments (Indicative)				
1.	Acquiring and plotting data			6 hours
2.	statistical Analysis such as Multivariate Analysis, PCA, LDA, Correlation, regression and analysis of variance			4 hours
3.	Time-series analysis stock market			4 hours
4.	Visualization on Streaming dataset			4 hours
5.	Dashboard Creation			6 hours
6.	Text visualization			6 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

CSE3021	SOCIAL AND INFORMATION NETWORKS		L	T	P	J	C
			3	0	0	4	4
Pre-requisite	Data Mining CSE3019		Syllabus version				
			v. 1.0				
Course Objectives:							
<ol style="list-style-type: none"> 1. Understand the components of social networks. 2. Model and visualize social networks. 3. Understand the role of semantic web in social networks. 4. Familiarize with the security concepts of social networks. 5. Find out various applications of social networks. 							
Expected Course Outcome:							
<ol style="list-style-type: none"> 1. Illustrate the basic components of social networks. 2. Analyze the different measurements and metrics of social networks. 3. Apply different techniques to detect and evaluate communities in social networks. 4. Apply various types of social network models. 5. Apply semantic web format to represent social networks. 6. Develop social network applications using visualization tools. 7. Usage of the security features in social and information networks for various practical applications. . 							
Student Learning Outcomes (SLO):			1,2,9,11,15,17				
<ol style="list-style-type: none"> 1. Having an ability to apply mathematics and science in engineering applications. 2. Having a clear understanding of the subject related concepts and of contemporary issues 9. Having problem solving ability- solving social issues and engineering problems. 11. Having interest in lifelong learning. 15. Having an ability to use the social media effectively for productive use. 17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice. 							
Module:1	Introduction		4 hours				
Introduction to social network analysis Fundamental concepts in network analysis social network data notations for social network data Graphs and Matrices.							
Module:2	Measures & Metrics		5 hours				
Strategic network formation - network centrality measures: degree, betweenness, closeness, eigenvector - network centralization density reciprocity transitivity ego network measures for ego network - dyadic network triadic network - cliques - groups- clustering search.							
Module:3	Community networks		6 hours				
Tamura features- Wold features-Simultaneous Auto-Regressive (SAR) Model-Wavelet transform features- Shape: Moment invariants Turning angles Fourier descriptors-Spatial information							
Module:4	Models		7 hours				
Small world network - WattsStrogatz networks - Statistical Models for Social Networks Network evolution models: dynamical models, growing models - Nodal attribute model: exponential random graph models Preferential attachment - Power Law - random network model: Erdos-Renyi and Barabasi-Albert Epidemics - Hybrid models of Network Formation.							
Module:5	Semantic Web		7 hours				
Modelling and aggregating social network data developing social semantic application evaluation of web-based social network extraction Data Mining Text Mining in social network Tools case study.							
Module:6	Visualization		8 hours				
Visualization of social networks novel visualizations and interactions for social networks ap-							

plications of social network analysis tools - sna: R Tools for Social Network Analysis - Social Networks Visualiser (SocNetV) - Pajek.			
Module:7			
Security & Applications		6 hours	
Managing Trust in online social network Security and Privacy in online social network security requirement for social network in Web 2.0 - Say It with Colors: Language-Independent Gender Classification on Twitter - Friends and Circles - TUCAN: Twitter User Centric ANalyzer.			
Module:8			
Recent Trends		2 hours	
Industry Expert talk			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Stanley Wasserman, Katherine Faust, Social network analysis: Methods and applications, Cambridge university press, 2009.		
2.	John Scott, Social network analysis, 3rd edition, SAGE, 2013.		
Reference Books			
1.	Borko Furht, Handbook of Social Network Technologies and applications, Springer, 2010.		
2.	Jalal Kawash, Online Social Media Analysis and Visualization (Lecture Notes in Social Networks), 2015.		
3.	Charu Aggarwal, Social Network data analysis, Springer, 2011.		
4.	Easley and Kleinberg, Networks, Crowds, and Markets: Reasoning about a highly connected world. Cambridge University Press, 2010.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		04-04-2014	
Approved by Academic Council		No. 37	Date 16-06-2015

CSE3024	WEB MINING	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		v. 1.0				
Course Objectives:						
<ol style="list-style-type: none"> 1. To acquire the knowledge of Web search, indexing and query processing 2. To perform web content mining for retrieving most relevant documents 3. Analyze on web structure and usage patterns 						
Expected Course Outcome:						
<ol style="list-style-type: none"> 1. Recognize the components of a web page and its related security issues 2. Build crawler and index the retrieved pages 3. Perform analysis on web structure and its content 4. Analyze social media data using Machine Learning techniques 5. Rene query terms for query expansion 6. Design a system to harvest information available on the web to build recommender systems 						
Student Learning Outcomes (SLO):		1,2,7				
<ol style="list-style-type: none"> 1.Having an ability to apply mathematics and science in engineering applications 2.Having a clear understanding of the subject related concepts and of contemporary issues 7.Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning) 						
Module:1	Introduction	5 hours				
Introduction of WWW – Architecture of the WWW – Web Document Representation- Web Search Engine – Challenges - Web security overview and concepts, Web application security, Basic web security model -Web Hacking Basics HTTP & HTTPS URL, Web Under the Cover Overview of Java security Reading the HTML source						
Module:2	WEB CRAWLING	5 hours				
Basic Crawler Algorithm: Breadth-First/ depth-First Crawlers, - Universal Crawlers- Preferential Crawlers: Focused Crawlers – Topical Crawlers.						
Module:3	INDEXING	5 hours				
Static and Dynamic Inverted Index– Index Construction and Index Compression- Latent Semantic Indexing. Searching using an Inverted Index: Sequential Search - Pattern Matching - Similarity search.						
Module:4	WEB STRUCTURE MINING	8 hours				
Link Analysis - Social Network Analysis - Co-Citation and Bibliographic Coupling - Page Rank- Weighted Page Rank- HITS - Community Discovery - Web Graph Measurement and Modelling- Using Link Information for Web Page Classification.						
Module:5	WEB CONTENT MINING	8 hours				
Classification: Decision tree for Text Document- Naive Bayesian Text Classification - Ensemble of Classifiers. Clustering: K-means Clustering - Hierarchical Clustering – Markov Models - Probability- Based Clustering. Vector Space Model – Latent semantic Indexing – Automatic Topic Extraction from Web Documents.						
Module:6	WEB USAGE MINING	9 hours				
Web Usage Mining - Click stream Analysis - Log Files - Data Collection and Pre-Processing - Data Modelling for Web Usage Mining - The BIRCH Clustering Algorithm - Modelling web user interests using clustering- Affinity Analysis and the A Priori Algorithm – Binning –Web usage mining using Probabilistic Latent Semantic Analysis – Finding User Access Pattern via Latent Dirichlet Allocation Model.						

Module:7	QUERY PROCESSING	3 hours	
Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency			
Module:8	Recent Trends	2 hours	
Industry Expert talk			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Bing Liu, “ Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)”, Springer; 2nd Edition 2009		
2	Zdravko Markov, Daniel T. Larose, “Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage”, John Wiley & Sons, Inc., 2007		
Reference Books			
1.	Guandong Xu ,Yanchun Zhang, Lin Li, “Web Mining and Social Networking: Techniques and Applications”, Springer; 1st Edition.2010		
2.	Soumen Chakrabarti, “Mining the Web: Discovering Knowledge from Hypertext Data”, Morgan Kaufmann; edition 2002		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1	To develop the Search Engine for retrieval process	4 Hours	
2	Develop Search engine using indexing	4 Hours	
3	Increase the efficiency document classification using Opinion Mining	3 Hours	
4	Prepare inverted indexing for the retrieved document and represent it as tries	4 Hours	
5	Fetch the document with highest similarity for the given query	3 Hours	
6	Compare various ranking schemes of document retrieval	4 Hours	
7	To develop the effective query refinement mechanism based on query algebra.	4 Hours	
8	Personalized web search using log analysis	4 Hours	
Total Laboratory Hours			30 hours
Mode of assessment: Project/Activity			
Recommended by Board of Studies		28-02-2017	
Approved by Academic Council		No. 46	Date 24-08-2017

CSE3025	LARGE SCALE DATA PROCESSING	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	Nil	Syllabus version				
		v. 1.0				
Course Objectives:						
1. To understand the different characteristics and requirement of big data frameworks. 2. To explain the concepts of distributed file system and Map Reduce programming. 3. To apply the exposure on inverted indexing and graph data analytic.						
Expected Course Outcome:						
1. Define the characteristics of big data and explain the data science life cycle. 2. Differentiate between conventional and contemporary distributed framework and Characterize storage and processing of large data. 3. Implement and demonstrate the use of the hadoop eco-system. 4. Compare scalable frameworks for large data. 5. Decompose a problem into map and reduce operations for implementation. 6. Design programs to analyze large scale text data. 7. Identify problems suitable for use of graph mining in large data processing.						
Student Learning Outcomes (SLO): 2,14,17						
2. Having a clear understanding of the subject related concepts and of contemporary issues. 14. Having an ability to design and conduct experiments, as well as to analyze and interpret data. 17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice.						
Module:1	INTRODUCTION TO BIG DATA AND ANALYTICS					4 hours
Big Data Overview Characteristics of Big Data Business Intelligence vs Data Analytics.						
Module:2	NEED OF DATA ANALYTICS					4 hours
Data Analytics Life Cycle Data Analytics in Industries Exploring Big data Challenges in handling Big Data.						
Module:3	Big Data Tools					4 hours
Need of Big data tools - understanding distributed systems - Overview of Hadoop comparing SQL databases and Hadoop Hadoop Eco System - Distributed File System: HDFS, Design of HDFS writing files to HDFS Reading files from HDFS.						
Module:4	Hadoop Architecture					6 hours
Hadoop Daemons - Hadoop Cluster Architecture YARN Advantages of YARN.						
Module:5	Introduction to MapReduce					6 hours
Developing MapReduce Program Anatomy of MapReduce Code - Simple Map Reduce Program - counting things Map Phase shuffle and sort - Reduce Phase Master slave architecture Job Processing in hadoop Map Reduce Pipelining.						
Module:6	MapReduce Programming Concepts					3 hours
Use of Combiner - Block vs Split Size - working with Input and output format Key,Text, Sequence, NLine file format, XML file format.						
Module:7	Inverted Indexing and Graph Analytics					3 hours
Web crawling inverted index Baseline and revised implementation - Graph Representation Parallel						

Breadth first search page rank issues with graph processing.			
		Total Lecture hours:	30 hours
Text Book(s)			
1.	Tom White, Hadoop The Definitive Guide, O'Reilly, 4th Edition, 2015.		
Reference Books			
1.	Alex Holmes, Hadoop in Practice, Manning Shelter Island, 2012.		
2.	Chuck Lam, Hadoop in Action. Manning Shelter Island, 2011.		
3.	Jimmy Lin and Chris Dyer, Data-Intensive Text Processing with MapReduce, 2010.		
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 hours
2.	Counting things using MapReduce		2 hours
3.	Command line interface with HDFS		2 hours
4.	MapReduce Program to show the need of Combiner		2 hours
5.	MapReduce I/O Formats key- value, text		2 hours
6.	MapReduce I/O Formats Nline		2 hours
7.	Multiline I/O.		2 hours
8.	Parallel Breadth First Search.		2 hours
9.	Sequence file Input / Output Formats		2 hours
10.	Baseline Inverted Indexing using MapReduce		2 hours
11.	Revised Inverted Indexing using MapReduce		2 hours
12.	Matrix Factorization using MapReduce		4 hours
13.	Video Processing using MapReduce		2 hours
14.	BioInformatics (Protien/Gene Sequence etc) processing with MapReduce		2 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

CSE3029	GAME PROGRAMMING				L	T	P	J	C	
					2	0	2	4	4	
Pre-requisite	Nil				Syllabus version					
					v. 1.0					
Course Objectives:										
<ol style="list-style-type: none"> To provide an in-depth introduction to technologies and techniques used in the game industry. To recognize the processes, mechanics, issues in game design and game engine development. To integrate various technologies such as multimedia, artificial intelligence and physics engine into a cohesive, interactive game application. 										
Expected Course Outcome: Upon Completion of the course, the students will be able to										
<ol style="list-style-type: none"> Identify the human roles involved in the game industry and describe their responsibilities. Create and produce digital components, games and documentation using a variety of Game Engines. Design the graphics based games and learn to manage the graphics devices. Construct the game using artificial intelligence and physics based modeling. Create various types of games with different types of modes and perspectives. Develop, test, and evaluate procedures of the creation, design and development of games. Design unique gaming environments, levels and characters. 										
Student Learning Outcomes (SLO): 5,6,18										
5. Having design thinking capability										
6. Having an ability to design a component or a product applying all the relevant standards and with realistic constraints										
18. Having critical thinking and innovative skills										
Module:1	Introduction to Game Programming				1 hours					
Overview of game programming, game industry										
Module:2	Game Engine Architecture				5 hours					
Engine Support, Resource Management, Real Time Game Architecture,										
Module:3	Graphics				6 hours					
Graphics Device Management, Tile-Based Graphics and Scrolling, GUI programming for games,										
Module:4	Artificial Intelligence and Physics				6 hours					
Artificial Intelligence in games, Physics based modeling, Path finding algorithms, Collision detection										
Module:5	Game design				8 hours					
Game design, Differing game types, modes, and perspectives, scripting, audio engineering, Sound and Music, level design, render threading										
Module:6	Project management				3 hours					
Game project management, Game design documentation, Rapid prototyping and game testing										
Module:7	Recent Trends				1 hours					
	Total Lecture hours:				30 hours					
Text Book(s)										
1.	Game Engine Architecture, 2nd Edition, Jason Gregory, A K Peters, 2014 ISBN 9781466560017									
Reference Books										

1.	Best of Game Programming Gems, Mark DeLoura, Course Technology, Cengage Learning, 2014, ISBN10:1305259785
2.	Rules of Play: Game Design Fundamentals, Katie Salen and Eric Zimmerman, MIT Press, 2003, ISBN 0-262-24045-9
3.	Real-Time Collision Detection, Christer Ericson, Morgan Kaufmann, 2005, ISBN 9781558607323
4.	XNA Game Studio 4.0 Programming. Tom Miller and Dean Johnson, Addison-Wesley Professional, 2010 ISBN-10:0672333457
5.	Introduction to Game Development, Second Edition, Steve Rabin, Charles River Media; 2009 ISBN-10: 1584506792
6.	Game Coding Complete, Mike McShaffry and David Graham, Fourth Edition, 2012 Cengage Learning PTR, ISBN-10: 1133776574
7.	Beginning Game Programming, Jonathan S. Harbour, Cengage Learning PTR; 4th edition, 2014, ISBN-10: 1305258959
8.	Fundamentals of Game Design, 3rd Edition, Ernest Adams, New Riders; 2013 ISBN-10: 0321929675
9.	Game Design Foundations, Second Edition, Roger E. Pedersen, Jones & Bartlett Learning; 2009, ISBN-10: 1598220349
10.	Level Up! The Guide to Great Video Game Design, 2nd Edition, Scott Rogers, Wiley 2014, ISBN: 978-1-118-87716-6

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

List of Challenging Experiments (Indicative)

1.	Game development using game engines such as Unity	2 hours
2.	Analyze a game and describe it in terms of its core elements	2 hours
3.	Development of 2D games	2 hours
4.	Development of 3D games	4 hours
5.	Analyze the game mechanics of a given game and design the game mechanics of a new game	2 hours
6.	Understand collision detection in games	2 hours
7.	Understand physics simulation in games	2 hours
8.	Understand UI design in games	2 hours
9.	Write a game design document	2 hours
10.	Explore the role of AI in games	4 hours
11.	Scripting with Lua	2 hours
12.	Practice programming techniques and discuss the benefits and challenges of using different languages such as Python, C++, C, Java, etc	2 hours
13.	Students may use platforms such as Windows platform, DirectX SDK for rendering, APIs such as Lua scripting language, Box2D Physics Engine, tools such as Visual Studio IDE for software development, Tiled for map editing, RUBE for Box2D level editing, Gimp for sprite sheet creation, Audacity for sound recording and editing.	2 hours

Total Laboratory Hours	30 hours
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Mode of evaluation:

Recommended by Board of Studies	04-04-2014
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Approved by Academic Council	No. 37	Date	16-06-2015
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CSE4003	CYBER SECURITY			L	T	P	J	C
				3	0	0	4	4
Pre-requisite	Nil	Syllabus version						
		v1.0						
Course Objectives:								
1. To learn the concepts of number theory, cryptographic techniques.								
2. To understand integrity and authentication process.								
3. To familiarize various cyber threats, attacks, vulnerabilities, defensive mechanisms, security policies and practices.								
Expected Course Outcome:								
1. Know the fundamental mathematical concepts related to security.								
2. Implement the cryptographic techniques to real time applications.								
3. Comprehend the authenticated process and integrity, and its implementation								
4. Know fundamentals of cybercrimes and the cyber offenses.								
5. Realize the cyber threats, attacks, vulnerabilities and its defensive mechanism.								
6. Design suitable security policies for the given requirements.								
7. Exploring the industry practices and tools to be on par with the recent trends								
Student Learning Outcomes (SLO):				1,5,9				
1. Having an ability to apply mathematics and science in engineering applications								
5. Having design thinking capability								
9. Having problem solving ability- solving social issues and engineering problems								
Module:1	Introduction to Number Theory						6 hours	
Finite Fields and Number Theory: Modular arithmetic, Euclidian Algorithm, Primality Testing: Fermats and Eulers theorem, Chinese Remainder theorem, Discrete Logarithms								
Module:2	Cryptographic Techniques						9 hours	
Symmetric key cryptographic techniques: Introduction to Stream cipher, Block cipher: DES, AES,IDEA Asymmetric key cryptographic techniques: principles,RSA,ElGamal,Elliptic Curve cryptography, Key distribution and Key exchange protocols.								
Module:3	Integrity and Authentication						5 hours	
Hash functions,Secure Hash Algorithm (SHA)Message Authentication, Message Authentica- tion Code (MAC), Digital Signature Algorithm : RSA ElGamal based								
Module:4	Cybercrimes and cyber offenses						7 hours	
Classification of cybercrimes, planning of attacks, social engineering:Human based, Computer based: Cyberstalking, Cybercafe and Cybercrimes								
Module:5	Cyber Threats, Attacks and Prevention						9 hours	
Phishing, Password cracking, Keyloggers and Spywares, DoS and DDoS attacks, SQL Injection Identity Theft (ID) : Types of identity theft, Techniques of ID theft								
Module:6	Cybersecurity Policies and Practices						7 hours	
What security policies are: determining the policy needs, writing security policies, Internet and email security policies, Compliance and Enforcement of policies, Review								
Module:7	Recent Trends						2 hours	
				Total Lecture hours:		45 hours		
Text Book(s)								
1.	Cryptography and Network security, William Stallings, Pearson Education, 7th Edition,							

	2016		
2	Cyber Security, Understanding cyber crimes, computer forensics and legal perspectives, Nina Godbole, Sunit Belapure, Wiley Publications, Reprint 2016		
3	Writing Information Security Policies, Scott Barman, New Riders Publications, 2002		
Reference Books			
1.	Cybersecurity for Dummies, Brian Underdahl, Wiley, 2011		
2.	Cryptography and Network security, Behrouz A. Forouzan, Debdeep Mukhopadhyay, McGraw Hill Education, 2 nd Edition, 2011		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		04-04-2014	
Approved by Academic Council		No. 37	Date 16-06-2015

CSE4004	DIGITAL FORENSICS				L	T	P	J	C
					3	0	2	0	4
Pre-requisite	Nil				Syllabus version				
					v1.0				
Course Objectives:									
1. To learn about examination, preventing and fighting digital crimes 2. To model about data acquisition and storing digital evidence 3. To explore operating system file structure, file system and mobile device forensics and its acquisition procedures									
Expected Course Outcome:									
1. Infer the role of a Computer forensics profession for investigation. 2. Summarize the requirements for use of data acquisition. 3. Identify the need of Process crime and Incident scenes for digital evidence. 4. Choose suitable data Recover techniques in windows environment. 5. Analyze various validation techniques of forensics data. 6. Experiment with current computer forensics hardware and software tools for E-mail investigation and mobile device forensics. 7. Prioritize the challenges associated with real time forensics applications/tools.									
Student Learning Outcomes (SLO): 2,4,5,9									
2.Having a clear understanding of the subject related concepts and of contemporary issues 4.Having Sense-Making Skills of creating unique insights in what is being seen or observed 5.Having design thinking capability 9.Having problem solving ability- solving social issues and engineering problems									
Module:1	Computer Forensics and Investigation				6 hours				
Understanding computer forensics, Preparing for Computer Investigations, Corporate High Tech Investigation									
Module:2	Data Acquisition and Recovery				6 hours				
Storage formats, Using acquisition tools, Data Recovery: RAID Data acquisition.									
Module:3	Processing Crime and Incident Scene				8 hours				
Identifying and collecting evidence, Preparation for search, Seizing and Storing Digital evidence									
Module:4	Computer Forensics tools (Encase) and Windows Operating System				8 hours				
Understanding file structure and file system, NTFS disks, Disk Encryption and Registry Manipulation. Computer Forensics software and hardware tools									
Module:5	Computer Forensics Analysis and Validation				7 hours				
Data collection and analysis, validation of forensics data, Addressing – data hiding technique									
Module:6	Email Investigation and Mobile device Forensics				6 hours				
Investigation e-mail crimes and Violations, Using specialized E-mail forensics tools. Understanding mobile device forensics and Acquisition procedures.									
Module:7	Role of Digital Forensics in Real time applications				2 hours				
SANS SIFT Investigative tool, PRO Discover Basic, Volatility, Sleuth Kit, CAINE investigative environment									
Module:8	Industry Trends				2 hours				

		Total Lecture hours: 45 hours	
Text Book(s)			
1.	Bill Nelson, Amelia Philips, Christopher Steuart, Guide to Computer Forensics and Investigations, Fourth Edition, Cengage Learning, 2016		
Reference Books			
1.	David Lilburn Watson, Andrew Jones, Digital Forensics Processing and Procedures, Syngress, 2013.		
2.	Cory Altheide, Harlan Carvey, Digital Forensics with Open Source Tools, British Library Cataloguing-in-Publication Data, 2011		
3.	Greg Gogolin, Digital Forensics Explained, CRC Press, 2013.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	Computer Forensics Investigation Process	2 Hours	
2.	Computer Forensics Lab	2 Hours	
3.	Understanding Hard Disks and File Systems	3 Hours	
4.	Windows Forensics	2 Hours	
5.	Data Acquisition and Duplication	3 Hours	
6.	Recovering Files and Partitions	2 Hours	
7.	Forensics Investigation Using Encase	2 Hours	
8.	Stenography and Image file Forensics	2 Hours	
9.	Application Password Cracker	2 Hours	
10.	Log Capturing and Event Correlation	2 Hours	
11.	Network Forensics, Investigating log and Network Traffic	2 Hours	
12.	Tracking and Investigating Email Crimes	3 Hours	
13.	Mobile Forensics	3 Hours	
Total Laboratory Hours			30 Hours
Mode of assessment: Project/Activity			
Recommended by Board of Studies		28-02-2017	
Approved by Academic Council		No. 46	Date 24-08-2017

CSE4011	VIRTUALIZATION				L	T	P	J	C
					3	0	0	4	4
Pre-requisite	Nil	Syllabus version							
		v1.0							
Course Objectives:									
1. To identify and select suitable hypervisor for a cloud environment.									
2. To acquire the knowledge of various virtualization techniques and tools.									
3. To understand the process of data center automation and secure virtualized environment.									
Expected Course Outcome:									
1. Illustrate the process of virtualization.									
2. Create and configure the hypervisors in cloud.									
3. Apply the virtualization concepts in server and manage the storage capacity.									
4. Analyze, identify and select suitable type of virtualization.									
5. Use the management tools for managing the virtualized cloud infrastructure.									
6. Apply suitable automation and security methods on data centre									
Student Learning Outcomes (SLO): 9,11,14,17									
9. Having problem solving ability- solving social issues and engineering problems									
11. Having interest in lifelong learning									
14. Having an ability to design and conduct experiments, as well as to analyze and interpret data									
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice									
Module:1	INTRODUCTION							4 hours	
Virtualization definition – virtual machine basics – benefits – need for virtualization – limitations – traditional vs. contemporary virtualization process – virtual machines – taxonomy – challenges.									
Module:2	HYPERVISORS							7 hours	
Introduction to Hypervisors – Type 1 Hypervisors – Type 2 Hypervisors – comparing hypervisors – virtualization considerations for cloud providers.									
Module:3	HARDWARE VIRTUALIZATION							7 hours	
Full virtualization - para virtualization - server virtualization - OS level virtualization - emulation – binary translation techniques – managing storage for virtual machines.									
Module:4	TYPES OF VIRTUALIZATION							8 hours	
Application virtualization - desktop virtualization - network virtualization - storage virtualization - comparing virtualization approaches.									
Module:5	VIRTUALIZATION MANAGEMENT							6 hours	
Management life cycle - managing heterogeneous virtualization environment – customized and modifying virtual machines – virtual machine monitoring – management tools.									
Module:6	AUTOMATION							6 hours	
Benefits of data center automation – virtualization for autonomic service provisioning – software defined data center - backup - disaster recovery.									
Module:7	SECURITY							5 hours	
Mapping Design (Models) to Code – Testing - Usability – Deployment – Configuration Management – Maintenance									
Module:8	RECENT TRENDS							2 hours	

	Total Lecture hours:	45 hours	
Text Book(s)			
1.	Nelson Ruest, Danielle Ruest, Virtualization, A beginners guide, 2009, MGH.		
2.	Nadeau, Tim Cerng, Je Buller, Chuck Enstall, Richard Ruiz, Mastering Microsoft Virtualization, Wiley Publication, 2010.		
Reference Books			
1.	William Von Hagen, Professional Xen Virtualization, Wiley Publication, 2008.		
2.	Matthew Portney, Virtualization Essentials, John Wiley & Sons, 2012.		
3.	Dave Shackelford, Virtualization security, protecting virtualized environment, John Wiley, 2012.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies			
Approved by Academic Council		Date	

CSE4014	HIGH PERFORMANCE COMPUTING				L	T	P	J	C
		3	0	0	4	4			
Pre-requisite	Nil	Syllabus version							
		v1.0							
Course Objectives:									
<ol style="list-style-type: none"> To provide knowledge on high performance computing concepts to the students. To comprehend the students how to analyze the parallel programming through OpenMP, MPI, CUDA. To teach the student how to apply job management techniques and evaluate the performance. 									
Expected Course Outcome:									
<ol style="list-style-type: none"> To knowledge the overview and analyze the performance metrics of high performance computing. To comprehend the various High Performance Computing Paradigms and Job Management Systems. To design and develop various applications with OpenMP, MPI and CUDA. To analyze the benchmarks of high performance computing. To demonstrate the various emerging trends of high performance computing. To apply high performance computing concepts in problem solving. 									
Student Learning Outcomes (SLO):		2, 11, 17							
2. Having a clear understanding of the subject related concepts and of contemporary issues									
11. Having interest in lifelong learning									
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice									
Module:1	Introduction to High Performance Computing (HPC)				4 hours				
Overview of Parallel Computers and high performance computing (HPC), History of HPC, Numerical and HPC libraries, Performance metrics.									
Module:2	HPC Paradigms				6 hours				
Supercomputing, Cluster Computing, Grid Computing, Cloud Computing, Many core Computing, Petascale Systems									
Module:3	Parallel Programming - I				7 hours				
Introduction to OpenMP, Parallel constructs, Runtime Library routines, Work-sharing constructs, Scheduling clauses, Data environment clauses, atomic, master Nowait Clause, Barrier Construct, overview of MPI, MPI Constructs, OpenMP vs MPI.									
Module:4	Job Management Systems				8 hours				
Batch scheduling: Condor, Slurm, SGE, PBS, Light weight Task Scheduling: Falcon, Sparrow									
Module:5	Parallel Programming - II				7 hours				
Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplication in CUDA, CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features									
Module:6	Achieving Performance				6 hours				
Measuring performance, Identifying performance bottlenecks, Partitioning applications for heterogeneous resources, Using existing libraries and frameworks									
Module:7	HPC Benchmarks				5 hours				
HTC, MTC (Many Task Computing), Top 500 Super computers in the world, Top 10 Super Computer architectural details, Exploring HPC Bechmarks: HPL, Stream.									
Module:8	Recent Trends				2 hours				

		Total Lecture hours: 45 hours	
Text Book(s)			
1.	Victor Eijkhout, Edmond Chow, Robert van de Geijn, Introduction to High Performance Scientific Computing, 2nd edition, revision 2016		
2.	Rob Farber, CUDA Application Design and Development, Morgan Kaufmann Publishers, 2013		
Reference Books			
1.	Zbigniew J. Czech, Introduction to parallel computing, 2nd edition, Cambridge University Press, 2016		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		04-04-2014	
Approved by Academic Council		No. 37	Date 16-06-2015

CSE4015	HUMAN COMPUTER INTERACTION				L	T	P	J	C
					3	0	0	4	4
Pre-requisite	Nil				Syllabus version				
					v. 1.0				
Course Objectives:									
<ol style="list-style-type: none"> To provide the basic knowledge on the levels of interaction, design models, techniques and validations focusing on the different aspects of human-computer interface and interactions To make the learners to think in design perspective and to evaluate interactive design To use the concepts and principles of HCI to analyze and propose solution for real life applications To become familiar with recent technology trends and challenges in HCI domain 									
Expected Course Outcome:									
<ol style="list-style-type: none"> Enumerate the basic concepts of human, computer interactions Create the processes of human computer interaction life cycle Analyze and design the various interaction design models Apply the interface design standards/guidelines for evaluating the developed interactions Establish the different levels of communication across the application stakeholders Apply product usability evaluations and testing methods Demonstrate the principles of human computer interactions through the prototype modelling 									
Student Learning Outcomes (SLO): 5, 8, 17									
5. Having design thinking capability 8. Having virtual collaborating ability 17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice									
Module:1	HCI FOUNDATIONS				6 hours				
Input-output channels, Human memory, Thinking: reasoning and problem solving, Emotion, Individual differences, Psychology and the design of interactive systems, Text entry devices, Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Paper: printing and scanning									
Module:2	DESIGNING INTERACTION				6 hours				
Overview of Interaction Design Models, Discovery - Framework, Collection - Observation, Elicitation, Interpretation - Task Analysis, Storyboarding, Use Cases, Primary Stakeholder Profiles, Project Management Document									
Module:3	INTERACTION DESIGN MODELS				8 hours				
Model Human Processor - Working Memory, Long-Term Memory, Processor Timing, Keyboard Level Model - Operators, Encoding Methods, Heuristics for M Operator Placement, What the Keyboard Level Model Does Not Model, Application of the Keyboard Level Model, GOMS - CMN-GOMS Analysis, Modeling Structure, State Transition Networks - Three-State Model, Glimpse Model, Physical Models, Fitts' Law									
Module:4	GUIDE LINES IN HCI				6 hours				
Shneiderman's eight golden rules, Norman's Seven principles, Norman's model of interaction, Nielsen's ten heuristics, Heuristic evaluation, contextual evaluation, Cognitive walk-through									
Module:5	COLLABORATION AND COMMUNICATION				5 hours				
Face-to-face Communication, Conversation, Text-based Communication, Group working, Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design									
Module:6	HUMAN FACTORS AND SECURITY				6 hours				

Groupware, Meeting and decision support systems, Shared applications and artifacts, Frameworks for groupware Implementing synchronous groupware, Mixed, Augmented and Virtual Reality			
Module:7	VALIDATION AND ADVANCED CONCEPTS	6 hours	
Validations - Usability testing, Interface Testing, User Acceptance Testing Past and future of HCI: the past, present and future, perceptual interfaces, context-awareness and perception			
Module:8	RECENT TRENDS	2 hours	
Total Lecture hours:		45 hours	
Text Book(s)			
1.	A Dix, Janet Finlay, G D Abowd, R Beale., Human-Computer Interaction, 3rd Edition, Pearson Publishers,2008		
Reference Books			
1.	Shneiderman, Plaisant, Cohen and Jacobs, Designing the User Interface: Strategies for Effective Human Computer Interaction, 5th Edition, Pearson Publishers, 2010.		
2	Hans-Jorg Bullinger," Human-Computer Interaction", Lawrence Erlbaum Associates, Publishers		
3	Jakob Nielsen," Advances in Human-computer Interaction",Ablex Publishing Corporation		
4	Thomas S. Huang," Real-Time Vision for Human-Computer Interaction", Springer		
5	Preece et al, Human-Computer Interaction, Addison-Wesley, 1994		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		04-04-2014	
Approved by Academic Council		No. 37	Date 16-06-2015

CSE4019	IMAGE PROCESSING				L	T	P	J	C
					3	0	0	4	4
Pre-requisite	Nil	Syllabus version							
		v1.0							
Course Objectives:									
<ol style="list-style-type: none"> 1. To provide the basic knowledge on image processing concepts. 2. To develop the ability to apprehend and implement various image processing algorithms. 3. To facilitate the students to comprehend the contextual need pertaining to various image processing applications. 									
Expected Course Outcome:									
<ol style="list-style-type: none"> 1. Ascertain and describe the basics of image processing concepts through mathematical interpretation. 2. Acquire the knowledge of various image transforms and image enhancement techniques involved. 3. Demonstrate image restoration process and its respective filters required. 4. Experiment the various image segmentation and morphological operations for a meaningful partition of objects. 5. Design the various basic feature extraction and selection procedures and illustrate the various image compression techniques and their applications. 6. Analyze and implement image processing algorithms for various real-time applications. 									
Student Learning Outcomes (SLO): 1,9,18									
<ol style="list-style-type: none"> 1. Having an ability to apply mathematics and science in engineering applications. 9. Having problem solving ability- solving social issues and engineering problems. 18. Having critical thinking and innovative skills. 									
Module:1	Introduction - Digital Image, its Representation							6 hours	
Image Representation and Image Processing Paradigm - Elements of digital image processing- Image model. Sampling and quantization-Relationships between pixels- Connectivity, Distance Measures between pixels - Color image (overview, various color models)-Various image formats bmp, jpeg, tiff, png, gif, etc.									
Module:2	Digital Image Properties - Operations on Digital Images							6 hours	
Topological Properties of Digital Images-Histograms, Entropy, Eigen Values-Image Quality Metrics- Noise in Images Sources, types. Arithmetic operations - Addition, Subtraction, Multi- plication, Division-Logical operations NOT, OR, AND, XOR-Set operators-Spatial operations Single pixel, neighbourhood, geometric-Contrast Stretching-Intensity slicing-Bit plane slicing Power Law transforms									
Module:3	Image Enhancement							6 hours	
Spatial and Frequency domain-Histogram processing-Spatial filtering-Smoothering spatial filters- Sharpening spatial filters- Discrete Fourier Transform-Discrete Cosine Transform-Haar Trans- form -Hough Transform-Frequency filtering-Smoothering frequency filters-Sharpening frequency filters- Selective filtering.									
Module:4	Digital Image Restoration- Digital Image Registration							7 hours	
Noise models - Degradation models-Methods to estimate the degradation-Image de-blurring- Restoration in the presence of noise only spatial filtering-Periodic noise reduction by frequency domain filtering-Inverse filtering-Wiener Filtering. Geometrical transformation-Point based methods- Surface based methods-Intensity based methods									

Module:5	Feature Extraction	6 hours	
Region of interest (ROI) selection - Feature extraction: Histogram based features - Intensity features-Color, Shape features-Contour extraction and representation-Homogenous region extraction and representation-Texture descriptors - Feature Selection: Principal Component Analysis (PCA).			
Module:6	Image Segmentation- Morphological Image Processing	6 hours	
Discontinuity detection-Edge linking and boundary detection. Thresholding-Region oriented segmentation- Histogram based segmentation.Object recognition based on shape descriptors. Dilation and Erosion-Opening and Closing-Medial axis transforms-Objects skeletons-Thinning boundaries.			
Module:7	Image Coding and Compression	6 hours	
Lossless compression versus lossy compression-Measures of the compression efficiency- Huffman coding-Bitplane coding-Shift codes-Block Truncation coding-Arithmetic coding-Predictive coding techniques-Lossy compression algorithm using the 2-D. DCT transform-The JPEG 2000 standard Baseline lossy JPEG, based on DWT.			
Module:8	Recent Trends	2 hours	
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, Third Ed., Prentice-Hall, 2008.		
Reference Books			
1.	William K. Pratt, Digital Image Processing, John Wiley, 4th Edition, 2007		
2.	Anil K. Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 1997		
3.	Sonka, Fitzpatrick, Medical Image Processing and Analysis, 1st Edition, SPIE,2000.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies		04-04-2014	
Approved by Academic Council		No. 37	Date 16-06-2015

CSE4020	MACHINE LEARNING			L	T	P	J	C
				2	0	2	4	4
Pre-requisite	Nil			Syllabus version				
				v1.0				
Course Objectives:								
1. Ability to comprehend the concept of supervised and unsupervised learning techniques 2. Differentiate regression, classification and clustering techniques and to implement their algorithms. 3. To analyze the performance of various machine learning techniques and to select appropriate features for training machine learning algorithms.								
Expected Course Outcome:								
1. Recognize the characteristics of machine learning that makes it useful to solve real-world problems. 2. Provide solution for classification and regression approaches in real-world applications. 3. Gain knowledge to combine machine learning models to achieve better results. 4. Choose an appropriate clustering technique to solve real world problems. 5. Realize methods to reduce the dimension of the dataset used in machine learning algorithms. 6. Choose a suitable machine learning model, implement and examine the performance of the chosen model for a given real world problems. 7. Understand cutting edge technologies related to machine learning applications.								
Student Learning Outcomes (SLO):				5,7,9				
5. Having design thinking capability 7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning) 9. Having problem solving ability - solving social issues and engineering problems								
Module:1	Introduction to Machine Learning			3 hours				
What is Machine Learning, Examples of Various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces, PAC Learning								
Module:2	Supervised Learning - I			4 hours				
Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Generalization error bounds: VC Dimension, Decision Trees: ID3, Classification and Regression Trees, Regression: Linear Regression, Multiple Linear Regression, Logistic Regression.								
Module:3	Supervised Learning - II			5 hours				
Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K-Nearest Neighbors								
Module:4	Ensemble Learning			3 hours				
Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking								
Module:5	Unsupervised Learning - I			7 hours				
Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional : K-means clustering, K-Mode Clustering, Self-Organizing Map, Expectation Maximization, Gaussian Mixture Models								
Module:6	Unsupervised Learning - II			3 hours				
Principal components analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis								
Module:7	Machine Learning in Practice			3 hours				
Machine Learning in Practice Design, Analysis and Evaluation of Machine Learning Experiments,								

Feature selection Mechanisms, Other Issues: Imbalanced data, Missing Values, Outliers			
Module:8	Recent Trends	2 hours	
Industry Expert talk			
		Total Lecture hours:	30 hours
Text Book(s)			
1.	Ethem Alpaydin, Introduction to Machine Learning , MIT Press, Prentice Hall of India, Third Edition 2014		
Reference Books			
1.	Sergios Theodoridis, Konstantinos Koutroumbas, Pattern Recognition, Academic Press, 4th edition, 2008, ISBN:9781597492720.		
2.	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning, MIT Press, 2012		
3.	Tom Mitchell, Machine Learning, McGraw Hill, 3rd Edition,1997.		
4.	Charu C. Aggarwal, Data Classification Algorithms and Applications , CRC Press, 2014		
5.	Charu C. Aggarwal, DATA CLUSTERING Algorithms and Applications, CRC Press, 2014		
6.	Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	Implement Decision Tree learning.	2 hours	
2.	Implement Logistic Regression.	2 hours	
3.	Implement classification using Multilayer perceptron.	2 hours	
4.	Implement classification using SVM	2 hours	
5.	Implement Adaboost	2 hours	
6.	Implement Bagging using Random Forests	2 hours	
7.	Implement K-means Clustering to Find Natural Patterns in Data.	2 hours	
8.	Implement Hierarchical clustering.	2 hours	
9.	Implement K-mode clustering	2 hours	
10	Implement Principle Component Analysis for Dimensionality Reduction.	2 hours	
11	Implement Multiple Correspondence Analysis for Dimensionality Reduction.	2 hours	
12	Implement Gaussian Mixture Model Using the Expectation Maximization.	2 hours	
13	Evaluating ML algorithm with balanced and unbalanced datasets.	2 hours	
14	Comparison of Machine Learning algorithms.	2 hours	
15.	Implement k-nearest neighbors algorithm	2 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

CSE 4022	NATURAL LANGUAGE PROCESSING				L	T	P	J	C
					3	0	0	4	4
Pre-requisite	Nil				Syllabus version				
					v1.0				
Course Objectives:									
<ol style="list-style-type: none"> 1. To introduce the fundamental concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS. 2. To examine the NLP models and interpret algorithms for classification of NLP sentences by using both the traditional, symbolic and the more recent statistical approach. 3. To get acquainted with the algorithmic description of the main language levels that includes morphology, syntax, semantics, and pragmatics for information retrieval and machine translation applications. 									
Expected Course Outcome:									
<ol style="list-style-type: none"> 1. Understand the principles and Process the Human Languages Such as English and other Indian Languages using computers. 2. Creating CORPUS linguistics based on digestive approach (Text Corpus method) 3. Demonstrate understanding of state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology. 4. Perform POS tagging for a given natural language. 5. Select a suitable language modelling technique based on the structure of the language. 6. Check the syntactic and semantic correctness of sentences using grammars and labelling. 7. Develop Computational Methods for Real World Applications and explore deep learning based NLP 									
Student Learning Outcomes (SLO): 2,7,17									
<p>2.Having a clear understanding of the subject related concepts and of contemporary issues</p> <p>7.Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning</p> <p>17.Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice</p>									
Module:1	INTRODUCTION TO NLP				3 hours				
Introduction to various levels of natural language processing, Ambiguities and computational challenges in processing various natural languages. Introduction to Real life applications of NLP such as spell and grammar checkers, information extraction, question answering, and machine translation.									
Module:2	TEXT PROCESSING				6 hours				
Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis.									
Module:3	MORPHOLOGY				6 hours				
Inflectional and Derivation Morphology, Morphological Analysis and Generation using finite state transducers.									
Module:4	LEXICAL SYNTAX				6 hours				
Introduction to word types, POS Tagging, Maximum Entropy Models for POS tagging, Multi-word Expressions.									
Module:5	LANGUAGE MODELING				6 hours				
The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models.									
Module:6	SYNTAX & SEMANTICS				10 hours				

Introduction to phrases, clauses and sentence structure, Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, Word Sense Disambiguation, WordNet, Thematic Roles, Semantic Role Labelling with CRFs.			
Module:7	APPLICATIONS OF NLP	6 hours	
NL Interfaces, Text Summarization, Sentiment Analysis, Machine Translation, Question answering.			
Module:8	RECENT TRENDS	2 hours	
Recent Trends in NLP			
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Daniel Jurafsky and James H. Martin “Speech and Language Processing”, 3rd edition, Prentice Hall, 2009.		
Reference Books			
1.	Chris Manning and HinrichSchütze, “Foundations of Statistical Natural Language Processing”, 2nd edition, MITPress Cambridge, MA, 2003.		
2.	NitinIndurkha, Fred J. Damerau “Handbook of Natural Language Processing”, Second Edition, CRC Press, 2010.		
3.	James Allen “Natural Language Understanding”, Pearson Publication 8th Edition. 2012.		
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).			
Recommended by Board of Studies		04-04-2014	
Approved by Academic Council		No. 37	Date 16-06-2015

CSE4027	MOBILE PROGRAMMING		L	T	P	J	C
			2	0	2	4	4
Pre-requisite	Nil	Syllabus version					
		v. 1.0					
Course Objectives:							
1. Students able to learn to write both web apps and native apps for Android using Eclipse and the Android SDK, to write native apps for iPhones, iPod Touches, and iPads using Xcode and the iOS SDK, and to write web apps for both platforms. The course also touches on Windows 8 application programming, so as to provide students with a stepping stone for application development in the mobile operating system of their choice. Additional topics covered include application deployment and availability on the corresponding app stores and markets, application security, efficient power management, and mobile device security							
Expected Course Outcome:							
1.Exposed to technology and business trends impacting mobile applications. 2.Competent with the characterization and architecture of mobile applications. 3.Competent with designing and developing mobile applications using one application development framework.							
Student Learning Outcomes (SLO):		1,6,10,15					
1. Having a clear understanding of the subject related concepts and of contemporary issues 6.Having an ability to design a component or a product applying all the relevant standards and with realistic constraints 10.Having a clear understanding of professional and ethical responsibility 15.Having an ability to use the social media effectively for productive use							
Module:1	Introduction to Mobile Devices	4 hours					
Mobile vs.desktop devices and architecture -Power Management-Screen resolution -Touch interfaces -Application deployment -App Store, Google Play, Windows Store -Development environments-XCode- Eclipse -VS2012-PhoneGAP-Native vs. web applications							
Module:2	HTML5/JS/CSS3	4 hours					
Quick recap of technologies -Mobile-specific enhancements -Browser- detection-Touch interfaces - Geolocation -Screen orientation-Mobile browser “interpretations”(Chrome/Safari/Gecko/IE)- Case studies().							
Module:3	Mobile OS Architecture	3 hours					
Comparing and Contrasting architectures of all three – Android, iOS and Windows-Underlying OS (Darwin vs. Linux vs. Win 8) -Kernel structure and native level programming -Runtime (Objective-C vs. Dalvik vsWinRT) -Approaches to power management - Security							
Module:4	Android/iOS/Win 8 Survival and basic	3 hours					
Building Application(iOS, Window, Android).- App structure, built-in Controls, file access, basic graphics Android/iOS/Win8 inbuilt APP- DB access, network access, contacts/photos							
Module:5	Underneath the frameworks	4 hours					
Native level programming on Android -Low-level programming on (jailbroken) iOS-Windows low level APIs							
Module:6	Power Management	4 hours					
Wake locks and assertions -Low-level OS support -Writing power-smart applications							
Module:7	Augmented Reality(AR) and Mobile Security	6 hours					

Web and AR-User interface-Mobile AR-evaluation of AR- standardization-GPS-Accelerometer - Camera -Mobile malware -Device protections - Mobile Security - overview of the current mobile threat landscape-An assessment of your current mobile security solution- complete analysis of your current risks- Recommendations on how to secure your company's mobile devices from advanced threats and targeted attacks		
Module:8	Recent Trends	2 hours
Industry Expert talk		
	Total Lecture hours:	30 hours
Text Book(s)		
1.	Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, Android SDK3 for Dummies,Wiley 2011.	
Reference Books		
1.	Valentino Lee, Heather Schneider, and Robbie Schell, Mobile Applications: Architecture, Design, and Development , Prentice Hall , 2004.	
2.	Brian Fling,Mobile Design and Development O'Reilly Media,2009	
3.	Maximiliano Firtman Programming the Mobile Web , O'Reilly Media, 2010.	
4.	Christian Crumlish and Erin Malone Designing Social Interfaces, O'Reilly Media , 2009	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	<p>1. Get the HelloVIT midlet on the "getting started" page working.</p> <p>2. Make some changes - e.g. the text of the String item.</p> <p>3. Put in an error - e.g. divide by zero, to see how the development environment attempts to point out on the PC when a runtime error occurs on the phone emulator.</p> <p>4. Get the MIDlet "First MIDlet Progam" in the handout working (ok, so it's really our second MIDlet). Copy the code from the handout.</p> <p>5. Modify the MIDlet by adding these additional items to the form e.g. TextField, DateField, Gauge. Look up the lcdui package to see what Items can be added and the parameters needed..</p> <p>6. You can output to the PC console while the program is running e.g. place this code in the constructor:</p> <p><i>System.out.println("in Constructor"); // This will ouput on the PC console, not on the phone</i></p> <p>7. Now add <i>:System.out.println("in CommandAction method");</i> to the Command Action method to see when that method is running.</p> <p>8. Add more<i>System.out.println's</i>in the following methods:</p> <ol style="list-style-type: none"> startApp pauseApp destroyApp <p>9. Note the sequence of method calls from MIDlet start to end.</p>	4 Hours
2	<p>First MIDlet - adding a new command</p> <ol style="list-style-type: none"> Continue to add to 2.0 First MIDlet by adding an "OK" command (look up the API command class) Have the"OK" command display on the phone's screen. Add code to process the "OK" command In the actionCommand method display the contents of the TextField using System.out.println () Add two more commands e.g. Send, Spell Check. Where were they placed? 	4 Hours

	<p>7. Add code to check for these commands - add System.out.println's to show when that code is being executed.</p> <p>8. Now use System.out.println in the OK processing code and see the text being modified while the program runs.</p> <p>9. Add another System.out.println in the OK to display the value of the gauge (if it's not interactive, go back to the API to see how to make it interactive)</p>	
3	<p>Additon MIDlet</p> <p>1. Create a MIDlet that allows you to enter a number. The number is then added to any previous number and the running total result is displayed. Use a TextBox to receive text from the user (instead of a Form as in the previous example).</p> <p>2. Can you crash the program by entering text instead of numbers? If you can then constrain the user input to numbers only.</p>	4 Hours
4	<p>Additon MIDlet on a real phone</p> <p>1. For the addition MIDlet : Use the IDE to Create a JAR file.</p> <p>2. (Optionally) Transfer the JAR file to your phone and test. See handout on how to create and deploy a JAR file.</p>	4 Hours
5	<p>Battery Status</p> <p>Create an MIDlet that displays a coloured bar to display a car battery's status. The battery voltage is entered into the MIDlet as a floating point number. Display a bar graph as follows: 0-9.5 - Red (battery dead) >9.6 <12 - Yellow (battery poor) >12 <14.4 - Green (battery good) >14.4 - Blue (Alternator faulty)</p>	4 Hours
6	<p>Secret Text</p> <p>Develop an MIDlet that has a TextField and Label GUI components. When a piece of text is entered the MIDlet 'encrypts' the text by replacing each letter using the following mapping:</p> <p>MLKJIHGFEDCBA NOPQRSTUVWXYZ</p> <p>So A -> Z, N-> M, B-> Y, O->L etc</p> <p>Display the encrypted text back in the TextField (so pressing enter should give you back the original text).</p> <p>Display the length of the entered text using the Label.</p> <p>Develop an MIDlet that has a TextField and Label GUI components. When a piece of text is entered the MIDlet 'encrypts' the text by replacing each letter using the following mapping:</p> <p>MLKJIHGFEDCBA NOPQRSTUVWXYZ</p> <p>So A -> Z, N-> M, B-> Y, O->L etc</p> <p>Display the encrypted text back in the TextField (so pressing enter should give you back the original text).</p> <p>Display the length of the entered text using the Label.</p>	5 Hours
7	<p>Missing Letter Game</p> <p>Develop an MIDlet or application that displays a word at random with a random letter(s) missing. The user has to guess the missing letter(s) by entering it/them into a text field(s). You can use an array or vector to store some words internally in the program.</p>	5 hours
Total Laboratory Hours		30 hours
Mode of assessment: Project/Activity		
Recommended by Board of Studies	13-05-2016	
Approved by Academic Council	No. 41	Date 17-06-2016

CSE4028	OBJECT ORIENTED SOFTWARE DEVELOPMENT	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	Nil	Syllabus version				
		V1.0				
Course Objectives (Cobs):						
<p>1. To make the students understand the essential and fundamental aspects of object oriented concepts along with their applications.</p> <p>2.To discuss and explore different analysis models, design and implement models of object-oriented software systems by means of a mid-sized project.</p> <p>3.To teach the students a solid foundation on different software development life cycle of Object-Oriented solutions for Real-World Problems</p>						
Expected Course Outcome (Cos):						
<p>1. Identify and select suitable Process Model for the given problem and have a thorough understanding of various Software Life Cycle models.</p> <p>2. Analyze the requirements of the given software project and produce requirement specifications.</p> <p>3. Apply the knowledge of object-oriented modelling concepts and design methods with a clear emphasis on Unified Modelling Language for a moderately realistic object oriented system.</p> <p>4. Apply various software architectures, including frameworks and design patterns, when developing software projects.</p> <p>5. Evaluate the software project using various Testing techniques.</p> <p>6. Predict the deployment strategy of the software project.</p> <p>7. Recognize the Configuration Management strategies of the software project</p>						
Student Learning Outcomes (SLO): 2,5,12,17						
<p>2. Having a clear understanding of the subject related concepts and of contemporary issues</p> <p>5. Having design thinking capability</p> <p>12. Having adaptive thinking and adaptability</p> <p>17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice</p>						
Module:1	INTRODUCTION TO SOFTWARE DEVELOPMENT	4 hours				
The Challenges of Software Development – An Engineering Perspective – Object-Orientation - Iterative Development Processes						
Module:2	PROCESS MODELS	3 hours				
Life cycle models – Unified Process – Iterative and Incremental – Workflow – Agile Processes						
Module:3	MODELING – OO SYSTEMS	4 hours				
Requirements Elicitation – Use Cases – Unified Modeling Language, Tools						
Module:4	ANALYSIS	4 hours				
Analysis Object Model (Domain Model) – Analysis Dynamic Models – Non-functional requirements – Analysis Patterns.						
Module:5	DESIGN	4 hours				
System Design, Architecture – Design Principles - Design Patterns – Dynamic Object Modeling – Static Object Modeling – Interface Specification – Object Constraint Language						
Module:6	DESIGN PATTERNS	5 hours				
Introduction – Design Patterns in Smalltalk MVC – Describing Design patterns –Catalog of Design Patterns- Organizing the Catalog –How Design Patterns Solve Design Problems – How to select a Design Pattern – How to use a Design Pattern – What makes a pattern? – Pattern Categories – Relationship						

between Patterns – Patterns and Software Architecture			
Module:7	IMPLEMENTATION, DEPLOYMENT AND MAINTENANCE	4 hours	
Mapping Design (Models) to Code – Testing - Usability – Deployment – Configuration Management – Maintenance			
Module:8	RECENT TRENDS	2 hours	
Recent Trends in Object oriented Software Development			
		Total Lecture hours:	30 hours
Text Book(s)			
1.	Carol Britton and Jill Doake, A Student Guide to Object-Oriented Development (Oxford: Elsevier, 2005).		
Reference Books			
1.	Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design patterns: Elements of Reusable object-oriented software”, Addison-Wesley, 1995.		
2.	Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2nd ed, Pearson Education, 2004.		
3.	Ivar Jacobson, Grady Booch, James Rumbaugh, The Unified Software Development Process, Pearson Education, 1999.		
4.	Alistair Cockburn, Agile Software Development 2nd ed, Pearson Education, 2007.		
Mode of Evaluation: CAT 1, CAT 2 & FAT			
List of Challenging Experiments (Indicative)			
	Lab (Indicative List of Experiments (in the areas of)		
	1 Introduction and project definition		3 Hours
	2 Software requirements Specification		3 Hours
	3 Introduction to UML and use case diagrams		3 Hours
	4 System modelling (DFD and ER)		3 Hours
	5 OO analysis: discovering classes		3 Hours
	6 Software Design: software architecture and object oriented design		3 Hours
	7 Flow of events and activity diagram		3 Hours
	8 State Transition Diagram		3 Hours
	9 Component and deployment diagrams		3 Hours
	10 Software testing (RFT,SCM Tools)		3 Hours
			Total Laboratory Hours
			30. Hours
Mode of evaluation: Review 1, Review 2 & FAT			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

UNIVERSITY CORE

CHY1002	Environmental Sciences	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	Chemistry of 12th standard or equivalent	Syllabus version				
		V:1.1				
Course Objectives:						
<ol style="list-style-type: none"> 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:						
<p>Students will be able to</p> <ol style="list-style-type: none"> 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. 						
Student Learning Outcomes (SLO):		1,2,3,4,5,9,11,12				
<ol style="list-style-type: none"> 1) Having an ability to apply mathematics and science in engineering applications 2) Having a clear understanding of the subject related concepts and of contemporary issues 3) Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient) 4) Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified) 5) Having design thinking capability 9) Having problem solving ability- solving social issues and engineering problems 10) Having a clear understanding of professional and ethical responsibility 11) Having interest in lifelong learning 						
Module:1	Environment and Ecosystem	7 hours				
<p>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.</p>						

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, 15 th Edition, Cengage learning.		
2.	George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment – Principles, Connections and Solutions, 17 th 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

Programme Name / Branch : B.Tech. Chemistry : Category : University Core (UC)					
CHY1701	Engineering Chemistry (UC)	L	T	P	J C
		3	0	2	0 4
Pre-requisite	Chemistry of 12 th standard or equivalent	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					
Student Learning Outcomes involved: 1,2,14					
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, 9 th Reprint, 2015. 3. B. Sivasankar, Engineering Chemistry 1 st Edition, Mc Graw Hill Education (India), 2008 4. "Photovoltaic solar energy : From fundamentals to Applications", Angèle Reinders, Pierre Verlinden, Wilfried van Sark, Alexandre Freundlich, Wiley publishers, 2017.	
Reference Books		
2	1. O.V. Roussak and H.D. Gesser, <i>Applied Chemistry-A Text Book for Engineers and Technologists</i> , Springer Science Business Media, New York, 2 nd Edition, 2013. 2. S. S. Dara, <i>A Text book of Engineering Chemistry</i> , S. Chand & Co Ltd., New Delhi, 20 th 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.	Water Quality Monitoring: Assessment of total dissolved oxygen in different water samples by Winkler's method	3 h
3.	Estimation of sulphate/chloride in drinking water by conductivity method	
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	54 th ACM	Date	13-06-2019

Course code	PROBLEM SOLVING AND PROGRAMMING				L	T	P	J	C
CSE1001					0	0	6	0	3
Pre-requisite	NIL				Syllabus version				
					v1.0				
Course Objectives:									
<ol style="list-style-type: none"> 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:									
<ol style="list-style-type: none"> 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 									
Student Learning Outcomes (SLO): 1, 12, 14									
<ol style="list-style-type: none"> 1. Having an ability to apply mathematics and science in engineering applications 12. Having adaptive thinking and adaptability 14. Having an ability to design and conduct experiments, as well as to analyze and interpret data 									
List of Challenging Experiments (Indicative)									
1	Steps in Problem Solving Drawing flowchart using yEd tool/Raptor Tool							4 Hours	
2	Introduction to Python, Demo on IDE, Keywords, Identifiers, I/O Statements							4 Hours	
3	Simple Program to display Hello world in Python							4 Hours	
4	Operators and Expressions in Python							4 Hours	
5	Algorithmic Approach 1: Sequential							4 Hours	
6	Algorithmic Approach 2: Selection (if, elif, if.. else, nested if else)							4 Hours	
7	Algorithmic Approach 3: Iteration (while and for)							6 Hours	
8	Strings and its Operations							6 Hours	
9	Regular Expressions							6 Hours	
10	List and its operations							6 Hours	
11	Dictionaries: operations							6 Hours	
12	Tuples and its operations							6 Hours	
13	Set and its operations							6 Hours	
14	Functions, Recursions							6 Hours	
15	Sorting Techniques (Bubble/Selection/Insertion)							6 Hours	
16	Searching Techniques : Sequential Search and Binary Search							6 Hours	
17	Files and its Operations							6 Hours	
							Total hours:	90 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		

CSE1002	PROBLEM SOLVING AND OBJECT ORIENTED PROGRAMMING	L	T	P	J	C
		0	0	6	0	3
Pre-requisite	Nil	Syllabus version				
		v. 1.0				
Course Objectives:						
1. To emphasize the benefits of object oriented concepts. 2. To enable 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..						
Student Learning Outcomes (SLO):		1,9,17				
1. Having an ability to apply mathematics and science in engineering applications. 9. Having problem solving ability- solving social issues and engineering problems. 17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice.						
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	15 hours				

	<p>A register is a component of a computer processor that can hold any type of data and can be accessed faster. As registers are faster to access, it is desirable to use them to the maximum so that the code execution is faster. For each code submitted to the processor, a register interference graph (RIG) is constructed. In a RIG, a node represents a temporary variable and an edge is added between two nodes (variables) t1 and t2 if they are live simultaneously at some point in the program. During register allocation, two temporaries can be allocated to the same register if there is no edge connecting them. Given a RIG representing the dependencies between variables in a code, implement an algorithm to determine the number of registers required to store the variables and speed up the code execution</p>	
5.	<p>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</p>	15 hours
6.	<p>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.</p>	15 hours
7.	<p>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.</p>	10 hours
Total Laboratory Hours		90 hours
Text Book(s)		
1.	Stanley B Lippman, Josee Lajoie, Barbara E, Moo, C++ primer, Fifth edition, Addison-Wesley, 2012.	
2	Ali Bahrami, Object oriented Systems development, Tata McGraw - Hill Education, 1999.	
3	Brian W. Kernighan, Dennis M. Ritchie , The C programming Language, 2nd edition, Prentice Hall Inc., 1988.	
Reference Books		
1.	Bjarne stroustrup, The C++ programming Language, Addison Wesley, 4th edition, 2013	
2.	Harvey M. Deitel and Paul J. Deitel, C++ How to Program, 7th edition, Prentice Hall, 2010	
3.	Maureen Sprankle and Jim Hubbard, Problem solving and Programming concepts, 9th edition, Pearson Education, 2014.	
Mode of assessment: PAT / CAT / FAT		

Recommended by Board of Studies	29-10-2015		
Approved by Academic Council	No. 39	Date	17-12-2015

CSE3099	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:						
<ol style="list-style-type: none"> 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 						
Student Learning Outcomes (SLO):						
		2, 9, 11, 13, 16				
<ol style="list-style-type: none"> 2. Having a clear understanding of the subject related concepts and of contemporary issues 9. Having problem-solving ability solving social issues and engineering problems 11. Having interest in lifelong learning 13. Having cross-cultural competency exhibited by working in teams 16. Having a good working knowledge of communicating in English 						
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		28-02-2016				
Approved by Academic Council		No. 37	Date	16-06-2015		

CSE3999	Technical Answers for Real World Problems (TARP)	L	T	P	J	C
		1	0	0	8	3
Pre-requisite	PHY1999 and 115 Credits Earned	Syllabus version				
		1.0				
Course Objectives:						
<ul style="list-style-type: none"> To help students to identify the need for developing newer technologies for industrial / societal needs To train students to propose and implement relevant technology for the development of the prototypes / products To make the students learn to the use the methodologies available for analysing the developed prototypes / products 						
Expected Course Outcome:						
At the end of the course, the student will be able to						
<ol style="list-style-type: none"> Identify real life problems related to society Apply appropriate technology(ies) to address the identified problems using engineering principles and arrive at innovative solutions 						
Student Learning Outcomes (SLO): 9, 18						
[9] Having problem-solving ability solving social issues and engineering problems						
[18] Having critical thinking and innovative skills						
Module:1						
						15 hours
<ol style="list-style-type: none"> Identification of real life problems Field visits can be arranged by the faculty concerned 6 – 10 students can form a team (within the same / different discipline) Minimum of eight hours on self-managed team activity Appropriate scientific methodologies to be utilized to solve the identified issue Solution should be in the form of fabrication/coding/modeling/product design/process design/relevant scientific methodology(ies) Consolidated report to be submitted for assessment 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 Project outcome to be evaluated in terms of technical, economical, social, environmental, political and demographic feasibility Contribution of each group member to be assessed 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		28-02-2016				
Approved by Academic Council		No.37	Date	16-06-2015		

CSE4098	Comprehensive Examination				L	T	P	J	C
					0	0	0	0	2
Pre-requisite					Syllabus version				
					1.00				
Student Learning Outcomes (SLO):		2							
[2] Having a clear understanding of the subject related concepts and of contemporary issues									
Digital Logic and Microprocessor									
Simplification of Boolean functions using K-Map – Combinational logic: Adder, subtractor, encoder, decoder, multiplexer, de-multiplexer – Sequential Logic: Flip flops- 8086 Microprocessor: instructions – peripherals: 8255, 8254, 8257.									
Computer Architecture and Organization									
Instructions - Instruction types- Instruction Formats - Addressing Modes- Pipelining- Data Representation - Memory Hierarchy- Cache memory-Virtual Memory- I/O Fundamentals- I/O Techniques - Direct Memory Access - Interrupts-RAID architecture									
Programming, Data Structures and Algorithms									
Programming in C; Algorithm Analysis – Iterative and Recursive Algorithms; ADT - Stack and its Applications - Queue and its Applications; Data Structures – Arrays and Linked Lists; Algorithms - Sorting – Searching; Trees – BST, AVL; Graphs – BFS , DFS , Dijkstra’s Shortest Path Algorithm.									
Theory of Computation									
Deterministic Finite Automata, Non deterministic Finite Automata, Regular Expressions, Context Free Grammar, Push down Automata and Context Free Languages, Turing Machines.									
Web Technologies									
Web Architecture- JavaScript – objects String, date, Array, Regular Expressions, DHTML-HTML DOM Events; Web Server – HTTP- Request/Response model-RESTful methods- State Management – Cookies , Sessions – AJAX.									
Operating Systems									
Processes, Threads, Inter-process communication, CPU scheduling, Concurrency and synchronization, Deadlocks, Memory management and Virtual memory & File systems.									
Database Management System									
DBMS, Schema, catalog, metadata, data independence, pre-compiler; Users-naïve, sophisticated, casual ;ER Model- Entity, attributes, structural constraints; Relational Model-Constraints, Relational Algebra operations; SQL- DDL, DML, TCL, DCL commands, basic queries and Top N queries; Normalization-properties, 1NF, 2NF, 3NF, BCNF; Indexing-different types, Hash Vs B-tree Index; Transaction-problems, Concurrency Control-techniques, Recovery-methods.									
Data Communication and Computer Networks									
Circuit Switching, Packet Switching, Frame Relay, Cell Switching, ATM , OSI Reference model, TCP\IP, Network topologies, LAN Technologies, Error detection and correction techniques, Internet protocols , IPv4/IPv6, Routing algorithms, TCP and UDP, Sockets, Congestion control, Application Layer Protocols, Network Security: Basics of public and private key cryptosystems-Digital Signatures and Hash codes, Transport layer security, VPN, Firewalls.									
Recommended by Board of Studies				05-03-2016					
Approved by Academic Council				No. 40		Date		18-03-2016	

MEE4099	Capstone Project				L	T	P	J	C
		0	0	0	0	0	0	20	
Pre-requisite	As per the academic regulations				Syllabus version				
									v. 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									
<ol style="list-style-type: none"> 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 									
Student Learning Outcomes (SLO): 5, 6, 20									
Contents									
<ol style="list-style-type: none"> 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				37 th AC		Date		16.06.2015	

ENG1011	English for Engineers				L	T	P	J	C
		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.									
Student Learning Outcomes (SLO): 3,6,18									
3. Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient)									
16. Having a good working knowledge of communicating in English									
18. Having critical thinking and innovative skills									
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, United Kingdom		
Reference Books			
1.	Steven Brown, Dorolyn Smith, Active Listening 3, 2011, 3 rd Edition, Cambridge University Press,		

2.	UK Tony Lynch, Study Listening, 2013, 2 nd Edition, Cambridge University Press, UK
3.	Liz Hamp-Lyons, Ben Heasley, Study Writing, 2010, 2 nd Edition, Cambridge University Press, UK
4.	Kenneth Anderson, Joan Maclean, Tony Lynch, Study Speaking, 2013, 2 nd Edition, Cambridge University Press, UK
5.	Eric H. Glendinning, Beverly Holmstrom, Study Reading, 2012, 2 nd 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, 4 th Edition, Oxford University Press, UK
9.	Heather Silyn-Roberts, Writing for Science and Engineering: Papers, Presentations and Reports, Jun 2016, 2 nd 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)

CO: 1,2,3,4,5

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

HUM1021	ETHICS AND VALUES	L	T	P	J	C
		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: <ol style="list-style-type: none"> Follow sound morals and ethical values scrupulously to prove as good citizens Understand various social problems and learn to act ethically Understand the concept of addiction and how it will affect the physical and mental health 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 Identify the main typologies, characteristics, activities, actors and forms of cybercrime 						
Student Learning Outcomes (SLO): 2,10,11,12						
2. Having a clear understanding of the subject related concepts and of contemporary issues 10. Having a clear understanding of professional and ethical responsibility 11. Having interest in lifelong learning 12. Having adaptive thinking and adaptability						
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

MAT-1011	Calculus for Engineers		L	T	P	J	C
			3	0	2	0	4
Pre-requisite	10+2 Mathematics or MAT1001	Syllabus Version					
		1.0					
Course Objectives :							
<ol style="list-style-type: none"> 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							
<ol style="list-style-type: none"> 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 							
Student Learning Outcome (SLO): 1, 2, 9							
[1] Having an ability to apply mathematics and science in engineering applications							
[2] Having a clear understanding of the subject related concepts and of contemporary issues							
[9] Having problem solving ability- solving social issues and engineering problems							
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, 13 th edition, Pearson, 2014. [2] Advanced Engineering Mathematics, Erwin Kreyszig, 10 th Edition, Wiley India, 2015.		
Reference Books		
1. Higher Engineering Mathematics, B.S. Grewal, 43 rd Edition ,Khanna Publishers, 2015 2. Higher Engineering Mathematics, John Bird, 6 th Edition, Elsevier Limited, 2017. 3. Calculus: Early Transcendentals, James Stewart, 8 th edition, Cengage Learning, 2017. 4. Engineering Mathematics, K.A.Stroud and Dexter J. Booth, 7 th 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

MAT2001	Statistics for Engineers	L	T	P	J	C
		3	0	2	0	4
Prerequisites	MAT1011 – Calculus for Engineers	Syllabus Version:				1.0
Course Objectives :						
<ol style="list-style-type: none"> To provide students with a framework that will help them choose the appropriate descriptive methods in various data analysis situations. To analyse distributions and relationship of real-time data. 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:						
<ol style="list-style-type: none"> Compute and interpret descriptive statistics using numerical and graphical techniques. Understand the basic concepts of random variables and find an appropriate distribution for analysing data specific to an experiment. Apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data. Make appropriate decisions using statistical inference that is the central to experimental research. Use statistical methodology and tools in reliability engineering problems. demonstrate R programming for statistical data 						
Student Learning Outcome (SLO):		1, 2, 7, 9, 14				
[1] Having an ability to apply mathematics and science in engineering applications.						
[2] Having a clear understanding of the subject related concepts and of contemporary issues.						
[7] Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning).						
[9] Having problem solving ability- solving social issues and engineering problems.						
[14] Having an ability to design and conduct experiments, as well as to analyse and interpret 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)		
<ul style="list-style-type: none"> Probability and Statistics for engineers and scientists, R.E.Walpole, R.H.Myers, S.L.Mayers and K.Ye, 9th Edition, Pearson Education (2012). Applied Statistics and Probability for Engineers, Douglas C. Montgomery, George C. Runger, 6th Edition, John Wiley & Sons (2016). 		
Reference books		
<ul style="list-style-type: none"> Reliability Engineering, E.Balagurusamy, Tata McGraw Hill, Tenth reprint 2017. Probability and Statistics, J.L.Devore, 8th Edition, Brooks/Cole, Cengage Learning (2012). Probability and Statistics for Engineers, R.A.Johnson, Miller Freund's, 8th edition, Prentice Hall India (2011). 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
•	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
•	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

MGT1022	Lean Start up Management				L	T	P	J	C
					1	0	0	4	2
Pre-requisite	Nil				Syllabus version				
					v.1.0				
Course Objectives: To develop the ability to									
<ol style="list-style-type: none"> 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:									
<ol style="list-style-type: none"> 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 <p>Foreseeing and quantifying business and financial risks</p>									
Student Learning Outcomes (SLO): 1,2,3,4,5									
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; 1 st edition (March 1, 2012)								
2	The Four Steps to the Epiphany, Steve Blank, K&S Ranch; 2 nd 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; 1 st 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
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

PHY1701	Engineering Physics	L	T	P	J	C
		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						
<ol style="list-style-type: none"> 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 						
Student Learning Outcomes (SLO): 2, 4, 5, 9						
<ol style="list-style-type: none"> 2. Having a clear understanding of the subject related concepts and of contemporary issues 4. Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified) 5. Having design thinking capability 9. Having problem solving ability- solving social issues and engineering problems 						
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, CO ₂ 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 Learning Private Ltd.		
5.	S. Nagabhushana and B. Sathyanarayana, Lasers and Optical Instrumentation, 2010, I.K. International Publishing House Pvt. Ltd.,		
6.	R. Shevgaonkar, Electromagnetic Waves, 2005, 1st Edition, Tata McGraw Hill		
7.	Principles of Electromagnetics, Matthew N.O. Sadiku, 2010, Fourth Edition, Oxford.		
8.	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 – Spectrometer	2 hrs	
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

PHY1999	Introduction to Innovative Projects	L	T	P	J	C
		1	0	0	4	2
Pre-requisite	None	Syllabus version				
		1.0				
Course Objectives:						
This course is offered to the students in the 1 st Year of B.Tech. in order to orient them towards independent, systemic thinking and be innovative.						
<ol style="list-style-type: none"> 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						
<ol style="list-style-type: none"> 1. Comprehend the various types of thinking skills. 2. Explain the innovative and creative ideas. 3. Analyze a suitable solution for socially relevant issues 						
Student Learning Outcomes (SLO): 2,3,9,17,18						
<ol style="list-style-type: none"> 2. Having a clear understanding of the subject related concepts and of contemporary issues 3. Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient) 9. Having problem solving ability- solving social issues and engineering problems 17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice 18. Having critical thinking and innovative skills 						
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 of 100 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 for the next 5 issues (issue 6 – 10) . (4 non- contact hours)		
Module:4 A	Systems thinking	1 hour
Systems Thinking essentials – examples – Counter Intuitive condemnns 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 deBono, Vermilion 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

BIT1003	Biology For Engineers	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	NIL	Syllabus version				
		2				
Course Objectives:						
1. Build a basic understanding of biology for engineers 2. Make up future-ready engineers to invent new biological tools.						
Expected Course Outcome:						
1. Interpret biological concepts 2. Classify and compare evolving systems 3. Relate biology ,chemistry and physics in modern perspective 4. Distinguish different and allied fields of biology 5. Make use of biological knowledge in industries 6. Discover biology in various fields						
Student Learning Outcomes (SLO): 2						
2. Have a clear understanding of subject related concepts and contemporary issues						
Module:1	Introduction to Biology and Evolution	6 hours				
Science of biology and contributions from various fields (Nobel Laureates). Biological complexity from viruses to complex eukaryotes, Biological diversity and bio-inspired designs. Evolution of life, Darwinism, molecular-evolution, neo Darwinism.						
Module:2	Chemistry and Complexity	6 hours				
Nano world of cells, Membrane bound and non-membranous organelles of cells, Central dogma and molecules involved, Cell structures, Organelles, Tissues, Organs and organ systems, Physiological constraints.						
Module:3	Physics of Biology	7 hours				
Biological transformation, storage and modulation of various energies: Light, Mechanical and Electrical energy; Thermodynamic principles in ecology (first and second laws of thermodynamics, open and closed systems, dissipative structures). Introduction to quantum biology.						
Module:4	Introduction to biological research	5 hours				
Biosafety and biohazards. Different scales of research. Major areas: food and agriculture, biomedical, environmental and energy.						
Module:5	Microbes as threats and tools in biology	6 hours				
Infectious diseases, Current epidemics, Microbes used for genetic engineering.						
Module:6	Antibody and allied technology	5 hours				
Antibody and immune system. Vaccines, large scale antibody production, antibody based						

detection and diagnostic systems, antibody as drug.		
Module:7	Human cell culture and computational Biology	8 hours
Basic cell culture technology, Cancer cell culture and drug discovery, Stem cells, Human on chip-concept, Regenerative medicine. Introduction to bioinformatics, molecular modelling, drug design and drug discovery, Systems biology, Bioinspired algorithms, DNA computation.		
Module:8	Contemporary issues:	2 hours
Lecture by Industrial Expert		
	Total Lecture hours:	45 hours
Text Book(s)		
1.	Arthur T. Johnson, Biology for Engineers, 27-Jun-2011 - Medical - 775 pages,CRC Press	
2.	Editors: Björn, Lars Olof (Ed.), Photobiology, The Science of Light and Life, 2015	
Reference Books		
1.	Christopher H. M. Jenkins, Bio-Inspired Engineering, 2011, Momentum Press	
2.	Jacobs CR, Huang H, Kwon RY, Introduction to Cellular Mechanics and Mechanobiology. New York: Garland Science, 2012. Print	
3.	Nagatomi J, Mechanobiology Handbook. Florida, 2011, CRC Press, Print.	
4.	Ronald R. Pethig, Stewart Smith, John Wiley & Sons, Introductory Bioelectronics: For Engineers and Physical Scientists, 22-Aug-2012 - Science - 464 pages	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	Virtual lab of cellular length scales	3 hours
2.	Exploration of PDB	2 hours
3.	Protein ligand docking experiment in silico	3 hours
4.	Evolutionary algorithm (e.g. game of life)	3 hours
5.	Virtual lab on photosynthesis and respiration	3 hours
6.	Glucose sensing mechanism of glucometer	3 hours
7.	Computational fluid dynamics in relevance to biological processes	2 hours
8.	3D printing in relevance to biological research	2 hours
9.	Bioelectricity experiment	3 hours
10	Potato osmometer and osmotic processes	2 hours
11	DNA isolation from fruits	2 hours
12	Glucose sensing and dissection of Glucometer chip.	2 hours

Total Laboratory Hours		30 hours	
Mode of evaluation:			
Recommended by Board of Studies	03-08-2017		
Approved by Academic Council	No. 46	Date	23-08-2017

BRIDGE COURSE

BIT1001	INTRODUCTION TO LIFE SCIENCES	L	T	P	J	C
		4	0	0	0	4
Pre-requisite	NIL	Syllabus version				
		1.2				
Course Objectives:						
<ol style="list-style-type: none"> 1. Compare living beings and lives processes. 2. Illustrate biota, biosphere, biodiversity and biological evolution. 3. Create interests in life sciences. 						
Expected Course Outcome:						
<ol style="list-style-type: none"> 1. Understand the science of life. 2. Determine the adaptations of biota and their functions in the nature. 3. Develop ideas, facts and theories relevant to biodiversity. 4. Choose new sources of renewable energy. 5. Analyze the contemporary issues of nature and role of biospheres. 6. Construct advanced biotechnologies for the sustainable utilizations and conservation. 						
Student Learning Outcomes (SLO):		2, 9, 11				
2. Having a clear understanding of the subject related concepts and of contemporary issues 9. Having problem solving ability- solving social issues and engineering problems 11. Having interest in lifelong learning						
Module:1	DIVERSITY IN THE LIVING WORLD	8 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	8 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	8 hours				
Bio-macromolecules, central Dogma of Molecular Biology, nucleic acids, proteins, carbohydrates, lipids , fats, Vitamins and Minerals; cellular metabolism.						
Module:4	MICROORGANISMS, ECOLOGYAND EVOLUTION	8 hours				

Microbial World, Classification. structure and types of bacteria, virus, micro algae and fungi,			
Microbial Growth, beneficial and harmful microorganisms. Ecology, Niches, Food chain and Food Web, Migration; Pollution. Theories of Evolution. Lamarckism, Darwinism, Speciation.			
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	8 hours	
Mendelian Genetics, Laws of Inheritance, Mono, di hybrid crosses, polygenic inheritance, Multiple alleles, Linkage and Crossing Over, Eugenics			
Module:8	BIOTECHNOLOGY	8 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.			
Total Lecture hours:		60 hours	
Text Book(s)			
1.	Campbell,N.A. Reece,J.B., and Simon, E.J. 2015. Essential Biology with Physiology (6th Edition). Campbell Biology Websites Series.		
Recommended by Board of Studies		03-08-2017	
Approved by Academic Council		No. 46	Date 24-08-2017

ENG1002	Effective English	L	T	P	J	C
		0	0	4	0	2
Pre-requisite	Not cleared English Proficiency Test (EPT)	Syllabus version				
		v.2.0				
Course Objectives:						
1. To enable students develop basic proficiency in Language Skills 2. To help students overcome communication barriers 3. To facilitate students communicate effectively in academic and social contexts						
Expected Course Outcome:						
1. Speak fluently in academic and social contexts 2. Listen for global and specific comprehension to improve study skills like note taking, summarizing, etc 3. Read and comprehend technical and general texts 4. Write grammatically correct creative and descriptive sentences and paragraphs in specific contexts 5. Enact on social contexts with a message, and communicate clearly and effectively in formal and informal contexts						
Student Learning Outcomes (SLO): 16, 18						
16. Good working knowledge of communicating in English 18. Critical thinking and innovative skills						
Mode of Evaluation: Online Quizzes, Presentation, Role play, Group Discussions, Assignments, Mini project.						
List of Challenging Experiments (Indicative)						
1.	Speaking: Introduce yourself using Temperament Sorter					8 hours
2.	Reading: Loud Reading with focus on pronunciation					4 hours
3.	Writing: Descriptive Writing – Process Compare & Contrast – Product description					6 hours
4.	Speaking: Just a Minute / Activities through VIT Community Radio					6 hours
5.	Writing: Travelogue Writing - 25+ FAQs (Wh-questions) on a place they have visited – Pair work					10 hours
6.	Speaking: Discuss facts and opinions using question tags					6 hours
7.	Writing: Formal Letter Writing focusing on Content					6 hours
8.	Vocabulary: Correct spelling errors					4 hours
9.	Speaking: Asking for and giving Directions/Instructions					6 hours
10.	Writing: Story writing using prompts/pictures					4 hours
					Total Laboratory Hours	60 hours
Text Books						
1.	Lewis Lansford and Peter Astley. Oxford English for Careers: Engineering 1: Student's Book. 2013. USA: Oxford University Press.					
2.	Jaimie Scanlon. Q: Skills for Success 1 Listening & Speaking. 2015. [Second Revised Edition]. Oxford: Oxford University Press.					
Reference Books						
1.	Sanjay Kumar and Puspallata. Communication Skills. 2015. [Second Edition] Print. New Delhi: Oxford University Press.					
2.	John Seely. Oxford Guide to Effective Writing and Speaking. 2013. [Third Edition]. New Delhi: Oxford University Press.					
3.	Meenakshi Raman. Communication Skills. 2011. [Second Edition]. New Delhi: Oxford University Press.					
4.	Terry O'Brien. Effective Speaking Skills. 2011. New Delhi: Rupa Publishers.					
5.	Barun Mitra. Effective Technical Communication: A Guide for Scientists and Engineers. 2015. New Delhi: Oxford University Press.					

Mode of evaluation: Online Quizzes, Presentation, Role play, Group Discussions, Assignments, Mini project.			
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Recommended by Board of Studies	22-07-2017		
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