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

(2020-2021)

B.Tech. Computer Science and Engineering

School of Computer Science and Engineering

B.Tech. Computer Science and Engineering

CURRICULUM AND SYLLABUS

(2020-2021 Admitted Students)

VIT®

Vellore Institute of Technology

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

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

VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

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

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

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

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

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

VISION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

To be a world-renowned centre of education, research and service in computing and allied domains.

MISSION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

- To offer computing education programs with the goal that the students become technically competent and develop lifelong learning skill.
- To undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.
- To foster vibrant outreach programs for industry, research organizations, academia and society.

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

School of Computer Science and Engineering

B.Tech-Computer Science and Engineering

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems.
2. Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.
3. Graduates will function in their profession with social awareness and responsibility.
4. Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.
5. Graduates will be successful in pursuing higher studies in engineering or management.
6. Graduates will pursue career paths in teaching or research.

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

B.Tech-Computer Science and Engineering

PROGRAMME OUTCOMES (POs)

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

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

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

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

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

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

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

PO_08: Having a clear understanding of professional and ethical responsibility

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

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

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

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

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

B.Tech-Computer Science and Engineering

ADDITIONAL PROGRAMME OUTCOMES (APOs)

APO_01: Having an ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ (Emotional Quotient)

APO_02: Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)

APO_03: Having design thinking capability

APO_04: Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning

APO_05: Having Virtual Collaborating ability

APO_06: Having an ability to use the social media effectively for productive use

APO_07: Having critical thinking and innovative skills

APO_08: Having a good digital footprint

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

School of Computer Science and Engineering

B.Tech-Computer Science and Engineering

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. The ability to formulate mathematical models and problem solving skills through programming techniques for addressing real life problems using appropriate data structures and algorithms.
2. The ability to design hardware and software interfaces through system programming skills based on the knowledge acquired in the system software and hardware courses.
3. The ability to provide solutions through the application of software engineering methodologies and database design principles with internet technologies for solving contemporary issues.

Programme Core	Programme Elective	University Core	University Elective	Total Credits
61	34	53	12	160

Course Code	Course Title	Course Type	L	T	P	J	C
PROGRAMME CORE							
CSE1003	Digital Logic and Design	ETL	3	0	2	0	4
CSE1004	Network and Communication	ETL	3	0	2	0	4
CSE1007	Java Programming	ETL	3	0	2	0	4
CSE2001	Computer Architecture and Organization	TH	3	0	0	0	3
CSE2004	Database Management Systems	ETLP	2	0	2	4	4
CSE2005	Operating Systems	ETL	3	0	2	0	4
CSE2006	Microprocessor and Interfacing	ETLP	2	0	2	4	4
CSE2003	Data Structures and Algorithms	ETL	3	0	2	0	4
CSE2012	Design and Analysis of Algorithms	ETL	3	0	2	0	4
CSE2013	Theory of Computation	TH	3	0	0	0	3
CSE3001	Software Engineering	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	2	0	0	4
MAT3004	Applied Linear Algebra	TH	3	2	0	0	4
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**J**	**C**
PROGRAMME ELECTIVE							
CSE1006	Blockchain and Cryptocurrency Technologies	TH	3	0	0	0	3
CSE2014	Compiler Design	ETL	3	0	2	0	4
CSE3006	Embedded System Design	ETL	3	0	2	0	4
CSE3009	Internet of Things	ETP	3	0	0	4	4
CSE3011	Robotics and its Applications	ETL	3	0	2	0	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
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
CSE3035	Principles of Cloud Computing	ETL	3	0	2	0	4
CSE3501	Information Security Analysis and Audit	ETLP	2	0	2	4	4
CSE3502	Information Security Management	ETLP	2	0	2	4	4

Course Code	Course Title	Course Type	L	T	P	J	C
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	ETL	3	0	2	0	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
MAT2002	Applications of Differential and Difference Equations	ETL	3	0	2	0	4

Course Code	Course Title	Course Type	L	T	P	J	C
UNIVERSITY CORE							
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
CSE1901	Technical Answers for Real World Problems (TARP)	ETP	1	0	0	4	2
CSE1902	Industrial Internship	PJT	0	0	0	0	1
CSE1903	Comprehensive Examination	PJT	0	0	0	0	1
CSE1904	Capstone Project	PJT	0	0	0	0	12
ENG1901	Technical English - I	LO	0	0	4	0	2
ENG1902	Technical English - II	LO	0	0	4	0	2
ENG1903	Advanced Technical English	ELP	0	0	2	4	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	3	0	2	0	4
MGT1022	Lean Start-up Management	ETP	1	0	0	4	2
PHY1701	Engineering Physics	ETL	3	0	2	0	4
PHY1901	Introduction to Innovative Projects	TH	1	0	0	0	1
FLC4097	Foreign Language Course Basket	CDB	0	0	0	0	2
ESP1001 - ESPANOL FUNDAMENTAL - TH							
ESP2001 - ESPANOL INTERMEDIO - ETL							
FRE1001 - Francais quotidien - TH							
FRE2001 - Francais progressif - ETL							
GER1001 - Grundstufe Deutsch - TH							
GER2001 - Mittelstufe Deutsch - ETL							
GRE1001 - Modern Greek - TH							
JAP1001 - Japanese for Beginners - TH							
RUS1001 - Russian for Beginners - TH							

Course Code	Course Title	Course Type	L	T	P	J	C
STS4097	Soft Skills B.Tech. / B.Des.	CDB	0	0	0	0	6
STS1001 - Introduction to Soft Skills - SS							
STS1002 - Introduction to Business Communication - SS							
STS1101 - Fundamentals of Aptitude - SS							
STS1102 - Arithmetic Problem Solving - SS							
STS1201 - Introduction to Problem Solving - SS							
STS1202 - Introduction to Quantitative, Logical and Verbal Ability - SS							
STS2001 - Reasoning Skill Enhancement - SS							
STS2002 - Introduction to Etiquette - SS							
STS2101 - Getting Started to Skill Enhancement - SS							
STS2102 - Enhancing Problem Solving Skills - SS							
STS2201 - Numerical Ability and Cognitive Intelligence - SS							
STS2202 - Advanced Aptitude and Reasoning Skills - SS							
STS3001 - Preparedness for External Opportunities - SS							
STS3004 - Data Structures and Algorithms - SS							
STS3005 - Code Mithra - SS							
STS3006 - Preparedness for External Opportunities - SS							
STS3007 - Preparedness for Career Opportunities - SS							
STS3101 - Introduction to Programming Skills - SS							
STS3104 - Enhancing Programming Ability - SS							
STS3105 - Computational Thinking - SS							
STS3201 - Programming Skills for Employment - SS							
STS3204 - JAVA Programming and Software Engineering Fundamentals - SS							
STS3205 - Advanced JAVA Programming - SS							
STS3301 - JAVA for Beginners - SS							
STS3401 - Foundation to Programming Skills - SS							
STS5002 - Preparing for Industry - SS							

Course Code	Course Title	Course Type	L	T	P	J	C
BRIDGE COURSE							

Course Code	Course Title	Course Type	L	T	P	J	C
NON CREDIT COURSE							
CHY1002	Environmental Sciences	TH	3	0	0	0	3
ENG1000	Foundation English - I	LO	0	0	4	0	2
ENG2000	Foundation English - II	LO	0	0	4	0	2
EXC4097	Co-Extra Curricular Basket	CDB	0	0	0	0	2
EXC1001 - Service to the Society - ECA							
EXC1002 - Youth Red Cross - ECA							
EXC1002 - Red Cross - ECA							
EXC1003 - ABCD-AnyBody Can Dance - ECA							
EXC1004 - Entrepreneurs Cell - ECA							
EXC1004 - Building Entrepreneurship Competencies and Skills - ECA							
EXC1005 - Energy and Environmental Protection Club - ECA							

Course Code	Course Title	Course Type	L	T	P	J	C
EXC1006 - Music - The Art of Culture - ECA							
EXC1007 - Sports for Healthy Life - ECA							
EXC1008 - Instrumentation for Engineers - ECA							
EXC1009 - Debating Skills - ECA							
EXC1010 - Mobility Engineering- Land, Air and Sea - ECA							
EXC1011 - Skills in Competitive Coding - ECA							
EXC1012 - Basics of Space Sciences - ECA							
EXC1013 - Roadmap to a Connected World - ECA							
EXC1014 - Dramatics Club - ECA							
EXC1014 - The Art of Acting - ECA							
EXC1016 - ASCE - VIT Student Chapter - ECA							
EXC1017 - Health Club - ECA							
EXC1017 - Health and Wellness - ECA							
EXC1018 - IETE - Student Chapter - ECA							
EXC1018 - Electronics and Telecommunication for Skill Development - ECA							
EXC1019 - The Fine Arts Club - ECA							
EXC1019 - Basic Art and Craft Techniques - ECA							
EXC1020 - Skills on Creativity - ECA							
EXC1021 - Computer Society of India - ECA							
EXC1021 - Computer in Society - ECA							
EXC1023 - Hindi Literary Association - ECA							
EXC1023 - Hindi Arts and Literature - ECA							
EXC1025 - Toastmasters International - VIT Chapter - ECA							
EXC1027 - Power and Energy for Societal Development - ECA							
EXC1028 - VIT Community Radio - ECA							
EXC1030 - Make a Difference - ECA							
EXC1030 - Child Empowerment and Development - ECA							
EXC1032 - Fifth Pillar - ECA							
EXC1032 - Building Blocks of Democracy - ECA							
EXC1033 - Robotics for Engineers - ECA							
EXC1034 - Techloop - ECA							
EXC1035 - Association for Computing Machinery - ECA							
EXC1035 - Computing in Science and Engineering - ECA							
EXC1049 - Innovation for Engineering Applications - ECA							
EXC1054 - The Art and Skills of Photography - ECA							
EXC1061 - Skill Development in Manufacturing - ECA							
EXC1068 - Discussion through Media - ECA							
EXC1069 - Fep-Si - ECA							
EXC1070 - Working to Engineer a Better World - ECA							
EXC1071 - Culinary Crusade - ECA							
EXC1072 - VIT Film Society - ECA							
EXC1072 - The Art and Skills of Film Making - ECA							
EXC1075 - The Institution of Engineers (India) - ECA							

Course Code	Course Title	Course Type	L	T	P	J	C
EXC1075 - ENGINEERING SKILLSET - ECA							
EXC1076 - Tamil Arts and Literature - ECA							
EXC1077 - National Cadet Corps (NCC) - ECA							
EXC1078 - VIT Spartans - ECA							
EXC1078 - Learning with Spartans - ECA							
EXC1079 - Anokha - ECA							
EXC1079 - Inception of Change - ECA							
EXC1080 - American Society of Mechanical Engineers - ECA							
EXC1081 - Open Source Development for Google Applications - ECA							
EXC1082 - Telugu Literary Association - ECA							
EXC1083 - Mozilla Firefox - ECA							
EXC1083 - Open Source User Interface - ECA							
EXC1084 - Apple Developers Group - ECA							
EXC1084 - IOS Platform - ECA							
EXC1085 - Technology And Gaming Club (TAG) - ECA							
EXC1087 - Engineering in Medicine and Biology - ECA							
EXC1088 - Energy for Societal Development - ECA							
EXC1090 - Economic Development and Commercial Sciences - ECA							
EXC1095 - Skills in Financial Investment - ECA							
EXC1097 - Practical Fundamentals of Chemical Engineering - ECA							
EXC1100 - Experiential Learning of Energy Engineers - ECA							
EXC1101 - Mathsomania - ECA							
EXC1102 - Art of Research and Publication - ECA							
EXC1107 - Skills on Chemical Engineering - ECA							
EXC1110 - Engineering for Industrial Applications - ECA							
EXC1111 - TechEd - ECA							
EXC1112 - Research for Biotechnology - ECA							
EXC1114 - Communication in Technology and Networking - ECA							
EXC1120 - Creativity Club - ECA							
EXC1121 - Social Entrepreneurship - ECA							
EXC1124 - Humanitarian Service - ECA							
EXC1127 - Debating on Internal Issues - ECA							
EXC1129 - Uddeshya - ECA							
EXC1129 - Peer Educator Training Programme - ECA							
EXC1132 - The way of Living - ECA							
EXC1134 - Child Care and Education - ECA							
EXC1135 - Kannada Arts and Literature - ECA							
EXC1157 - Trekking Club - ECA							
EXC4097 - Co/Extra Curricular - ECA							

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, verication 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

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:

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:

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**

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

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:

1. To acquaint students with the basic concepts of fundamental component, architecture, register organization and performance metrics of a computer.
2. To impart the knowledge of data representation in binary and understand implementation of arithmetic algorithms in a typical computer.
3. 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 ofmachine level programming.
4. 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:

1. Differentiate Von Neumann, Harvard, and CISC and RISC architectures. Analyze the performance of machines with different capabilities.
2. Illustrate binary format for numerical and characters. Validate efficient algorithm for arithmetic operations.
3. 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.
4. 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.
5. 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.
6. 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.
7. Classify parallel machine models. Illustrate typical 6-stage pipeline for overlapped execution. Analyze the hazards and solutions.

Student Learning Outcomes (SLO): 1,2,5

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
5. 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 - Flynns 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

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

Course Objectives:

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

Expected Course Outcome:

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

Student Learning Outcomes (SLO): 1,5,7

2. Having an ability to apply mathematics and science in engineering applications
5. Having design thinking capability
7. 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

Course code	Course Title	L	T	P	J	C
CSE2005	OPERATING SYSTEMS	3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		v.x.x				

Course Objectives:

1. To introduce the operating system concepts, designs and provide skills required to implement the services.
2. To describe the trade-offs between conflicting objectives in large scale system design.
3. To develop the knowledge for application of the various design issues and services.

Expected Course Outcome:

1. Interpret the evolution of OS functionality, structures and layers.
2. Apply various types of system calls and to find the stages of various process states.
3. Design a model scheduling algorithm to compute various scheduling criteria.
4. Apply and analyze communication between inter process and synchronization techniques.
5. Implement page replacement algorithms, memory management problems and segmentation.
6. Differentiate the file systems for applying different allocation and access techniques.
7. Representing virtualization and demonstrating the various Operating system tasks and the principle algorithms for enumerating those tasks.

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	3 hours	CO:1

Introduction to OS: Functionality of OS - OS design issues - Structuring methods (monolithic, layered, modular, micro-kernel models) - Abstractions, processes, resources - Influence of security, networking, and multimedia.

Module:2	OS Principles	4 hours	CO:2

System calls, System/Application Call Interface – Protection: User/Kernel modes - Interrupts - Processes - Structures (Process Control Block, Ready List etc.), Process creation, management in Unix – Threads: User level, kernel level threads and thread models.

Module:3	Scheduling	9 hours	CO:3

Processes Scheduling - CPU Scheduling: Pre-emptive, non-pre-emptive - Multiprocessor scheduling – Deadlocks - Resource allocation and management - Deadlock handling mechanisms: prevention, avoidance, detection, recovery.

Module:4	Concurrency	8 hours	CO:4

Inter-process communication, Synchronization - Implementing synchronization primitives (Peterson's solution, Bakery algorithm, synchronization hardware) - Semaphores – Classical

synchronization problems, Monitors: Solution to Dining Philosophers problem – IPC in Unix, Multiprocessors and Locking - Scalable Locks - Lock-free coordination.			
Module:5	**Memory Management**	**7 hours**	**CO:5**
Main memory management, Memory allocation strategies, Virtual memory: Hardware support for virtual memory (caching, TLB) – Paging - Segmentation - Demand Paging - Page Faults - Page Replacement -Thrashing - Working Set.			
Module:6	**Virtualization and File System Management**	**6 hours**	**CO:7**
Virtual Machines - Virtualization (Hardware/Software, Server, Service, Network - Hypervisors - Container virtualization - Cost of virtualization - File system interface (access methods, directory structures) - File system implementation (directory implementation, file allocation methods) - File system recovery - Journaling - Soft updates - Log-structured file system - Distributed file system.			
Module:7	**Storage Management, Protection and Security**	**6 hours**	**CO:6**
Disk structure and attachment – Disk scheduling algorithms (seek time, rotational latency based)- System threats and security – Policy vs mechanism - Access vs authentication - System protection: Access matrix – Capability based systems - OS: performance, scaling, future directions in mobile OS.			
Module:8	**Recent Trends**	**2 hours**	**CO:7**
	Total Lecture hours:	**45 hours**	

Text Book(s)		
1.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne-Operating System Concepts, Wiley (2018).	
Reference Books		
1.	Ramez Elmasri, A.Gil Carrick, David Levine, Operating Systems, A Spiral Approach - McGrawHill Higher Education (2010).	
2.	Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau, Operating Systems, Three Easy Pieces, Arpaci-Dusseau Books, Inc (2015).	
3.	Andrew S. Tanenbaum, Modern Operating Systems, Pearson, 4th Edition (2016).	
4.	William Stallings, Operating Systems: Internals and Design Principles, Pearson, 9th Edition (2018).	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Experiments		
1.	Design 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 evaluation: Project/Activity		
Recommended by Board of Studies	09-09-2020	
Approved by Academic Council	No. 59	Date 24-09-2020

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:

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:

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**

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

Course code	Data Structures and Algorithms	L	T	P	J	C
CSE2003		3	0	2	0	4
Pre-requisite	Nil	Syllabus version				
		v. XX.XX				

Course Objectives:

1. To understand the basic concepts of data structures and algorithms.
2. To differentiate linear and non-linear data structures and the operations upon them.
3. Ability to perform sorting and searchingin a given set ofdata items.
4. To comprehend the necessity of time complexity in algorithms.

Expected Course Outcome:

1. Understanding the fundamental analysis and time complexity for a given problem.
2. Articulate linear data structures and legal operations permitted on them.
3. Articulate non-linear data structures and legal operations permitted on them.
4. Applyinga suitable algorithm for searching and sorting.
5. Understanding graph algorithms, operations, and applications.
6. Understanding the importance of hashing.
7. Applying the basic data structures to understand advanced data structure operations and applications.
8. Application ofappropriate data structures to find solutions to practical problems.

Student Learning Outcomes (SLO): **1,5,6,9,11**

1. Having an ability to apply mathematics and science in engineering applications.
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.
9. Having problem solving ability- solving social issues and engineering problems.
11. Having an interest in lifelong learning.

Module:1	Introduction to Algorithms and Analysis	6 hours	CO:1

Overview and importance of algorithms and data structures. Fundamentals of algorithm analysis, Space and time complexity of an algorithm, Types of asymptotic notations and orders of growth, Algorithm efficiency – best case, worst case, average case, Analysis of non-recursive and recursive algorithms, Asymptotic analysis for recurrence relation – Recursive Tree Method.

Module:2	Linear Data Structures	8 hours	CO: 2,8

Array- 1D and 2D array , Stack - Applications of stack: Expression Evaluation - Conversion of Infix to postfix and prefix expression, Tower of Hanoi.

Queue - Types of Queue: Circular Queue, Double Ended Queue (deQueue), Applications – Priority Queue using Arrays - List - Singly linked lists – Doubly linked lists - Circular linked lists, Applications -Polynomial Manipulation - Josephus problem(permutation)

Module:3	Sorting and Search Techniques	8 hours	CO:4,8

Searching - Linear Search and binary search, Applications - Finding square root of ‘n’-Longest

Common Prefix Sorting – Insertion sort - Selection sort – Bubble sort – (Counting Sort) - Quick sort- Merge sort , Analysis, Applications - Finding the 'n' closest pair's			
Module:4	**Non-linear Data Structures - Trees**	**6 hours**	**CO:5,8**
Tree - Terminology, Binary Tree – Terminology and Properties, Tree Traversals, Expression Trees – Binary Search Trees – operations in BST – insertion, deletion, finding min and max, Finding the kth minimum element in a BST, Applications – Dictionary			
Module:5	**Non-linear Data Structures - Graphs**	**6 hours**	**CO:3,8**
Graph – basic definition and Terminology – Representation of Graph – Graph Traversal: Breadth First Search (BFS), Depth First Search (DFS) - Minimum Spanning Tree: Prim's, Kruskal's- Single Source Shortest Path: Dijkstra's Algorithm.			
Module:6	**Hashing**	**4 hours**	**CO:6,8**
Hash functions, open hashing-separate chaining, closed hashing - linear probing, quadratic probing, double hashing, random probing, rehashing, extendible hashing, Applications – Dictionary- Telephone directory			
Module:7	**Heaps and Balanced Binary Search Trees**	**5 hours**	**CO:7,8**
Heaps - Heap sort, Applications -Priority Queue using Heaps AVL trees – Terminology - basic operations(rotation, insertion and deletion			
Module:8	**Recent Trends**	**2 hours**	**CO:8**
Recent trends in algorithms and data structures			
	Total Lecture hours:	**45 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.
2	Mark A. Weiss,Data Structures & Algorithm Analysis in C++, 3rd edition, 2008, PEARSON.

Reference Books

1. Kurt Mehlhorn, and Peter Sanders – Algorithms and Data Sturctures The Basic Toolbox, Springer-Verlag Berlin Heidelberg, 2008.
2. Horowitz, Sahni, and S. Anderson-Freed , Fundamentals of Data Structures in C UNIVERSITIES PRESS,Second Edition,2008.

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

List of Experiments (Indicative)		**CO:3,4,5**
1.	Implementation of Stack and its applications	4 hours
2.	Implementation of queue and its applications	4 hours

3.	Linked List	4 hours
4.	Searching algorithm	2 hours
5.	Sorting algorithm – insertion, bubble, selection etc.	2 hours
6.	Randomized Quick sort and merge sort	2 hours
7.	Binary Tree traversals	2 hours
8.	Binary search tree	2 hours
9.	DFS, BFS	3 hours
10.	Minimum Spanning Tree – Prim's and Kruskal's	3hours
11.	Single source shortest path algorithm – Connected Components and finding a cycle in a graph	2 hours
	Total Laboratory Hours	30 hours

Mode of evaluation:			
Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Course code	Design and Analysis of Algorithms	L	T	P	J	C
CSE2012		3	0	2	0	4
Pre-requisite	CSE2003 – Data Structures and Algorithms	Syllabus version				
		v. xx.xx				

Course Objectives:

1. To provide a mathematical foundation for analyzing and proving the efficiency of an algorithm.
2. To focus on the design of algorithms in various domains of computer engineering.
3. To provide familiarity with main thrusts of work in algorithms sufficient to give some context for formulating and seeking known solutions to an algorithmic problem.

Expected Course Outcome:

On completion of this course, student should be able to

1. Ability to use mathematical tools to analyze and derive the running time of algorithms and prove the correctness.
2. Explain and apply the major algorithm design paradigms.
3. Explain the major graph algorithms and their analyses.
4. Explain the major String Matching algorithms and their analysis.
5. Explain the major Computational Geometry algorithms and their analysis.
6. Provide algorithmic solutions to real-world problem from various domains.
7. Explain the hardness of real world problems with respect to algorithmic efficiency and learning to cope with it.

Student Learning Outcomes (SLO): 1,5,6,9,11

1. Having the ability to apply mathematics and science in engineering applications.
5. Having design thinking capability.
6. Having the ability to design a component or a product applying all the relevant standards andwith realistic constraints.
9. Having problem solving ability- solving social issues and engineering problems.
11. Having interest in lifelong learning.

Module:1	Algorithm Development	4 hours	CO: 1

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.

Module:2	Algorithm Design Techniques	10 hours	CO: 2

Brute force techniques – Travelling Salesman Problem, Divide and Conquer - Finding a maximum and minimum in a given array -Matrix multiplication: Strassen's algorithm, Greedy techniques Huffman Codes and Data Compression -Fractional Knapsack problem, Dynamic programming - O/1 Knapsack problem-Matrix chain multiplication, LCS, Travelling Salesman Problem, Backtracking-N-Queens Problem, Knights Tour on Chess Board.

Module:3	String Matching Algorithms	5 hours	CO:1,4

Naïve String matching Algorithms, KMP algorithm, Rabin-Karp Algorithm

Module:4	**Computational Geometry Algorithms**	**5 hours**	**CO:1,5**
Line Segments – properties, intersection; Convex Hull finding algorithms- Graham's Scan, Jarvis's March Algorithm.			
Module:5	**Graph Algorithms**	**6 hours**	**CO:1,3**
All pair shortest path – Floyd-Warshall Algorithm. Network Flows - Flow Networks, Maximum Flows – Ford-Fulkerson Algorithm, Push Re-label Algorithm, Minimum Cost Flows – Cycle Cancelling Algorithm.			
Module:6	**Complexity Classes**	**7 hours**	**CO:1,6**
The Class P, The Class NP, Reducibility and NP-completeness – SAT (without proof), 3-SAT, Vertex Cover, Independent Set, Maximum Clique.			
Module:7	**Approximation and Randomized Algorithms**	**6 hours**	**CO:7**
Approximation Algorithms - The set-covering problem – Vertex cover, K-center clustering. Randomized Algorithms - The hiring problem, Finding the global Minimum Cut			
Module:8	**Recent Trends**	**2 hours**	**CO:7**
	Total Lecture hours:	**45 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. Jon Kleinberg, ÉvaTardos ,Algorithm Design, Pearson education, 2014
2. Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, "Network Flows: Theory, Algorithms, and Applications", Pearson Education, 2014.

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

Assignment: Exploring Finite Automata and String Matching

List of Experiments (Indicative)	**Total Hours: 30**
1. Design and implement an algorithm that multiplies two 'n' digit numbers faster than $O(n^3)$. 2. Design and implement an algorithm that will find the top and the least scores of students from an online Quiz. Note: The scores are stored in an array. 3. Design a solution for an Airline Customer on what to leave	

behind and what to carry based on cabin baggage weight limits. The Customer has to pack as many items as the limit allows while maximizing the total worth. The data can be shared in a CSV File. 4. Assume you have an unparenthesized arithmetic expression with only + and - operators. You can change the value of expression by parenthesizing at different positions. To keep it simple, assume that parenthesis occur only before or immediately after operands and not operators. Design an algorithm that can take a maximum possible value the expression can take in after adding the parenthesis. 5. About 14 historic sites in Tamilnadu is shown in https://www.google.com/maps/search/historic+sites+in+tamilnadu/@10.7929896,78.2883573,7z/data=!3m1!4b1 Design a solution that identifies the shortest possible routes for a traveler to visit these sites. 6. Design a solution to see if a content C = PGGA is plagiarized in Text T = SAQSPAPGPGGAS. 7. You can find the schematics of Delhi Art Gallery (Ground Floor) in: https://www.archdaily.com/156154/delhi-art-gallery-re-design-vertex-design/50151feb28ba0d02f0000302-delhi-art-gallery-re-design-vertex-design-first-floor-plan Design a model to install fewest possible Closed Circuit Cameras covering all hallways and turns. 8. A maze has to be created and path has to be displayed which will be taken by the rat by using backtracking concept. 9. Consider x=aabab and y=babb. Each insertion and deletion has a unit 1) cost where as a change costs 2 units. Find a minimum cost edit sequence that transforms x into y by using suitable algorithm design technique. 10. Implement N-Queens problem and analyse its time complexity using backtracking. 11. Write a program to find all the Hamiltonian cycles in a connected undirected graph G(V,E) using backtracking 12. Design and implement a solution to find a subset of a given set S = {Sl, S2,.....,Sn} of n positive integers whose SUM is	

equal to a given positive integer d. For example, if S ={1, 2, 5, 6, 8} and d= 9,there are two solutions {1,2,6}and {1,8}. Display a suitable message, if the given problem instance doesn't have a solution.			
Mode of evaluation:			
Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Course code	Theory of Computation	L	T	P	J	C
CSE2013		3	0	0	0	3
Pre-requisite		Syllabus version				
		v. xx.xx				

Course Objectives:

The objectives of this course are to learn

1. Types of grammars and models of automata.
2. Limitation of computation: What can be and what cannot be computed.
3. Establishing connections among grammars, automata and formal languages.

Expected Course Outcome:

After successfully completing the course the student should be able to

1.Compare and analyze different computational models

2. Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.

3. Identify limitations of some computational models and possible methods of proving them.

Student Learning Outcomes (SLO): 1, 5, 18

1. Having an ability to apply mathematics and science in engineering applications
5. Having design thinking capability
18. Having critical thinking and innovative skills

Module:1	Introduction to Languages and Grammars	4 hours	CO: 1

Recall on Proof techniques in Mathematics -Overview of a Computational Models - Languages and Grammars - Alphabets - Strings - Operations on Languages, Overview on Automata

Module:2	Finite State Automata	8 hours	CO: 2

Finite Automata (FA) - Deterministic Finite Automata (DFA) - Non-deterministic Finite Automata (NFA) - NFA with epsilon transitions – NFA without epsilon transition, conversion of NFA to DFA, Equivalence of NFA and DFA – minimization of DFA

Module:3	Regular Expressions and Languages	7 hours	CO: 2

Regular Expression - FA and Regular Expressions: FA to regular expression and regular expression to FA- - Pattern matching and regular expressions - Regular grammar and FA- Pumping lemma for regular languages - Closure properties of regular languages.

Module:4	Context Free Grammars	7 hours	CO: 3

Context-Free Grammar (CFG) – Derivations- Parse Trees - Ambiguity in CFG - CYK algorithm – Simplification of CFG – Elimination of Useless symbols, Unit productions, Null productions - Normal forms for CFG: CNF and GNF - Pumping Lemma for CFL - Closure Properties of CFL

Module:5	Pushdown Automata	5 hours	CO: 2

Definition of the Pushdown automata - Languages of a Pushdown automata – Power of Non-Deterministic Pushdown Automata and Deterministic pushdown automata

Module:6	**Turing Machine**	**6 hours**	**CO: 3**
Turing Machines as acceptor and transducer - Multi head and Multi tape Turing Machines – Universal Turing Machine - The Halting problem - Turing-Church thesis			
Module:7	**Recursive and Recursively Enumerable Languages**	**6 hours**	**CO: 3**
Recursive and Recursively Enumerable Languages, Language that is not Recursively Enumerable (RE) – computable functions – Chomsky Hierarchy – Undecidable problems - Post's Correspondence Problem			
Module:8	**Recent Trends**	**2 hours**	**CO: 3**
	Total Lecture hours:	**45 hours**	

Text Book(s)

1. J.E. Hopcroft, R. Motwani and J.D. Ullman, "Introduction to Automata Theory, Languages and Computation", Third Edition, Pearson Education, India 2008. ISBN: 978-8131720479
2. Peter Linz, "An Introduction to Formal Languages and Automata", Sixth Edition, Jones & Bartlett, 2016. ISBN**:** 978-9384323219

Reference Books

1. K. Krithivasan and R. Rama, "Introduction to Formal Languages, Automata and Computation", Pearson Education, 2009. ISBN: 978-8131723562
2. Michael Sipser, Introduction of the Theory and Computation, Cengage; 3rd edition, 2014, ISBN: 978-8131525296
3. Dexter C. Kozen, "Automata and Computability", Springer; Softcover reprint of the original 1st ed. 1997 edition. 2012
4. John C Martin, "Introduction to Languages and the Theory of Computation", McGraw Hill Publishing Company, Fourth Edition, 2011.

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

Mode of assessment:

Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

CSE3001	SOFTWARE ENGINEERING	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To introduce the essential software engineering concepts involved
2. To impart skills in the design and implementation of efficient software systems across disciplines
3. To familiarize engineering practices and standards used in developing software products and components

Expected Course Outcome:

1. Apply the principles of the engineering processes in software development.
2. Demonstrate software project management activities such as planning,scheduling and Estimation.
3. Model the requirements for the software projects.
4. Design and Test the requirements of the software projects.
5. Implement the software development processes activities from requirements to validation and verification.
6. Apply and evaluate the standards in process and in product.

Student Learning Outcomes (SLO): 1, 5, 6

1. Having an ability to apply mathematics and science in engineering applications.
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	OVERVIEW OF SOFTWARE ENGINEERING	5 hours

Nature of Software, Software Engineering, Software process, project, product, Process Models Classical Evolutionary models, Overview of System Engineering

Module:2	INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT	3 hours

Planning scope, milestones deliverables, Risk Management, Metrics Measurement

Module:3	MODELLING REQUIREMENTS	6 hours

Requirements Engineering process Requirement Elicitation, System Modelling - Requirements Specification and Requirement Validation

Module:4	SOFTWARE DESIGN	4 hours

Design concepts and principles - Abstraction - Refinement - Modularity Cohesion coupling, Architectural design, Detailed Design Transaction Transformation, Refactoring of designs, Object-oriented Design User-Interface Design

Module:5	VALIDATION and VERIFICATION	4 hours

Strategic Approach to Software Testing, Testing Fundamentals Test Plan, Test Design, Test Execution, Reviews, Inspection Auditing

Module:6	SOFTWARE EVOLUTION	4 hours

Software Maintenance, Types of Maintenance, Software Configuration Management, Overview of RE-engineering Reverse Engineering

Module:7	QUALITY ASSURANCE	2 hours

Product Process Metrics, Quality Standards Models ISO, TQM, Six-Sigma

Module:8	RECENT TRENDS	2 hours

Recent Trends in Software Design/Specialized Software Testing, Related Tools and Standards				
	Total Lecture hours:	**30 hours**		
Text Book(s)				
1.	Roger Pressman, Software Engineering: A Practitioner's Approach, 7th Edition, McGraw-Hill, 2010.			
Reference Books				
1.	Ian Sommerville, Software Engineering, 9th Edition, Addision-Wesley, 2016			
2.	Pankaj Jalote, A Concise Introduction to Software Engineering, Springer, 2008			
3.	William E. Lewis , Software Testing and Continuous Quality Improvement, Third Edition, Auerbach Publications, 2008			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
List of Challenging Experiments (Indicative)				
1.	Work Break-down Structure (Process Based, Product Based, Geographic Based and Role Based)			3 hours
2.	Estimations Cost and Schedule			3 hours
3.	Entity Relationship Diagram, Context flow diagram, DFD (Structural Modeling and Functional Modeling)			4 hours
4.	State Transition Diagrams (Behavioral Modeling)			4 hours
5.	System Requirements Specification			4 hours
6.	UML diagrams for OO Design			4 hours
7.	Tools for Version Control			3 hours
8.	Black-box, White-box testing			3 hours
9.	Non-functional testing			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	

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:

1. To comprehend and analyze the basic concepts of web programming and internet protocols.
2. To describe how the client-server model of Internet programming works.
3. To demonstrates the uses of scripting languages and their limitations.

Expected Course Outcome:

After successfully completing the course the student should be able to

1. Differentiate web protocols and web architecture.
2. Apply JavaScript, HTML and CSS effectively to create interactive and dynamic websites.
3. Implement client side scripting using JavaScript.
4. Develop applications using Java.
5. Implement server side script using PHP, JSP and Servlets.
6. Develop XML based web applications.
7. Develop application using recent environment like Node JS, Angular JS, JSON and AJAX.

Student Learning Outcomes (SLO): 2, 5, 6, 17

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
17. 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:

1. To introduce the fundamentals of parallel and distributed computing architectures and paradigms.
2. To understand the technologies, system architecture, and communication architecture that propelled the growth of parallel and distributed computing systems.
3. 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:

1. Design and implement distributed computing systems.
2. Asses models for distributed systems.
3. Design and implement distributed algorithms.
4. Experiment with mechanisms such as client/server and P2P algorithms, remote procedure calls (RPC/RMI), and consistency.
5. Analyse the requirements for programming parallel systems and critically evaluate the strengths and weaknesses of parallel programming models.
6. Differentiate between the major classes of parallel processing systems.
7. 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

3. Having a clear understanding of the subject related concepts and of contemporary issues.
5. Having design thinking capability.
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	**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

<table>
<tr><td>2.</td><td colspan="4">Simon Haykin, „Communication Systems", John Wiley & Sons, 5 t h Edition, 2009.</td></tr>
<tr><td>3.</td><td colspan="4">Charles K Alexander, Mathew N O Sadiku, „Fundamentals of Electric Circuits", Tata McGraw Hill, 2012.</td></tr>
<tr><td>4.</td><td colspan="4">Batarseh, „Power Electronics Circuits", Wiley, 2003</td></tr>
<tr><td>5.</td><td colspan="4">H. Hayt, J.E. Kemmerly and S. M. Durbin, „Engineering Circuit Analysis", 6/e, Tata McGraw Hill, New Delhi, 2011.</td></tr>
<tr><td>7.</td><td colspan="4">Fitzgerald, Higgabogan, Grabel, „Basic Electrical Engineering", 5t h edn, McGraw Hill, 2009.</td></tr>
<tr><td>8.</td><td colspan="4">S.L.Uppal, „Electrical Wiring Estimating and Costing ", Khanna publishers, NewDelhi, 2008.</td></tr>
<tr><td colspan="5">Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar</td></tr>
<tr><td colspan="3">List of Challenging Experiments (Indicative)</td><td colspan="2"></td></tr>
<tr><td>1.</td><td colspan="3">Thevenin"s and Maximum Power Transfer Theorems – Impedance matching of source and load</td><td>3 hours</td></tr>
<tr><td>2.</td><td colspan="3">Sinusoidal steady state Response of RLC circuits</td><td>3 hours</td></tr>
<tr><td>3.</td><td colspan="3">Three phase power measurement for ac loads</td><td>3 hours</td></tr>
<tr><td>4.</td><td colspan="3">Staircase wiring circuit layout for multi storey building</td><td>3 hours</td></tr>
<tr><td>5.</td><td colspan="3">Fabricate and test a PCB layout for a rectifier circuit</td><td>3 hours</td></tr>
<tr><td>6.</td><td colspan="3">Half and full adder circuits.</td><td>3 hours</td></tr>
<tr><td>7.</td><td colspan="3">Full wave Rectifier circuits used in DC power supplies. Study the characteristics of the semiconductor device used</td><td>3 hours</td></tr>
<tr><td>8.</td><td colspan="3">Regulated power supply using zener diode. Study the characteristics of the Zener diode used</td><td>3 hours</td></tr>
<tr><td>9.</td><td colspan="3">Lamp dimmer circuit (Darlington pair circuit using transistors) used in cars. Study the characteristics of the transistor used</td><td>3 hours</td></tr>
<tr><td>10.</td><td colspan="3">Characteristics of MOSFET</td><td>3 hours</td></tr>
<tr><td colspan="4">Total Laboratory Hours</td><td>30 hours</td></tr>
<tr><td colspan="5">Mode of assessment: CAT / Assignment / Quiz / FAT / Project / Seminar</td></tr>
<tr><td colspan="2">Recommended by Board of Studies</td><td colspan="3">29/05/2015</td></tr>
<tr><td colspan="2">Approved by Academic Council</td><td>37th AC</td><td>Date</td><td>16/06/2015</td></tr>
</table>

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:

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

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

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, Graph colouring, covering, Partitioning	12 hours

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	• 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)

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

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

MAT3004	Applied Linear Algebra	L	T	P	J	C
		3	2	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	• 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, 9th Edition Pearson Education, 2011.

Reference Books

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

Mode of Evaluation

Digital Assignments, Continuous Assessments, Final Assessment Test

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

PROGRAMME ELECTIVE

CSE1006	BLOCKCHAIN AND CRYPTOCURRENCY TECHNOLOGIES	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To understand the mechanism of Blockchain and Cryptocurrency.
2. To understand the functionality of current implementation of blockchain technology.
3. To understand the required cryptographic background.
4. To explore the applications of Blockchain to cryptocurrencies and understanding limitations of current Blockchain.
5. An exposure towards recent research.

Expected Course Outcome:

1. To Understand and apply the fundamentals of Cryptography in Cryptocurrency
2. To gain knowledge about various operations associated with the life cycle of Blockchain and Cryptocurrency
3. To deal with the methods for verification and validation of Bitcoin transactions
4. To demonstrate the general ecosystem of several Cryptocurrency
5. To educate the principles, practices and policies associated Bitcoin business

Student Learning Outcomes (SLO):	**9, 17**

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

Module:1	**Introduction to Cryptography and Cryptocurrencies**	**5 hours**

Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency.

Module:2	**How Blockchain Achieves and How to Store and Use**	**7 hours**

Decentralization-Centralization vs. Decentralization-Distributed consensus, Consensus with- out identity using a blockchain, Incentives and proof of work. Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

Module:3	**Mechanics of Bitcoin**	**5 hours**

Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bit- coin network, Limitations and improvements.

Module:4	**Bitcoin Mining**	**5 hours**

The task of Bitcoin miners, Mining Hardware, Energy consumption and ecology, Mining pools, Mining incentives and strategies

Module:5	**Bitcoin and Anonymity**	**5 hours**

Anonymity Basics, How to De-anonymize Bitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash.

Module:6	**Community, Politics, and Regulation**	**9 hours**

Consensus in Bitcoin, Bitcoin Core Software, Stakeholders: Who"s in Charge, Roots of Bitcoin, Governments Notice on Bitcoin, Anti Money Laundering Regulation, New York"s Bit License Proposal. Bitcoin as a Platform: Bitcoin as an Append only Log, Bitcoins as Smart Property, Secure Multi Party Lotteries in Bitcoin, Bitcoin as Public Randomness, Source-Prediction Markets, and Real World Data Feeds.

Module:7	**Altcoins and the Cryptocurrency Ecosystem**	**7 hours**
Altcoins: History and Motivation, A Few Altcoins in Detail, Relationship Between Bitcoin and Altcoins, Merge Mining-Atomic Crosschain Swaps-6 BitcoinBacked Altcoins, Side Chains, Ethereum and Smart Contracts.		
Module:8	**Recent Trends and applications**	**2 hours**

	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Narayanan, A., Bonneau, J., Felten, E., Miller, A., and Goldfeder, S. (2016). Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press.
Reference Books	
1.	Antonopoulos, A. M. (2014). Mastering Bitcoin: unlocking digital cryptocurrencies. OReilly Media, Inc.”.
2.	Franco, P. (2014). Understanding Bitcoin: Cryptography, engineering and economics. John Wiley and Sons.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	10-08-2018		
Approved by Academic Council	No. 52	Date	14-09-2018

CSE3006	EMBEDDED SYSTEMS DESIGN	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**CSE2006-Microprocessor and Interfacing**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To expose students to various challenges and 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:

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**

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. 47	Date	05-10-2017

CSE3009	INTERNET OF THINGS	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To apprise students with basic knowledge of IoT that paves a platform to understand physical, logical design and business models
2. 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.
3. To explain the students how to code for an IoT application and deploy for real-time scenario.

Expected Course Outcome:

1. Describe various layers of IoT protocol stack and describe protocol functionalities.
2. Evaluate efficiency trade-offs among alternative communication models for an efficient IoT application design.
3. Comprehend advanced IoT applications and technologies from the basics of IoT.
4. Understand working principles of various sensor for different IoT platforms.
5. Estimate the cost of hardware and software for low cost design IoT applications.
6. Compare various application business models of different domains.
7. Solve real-time problems and demonstrate IoT applications in various domains using prototype models.

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	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 Con- trol 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 plat- formReading 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	2	0	4
Pre-requisite	**NIL**	**Syllabus version**				
		v.2.0				

Course Objectives:

1. To introduce the parts of robots, basic working concepts and types of robots
2. To make the students familiar with the various drive systems of robots, sensors and their applications in robots
3. To discuss the applications and implementation of robots

Expected Course Outcome:

1. Explain the basic working concepts of robots
2. Analyze the function of sensor in robot and design the robotic arm with various tools
3. Program the robot for typical application and path planning of robot using robotic vision
4. Understand the various robot programming languages
5. Conduct and design the experiments for various robot operations
6. Use the advanced techniques for robot processing

Student Learning Outcomes (SLO): 1, 6, 17

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 constraint
17. Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

Module:1	**Introduction**	**3 hours**

Introduction, brief history, components of robotics, classification, workspace, work-envelop, motion of robotic arm, end-effectors and its types, service robot and its application, Artificial Intelligence in Robotics.

Module:2	**Actuators and sensors**	**7 hours**

Types 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

Module:3	**Kinematics of robots**	**6 hours**

Representation of joints and frames, frames transformation, homogeneous matrix, D-H matrix, Forward and inverse kinematics: two link planar (RR) and spherical robot (RRP). Mobile robot Kinematics: Differential wheel mobile robot.

Module:4	**Localization**	**6 hours**

Self-localizations and mapping - Challenges in localizations – IR based localizations – vision based localizations – Ultrasonic based localizations - GPS localization systems.

Module:5	**Path Planning**	**6 hours**

Introduction, path planning-overview-road map path planning-cell decomposition path planning-potential field path planning-obstacle avoidance-case studies

Module:6	**Vision system**	**6 hours**

Robotic vision systems-image representation-object recognition-and categorization-depth measurement- image data compression-visual inspection-software considerations

Module:7	Application	9 hours
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. Richared D.Klafter. Thomas Achmielewski and Mickael Negin, Robotic Engineering and 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, THH-2009
3. ABB reference Manual

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

List of Challenging Experiments (Indicative)

Study of robotics part and microcontroller family and programming environments	2 hours
1. Sensor interface application program development (Like IR, Ultrasonic, etc.)	4 hours
2. Motor interface application development	4 hours
3. Sensor and motor interface control aspects	4 hours
4. Robotic ARM design and simulation	4 hours
5. Vision system simulation	4 hours
6. Interactive –Chat Bots	4 hours
7. Application of robot1- Firefighting robot simulation	2 hours
8. Application of robot2- Drones simulation	2 hours
9. Application of robot3- Service robot simulation	2 hours
Total Laboratory Hours	32 hours

Mode of assessment:

Recommended by Board of Studies	DD-MM-YYYY		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

CSE3013	ARTIFICIAL INTELLIGENCE	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To impart artificial intelligence principles, techniques and its history
2. To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems
3. To develop intelligent systems by assembling solutions to concrete computational problems

Expected Course Outcome:

1. Evaluate Artificial Intelligence (AI) methods and describe their foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
3. Demonstrate knowledge of reasoning and knowledge representation for solving real world problems
4. Analyze and illustrate how search algorithms play vital role in problem solving
5. Illustrate the construction of learning and expert system
6. Discuss current scope and limitations of AI and societal implications.

Student Learning Outcomes (SLO): 1, 7, 17

2. Having an ability to apply mathematics and science in engineering applications
7. Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)
17. 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

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:

1. To understand the fundamentals of images and key image features for image and video retrieval.
2. To provide the exposure on importance of similarity measures in content-based image and video retrieval.
3. To design the algorithm for content-based image retrieval and classify images using machine learning algorithms.

Expected Course Outcome:

1. Understand the basic feature extraction methods used in Content based Image and Video retrieval to build the robust feature vectors for the Images.
2. Extract the features based on various color models and apply on image and video retrieval.
3. Apply texture and shape features for retrieval using various texture and shape models.
4. Classify videos and image frames based on motion features.
5. Apply similarity metrics to compute the distance between two images or videos.
6. Use high level features using SIFT, SURF, color histograms and wavelets for image and video retrieval.
7. Explore the computer vision tool box for object detection, tracking and processing videos.

Student Learning Outcomes (SLO): 2, 7, 14

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.

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 Retreival System and Gap Analysis for Visual Art Image Retreival 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

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:

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:

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**

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:

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:

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**

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 centralizationdensity reciprocity transitivity ego network measures for ego network - dyadic network triadic network - cliques - groups- clustering search.

Module:3	**Community networks**	**6 hours**

Community structure - modularity, overlapping communities - detecting communities in social networks – Discovering communities: methodology, applications - community measurement - evaluating communities – applications.

Module:4	**Models**	**7 hours**

Small world network - WattsStrogatz networks - Statistical Models for Social Networks Net- work evolution models: dynamical models, growing models - Nodal attribute model: expo- nential random graph models Preferential attachment - Power Law - random network model: Erdos-Renyi and Barabasi-AlbertEpidemics - Hybrid models of Network Formation.

Module:5	**Semantic Web**	**7 hours**

Modelling and aggregating social network data developing social semantic application eval- uation 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:

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:

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

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 eefficiency 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 Pro- gram - 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:

1. To provide an in-depth introduction to technologies and techniques used in the game industry.
2. To recognize the processes, mechanics, issues in game design and game engine development.
3. 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

1. Identify the human roles involved in the game industry and describe their responsibilities.
2. Create and produce digital components, games and documentation using a variety of Game Engines.
3. Design the graphics based games and learn to manage the graphics devices.
4. Construct the game using artificial intelligence and physics based modeling.
5. Create various types of games with different types of modes and perspectives.
6. Develop, test, and evaluate procedures of the creation, design and development of games.
7. 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

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 simulationin games	2 hours
8	Understand UI design in games	2 hours
9	Writeagame designdocument	2 hours
10	Explore the role of AI in games	4 hours
11	Scripting with Lua	2 hours
12	Practiceprogrammingtechniquesanddiscussthebenefitsandchallengesofusing 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

Mode of evaluation:

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

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 Reminder 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, Voltality, 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 Shackleford, 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:

1. To provide knowledge on high performance computing concepts to the students.
2. To comprehend the students how to analyze the parallel programming through OpenMP, MPI, CUDA.
3. To teach the student how to apply job management techniques and evaluate the performance.

Expected Course Outcome:

1. To knowledge the overview and analyze the performance metrics of high performance computing.
2. To comprehend the various High Performance Computing Paradigms and Job Management Systems.
3. To design and develop various applications with OpenMP, MPI and CUDA.
4. To analyze the benchmarks of high performance computing.
5. To demonstrate the various emerging trends of high performance computing.
6. 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: Falkon, 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:

1. 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
2. To make the learners to think in design perspective and to evaluate interactive design
3. To use the concepts and principles of HCI to analyze and propose solution for real life applications
4. To become familiar with recent technology trends and challenges in HCI domain

Expected Course Outcome:

1. Enumerate the basic concepts of human, computer interactions
2. Create the processes of human computer interaction life cycle
3. Analyze and design the various interaction design models
4. Apply the interface design standards/guidelines for evaluating the developed interactions
5. Establish the different levels of communication across the application stakeholders
6. Apply product usability evaluations and testing methods
7. 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

Shneideman's eight golden rules, Norman's Sever 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:

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:

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**

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, Multiplication, 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-Smoothening spatial filters-Sharpening spatial filters- Discrete Fourier Transform-Discrete Cosine Transform-Haar Transform -Hough Transform-Frequency filtering-Smoothening 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- Huffmann 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
		3	0	2	0	4
Pre-requisite	**MAT2001**	**Syllabus version**				
		v1.1				

Course Objectives:

1. Basic ability to understand the concept of supervised and unsupervised learning techniques
2. Differentiate regression, classification and clustering techniques and to implement these algorithms.
3. To analyze the performance of various machine learning techniques
4. To select appropriate features for training machine learning algorithms and to reduce the dimension of the dataset.
5. To find an efficient method to handle missing and imbalanced data and to combine different machine learning algorithms to achieve a better results.

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**	**4 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**	**7 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**	**7 hours**

Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K-Nearest Neighbors.

Module:4	**Ensemble Learning**	**6 hours**

Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: Random Forest Trees, Boosting: Adaboost, Stacking.

Module:5	**Unsupervised Learning - I**	**8 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**	**6 hours**

Principal components analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis.

Module:7	Machine Learning in Practice	7 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 in Machine Learning	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

CSE4022	NATURAL LANGUAGE PROCESSING	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**Nil**	**Syllabus version**				
		v1.0				

Course Objectives:

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:

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**

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
17.Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

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.	NitinIndurkhya, 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 Secuirty - 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.	1. Get the HelloVIT midlet on the "getting started" page working. 2. Make some changes - e.g. the text of the String item. 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. 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. 5. Modify the MIDlet by additing these additional items to the form e.g. TexField, DateField, Gauge. Look up the lcdui package to see what Items can be added and the parameters needed.. 6. You can output to the PC console while the program is running e.g. place this code in the constructor: *System.out.println("in Constructor"); // This will ouput on the PC console, not on the phone* 7. Now add :*System.out.println("in CommandAction method");* to the Command Action method to see when that method is running. 8. Add more*Sytem.out.println's*in the following methods: 1. startApp 2. pauseApp 3. destroyApp 9. Note the sequence of method calls from MIDlet start to end.	4 Hours
2	**First MIDlet - adding a new command** 1. Continue to add to 2.0 First MIDlet by adding an "OK" command (look up the API command class) 2. Have the"OK" command display on the phone's screen. 3. Add code to process the "OK" command 4. In the actionCommand method display the contents of the TextFrield using System.out.println ( ) 5. Add two more commands e.g. Send, Spell Check. 6. Where were they placed? 7. Add code to check for these commands - add System.out.println's to show	4 Hours

	when that code is being executed. 8. Now use System.out.prinln in the OK processing code ad see the text being modified while the program runs. 9. Add another System.out.prinln 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)	
3	**Additon MIDlet** 1. Create a MIDlet that allows you to enter a number. The number is then added to any prevous number and the running total result is displayed. Use a TextBox to recieve text from the user (instead of a Form as in the previous example). 2. Can you crash the program by entering text instead of numbers? If you can then constrain the user input to numbers only.	4 Hours
4	**Additon MIDlet on a real phone** 1. For the addition MIDlet : Use the IDE to Create a JAR file. 2. (Optionally) Transfer the JAR file to you phone and test. See handout on how to create and deploy a JAR file.	4 Hours
5	**Battery Status** 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)	4 Hours
6	**Secret Text** 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: **MLKJIHGFEDCBA** **NOPQRSTUVWXYZ** So A -> Z, N-> M, B-> Y, O->L etc Display the encrypted text back in the TextField (so pressing enter should give you back the original text). Display the length of the entered text using the Label. 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: **MLKJIHGFEDCBA** **NOPQRSTUVWXYZ** So A -> Z, N-> M, B-> Y, O->L etc Display the encrypted text back in the TextField (so pressing enter should give you back the original text). Display the length of the entered text using the Label.	5 Hours
7	**Missing Letter Game** 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.	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):

1. To make the students understand the essential and fundamental aspects of object oriented concepts along with their applications.
2.To discuss and explore different analysis models, design and implement models of object-oriented software systems by means of a mid-sized project.
3.To teach the students a solid foundation on different software development life cycle of Object-Oriented solutions for Real-World Problems

Expected Course Outcome (Cos):

1.Identify and select suitable Process Model for the given problem and have a thorough understanding of various Software Life Cycle models.
2.Analyze the requirements of the given software project and produce requirement specifications.
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.
4.Apply various software architectures, including frameworks and design patterns, when developing software projects.
5.Evaluate the software project using various Testing techniques.
6.Predict the deployment strategy of the software project.
7.Recognize the Configuration Management strategies of the software project

Student Learning Outcomes (SLO):	**2,5,12,17**

2.Having a clear understanding of the subject related concepts and of contemporary issues
5.Having design thinking capability
12.Having adaptive thinking and adaptability
17.Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

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

Course code	Course Title	L	T	P	J	C
CSE2014	Compiler Design	3	0	2	0	4
Pre-requisite	CSE2013 Theory of Computation	Syllabus version				

Course Objectives:

1. To provide foundation for study of high performance compiler design.
2. To make students familiar with lexical analysis and parsing techniques.
3. To understand the various actions carried out in semantic analysis.
4. To make the students to get familiar how the intermediate code is generated.
5. To understand the principles of code optimization techniques.
6. To provide fundamental knowledge of various language translators.

Expected Course Outcome:

1. Demonstrate the functioning of a Compiler and to develop a firm and enlightened grasp of concepts such as higher level programming, assemblers, automata theory, and formal languages, language specifications.
2. Develop language specifications using context free grammars (CFG).
3. Apply the ideas, the techniques, and the knowledge acquired for the purpose of developing software systems.
4. Constructing symbol tables and generating intermediate code.
5. Obtain insights on compiler optimization.
6. Apply the skills on devising, selecting and using tools and techniques towards compiler design

Student Learning Outcomes (SLO): 1, 2, 5

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 and apply them to identify, formulate and analyse complex engineering problems.
5. Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice

Module:1	INTRODUCTION TO COMPILATION AND LEXCIAL ANALYSIS	7 hours	CO: 1

Introduction to programming language translators-Structure and Phases of a Compiler-Design Issues-Patterns-Lexemes-Tokens-Attributes-Specification of Tokens-Extended Regular Expression- Regular expression to Deterministic Finite Automata (Direct method).

Module:2	SYNTAX ANALYSIS –TOP DOWN	5 hours	CO: 2

Role of Parser- Parse Tree - Elimination of Ambiguity - Top Down Parsing - Recursive Descent Parsing - Non Recursive Descent Parsing - Predictive Parsing - LL(1) Grammars.

Module:3	SYNTAX ANALYSIS –BOTTOM UP	7 hours	CO: 2

Shift Reduce Parsers- Operator Precedence Parsing -LR Parsers,Construction of SLR Parser Tables and Parsing, CLR Parsing, LALR Parsing

Module:4	SEMANTICS ANALYSIS	6 hours	CO: 4

Syntax Directed Definition – Evaluation Order - Applications of Syntax Directed Translation - Syntax Directed Translation Schemes - Implementation of L attributed Syntax Directed Definition.			
Module:5	**INTERMEDIATE CODE GENERATION**	**6 hours**	**CO: 6**
Variants of Syntax trees - Three Address Code- Types – Declarations - Procedures - Assignment Statements - Translation of Expressions - Control Flow - Back Patching- Switch Case Statements.			
Module:6	**CODE OPTIMIZATION**	**6 hours**	**CO: 5**
Loop optimizations- Principal Sources of Optimization -Introduction to Data Flow Analysis - Basic Blocks - Optimization of Basic Blocks - Peephole Optimization- The DAG Representation of Basic Blocks -Loops in Flow Graphs.			
Module:7	**CODE GENERATION**	**6 hours**	**CO: 6**
Issues in the design of a code generator- Target Machine- Next-Use Information - Register Allocation and Assignment, Runtime Organization, Activation Records.			
Module:8	**RECENT TRENDS**	**2 hours**	**CO: 6**
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	A. V. Aho, Monica S. Lam, Ravi Sethi and Jeffrey D. Ullman, Compilers: Principles, techniques, & tools, Second Edition, Pearson Education, 2007.
2.	K. D. Cooper and L. Torczon, Engineering a compiler, Morgan Kaufmann, 2nd edition, 2011.
3.	Steven S.Muchnick "Advanced Compiler design implementation", Elsevier Science India, 2003.
Reference Books	
1.	Andrew A.Appel , Modern Compiler Implementation in Java, Cambridge University Press; 2nd edition, 2002.
2.	Allen Holub, Compiler Design in C, Prentice Hall, 1990
3.	Torbengidius Mogensen, Basics of Compiler Design, Springer, 2011.
4.	Charles N, Ron K Cytron, Richard J LeBlanc Jr., Crafting a Complier, Pearson Education, 2010.

Mode of Evaluation:CAT/ Digital Assignment/Quiz/FAT/ Project.

List of Experiments		**CO: 3**
1.	Write a LEX program to recognize valid arithmetic expression. Identifiers in the expression could be only integers and operators could be + and *. Count the identifiers & operators present and print them separately.	3 hours
2.	Write a LEX program to eliminate comment lines in a C program and copy the resulting program into a separate file	3 hours
3.	Write YACC program to recognize all strings for which starts with n number of 'a' followed by n number of 'b'.	3 hours
4.	Write YACC program to recognize valid identifier, operators and keywords in the given text (C program) file.	3 hours
5.	Implementation of calculator using lex and yacc.	3 hours

6.	Convert the bnf rules into yacc form and write code to generate abstract syntax tree	3 hours
7.	SCHEME EXPRESSION Write a scheme expression that evaluates the polynomial Write 5 *(4.5 - 8.5) + 77 as a scheme expression, and find its value. Define a function middle that takes five numbers as argument and returns the middle of the five	3 hours
8.	Intro to Flex and Bison Modify the scanner and parser so that terminating a statement with ";b" instead of ";" results in the output being printed in binary.	3 hours
9.	Write a recursive descent parser for the CFG language and implement it using LLVM	3 hours
10.	Write a LR parser for the CFG language and implement it in the using LLVM	3 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment:Assessment Examination, FAT Lab Examination			
Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

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 Strum-Liouville"s problem
5. Know the Z-transform and its application in population dynamics and digital signal processing
6. Demonstrate MATLAB programming for engineering problems

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	**Strum Liouville's problems and power series Solutions**	**6 hours**
The Strum-Liouville"s Problem - Orthogonality of Eigen functions - Series solutions of differential equations about ordinary and regular singular points - Legendre differential equation - Bessel"s differential equation		
Module:6	**Z-Transform**	**6 hours**
Z-transform -transforms of standard functions - Inverse Z-transform: by partial fractions and convolution method		
Module:7	**Difference equations**	**5 hours**
Difference equation - First and second order difference equations with constant coefficients - Fibonacci sequence - Solution of difference equations - Complementary function - Particular integral by the method of undetermined coefficients - Solution of simple difference equations using Z-transform		
Module:8	**Contemporary Issues**	**2 hours**
Industry Expert Lecture		
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, John Wiley India, 2015
Reference Books	
1.	Higher Engineering Mathematics, B. S. Grewal, 43rd Edition, Khanna Publishers, India, 2015
2.	Advanced Engineering Mathematics by Michael D. Greenberg, 2nd Edition, Pearson Education, Indian edition, 2006

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

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:

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

Expected Course Outcome:

Students will be able to

1. Students will **recognize** the environmental issues in a problem oriented interdisciplinary perspectives
2. Students will **understand** the key environmental issues, the science behind those problems and potential solutions.
3. Students will **demonstrate** the significance of biodiversity and its preservation
4. Students will **identify** various environmental hazards
5. Students will **design** various methods for the conservation of resources
6. Students will **formulate** action plans for sustainable alternatives that incorporate science, humanity, and social aspects
7. Students will have foundational **knowledge** enabling them to make sound life decisions as well as enter a career in an environmental profession or higher education.

Student Learning Outcomes (SLO):	1,2,3,4,5,9,11,12

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

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

Module:2	**Biodiversity**	**6 hours**
Importance, types, mega-biodiversity; Species interaction - Extinct, endemic, endangered and rare species; Hot-spots; GM crops- Advantages and disadvantages; Terrestrial biodiversity and Aquatic biodiversity – Significance, Threats due to natural and anthropogenic activities and Conservation methods.		
Module:3	**Sustaining Natural Resources and Environmental Quality**	**7 hours**
Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards. Water footprint; virtual water, blue revolution. Water quality management and its conservation. Solid and hazardous waste – types and waste management methods.		
Module:4	**Energy Resources**	**6 hours**
Renewable - Non renewable energy resources- Advantages and disadvantages - oil, Natural gas, Coal, Nuclear energy. Energy efficiency and renewable energy. Solar energy, Hydroelectric power, Ocean thermal energy, Wind and geothermal energy. Energy from biomass, solar-Hydrogen revolution.		
Module:5	**Environmental Impact Assessment**	**6 hours**
Introduction to environmental impact analysis. EIA guidelines, Notification of Government of India (Environmental Protection Act – Air, water, forest and wild life). Impact assessment methodologies. Public awareness. Environmental priorities in India.		
Module:6	**Human Population Change and Environment**	**6 hours**
Urban environmental problems; Consumerism and waste products; Promotion of economic development – Impact of population age structure – Women and child welfare, Women empowerment. Sustaining human societies: Economics, environment, policies and education.		
Module:7	**Global Climatic Change and Mitigation**	**5 hours**
Climate disruption, Green house effect, Ozone layer depletion and Acid rain. Kyoto protocol, Carbon credits, Carbon sequestration methods and Montreal Protocol. Role of Information technology in environment-Case Studies.		
Module:8	**Contemporary issues**	**2 hours**
Lecture by Industry Experts		
	Total Lecture hours:	**45 hours**
Text Books		

1.	G. Tyler Miller and Scott E. Spoolman (2016), Environmental Science, 15th Edition, Cengage learning.		
2.	George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment – Principles, Connections and Solutions, 17th Edition, Brooks/Cole, USA.		
Reference Books			
1.	David M.Hassenzahl, Mary Catherine Hager, Linda R.Berg (2011), Visualizing Environmental Science, 4thEdition, John Wiley & Sons, USA.		
Mode of evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT			
Recommended by Board of Studies	12.08.2017		
Approved by Academic Council	No. 46	Date	24.08.2017

CHY1701	Engineering Chemistry (UC)	L	T	P	J	C
		3	0	2	0	4
Pre-requisite	**Chemistry of 12th 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, 9th Reprint, 2015. 3. B. Sivasankar, Engineering Chemistry 1st Edition, Mc Graw Hill Education (India), 2008 4. Photovoltaic solar energy : From fundamentals to Applications , Ang le Reinders, Pierre Verlinden, Wilfried van Sark, Alexandre Freundlich, Wiley publishers, 2017.
Reference Books	
2	1. O.V. Roussak and H.D. Gesser, ***Applied Chemistry-A Text Book for Engineers and Technologists***, Springer Science Business Media, New York, 2nd Edition, 2013. 2. S. S. Dara, ***A Text book of Engineering Chemistry,*** S. Chand & Co Ltd., New Delhi, 20th Edition, 2013.
Mode of Evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT	

List of Experiments

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

Recommended by Board of Studies	31-05-2019		
Approved by Academic Council	54th 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:

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

Expected Course Outcome:

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

Student Learning Outcomes (SLO): 1, 12, 14

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** A register is a component of a computer processor that can hold any type of	15 hours

	data and can be accessed faster. As registers are faster to access, it is desirable to use them to the maximum so that the code execution is faster. For each code submitted to the processor, a register interference graph (RIG) is constructed. In a RIG, a node represents a temporary variable and an edge is added between two nodes (variables) t1 and t2 if they are live simultaneously at some point in the program. During register allocation, two temporaries can be allocated to the same register if there is no edge connecting them. Given a RIG representing the dependencies between variables in a code, implement an algorithm to determine the number of registers required to store the variables and speed up the code execution	
5.	**Selective Job Scheduling Problem** A server is a machine that waits for requests from other machines and responds to them. The purpose of a server is to share hardware and software resources among clients. All the clients submit the jobs to the server for execution and the server may get multiple requests at a time. In such a situation, the server schedule the jobs submitted to it based on some criteria and logic. Each job contains two values namely time and memory required for execution. Assume that there are two servers that schedules jobs based on time and memory. The servers are named as Time Schedule Server and memory Schedule Server respectively. Design a OOP model and implement the time Schedule Server and memory Schedule Server. The Time Schedule Server arranges jobs based on time required for execution in ascending order whereas memory Schedule Server arranges jobs based on memory required for execution in ascending order	15 hours
6.	**Fragment Assembly in DNA Sequencing** DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other organisms. The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), and thymine (T). In DNA sequencing, each DNA is sheared into millions of small fragments (reads) which assemble to form a single genomic sequence (superstring). Each read is a small string. In such a fragment assembly, given a set of reads, the objective is to determine the shortest superstring that contains all the reads. For example, given a set of strings, 000, 001, 010, 011, 100, 101, 110, 111 the shortest superstring is 0001110100. Given a set of reads, implement an algorithm to find the shortest superstring that contains all the given reads.	15 hours
7.	**House Wiring** An electrician is wiring a house which has many rooms. Each room has many power points in different locations. Given a set of power points and the distances between them, implement an algorithm to find the minimum cable required.	10 hours
	Total Laboratory Hours	**90 hours**

Text Book(s)	
1.	Stanley B Lippman, Josee Lajoie, Barbara E, Moo, C++ primer, Fifth edition, Addison-Wesley, 2012.
2	Ali Bahrami, Object oriented Systems development, Tata McGraw - Hill Education, 1999.
3	Brian W. Kernighan, Dennis M. Ritchie , The C programming Language, 2nd edition, Prentice Hall Inc., 1988.
Reference Books	
1.	Bjarne stroustrup, The C++ programming Language, Addison Wesley, 4th edition, 2013
2.	Harvey M. Deitel and Paul J. Deitel, C++ How to Program, 7th edition, Prentice Hall, 2010
3.	Maureen Sprankle and Jim Hubbard, Problem solving and Programming concepts, 9th edition, Pearson Eduction, 2014.
Mode of assessment: **PAT / CAT / FAT**	
Recommended by Board of Studies	29-10-2015

Approved by Academic Council	No. 39	Date	17-12-2015

CSE1902	Industrial Internship	L	T	P	J	C
		0	0	0	0	1
Pre-requisite	Completion of minimum of Two semesters					

Course Objectives:

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

Expected Course Outcome:

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

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

Student Learning Outcomes (SLO):	**2, 9, 11, 13, 16**

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

CSE1901	Technical Answers for Real World Problems (TARP)	L	T	P	J	C
		1	0	0	4	2
Pre-requisite	**Nil**	**Syllabus version**				
		1.0				

Course Objectives:

- 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 ofthe 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

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

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**

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

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

Recommended by Board of Studies	28-02-2016		
Approved by Academic Council	No.37	Date	16-06-2015

CSE1903	Comprehensive Examination	L	T	P	J	C
		0	0	0	0	1
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

CSE1904	Capstone Project	L	T	P	J	C
		0	0	0	0	12
Pre-requisite	**As per the academic regulations**	**Syllabus version**				
		v. 1.0				

Course Objectives:

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

Expected Course Outcome:

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

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

Student Learning Outcomes (SLO):	**5, 6, 20**

Contents

1. Capstone Project may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.

2. Project can be for one or two semesters based on the completion of required number of credits as per the academic regulations.

3. Can be individual work or a group project, with a maximum of 3 students.

4. In case of group projects, the individual project report of each student should specify the individual's contribution to the group project.

5. Carried out inside or outside the university, in any relevant industry or research institution.

6. Publications in the peer reviewed journals / International Conferences will be an added advantage

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

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

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

Course Code	Course Title	L	T	P	J	C
ENG1901	Technical English - I	0	0	4	0	2
Pre-requisite	Foundation English-II	Syllabus Version				
		1				

Course Objectives:

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

Expected Course Outcome:

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

Student Learning Outcomes (SLO):	**3,16, 18**

3 . Having ability to be socially intelligent with good SIQ (Social Intelligence Quotient) and EQ
(Emotional Quotient)
16 . Having good working knowledge of communicating i n English
18. Having critical thinking and innovative skills

Module:1	**Advanced Grammar (CO: 1,2)**	**4 hours**

Articles, Tenses, Voice and Prepositions
Activity: Worksheets on Impersonal Passive Voice, Exercises from the prescribed text

Module:2	**Vocabulary Building I (CO:2&5)**	**4 hours**

Idioms and Phrases, Homonyms, Homophones and Homographs
Activity: Jigsaw Puzzles; Vocabulary Activities through Web tools

Module:3	**Listening for Specific Purposes (CO:4&5)**	**4 hours**

Gist, monologues, short conversations, announcements, briefings and discussions
Activity: Gap filling; Interpretations

Module:4	**Speaking for Expression (CO:3&4)**	**6 hours**

Introducing oneself and others, Making Requests & responses, Inviting and Accepting/Declining Invitations
Activity: Brief introductions; Role-Play; Skit.

Module:5	**Reading for Information (CO: 5&4)**	**4 hours**

Reading Short Passages, News Articles, Technical Papers and Short Stories
Activity: Reading specific news paper articles; blogs

Module:6	**Writing Strategies (CO:5&3)**	**4 hours**
Joining the sentences, word order, sequencing the ideas, introduction and conclusion Activity: Short Paragraphs; Describing familiar events; story writing		
Module:7	**Vocabulary Building II (CO:2,3&5)**	**4 hours**
Enrich the domain specific vocabulary by describing Objects, Charts, Food, Sports and Employment. Activity: Describing Objects, Charts, Food, Sports and Employment		
Module:8	**Listening for Daily Life (CO: 4 &5)**	**4 hours**
Listening for statistical information, Short extracts, Radio broadcasts and TV interviews Activity: Taking notes and Summarizing		
Module:9	**Expressing Ideas and Opinions (3,4 &5)**	**6 hours**
Telephonic conversations, Interpretation of Visuals and describing products and processes. Activity: Role-Play (Telephonic); Describing Products and Processes		
Module: 10	**Comprehensive Reading (1,2&5)**	**4 hours**
Reading Comprehension, Making inferences, Reading Graphics, Note-making, and Critical Reading. Activity: Sentence Completion; Cloze Tests		
Module: 11	**Narration (5,2 &4)**	**4 hours**
Writing narrative short story, Personal milestones, official letters and E-mails. Activity: Writing an E-mail; Improving vocabulary and writing skills.		
Module:12	**Pronunciation (2,3 &4)**	**4 hours**
Speech Sounds, Word Stress, Intonation, Various accents Activity: Practicing Pronunciation through web tools; Listening to various accents of English		
Module:13	**Editing (1,4&5)**	**4 hours**
Simple, Complex & Compound Sentences, Direct & Indirect Speech, Correction of Errors, Punctuations. Activity: Practicing Grammar		
Module:14	**Short Story Analysis (5,2&3)**	**4 hours**
"The Boundary" by Jhumpa Lahiri Activity: Reading and analyzing the theme of the short story.		
	Total Lecture hours	**60 hours**

Text Book / Workbook	
1.	Wren, P.C.; Martin, H.; Prasada Rao, N.D.V. (1973–2010). *High School English Grammar & Composition*. New Delhi: Sultan Chand Publishers.
2	Kumar, Sanjay,; Pushp Latha. (2018) English Language and Communication Skills for Engineers, India: Oxford University Press.

Reference Books	
1.	Guptha S C, (2012) *Practical English Grammar & Composition*, 1st Edition, India: Arihant Publishers
2.	Steven Brown, (2011) Dorolyn Smith, *Active Listening* ***3,*** 3rd Edition, UK: Cambridge University Press.
3.	Liz Hamp-Lyons, Ben Heasley, (2010) *Study Writing*, 2nd Edition, UK: Cambridge University Pres.
4.	Kenneth Anderson, Joan Maclean, (2013) Tony Lynch, *Study Speaking*, 2nd Edition, UK: Cambridge, University Press.
5.	Eric H. Glendinning, Beverly Holmstrom, (2012) *Study Reading*, 2nd Edition, UK: Cambridge University Press.
6.	Michael Swan, (2017) *Practical English Usage* (Practical English Usage), 4th edition, UK: Oxford University Press.
7.	Michael McCarthy, Felicity O'Dell, (2015) *English Vocabulary in Use Advanced* (South Asian Edition), UK: Cambridge University Press.
8.	Michael Swan, Catherine Walter, (2012) *Oxford English Grammar Course Advanced*, Feb, 4th Edition, UK: Oxford University Press.
9.	Watkins, Peter. (2018) *Teaching and Developing Reading Skills: Cambridge Handbooks for Language teachers*, UK: Cambridge University Press.
10.	(*The Boundary by Jhumpa Lahiri)* URL: https://www.newyorker.com/magazine/2018/01/29/the-boundary?intcid=inline_amp
Mode of evaluation: Quizzes, Presentation, Discussion, Role play, Assignments and FAT	

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

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

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

Course Code	Course Title	L	T	P	J	C
ENG 1902	Technical English - II	0	0	4	0	2

Pre-requisite	71% to 90% EPT score	Syllabus Version
		1

Course Objectives:

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

Expected Course Outcome:

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

Student Learning Outcomes (SLO):	3,16, 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
ving critical thinking and innovative skills

Module:1	Listening for Clear Pronunciation	4 hours

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

Module:2	Introducing Oneself	4 hours

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

Module:3	Effective Writing	6 hours

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

Module:4	Comprehensive Reading	4 hours

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

Module:5	Listening to Narratives	4 hours

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

Module:6	**Academic Writing and Editing**	**6 hours**
Writing: Editing/ Proofreading symbols Citation Formats Structure of an Abstract and Research Paper Activity: Writing Abstracts and research paper; Work with Editing/ Proofreading exercise		
Module:7	**Team Communication**	**4 hours**
Speaking: Group Discussions and Debates on complex/ contemporary topics Discussion evaluation parameters, using logic in debates Activity: Group Discussions on general topics		
Module:8	**Career-oriented Writing**	**4 hours**
Writing: Resumes and Job Application Letters, SOP Activity: Writing resumes and SOPs		
Module:9	**Reading for Pleasure**	**4 hours**
Reading: Reading short stories Activity: Classroom discussion and note-making, critical appreciation of the short story		
Module: 10	**Creative Writing**	**4 hours**
Writing: Imaginative, narrative and descriptive prose Activity: Writing about personal experiences, unforgettable incidents, travelogues		
Module: 11	**Academic Listening**	**4 hours**
Listening: Listening in academic contexts Activity: Listening to lectures, Academic Discussions, Debates, Review Presentations, Research Talks, Project Review Meetings		
Module:12	**Reading Nature-based Narratives**	**4 hours**
Narratives on Climate Change, Nature and Environment Activity: Classroom discussions, student presentations		
Module:13	**Technical Proposals**	**4 hours**
Writing: Technical Proposals Activities: Writing a technical proposal		
Module:14	**Presentation Skills**	**4 hours**
Persuasive and Content-Specific Presentations Activity: Technical Presentations		
	Total Lecture hours:	**60 hours**

Text Book / Workbook

1.	Oxenden, Clive and Christina Latham-Koenig. *New English File: Advanced Students Book*. Paperback. Oxford University Press, UK, 2017.
2	Rizvi, Ashraf. *Effective Technical Communication*. McGraw-Hill India, 2017.

Reference Books

1.	Oxenden, Clive and Christina Latham-Koenig, *New English File: Advanced: Teacher's Book with Test and Assessment*. CD-ROM: Six-level General English Course for Adults. Paperback. Oxford University Press, UK, 2013.
2.	Balasubramanian, T. *English Phonetics for the Indian Students: A Workbook*. Laxmi Publications, 2016.

3.	Philip Seargeant and Bill Greenwell, *From Language to Creative Writing*. Bloomsbury Academic, 2013.
4.	Krishnaswamy, N. *Eco-English*. Bloomsbury India, 2015.
5.	Manto, Saadat Hasan. *Selected Short Stories*. Trans. Aatish Taseer. Random House India, 2012.
6.	Ghosh, Amitav. *The Hungry Tide*. Harper Collins, 2016.
7.	Ghosh, Amitav. *The Great Derangement: Climate Change and the Unthinkable*. Penguin Books, 2016.
8.	*The MLA Handbook for Writers of Research Papers,* 8th ed. 2016.
	Online Sources: https://americanliterature.com/short-short-stories. (75 *short* short stories) http://www.eco-ction.org/dt/thinking.html (Leopold, Aldo."Thinking like a Mountain") /www.esl-lab.com/; www.bbc.co.uk/learningenglish/; /www.bbc.com/news; /learningenglish.voanews.com/a/using-voa-learning-english-to-improve-listening-skills/3815547.html

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

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

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

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

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

Course Code	Course title	L	T	P	J	C
ENG1903	Advanced Technical English	0	0	2	4	2
Pre-requisite	Greater than 90 % EPT score	Syllabus Version				
		1				

Course Objectives:

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

Expected Course Outcome:

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

Student Learning Outcomes (SLO):	3,16, 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	Negotiation and Decision Making Skills through Literary Analysis	5 hours

Concepts of Negotiation and Decision Making Skills
Activity: Analysis of excerpts from Shakespeare's "The Merchant of Venice" (court scene) and discussion on negotiation skills.
Critical evaluation of excerpts from Shakespeare's "Hamlet"(Monologue by Hamlet) and discussion on decision making skills

Module:2	Writing reviews and abstracts through movie interpretations	5 hours

Review writing and abstract writing with competency
Activity: Watching Charles Dickens "Great Expectations" and writing a movie review
Watching William F. Nolan's "Logan's Run" and analyzing it in tune with the present scenario of depletion of resources and writing an abstract

Module:3	Technical Writing	4 hours

Stimulate effective linguistics for writing: content and style
Activity: Proofreading
Statement of Purpose

Module:4	Trans-Cultural Communication	4 hours

Nuances of Trans-cultural communication
Activity:
Group discussion and case studies on trans-cultural communication.
Debate on trans-cultural communication.

Module:5	**Report Writing and Content Writing**	**4 hours**
Enhancing reportage on relevant audio-visuals Activity: Watch a documentary on social issues and draft a report Identify a video on any social issue and interpret		
Module:6	**Drafting project proposals and article writing**	**4 hours**
Dynamics of drafting project proposals and research articles Activity: Writing a project proposal. Writing a research article.		
Module:7	**Technical Presentations**	**4 hours**
Build smart presentation skills and strategies Activity: Technical presentations using PPT and Web tools		
	Total Lecture hours	**30 hours**

Text Book / Workbook	
1.	Raman, Meenakshi & Sangeeta Sharma. *Technical Communication: Principles and Practice*, 3rd edition, Oxford University Press, 2015.
Reference Books	
1	Basu B.N. *Technical Writing*, 2011 Kindle edition
2	Arathoon, Anita. *Shakespeare's The Merchant of Venice* (Text with Paraphrase), Evergreen Publishers, 2015.
3	Kumar, Sanjay and Pushp Lata. *English Language and Communication Skills for Engineers,* Oxford University Press, India, 2018.
4	Frantisek, Burda. *On Transcultural Communication*, 2015, LAP Lambert Academic Publishing, UK.
5	Geever, C. Jane. *The Foundation Center's Guide to Proposal Writing*, 5th Edition, 2007, Reprint 2012 The Foundation Center, USA.
6	Young, Milena. *Hacking Your Statement of Purpose: A Concise Guide to Writing Your SOP*, 2014 Kindle Edition.
7	Ray, Ratri, *William Shakespeare's Hamlet*, The Atlantic Publishers, 2011.
8	C Muralikrishna & Sunitha Mishra, *Communication Skills for Engineers,* 2nd edition, NY: Pearson, 2011.
Mode of Evaluation: Quizzes, Presentation, Discussion, Role Play, Assignments	

List of Challenging Experiments (Indicative)		
1.	Enacting a court scene - Speaking	**6 hours**
2.	Watching a movie and writing a review	**4 hours**
3.	Trans-cultural – case studies	**2 hours**
4.	Drafting a report on any social issue	**6 hours**
5.	Technical Presentation using web tools	**6 hours**
6.	Writing a research paper	**6 hours**
J- Component Sample Projects		
1.	Short Films	
2.	Field Visits and Reporting	

3.	Case studies	
4.	Writing blogs	
5.	Vlogging	
	Total Hours (J-Component)	**60 hours**

Mode of evaluation: Quizzes, Presentation, Discussion, Role play, Assignments and FAT		
Recommended by Board of Studies	08.06.2019	
Approved by Academic Council	55	Date: 13-06-2019

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

Course code	Course title	L	T	P	J	C
PHY1901	Introduction to Innovative Projects	1	0	0	0	1
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

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

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

Expected Course Outcome: Students will be able to

1. Understand the various types of thinking skills.
2. Enhance the innovative and creative ideas.
3. Find out a suitable solution for socially relevant issues- J component

Student Learning Outcomes (SLO):	2,3,9,17,18

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 of100 society related issues, problems for which they need solutions and categories them and upload along with details of people met and lessons learnt. **(4 non-contact hours)**

Module:1 C	Lateral Thinking Skill	1 hour

Blooms Taxonomy – HOTS – Outof the box thinking – deBono lateral thinking model – Examples **Project :** Last weeks - incomplete portion to be done and uploaded		
Module:2 A	**Creativity**	**1 hour**
Creativity Models – Walla – Barrons – Koberg & Begnall – Examples **Project :** Selecting 5 out of 100 issues identified for future work. Criteria based approach for prioritisation, use of statistical tools & upload . **(4 non- contact hours)**		
Module:2 B	**Brainstorming**	**1 hour**
25 brainstorming techniques and examples **Project :** Brainstorm and come out with as many solutions as possible for the top 5 issues identified & upload . **(4 non- contact hours)**		
Module:3	**Mind Mapping**	**1 hour**
Mind Mapping techniques and guidelines. Drawing a mind map **Project :** Using Mind Maps get another set of solutions forthe next 5 issues (issue 6 – 10) . **(4 non- contact hours)**		
Module:4 A	**Systems thinking**	**1 hour**
Systems Thinking essentials – examples – Counter Intuitive condemns **Project :** Select 1 issue / problem for which the possible solutions are available with you. Apply Systems Thinking process and pick up one solution [explanation should be given why the other possible solutions have been left out]. Go back to the customer and assess the acceptability and upload. . **(4 non- contact hours)**		
Module:4 B	**Design Thinking**	**1 hour**
Design thinking process – Human element of design thinking – case study **Project :** Apply design thinking to the selected solution, apply the engineering & scientific tinge to it. Participate in "design week" celebrations upload the weeks learning out come.		
Module:5 A	**Innovation**	**1 hour**
Difference between Creativity and Innovation – Examples of innovation –Being innovative. **Project:** A literature searches on prototyping of your solution finalized. Prepare a prototype model or process and upload. . **(4 non- contact hours)**		
Module:5 B	**Blocks for Innovation**	**1 hour**
Identify Blocks for creativity and innovation – overcoming obstacles – Case Study **Project :** Project presentation on problem identification, solution, innovations-expected results – Interim review with PPT presentation. . **(4 non- contact hours)**		
Module:5 C	**Innovation Process**	**1 hour**
Steps for Innovation – right climate for innovation **Project:** Refining the project, based on the review report and uploading the text. . **(4 non-contact hours)**		
Module:6 A	**Innovation in India**	**1 hour**
Stories of 10 Indian innovations **Project:** Making the project better with add ons. . **(4 non- contact hours)**		
Module:6 B	**JUGAAD Innovation**	**1 hour**
Frugal and flexible approach to innovation - doing more with less Indian Examples **Project:** Fine tuning the innovation project with JUGAAD principles and uploading (Credit for JUGAAD implementation) . **(4 non- contact hours)**		
Module:7 A	**Innovation Project Proposal Presentation**	**1 hour**
Project proposal contents, economic input, ROI – Template **Project:** Presentation of the innovative project proposal and upload . **(4 non- contact hours)**		
Module:8 A	Contemporary issue in Innovation	**1 hour**

Contemporary issue in Innovation **Project:** Final project Presentation , Viva voce Exam (**4 non- contact hours)**			
	Total Lecture hours:	**15 hours**	
Text Book(s)			
1.	How to have Creative Ideas, Edward debone, Vermilon publication, UK, 2007		
2.	The Art of Innovation, Tom Kelley & Jonathan Littman, Profile Books Ltd, UK, 2008		
Reference Books			
1.	Creating Confidence, Meribeth Bonct, Kogan Page India Ltd, New Delhi, 2000		
2.	Lateral Thinking Skills, Paul Sloane, Keogan Page India Ltd, New Delhi, 2008		
3.	Indian Innovators, Akhat Agrawal, Jaico Books, Mumbai, 2015		
4.	JUGAAD Innovation, Navi Radjou, Jaideep Prabhu, Simone Ahuja Random house India, Noida, 2012.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar Three reviews with weightage of 25 : 25 : 50 along with reports			
Recommended by Board of Studies	15-12-2015		
Approved by Academic Council	No. 39	Date	17-12-2015

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 andpolity
2. To understand the negative health impacts of certain unhealthy behaviors
3. To appreciate the need and importance of physical, emotional health and social health

Expected Course Outcome:

Students will be able to:

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

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 :

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

Expected Course Outcomes:

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

1. apply single variable differentiation and integration to solve applied problems in engineering and find the maxima and minima of functions
2. understand basic concepts of Laplace Transforms and solve problems with periodic functions, step functions, impulse functions and convolution
3. evaluate partial derivatives, limits, total differentials, Jacobians, Taylor series and optimization problems involving several variables with or without constraints
4. evaluate multiple integrals in Cartesian, Polar, Cylindrical and Spherical coordinates.
5. understand gradient, directional derivatives, divergence, curl and Greens", Stokes, Gauss theorems
6. demonstrate MATLAB code for challenging problems in engineering

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 ofcontemporary 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, 13th edition, Pearson, 2014.
[2] Advanced Engineering Mathematics, Erwin Kreyszig, 10th Edition, Wiley India, 2015.

Reference Books

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

Mode of Evaluation

Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test

List of Challenging Experiments (Indicative)		
1.	Introduction to MATLAB through matrices, and general Syntax	2 hours
2	Plotting and visualizing curves and surfaces in MATLAB – Symbolic computations using MATLAB	2 hours
3.	Evaluating Extremum of a single variable function	2 hours
4.	Understanding integration as Area under the curve	2 hours
5.	Evaluation of Volume by Integrals (Solids of Revolution)	2 hours
6.	Evaluating maxima and minima of functions of several variables	2 hours
7.	Applying Lagrange multiplier optimization method	2 hours
8.	Evaluating Volume under surfaces	2 hours
9.	Evaluating triple integrals	2 hours
10.	Evaluating gradient, curl and divergence	2 hours
11.	Evaluating line integrals in vectors	2 hours
12.	Applying Green's theorem to real world problems	2 hours
	Total Laboratory Hours	**24 hours**

Mode of Assessment:

Weekly assessment, Final Assessment Test

Recommended by Board of Studies	12-06-2015		
Approved by Academic Council	No. 37	Date	16-06-2015

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 :

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

Expected Course Outcome:

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

1. Compute and interpret descriptive statistics using numerical and graphical techniques.
2. Understand the basic concepts of random variables and find an appropriate distribution for analysing data specific to an experiment.
3. Apply statistical methods like correlation, regression analysis in analysing, interpreting experimental data.
4. Make appropriate decisions using statistical inference that is the central to experimental research.
5. Use statistical methodology and tools in reliability engineering problems.
6. demonstrate R programming for statistical data

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)

- 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

- 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

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

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

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

Foreseeing and quantifying business and financial risks

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; 1st edition (March 1, 2012)
2	The Four Steps to the Epiphany, Steve Blank, K&S Ranch; 2nd edition (July 17, 2013)
3	The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Eric Ries, Crown Business; (13 September 2011)

Reference Books

1.	Holding a Cat by the Tail, Steve Blank, K&S Ranch Publishing LLC (August 14, 2014)

2	Product Design and Development, Karal T Ulrich, SD Eppinger, McGraw Hill
3	Zero to One: Notes on Startups, or How to Build the Future, Peter Thiel, Crown Business(2014)
4	Lean Analytics: Use Datato Build a Better Startup Faster (Lean Series), Alistair Croll& Benjamin Yoskovitz, O'Reilly Media; 1st Edition (March 21, 2013)
5	Inspired: How To Create Products Customers Love, Marty Cagan, SVPG Press; 1st edition (June 18, 2008)
6	**Website References:** 1. http://theleanstartup.com/ 2. https://www.kickstarter.com/projects/881308232/only-on-kickstarter-the-leaders-guide-by-eric-ries 3. http://businessmodelgeneration.com/ 4. https://www.leanstartupmachine.com/ 5. https://www.youtube.com/watch?v=fEvKo90qBns 6. http://thenextweb.com/entrepreneur/2015/07/05/whats-wrong-with-the-lean-startup-methodology/#gref 7. http://www.businessinsider.in/Whats-Lean-about-Lean-Startup/articleshow/53615661.cms 8. https://steveblank.com/tools-and-blogs-for-entrepreneurs/ 9. https://hbr.org/2013/05/why-the-lean-start-up-changes-everything 10. chventures.blogspot.in/ platformsandnetworks.blogspot.in/p/saas-model.html

Mode of Evaluation: Assignments; Field Trips, Case Studies; e-learning; Learning through research, TED Talks

Project		
1.	Project	60 hours
	Total Project	**60 hours**

Recommended by Board of Studies	08-06-2015		
Approved by Academic Council	37	Date	16-06-2015

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

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 ofoptoelectronic 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

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, CO2 and Dye laser and their engineering applications.

Module:5	Electromagnetic Theory and its application	6 hours

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

Module:6	Propagation of EM waves in Optical fibers and Optoelectronic Devices	10 hours

Light propagation through fibers, Acceptance angle, Numerical Aperture, Types of fibers - step

index, graded index, single mode & multimode, Attenuation, Dispersion-intermodal and intramodal. Sources-LED & Laser Diode, Detectors-Photodetectors- PN & PIN - Applications of fiber optics in communication- Endoscopy.

Module:7	**Special Theory of Relativity**	**5 hours**

Frame of reference, Galilean relativity, Postulate of special theory of relativity, Simultaneity, length contraction and time dilation.

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

Lecture by Industry Experts

	Total Lecture hours:	**45 hours**

Text Book(s)

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

Reference Books

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

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

List of Experiments

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

BRIDGE COURSE

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 notetaking, 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 Puspalata. 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. BarunMitra. Effective Technical Communication: AGuide for Scientists and Engineers. 2015. New Delhi: Oxford University Press.

Mode of evaluation: Online Quizzes, Presentation, Role play, Group Discussions, Assignments, Mini project.			
Recommended by Board of Studies	22-07-2017		
Approved by Academic Council	No. 46	Date	24-08-2017