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

(2019-2020)

B. Tech. Computer Science and Engineering with Specialization in IoT

School of Computer Science and Engineering

B.Tech (CSE) - Specialization in IoT

CURRICULUM AND SYLLABUS

(2019-2020 Admitted Students)

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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.

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B.Tech-CSE (Spl. in Internet of Things)

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.

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B.Tech-CSE (Spl. in Internet of Things)

PROGRAMME OUTCOMES (POs)

PO_1 Having an ability to apply mathematics and science in engineering applications

PO_2 Having a clear understanding of the subject related concepts and of contemporary issues

PO_3 Having an ability to design a component or a product applying all the relevant standards and with realistic constraints

PO_4 Having an ability to design and conduct experiments, as well as to analyze and interpret data

PO_5 Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

PO_6 Having problem solving ability-solving social issues and engineering problems

PO_7 Having adaptive thinking and adaptability

PO_8 Having a clear understanding of professional and ethical responsibility

PO_9 Having cross cultural competency exhibited by working in teams

PO_10 Having a good working knowledge of communicating in English

PO_11 Having a good cognitive load management [discriminate and filter the available data] skills

PO_12 Having interest in lifelong learning

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B.Tech-CSE (Spl. in Internet of Things)

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 inter-connect and communicate among the systems, gadgets, sensors to analysis the data and to collectively perform the task to produce innovative, cost-effective and energy efficient products for the betterment of society and industry.

CREDIT STRUCTURE

Category-wise Credit distribution

CREDIT INFO		
S.no	**Catagory**	**Credits**
1	Programme Core	73
2	Programme Elective	10
3	University Core	53
4	University Elective	12
5	Specialization Elective	12
6	Bridge Course	0
7	Non Credit Course	5
Total Credits		165

Programme Core									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	BCT3001	Wireless Ad-hoc and Sensor Networks	Embedded Theory and Project	1.0	3	0	0	4	4.0
2	BCT3002	Embedded System Architecture and Design	Embedded Theory and Lab	1.0	3	0	2	0	4.0
3	CSE1003	Digital Logic and Design	Embedded Theory and Lab	1.1	3	0	2	0	4.0
4	CSE1004	Network and Communication	Embedded Theory and Lab	1.1	3	0	2	0	4.0
5	CSE1007	Java Programming	Embedded Theory and Lab	1.0	3	0	2	0	4.0
6	CSE2001	Computer Architecture and Organization	Theory Only	1.0	3	0	0	0	3.0
7	CSE2002	Theory of Computation and Compiler Design	Theory Only	1.1	4	0	0	0	4.0
8	CSE2003	Data Structures and Algorithms	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
9	CSE2004	Database Management Systems	Embedded Theory and Lab	1.1	3	0	2	0	4.0
10	CSE2005	Operating Systems	Embedded Theory and Lab	1.1	3	0	2	0	4.0
11	CSE2010	Advanced C Programming	Embedded Theory and Lab	1.0	2	0	2	0	3.0
12	CSE2015	Internet Programming and Web Technologies	Embedded Theory and Lab	1.0	3	0	2	0	4.0
13	CSE2016	Microprocessor and Microcontrollers	Embedded Theory and Lab	1.0	3	0	2	0	4.0
14	CSE3035	Principles of Cloud Computing	Embedded Theory and Lab	1.0	3	0	2	0	4.0
15	ECE3051	Analog and Digital Signal Processing	Embedded Theory and Lab	1.0	3	0	2	0	4.0
16	EEE1001	Basic Electrical and Electronics Engineering	Embedded Theory and Lab	1.0	2	0	2	0	3.0

Programme Core									
17	MAT1014	Discrete Mathematics and Graph Theory	Theory Only	1.1	3	2	0	0	4.0
18	MAT2002	Applications of Differential and Difference Equations	Embedded Theory and Lab	1.0	3	0	2	0	4.0
19	MAT3004	Applied Linear Algebra	Theory Only	1.1	3	2	0	0	4.0

Programme Elective									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	CSE1006	Blockchain and Cryptocurrency Technologies	Theory Only	1.0	3	0	0	0	3.0
2	CSE3001	Software Engineering	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
3	CSE3013	Artificial Intelligence	Embedded Theory and Project	1.0	3	0	0	4	4.0
4	CSE3022	Soft Computing	Embedded Theory and Project	1.0	3	0	0	4	4.0
5	CSE3501	Information Security Analysis and Audit	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
6	CSE3502	Information Security Management	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
7	CSE4003	Cyber Security	Embedded Theory and Project	1.0	3	0	0	4	4.0
8	CSE4007	Mobile Computing	Embedded Theory and Project	1.0	3	0	0	4	4.0
9	CSE4019	Image Processing	Embedded Theory and Project	1.0	3	0	0	4	4.0
10	CSE4020	Machine Learning	Embedded Theory, Lab and Project	1.1	2	0	2	4	4.0
11	CSE4022	Natural Language Processing	Embedded Theory and Project	1.0	3	0	0	4	4.0

University Core									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	CHY1701	Engineering Chemistry	Embedded Theory and Lab	1.0	3	0	2	0	4.0
2	CSE1001	Problem Solving and Programming	Lab Only	1.0	0	0	6	0	3.0

University Core									
3	CSE1002	Problem Solving and Object Oriented Programming	Lab Only	1.0	0	0	6	0	3.0
4	CSE1901	Technical Answers for Real World Problems (TARP)	Embedded Theory and Project	1.0	1	0	0	4	2.0
5	CSE1902	Industrial Internship	Project	1.0	0	0	0	0	1.0
6	CSE1903	Comprehensive Examination	Project	1.0	0	0	0	0	1.0
7	CSE1904	Capstone Project	Project	1.0	0	0	0	0	12.0
8	ENG1901	Technical English - I	Lab Only	1.0	0	0	4	0	2.0
9	ENG1902	Technical English - II	Lab Only	1.0	0	0	4	0	2.0
10	ENG1903	Advanced Technical English	Embedded Lab and Project	1.0	0	0	2	4	2.0
11	FLC4097	Foreign Language Course Basket	Basket	1.0	0	0	0	0	2.0
12	HUM1021	Ethics and Values	Theory Only	1.2	2	0	0	0	2.0
13	MAT1011	Calculus for Engineers	Embedded Theory and Lab	1.0	3	0	2	0	4.0
14	MAT2001	Statistics for Engineers	Embedded Theory and Lab	1.1	3	0	2	0	4.0
15	MGT1022	Lean Start-up Management	Embedded Theory and Project	1.0	1	0	0	4	2.0
16	PHY1701	Engineering Physics	Embedded Theory and Lab	1.0	3	0	2	0	4.0
17	PHY1901	Introduction to Innovative Projects	Theory Only	1.0	1	0	0	0	1.0
18	STS4097	Soft Skills B.Tech. / B.Des.	Basket	1.0	0	0	0	0	6.0

Specialization Elective									
sl.no	**Course Code**	**Course Title**	**Course Type**	**Version**	**L**	**T**	**P**	**J**	**Credits**
1	BCT3004	Privacy and Security in Internet of Things	Embedded Theory and Project	1.0	3	0	0	4	4.0
2	BCT3005	Fundamentals of Fog and Edge Computing	Embedded Theory and Project	1.0	3	0	0	4	4.0
3	BCT3006	Industrial and Medical Internet of Things	Embedded Theory and Project	1.0	2	0	0	4	3.0
4	BCT3007	Programming for Internet of Things Boards	Embedded Theory, Lab and Project	1.0	2	0	2	4	4.0
5	BCT3008	Software Defined Networks	Embedded Theory and Project	1.0	3	0	0	4	4.0
6	BCT4001	Sensors and Actuator Devices	Embedded Theory and Lab	1.0	3	0	2	0	4.0

Specialization Elective									
7	BCT4002	Architecting Smart Internet of Things Devices	Embedded Theory and Project	1.0	3	0	0	4	4.0
8	BCT4003	Wearable Computing	Embedded Theory and Project	1.0	3	0	0	4	4.0
9	BCT4004	Design of Smart Systems	Embedded Theory and Project	1.0	3	0	0	4	4.0
10	BCT4005	Design of Smart Cities	Embedded Theory and Project	1.0	3	0	0	4	4.0
11	BCT4006	Cognitive Internet of Things	Theory Only	1.0	3	0	0	0	3.0
12	BCT4007	Applications of Internet of Things in Robotics	Theory Only	1.0	3	0	0	0	3.0
13	BCT4009	Internet of Things Architectures and its Protocol	Theory Only	1.0	3	0	0	0	3.0

Bridge Course									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	ENG1000	Foundation English - I	Lab Only	1.0	0	0	4	0	2.0
2	ENG2000	Foundation English - II	Lab Only	1.0	0	0	4	0	2.0

Non Credit Course									
sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	CHY1002	Environmental Sciences	Theory Only	1.1	3	0	0	0	3.0
2	EXC4097	Co-Extra Curricular Basket	Basket	1.0	0	0	0	0	2.0

PROGRAMME CORE

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 theencoder,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, tosolve real world engineering problems and analyze the results.

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 - TabulationMethod

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
2.	Implementation of Logic Circuits by verification of Boolean laws and verification of De Morgans law			3 hours
3.	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
4.	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
5.	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
6.	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
7.	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

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 anddatabase 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.

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 algorithmfor 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 errordetection 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 foroverlapped execution. Analyze the hazards and solutions.

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 inter-leaving 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

CSE2002	THEORY OF COMPUTATION AND COMPILER DESIGN	L	T	P	J	C
		4	0	0	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. Provides required theoretical foundation for a computational model and compiler design
2. Discuss Turing machines as a abstract computational model
3. Compiler algorithms focus more on low level system aspects.

Expected Course Outcome:

On successful completion of the course, the student should be able to:

1. Design computational models for formal languages
2. Design scanners and parsers using top-down as well as bottom-up paradigms
3. Design symbol tables and use them for type checking and other semantic checks
4. Implement a language translator
5. Use tools such as lex, YACC to automate parts of implementation process

Module:1	**Introduction To Languages and Grammers**	**3 hours**

Overview of a computational model - Languages and grammars – alphabets – Strings - Operations on languages, Introduction to Compilers - Analysis of the Source Program - Phases of a Compiler

Module:2	**Regular Expressions and Finite Automata**	**9 hours**

Finite automata – DFA – NFA – Equivalence of NFA and DFA (With Proof) - Regular expressions – Conversion between RE and FA (With Proof) Lexical Analysis - Recognition of Tokens - Designing a Lexical Analyzer using finite automata

Module:3	**Myhill-Nerode Theorem**	**4 hours**

Myhill-Nerode Theorem - Minimization of FA – Decision properties of regular languages – Pumping lemma for Regular languages (With Proof)

Module:4	**CFG, PDAs and Turing Machines**	**15 hours**

CFG – Chomsky Normal Forms - NPDA – DPDA - Membership algorithm for CFG. Syntax Analysis - Top-Down Parsing - Bottom-Up Parsing - Operator-Precedence Parsing - LR Parsers

Module:5	**Turing Machines**	**5 hours**

Turing Machines – Recursive and recursively enumerable languages – Linear bounded automata - Chomsky's hierarchy – Halting problem

Module:6	**Intermediate Code Generation**	**10 hours**

Intermediate Code Generation - Intermediate Languages – Declarations - Assignment Statements - Boolean Expressions - Case Statements – Backpatching - Procedure Calls.

Module:7	**Code Optimization**	**7 hours**

Code Optimization - Basic Blocks and Flow Graphs – The DAG Representation of Basic Blocks - The Principal Sources of Optimization - Optimization of Basic Blocks - Loops in Flow Graphs - Peephole Optimization - Introduction to Global Data-Flow Analysis

Module:8	**Code Generation**	**7 hour**

Code Generation – Issues in the Design of a Code Generator - The Target Machine - Run-Time Storage Management - Next-Use Information - Register Allocation and Assignment - A Simple Code Generator - Generating Code from DAG

Recent Trends – Just-in-time compilation with adaptive optimization for dynamic languages - Parallelizing Compilers

Total Lecture Hours			
	Total Lecture hours:	**60 hours**	

Text Book(s)	
1.	Introduction to Automata Theory, Languages, and Computation (3rd Edition), John E Hopcroft, Rajeev Motwani, Jeffery D. Ullman, Pearson education, 2013.
2.	Principles of Compiler Design, Alferd V. Aho and Jeffery D. Ullman, Addison Wesley, 2006
Reference Books	
1.	Introduction to Languages and the Theory of Computation, John Martin, McGraw-Hill Higher Education,2010
2.	Modern Compiler Implementation in Java, 2nd ed., Andrew W. Appel Cambrdige University Press, 2012.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	19-11-2018		
Approved by Academic Council	No. 53	Date	13-12-2018

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

Course Objectives:

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

Expected Course Outcome:

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

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

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

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

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

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

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

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

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

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

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

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

Tractable and Intractable Problems, Decidable and Undecidable problems, Computational complexity Classes: P, NP and NP complete - Cooks Theorem (without proof),3-CNF-SAT Problem, Reduction of 3-CNF-SAT to Clique Problem, Reduction of 3-CNF-SAT to Subset sum problem.

Module:7	**Recent Trends**	**2 hours**

Algorithms related to Search Engines			
	Total Lecture hours:		**30 hours**
Text Book(s)			
1.	Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009.		
Reference Books			
1.	Sanjoy Dasgupta, C.Papadimitriou and U.Vazirani , Algorithms , Tata McGraw-Hill, 2008.		
2.	A. V. Aho, J.E. Hopcroft and J. D. Ullman, Data Strucures and Algorithms ,Pearson India, Ist Edition, 2002		
3.	A. V. Aho, J.E. Hopcroft and J. D. Ullman, The Design and Analysis of Computer Algorithms ,Pearson,1st edition, 2006.		
4.	Sara Baase , Allen Van Gelder, Computer Algorithms, Introduction to Design and Analysis, 3rd edition, Wesley Longman Publishing, 1999.		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	Extract the features based on various color models and apply on image and video retrieval		2 hours
2.	Arrays, loops and Lists		2 hours
3.	Stacks and Queues		2 hours
4.	Searching and Sorting		3 hours
5.	Linked List and operations		4 hours
6.	Brute force technique		2 hours
7.	Greedy Technique		2 hours
8.	Backtracking		2 hours
9.	Dynamic Programming		2 hours
10.	Trees and Tree Operations		3 hours
11.	BFS and DFS		3 hours
12.	Minimum Spanning Tree		3 hours
		Total Laboratory Hours	**30 hours**
Mode of assessment: Project/Activity			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

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

Course Objectives:

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 optimizationtechniques.
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 ofDBMS.

Module:1	DATABASE SYSTEMS CONCEPTS AND ARCHITECTURE	5 hours

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

Module:2	DATA MODELING	4 hours

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

Module:3	SCHEMA REFINEMENT	6 hours

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

Module:4	QUERY PROCESSING AND TRANSACTION PROCESSING	5 hours

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

Module:5	CONCURRENCY CONTROL AND RECOVERY TECHNIQUES	4 hours

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

Module:6	PHYSICAL DATABASE DESIGN	3 hours

Indexing: Single level indexing, multi-level indexing, dynamic multilevel Indexing

Module:7	**RECENT TRENDS - NOSQL DATABASE MANAGEMENT**	**3 hours**
Introduction, Need of NoSQL, CAP Theorem, different NoSQL data models: Key-value stores, Column families, Document databases, Graph databases		
	Total Lecture hours:	**30 hours**

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

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

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

CSE2005	OPERATING SYSTEMS	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		v1.0				

Course Objectives:

1. To introduce the concept of Operating system concepts and designs and provide theskills 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 problemsand 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.

Module:1	**Introduction**	**2 hours**

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

Module:2	**OS Principles**	**3 hours**

System Calls System/Application Call Interface - Protection User/Kernel modes - Interrupts Processes and Threads - Structures (Process Control Block, Ready List etc).

Module:3	**Scheduling**	**5 hours**

Processes Scheduling - CPU Scheduling - Pre-emptive non-pre-emptive - Resource allocation and management - Deadlocks Deadlock Handling Mechanisms.

Module:4	**Concurrency**	**4 hours**

Inter-process communication Synchronization - Implementing Synchronization Primitives Semaphores - Monitors - Multiprocessors and Locking - Scalable Locks - Lock-free Coordination.

Module:5	**Memory management**	**5 hours**

Main Memory management Memory allocation strategies Caching -Virtual Memory Hardware TLB - Virtual Memory OS techniques Paging Segmentation Page Faults Page Replacement Thrashing Working Set.

Module:6	**Virtualization**	**4 hours**

Virtual Machines Virtualization (Hardware/Software, Server, Service, Network) Hypervisors -OS - Container Virtualization - Cost of virtualization.

Module:7	**File systems**	**3 hours**

File system interface - file system implementation File system recovery Journaling - Soft updates LFS - Distributed file system.

Module:8	**Security Protection and trends**	**4 hours**
Security and Protection - Mechanism Vs Policies Access and authentication - models of protection Memory Protection Disk Scheduling - OS performance, Scaling OS - Mobile OS: Recent Trends: - Future directions in Mobile OS / Multi-core Optimization /Power efficient Scheduling		
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne-Operating System Concepts, Wiley (2012).
Reference Books	
1.	Ramez Elmasri, A Carrick, David Levine, Operating Systems, A Spiral Approach - McGrawHill Science Engineering Math (2009).
2.	Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau, Operating Systems, Three Easy Pieces,Arpaci-Dusseau Books, Inc (2015).

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

List of Challenging Experiments (Indicative)		
1.	Write a boot loader - to load a particular OS say TinyOS/ KolibriOS image - code to access from BIOS to loading the OS - involves little assembly code may use QEMU/virtual machines for emulation of hardware.	3 hours
2.	Allocate/free memory to processes in whole pages, find max allocatable pages, incorporate address translation into the program.	3 hours
3.	Create an interrupt to handle a system call and continue the previously running process after servicing the interrupt.	3 hours
4.	Write a Disk driver for the SATA interface. Take care to check readiness of the controller, locked buffer cache, accept interrupts from OS during the period, interrupting the OS again once done and clearing buffers.	3 hours
5.	Demonstrate the use of locks in conjunction with the IDE driver.	3 hours
6.	Run an experiment to determine the context switch time from one process to another and one kernel thread to another. Compare the findings.	3 hours
7.	Determine the latency of individual integer access times in main memory, L1 Cache and L2 Cache. Plot the results in log of memory accessed vs average latency.	3 hours
8.	Compare the overhead of a system call with a procedure call. What is the cost of a minimal system call?	3 hours
9.	Compare the task creation times. Execute a process and kernel thread, determine the time taken to create and run the threads.	3 hours
10.	Determine the file read time for sequential and random access based of varying sizes of the files. Take care not to read from cached data - used the raw device interface. Draw a graph log/log plot of size of file vs average per-block time.	3 hours
	Total Laboratory Hours	30 hours

Mode of assessment: Project/Activity

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

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 variousmodulation techniques in communication engineering
6. Design and conduct experiments to analyze and interpret data

Module:1	**DC circuits**	**5 hours**

Basic circuit elements and sources, Ohms law, Kirchhoff's laws, series and parallel connection of circuit elements, Node voltage analysis, Mesh current analysis, Thevenin's and Maximum power transfer theorem

Module:2	**AC circuits**	**6 hours**

Alternating voltages and currents, AC values, Single Phase RL, RC, RLC Series circuits, Power in AC circuits-Power Factor- Three Phase Systems – Star and Delta Connection- Three Phase Power Measurement – Electrical Safety –Fuses and Earthing, Residential wiring

Module:3	**Electrical Machines**	**7 hours**

Construction, Working Principle and applications of DC Machines, Transformers, Single phase and Three-phase Induction motors, Special Machines-Stepper motor, Servo Motor and BLDC motor

Module:4	**Digital Systems**	**5 hours**

Basic logic circuit concepts, Representation of Numerical Data in Binary Form- Combinational logic circuits, Synthesis of logic circuits

Module:5	**Semiconductor devices and Circuits**	**7 hours**

Conduction in Semiconductor materials, PN junction diodes, Zener diodes, BJTs, MOSFETs, Rectifiers, Feedback Amplifiers using transistors. Communication Engineering: Modulation and Demodulation - Amplitude and Frequency Modulation

	Total Lecture hours:	**30 hours**	

Text Book(s)

1. 1. John Bird, „Electrical circuit theory and technology ", Newnes publications, 4 t h Edition, 2010.

Reference Books

1. Allan R. Hambley, „Electrical Engineering -Principles & Applications" Pearson Education, First Impression, 6/e, 2013
2. Simon Haykin, „Communication Systems", John Wiley & Sons, 5 t h Edition, 2009.
3. Charles K Alexander, Mathew N O Sadiku, „Fundamentals of Electric Circuits", Tata McGraw Hill, 2012.

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

MAT1014	DISCRETE MATHEMATICS AND GRAPH THEORY	L	T	P	J	C
		3	1	0	0	4
Pre-requisite	Nil	Syllabus Version				
		1.0				

Course Objectives:

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.

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. Trembleyand 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

MAT2002	APPLICATIONS OF DIFFERENTIAL AND DIFFERENCEEQUATIONS	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 thetransform techniques to solve linear systems, that arise in sciences and engineering
3. Enriching the skills in solving initial and boundary value problems
4. Impart the knowledge and application of difference equations and the Z-transform in discrete systems, that are inherent in natural and physical processes

Expected Course Outcomes:

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

1. Employ the tools of Fourier series to find harmonics of periodic functions from the tabulated values
2. Apply the concepts of eigenvalues, eigen vectors and diagonalisation in linear systems
3. Know the techniques of solving differential equations
4. Understand the series solution of differential equations and finding eigen values, eigen functions of Strum-Liouville"s problem
5. Know the Z-transform and its application in population dynamics and digital signal processing
6. Demonstrate MATLAB programming for engineering problems

Module:1	Fourier series	6 hours

Fourier series - Euler"s formulae - Dirichlet"s conditions - Change of interval - Half range series – RMS value – Parseval"s identity – Computation of harmonics

Module:2	Matrices	6 hours

Eigenvalues and Eigen vectors - Properties of eigenvalues and eigen vectors – Cayley-Hamilton theorem - Similarity of transformation - Orthogonal transformation and nature of quadratic form

Module:3	Solution of ordinary differential equations	6 hours

Linear second order ordinary differential equation with constant coefficients – Solutions of homogenous and non-homogenous equations - Method of undetermined coefficients – method of variation of parameters – Solutions of Cauchy-Euler and Cauchy-Legendre differential equations

Module:4	Solution of differential equations through Laplace transform and matrix method	8 hours

Solution of ODE"s - Nonhomogeneous terms involving Heaviside function, Impulse function - Solving nonhomogeneous system using Laplace transform – Reduction of *n*th order differential equation to first order system - Solving nonhomogeneous system of first order differential equations $(X' = AX + G)$ and

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 fractionsand 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 simpledifference 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

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.

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

Course code	Course title	L	T	P	J	C
CSE2016	MICROPROCESSOR AND MICROCONTROLLERS	3	0	2	0	4
Pre-requisite	CSE 2001 – Computer Architecture and Organization	Syllabus version				
Anti-requisite	CSE2006 – Microprocessor and Interfacing	V 1.0				

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 microcontrollers 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. Learn the advanced features of Co-Processor and SHARC - Digital signal Processor
5. Recognize the functionalities of microcontroller, latest version processors and its application.
6. Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyze the results.

Module:1	Overview of Microprocessor and ALP	7 hours

Microprocessor pin diagram, Architecture, **Memory Interfacing-** addressing mode and Instruction set-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:2	Introduction to ARM Architecture	6 hours

Basic ARM Architecture-ARM organization Core Data Flow Model-ARM Register Organization-Modes and states-Pipeline and Related Issues-Interrupts and Exceptions

Module:3	ARM and TUUMB Instruction Sets	4 hours

Data Processing Instructions-Conditional Executions-Load and Store Instructions-Multiplication Instructions-Software Interrupt Instructions-Branching Instructions-Barrel Shifting Operations-Stack in ARM-Programs with ARM Core-THUMB State in ARM Core

Module:4	SHARC- Digital signal Processor	6 hours

How DSPs are Different from Other Microprocessors-Circular Buffering-Architecture of the Digital Signal Processor-Fixed versus Floating Point-C versus Assembly-How Fast are DSPs?-The Digital Signal Processor Market.

Module:5	Introduction to Microcontroller	8 hours

8051 Microcontroller Architecture, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, I/O Ports in 8051, Types of Special Function Registers and their uses in 8051- Interfacing of Timer, Serial data transfer and Interrupt- ADC and DAC.

Module:6	Prototype development with Microcontroller 1	6 hours

Setting Up Arduino- Controlling a Relay Using an Arduino- Controlling an LED with an Arduino- Playing a Sound with an Arduino-Using an Alphanumeric LCD Shield with Arduino.

Module:7	**Prototype development with Microcontroller 2**	**6 hours**
Setting Up a Raspberry Pi- Connecting to Your Pi from a Second Computer- Blinking an LED- Controlling a Relay with Raspberry Pi.		
Module:8	**Recent trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	D.P. Kothari, Shriram K .Vasudevan, Subashri V, Sivaraman Ramachandran - Analysis of Microcontrollers, Scientific International PVT. LTD. First edition 2013
2.	Simon Monk, Hacking Electronics: Learning Electronics with Arduino and Raspberry Pi, 2nd Edition, McGraw-Hill Education, 2017
Reference Books	
1.	Douglas V. Hall, SSSP Rao" Microprocessors and Interfacing Programming and Hardware". Tata McGraw Hill, Third edition, 2012.
2.	Smith, Steven W. "Digital Signal Processing: A Practical Guide for Engineers and Scientists" 1st edition Newnes, 2013

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

List of Experiments		
1.	Arithmetic operations 8/16 bit using different addressing modes.	1.5 hours
2.	Finding the factorial of an 8 /16 bit number.	1.5 hours
3.	(a) Solving nCr and nPr (b) Compute nCr and nPr using recursive procedure. Assume that 'n' and 'r' are non-negative integers	1.5 hours
4.	Fibonacci series	1.5 hours
5.	Sorting in ascending and descending order	1.5 hours
	(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.	1.5 hours
8.	ALP for number system conversions	2.5 hours
9.	(a) String operations(String length, reverse, comparison, concatenation, palindrome)	1.5 hours
10.	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.	Stepper motor interface using 8086/ Arduino	2.5 hours
13	To build a 2 digit up down counter circuit using Microcontroller	2.0 Hours
14	Interface ADC converter with Raspberry Pi	2.5 hours
15	To interfacing an 8X8 LED matrix with Arduino and displaying a message in the form of scrolling text	2.5 hours
	Total Laboratory Hours	30 hours

Mode of assessment:			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	61	Date	18-02-2021

CSE2015	INTERNET PROGRAMMING AND WEB TECHNOLOGIES	L	T	P	J	C
		3	0	2	0	4
Pre-requisite		**Syllabus version**				
Anti-requisite	CSE3002	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. Know the different web protocols and web architecture.
2. Apply HTML and CSS effectively to create dynamic websites.
3. Create event responsive webpages using AJAX and JQuery.
4. Implement server-side programming like session, cookies, file handling and database connectivity using PHP.
5. Learn web data storage and transfer technologies using Angular
6. Develop web applications using advanced technologies such as Node JS

Module:1	**Introduction to Internet**	**4 hours**

Internet Overview- Networks – WWW –Web Protocols — Web Organization and Addressing – Internet Service Providers, DNS Servers, Connection Types, Internet Addresses - Web Browsers and Web Servers -Security and Vulnerability-Web System Architecture – URL - Domain Name – Web Content Authoring - Webserver Administration – Search Engines

Module:2	**Client Side Scripting**	**8 hours**

HTML5 – Text tags; Graphics, Form elements, HTML 5 Input types, HTML 5 Input types, semantic tags, CSS3 - Selectors, Box Model, Backgrounds and Borders, Text Effects, Animations, Cascading and inheritance of style properties - Normal Flow Box Layout-Beyond the Normal Flow – Introduction to responsive design – bootstrap

Module:3	**Client Side Scripting**	**7 hours**

JavaScript -Variables and Data Types - Statements – Operators- Literals- Functions- Objects- Arrays- Built-in Objects, DOM – BOM - Regular Expression Exceptions, Event handling, Validation - JQuery

Module:4	**Developing Interactive Web Applications**	**5 hours**

AJAX –AJAX calls - XML http – request – response – AJAX with PHP - Data Formats - AJAX with Database – Processing Server Response - AJAX Security

Module:5	**Server Side Scripting**	**7 hours**

Introduction to Node.js- NPM - Events, Timers, and Callbacks in Node.js – file upload – email – Express framework – request –response –routing - templates- view engines. Introduction to Mongo DB- creating DB, collection – CRUD operations - Accessing MongoDB from Node.js. – Accessing online Mongo DB from Node JS.

Module:6	**React Web Framework**	**6 hours**
Introduction – Environment setup – JSX – React DOM – React Elements - Components – react state – Props – Hooks – Component life cycle		
Module:7	**React Web Framework**	**6 hours**
React Router – event handlers - React lists – react forms – react HTML render – react refs – react CSS – Array immutability – Lazy loading – Storing to local storage – Create a sample React App		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Paul J. Deitel, Harvey Deitel, Internet and World Wide Web How To Program, 6th Edition, Pearson, 2020.
2.	Vasan Subramanian, Pro MERN Stack - Full stack web app development, 2nd Edition, 2019
Reference Books	
1.	Jessica Minnick, Responsive Web Design with HTML 5 & CSS, Cengage Learning, 2020.
2.	Frank Zammetti, Modern Full-Stack Development: TypeScript, React, Node.js, 1st Edition, Apress,2020

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

List of Experiments (Indicative)		
1.	HTML form validation with JavaScript	3 hours
2.	PHP : Forms and File handling	3 hours
3	PHP : Session Management and Cookies, Databases	3 hours
4.	Custom Services in Applications using AJAX	6 hours
5.	Database and Server Response with AJAX	6 hours
6.	React : Content projection, Manipulating Data With Pipes	6 hours
7.	Node JS and Mongo DB	6 hours
	Total Laboratory Hours	30 hours

Mode of assessment: Project/Activity

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	Course Title	L	T	P	J	C
CSE3035	PRINCIPLES OF CLOUD COMPUTING	3	0	2	0	4
Pre-requisite		Syllabus version				
		V 1.0				

Course Objectives:

1. To introduce the cloud computing concepts and map reduce programming model.
2. To provide skills and knowledge about operations and management in cloud technologies so as to implement large scale systems.
3. To provide skills to design suitable cloud infrastructure that meets the business services and customer needs.

Expected Course Outcome:

1. Understand the evolution, principles, and benefits of Cloud Computing in order to assess existing cloud infrastructures to choose an appropriate architecture that meets business needs.
2. Decide a suitable model to capture the business needs by interpreting different service delivery and deployment models.
3. Understand virtualization foundations to cater the needs of elasticity, portability and resilience by cloud service providers.
4. Infer architectural style, work flow of real world applications and to implement the cloud applications using map reduce programming models.
5. Design a cloud framework with appropriate resource management policies and mechanism.
6. Compare operation and economic models of various trending cloud platforms prevailing in IT industry.

Module:1	Foundations of cloud	6 hours

Inception and need for cloud computing: Motivations from distributed computing predecessors - Evolution - Characteristics - Business Benefits – Challenges in cloud computing - Exploring the Cloud Computing Stack - Fundamental Cloud Architectures – Advanced Cloud Architectures - Specialized Cloud Architectures

Module:2	Service Delivery and Deployment Models	5 hours

Service Models (XaaS): Infrastructure as a Service (IaaS) - Platform as a Service (PaaS) - Software as a Service(SaaS) - Deployment Models: Types of cloud - Public cloud - Private cloud - Hybrid cloud – Service level agreements - Types of SLA – Lifecycle of SLA- SLA Management

Module:3	Cloud Resource Virtualization	5 hours

Virtualization as Foundation of Cloud – Understanding Hypervisors – Understanding Machine Image and Instances - Managing Instances – Virtual Machine Provisioning and Service Migrations

Module:4	Cloud Computing: Applications and Paradigms	8 hours

Existing Cloud Applications and Opportunities for New Applications - Architectural Styles for Cloud Applications - Workflows: Coordination of Multiple Activities - Coordination Based on a State Machine Model: The ZooKeeper - The MapReduce Programming Model - A Case Study: The GrepTheWeb Application

Module:5	Resource Management and Scheduling in Cloud	6 hours

Policies and Mechanisms for Resource Management – Stability of a Two-Level Resource Allocation

Architecture- Feedback Control Based on Dynamic Thresholds - Coordination of Specialized Autonomic Performance Managers - A Utility-Based Model for Cloud-Based Web Services - Resource Bundling: Combinatorial Auctions for Cloud Resources – Scheduling Algorithms for Computing Clouds - Resource Management and Dynamic Application Scaling		
Module:6	**Cloud Platforms and Application Development**	**9 hours**
Comparing Amazon web services, Google AppEngine, Microsoft Azure from the perspective of architecture (Compute, Storage Communication) services and cost models. Cloud application development using third party APIs, Working with EC2 API – Google App Engine API - Facebook API, Twitter API.		
Module:7	**Advances is Cloud**	**4 hours**
Media Clouds - Security Clouds - Computing Clouds - Mobile Clouds – Federated Clouds – Hybrid Clouds		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Rajkumar Buyya, James Broberg, Andrzej, M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 1st Edition, 2013.
2.	Sosinsk, Barrie, Cloud Computing Bible, John Wiley & Sons, 1st Edition, 2011.
Reference Books	
1.	Marinescu, Dan C. Cloud Computing: Theory and Practice. Morgan Kaufmann, 2017.
2.	Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Mc Graw Hill Education, 1st Edition, 2017.
3.	Buyya, Rajkumar, Christian Vecchiola, and S. Thamarai Selvi. Mastering Cloud Computing: Foundations and Applications Programming, Tata Mcgraw Hill, 1st Edition, 2017.
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Experiments		
1.	Configure a VM instance in your local machine and in cloud (by creating a cloud account). Allocate CPU, memory and storage space as per a specified requirement. Install Guest OS image in that instance, launch the same and confirm the successful installation of the OS by performing few OS commands.	3 hours
2.	Configure a Nested Virtual Machine (VM under another VM) in cloud and local machine. Install OS images and work with few OS commands.	2 hours
3	Create a ssh tunnel between your server in local machine and remote clients in EC2 instances and test the connections with programs using X11 traffic	3 hours
4.	Install the Hadoop framework and create an application using Map Reduce Programming Model	2 hours
5.	Perform live QEMU-KVM VM migrations using NFS	3 hours
6.	Experiment cloud scheduling algorithms using Cloud Sim/ OPNET / CloudAnalyst tool.	3 hours
7.	Experiment cloud load balancing algorithms using Cloud Sim/ OPNET/ CloudAnalyst tool.	2 hours
8.	Monitor, visualize and analyze performance of resource utilization in cloud platforms using Grafana tool.	2 hours
9.	Configure a VLAN using cisco packet tracer and analyze traffic issues	2 hours

10.	Build container images, launch the container instance in the cloud and run an application inside the container instance in cloud			2 hours
11.	EC2 AWS – Instance Creation, Migration			2 hours
12.	DaaS – Deployment of a basic web app and add additional Functionality (Javascripts based)			2 hours
13.	SaaS – Deployment of any SaaS application for a online Collaborative tool			2 hours
			Total Laboratory Hours	30 hours
Mode of evaluation: Project/Activity				
Recommended by Board of Studies	11-02-2021			
Approved by Academic Council	No. 61	Date	18-02-2021	

Course code	Course title	L	T	P	J	C
BCT3002	**EMBEDDED SYSTEM ARCHITECTURE AND DESIGN**	**3**	**0**	**2**	**0**	**4**
Pre-requisite	**Microprocessor and Microcontrollers**	**Syllabus version**				
		v. 1.0				

Course Objectives:

1. To make the student to design, implement and explore hardware and software design using appropriate techniques and tools.
2. Ability to understand comprehensively the technologies and techniques underlying in building an embedded solution to a wearable, mobile and portable system.

Expected Course Outcome:

1. Learn embedded systems basic, system modeling, computational tools and control for embedded systems operated in real time.
2. Extend their skills in analysis, approach, optimization and implementation
3. Design, test and critically evaluate embedded solutions to real world situations using (embedded) computer systems interfaced to hardware.
4. Distinguish Real Time Operating Systems (RTOS) from workstation/server Operating System (OS) and differentiate real-times scheduling from traditional OS scheduling.
5. Identify roles of hardware and software in networked embedded systems
6. Illustrate current and future industrial challenges and emerging embedded systems engineering trends.

Module:1	**Introduction to Embedded System**	**4 hours**

Definition of an Embedded System – Characteristics/Attributes of Embedded Systems – Challenges in embedded system design –Formalism for system design, Example- embedded system.

Module:2	**Embedded System Processor**	**7 hours**

Embedded system processor- PIC, ARM- Programming input and output, Supervisor mode, Exception , traps, Co-processors, Memory System Mechanisms , Introduction to programming in Embedded C.

Module:3	**I/O interfacing**	**7 hours**

CPU Bus, Memory Device, IO device - Timers, watch-dog timer, counters, UART, Sensors and actuators interfacing, LCD controller, Keypad controller, Stepper motor controller, ADC Converters, Real time Clock, Component Interfacing, Designing with microprocessor , Design Example: Alarm Clock.

Module:4	**Program Design Analysis**	**4 hours**

Components for embedded system, Models of program, Assembly, linking, loading, Compilation techniques, Program optimization.

Module:5	**Real Time Operating System (RTOS) and Networks**	**9 hours**

RTOS vs General purpose operating system, Multiple tasks and Multiple process, Preemptive RTOS, Priority based RTOS, Inter process communication- Shared memory communication,

Message communication and Signals. Distributed Embedded Architectures, Networks for embedded Systems, Network based design, Internet Enabled System.		
Module:6	**Layers of embedded system**	**6 hours**
Embedded Design life cycle, Embedded System modeling, Layers of an Embedded System – hardware layer – Application layer – Software Layer – middleware. EDLC Approaches, Interfaces to the external world.		
Module:7	**Reconfigurable Embedded System**	**6 hours**
FPGA- The Role of FPGAs, FPGAs types, FPGAs vs Custom VLSI, Fine - Grained and Course - Grained Reconfigurable Architecture, Case Studies.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Wayner Wolf, Computers as components – Principles of embedded computing system design, 4th edition,Morgan Kaufman Publishers, 2016
2. Kamal R. Embedded systems: architecture, programming and design. Tata McGraw-Hill Education; 2011.

Reference Books

1. Shibu, K. V. Introduction to embedded systems, 1st edition, Tata McGraw-Hill Education, 2009.
2. Vahid, Frank, and Tony D. Givargis. Embedded system design: a unified hardware/software introduction, 1st edition, John Wiley & Sons, 2006.
3. Zhu Y. Embedded Systems with ARM® Cortex-M3 Microcontrollers in Assembly Language and C. E-Man Press; 2014.
4. Wolf W. FPGA-based system design. Pearson education; 2004 Jun 15.

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

List of Experiments (Indicative)

1	Introduction to Software Development Tools	2 hours
2.	Programming in Embedded C	4 hours
3.	Programming in 8051Handling Port	5 hours
4.	Interface to Switches, LEDs, and 7-segment displays 4.	5 hours
5.	Interface to a Hexadecimal Keypad, Interfacing real time clock and serial port.	5 hours
6	Interfacing stepper motor and temperature sensor	2 hours
7.	Writing programs to perform user output to the LCD	2 hours
8	Writing Interrupt Service Routines	5 hours
	Total Laboratory Hours	**30 hours**

Mode of evaluation: CAT/FAT

Recommended by Board of Studies	11.02.2021		
Approved by Academic Council	No. 61	Date	18.02.2021

Course code	Course Title	L	T	P	J	C
CSE3035	PRINCIPLES OF CLOUD COMPUTING	3	0	2	0	4
Pre-requisite		Syllabus version				
		V 1.0				

Course Objectives:

1. To introduce the cloud computing concepts and map reduce programming model.
2. To provide skills and knowledge about operations and management in cloud technologies so as to implement large scale systems.
3. To provide skills to design suitable cloud infrastructure that meets the business services and customer needs.

Expected Course Outcome:

1. Understand the evolution, principles, and benefits of Cloud Computing in order to assess existing cloud infrastructures to choose an appropriate architecture that meets business needs.
2. Decide a suitable model to capture the business needs by interpreting different service delivery and deployment models.
3. Understand virtualization foundations to cater the needs of elasticity, portability and resilience by cloud service providers.
4. Infer architectural style, work flow of real world applications and to implement the cloud applications using map reduce programming models.
5. Design a cloud framework with appropriate resource management policies and mechanism.
6. Compare operation and economic models of various trending cloud platforms prevailing in IT industry.

Module:1	Foundations of cloud	6 hours

Inception and need for cloud computing: Motivations from distributed computing predecessors - Evolution - Characteristics - Business Benefits – Challenges in cloud computing - Exploring the Cloud Computing Stack - Fundamental Cloud Architectures – Advanced Cloud Architectures - Specialized Cloud Architectures

Module:2	Service Delivery and Deployment Models	5 hours

Service Models (XaaS): Infrastructure as a Service (IaaS) - Platform as a Service (PaaS) - Software as a Service(SaaS) - Deployment Models: Types of cloud - Public cloud - Private cloud - Hybrid cloud – Service level agreements - Types of SLA – Lifecycle of SLA- SLA Management

Module:3	Cloud Resource Virtualization	5 hours

Virtualization as Foundation of Cloud – Understanding Hypervisors – Understanding Machine Image and Instances - Managing Instances – Virtual Machine Provisioning and Service Migrations

Module:4	Cloud Computing: Applications and Paradigms	8 hours

Existing Cloud Applications and Opportunities for New Applications - Architectural Styles for Cloud Applications - Workflows: Coordination of Multiple Activities - Coordination Based on a State Machine Model: The ZooKeeper - The MapReduce Programming Model - A Case Study: The GrepTheWeb Application

Module:5	Resource Management and Scheduling in Cloud	6 hours

Policies and Mechanisms for Resource Management – Stability of a Two-Level Resource Allocation Architecture- Feedback Control Based on Dynamic Thresholds - Coordination of Specialized Autonomic Performance Managers - A Utility-Based Model for Cloud-Based Web Services - Resource Bundling: Combinatorial Auctions for Cloud Resources – Scheduling Algorithms for

Computing Clouds - Resource Management and Dynamic Application Scaling		
Module:6	**Cloud Platforms and Application Development**	**9 hours**
Comparing Amazon web services, Google AppEngine, Microsoft Azure from the perspective of architecture (Compute, Storage Communication) services and cost models. Cloud application development using third party APIs, Working with EC2 API – Google App Engine API - Facebook API, Twitter API.		
Module:7	**Advances is Cloud**	**4 hours**
Media Clouds - Security Clouds - Computing Clouds - Mobile Clouds – Federated Clouds – Hybrid Clouds		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)		
1.	Rajkumar Buyya, James Broberg, Andrzej, M. Goscinski, Cloud Computing: Principles and Paradigms, Wiley, 1st Edition, 2013.	
2.	Sosinsk, Barrie, Cloud Computing Bible, John Wiley & Sons, 1st Edition, 2011.	
Reference Books		
1.	Marinescu, Dan C. Cloud Computing: Theory and Practice. Morgan Kaufmann, 2017.	
2.	Toby Velte, Anthony Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Mc Graw Hill Education, 1st Edition, 2017.	
3.	Buyya, Rajkumar, Christian Vecchiola, and S. Thamarai Selvi. Mastering Cloud Computing: Foundations and Applications Programming, Tata Mcgraw Hill, 1st Edition, 2017.	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Experiments		
1.	Configure a VM instance in your local machine and in cloud (by creating a cloud account). Allocate CPU, memory and storage space as per a specified requirement. Install Guest OS image in that instance, launch the same and confirm the successful installation of the OS by performing few OS commands.	3 hours
2.	Configure a Nested Virtual Machine (VM under another VM) in cloud and local machine. Install OS images and work with few OS commands.	2 hours
3	Create a ssh tunnel between your server in local machine and remote clients in EC2 instances and test the connections with programs using X11 traffic	3 hours
4.	Install the Hadoop framework and create an application using Map Reduce Programming Model	2 hours
5.	Perform live QEMU-KVM VM migrations using NFS	3 hours
6.	Experiment cloud scheduling algorithms using Cloud Sim/ OPNET / CloudAnalyst tool.	3 hours
7.	Experiment cloud load balancing algorithms using Cloud Sim/ OPNET/ CloudAnalyst tool.	2 hours
8.	Monitor, visualize and analyze performance of resource utilization in cloud platforms using Grafana tool.	2 hours
9.	Configure a VLAN using cisco packet tracer and analyze traffic issues	2 hours
10.	Build container images, launch the container instance in the cloud and run an application inside the container instance in cloud	2 hours
11.	EC2 AWS – Instance Creation, Migration	2 hours

12.	DaaS – Deployment of a basic web app and add additional Functionality (Javascripts based)			2 hours
13.	SaaS – Deployment of any SaaS application for a online Collaborative tool			2 hours
			Total Laboratory Hours	30 hours
Mode of evaluation: Project/Activity				
Recommended by Board of Studies	11-02-2021			
Approved by Academic Council	No. 61	Date	18-02-2021	

Course code	WIRELESS AD-HOC AND SENSOR NETWORKS	L	T	P	J	C
BCT3001		3	0	0	4	4
Pre-requisite	CSE1004 Computer Networks	Syllabus version				
		v. XX.XX				

Course Objectives:

1. Understand the design issues in ad hoc and sensor networks.
2. Learn the different types of MAC protocols.
3. Familiar with different types of adhoc routing protocols.
4. Expose to the TCP issues in adhoc networks.
5. Learn the architecture and protocols of wireless sensor networks

Expected Course Outcome:

1. Understanding the concepts, network architectures and applications of ad hoc and wireless sensor networks
2. Understanding challenges in the layered architecture of Ad hoc wireless networks
3. Understanding the working of MAC and Routing Protocols for ad hoc and sensor networks
4. Analyze the protocol design issues of ad hoc and sensor networks
5. Design routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues
6. Evaluate the QoS related performance measurements of ad hoc and sensor networks
7. Design Transport layer QoS protocols using Tools

Module:1	INTRODUCTION	5 hours	CO: 1, 2

Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel

Module:2	MANET and WSN	5 hours	CO: 1, 2

Mobile Ad hoc Networks (MANETs) and wireless sensor networks (WSNs) :concepts and architectures. Applications of Ad Hoc and Sensor networks. Design Challenges in Ad hoc and Sensor Networks.

Module:3	MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS	5 hours	CO: 1, 2,3

Issues in designing a MAC Protocol- Classification of MAC Protocols- Contention based protocols- Contention based protocols with Reservation Mechanisms- Contention based protocols with Scheduling Mechanisms – Multi channel MAC-IEEE 802.11

Module:4	ROUTING PROTOCOLS IN WIRELESS AD-HOC NETWORKS	6 hours	CO: 3,4,5

Issues in designing a routing protocol for Ad hoc networks- proactive routing, reactive routing (on-demand), hybrid routing

Module:5	TRANSPORT LAYER IN AD-HOC NETWORKS	6 hours	CO: 3,4,5

Classification of Transport Layer solutions-TCP over Ad hoc wireless Networks.

Module:6	**WIRELESS SENSOR NETWORKS (WSNS) AND MAC PROTOCOLS**	**5 hours**	**CO: 3,4,5**
Issues in Designing in MAC protocol for WSN, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – S-MAC, T-MAC, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, BLUETOOTH, ZIGBEE, RFID			
Module:7	**WSN ROUTING, LOCALIZATION**	**10 hours**	**CO: 4,5,6**
Issues in Ad- Hoc and WSN routing protocols - Secure Ad hoc routing protocols – LEACH, PEGASIS, Direct Diffusion, Energy Efficient WSN Routing protocols, QoS WSN Routing Protocols -Localization – Indoor and Sensor Network Localization-absolute and relative localization, triangulation, Transport Layer issues-QOS in WSN-Energy Efficient Design-Synchronization and basic security issues in WSN- Supporting Tools TinyOS, nesC, CONTIKIOS, COOJA, TOSSIM.			
Module:8	**Recent Trends**	**2 hours**	**CO: 6,7**
	Total Lecture hours:	**45 hours**	

Text Book(s)

1.	C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008.
2	Dargie, Waltenegus, and Christian Poellabauer. Fundamentals of wireless sensor networks: theory and practice. John Wiley & Sons, 2010.

Reference Books

1.	Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006.
2	Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication – 2002.
3	Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005
4	Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks- Technology, Protocols, and Applications", John Wiley, 2007. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

Mode of Evaluation: Exam, Digital Assignment, Quiz			
Recommended by Board of Studies	09-09-2020		
Approved by Academic Council	No. 59	Date	24-09-2020

Some J Component Topics

1. Compare the Proactive based routing protocols in MANET
2. Compare the Re-active based routing protocols in MANET
3. Load balancing Routing Protocols in MANET
4. Secure Routing protocols in MANET
5. WSN based remote Monitoring system
6. WSN based remote Monitoring Healthcare system using ZigBEE protocol
7. WSN based remote Environment Monitoring system
8. Wireless Sensors Based System for Home Energy Consumption
9. *Military Applications Based on Wireless Sensor Networks*
10. *Agriculture Applications Based on Wireless Sensor Networks*
11. *Accident Identification System using WSN*
12. WSN based remote Logistics Monitoring system

Course code	ADVANCED C PROGRAMMING	L	T	P	J	C
CSE2010		2	0	2	0	3
Pre-requisite	CSE1001	Syllabus version				
Anti-requisite	CSE1008	v. xx.xx				

Course Objectives:

1. In depth understanding of storage classes, memory allocation and pointer manipulation.
2. High level and low level organization of files.
3. Explore the power of macros and preprocessor directives.

Expected Course Outcome:

At the end of this course students will be able to:

1. Learn various control structures and derived data types for solving real world problems using user defined functions.
2. Explore dynamic memory allocations strategies and user defined data types.
3. Realize the features of various Input and Output methods including files.
4. Idealize the power of preprocessor directives and recognize programming methods
5. Able to modularize the programming using various input, output, mathematical and utility functions in C and unix system interfaces.
6. Able to design the software in c using features of graphics, embedded programming concepts.
7. Apply the learned concepts and design algorithmic solutions for the real world problems.

Module:1	Control Structures, Functions and Pointer	3 hours	CO: 1

Review of C fundamentals : Data types, Operators and Expressions, Control structures, Arrays, Functions, String, Pointers and Structures.

Module:2	Memory Allocation	5 hours	CO: 2

The memory layout in c programming, dynamic memory allocation: malloc(), calloc(), realloc(), free(), core dump, memory leak, dangling pointer. Pointers and array: Pointer and one dimensional arrays, Array of pointers, Pointers and two dimensional arrays, Subscripting pointer to an array, Dynamic 1D and 2D array.

Module:3	User defined data types	5 hours	CO: 2

Structures, array of structures, passing structure to functions, function pointers : Passing and returning values using pointers, Array as function argument, Using Pointers as Arguments, Functions returning address, Function returning pointers, Pointer to a function, Calling a function through function pointer, Functions with varying number of arguments. arrays and structures within structures, Unions, Bit fields, enumerations, typedef.

Module:4	Input/Output Manipulation and Files	5 hours	CO: 3

I/O Manipulation: Standard I/O, Formatted Output - printf, Formated Input - scanf, Variable length argument list, file access including FILE structure, fopen, stdin, sdtout and stderr, Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions. Files manipulations: File Descriptors, File pointer, Working with text files, working with binary files, Character I/O, EOF, Sequential and random access.

Module:5	Preprocessor Directives and programming method	4 hours	CO: 4

Preprocessor Directives: #include statements, #define statements, #error, Conditional compilation, #undef, The # and ## preprocessor operators, Predefined macro names, Nested macros, Multiline

macros, Macros pitfalls, Macros Vs enums, Inline functions, Macros vs inline functions, Inline recursive functions, Command line arguments, Environment Variables in C Programs, Type qualifiers. Programming Method: Debugging, User Defined Header, User Defined Library Function, makefile utility.			
Module:6	**Standard Library functions and Unix system Interface**	**3 hours**	**CO: 5**
Standard Library functions: I/O functions, string and character functions, mathematical functions, time, date and localization functions, utility functions, wide-character functions. Unix system Interface: File Descriptor, Low level I/O - read and write, Open, create, close and unlink, Random access - Iseek, Discussions on Listing Directory, Storage allocator.			
Module:7	**Graphics, embedded C and Software development using C**	**3 hours**	**CO: 6**
Graphics: writing a text graphics program, writing a pixel graphics program, two dimensional graphics. Embedded C programming : Basics, Data types, keywords, programming structure, basic embedded c programming. Software development using c: Building a windows 2000 skeleton, software engineering using c, efficiency, porting programming.			
Module:8	**Contemporary issues**	**2hours**	**CO: 7**
	Total Lecture hours:	**30 hours**	

Text Book(s)

1.	Byron Gottfried and Jitender Chhabra , "Programming with C (Schaum's Outlines Series)", Third Edition. McGraw Hill Education. ISBN: 978-0070145900, July 2017.
2.	Herbert Schildt., "C: The Complete Reference", Fourth Edition. McGraw Hill Education. 978-0070411838. July 2017.
3.	Brian W. Kernighan and Dennis Ritchie, "The C Programming Language", Pearson Education India; 2nd Edition. ISBN: 978-9332549449. 2015.
4.	Peter Prinz and Tony Crawford, "C in a Nutshell: The Definitive Reference". O'Reilly Media. Inc., Second Edition. ISBN: 978-1491904756. December 2015.
5.	K R. Venugopal, Sudeep. R Prasad, "Mastering C", McGraw Hill Publishers, Second Edition. ISBN: 9789332901278. May 2015.

Reference Books

1.	Jeff Szuhay, "Learn C Programming: A beginner's guide to learning C programming the easy and disciplined way", Packt Publishing Limited, First Edition, ISBN: 978-1789349917. June 2020.
2.	Zed A Shaw, "Learn C the Hard Way: Practical Exercises on the Computational Subjects You Keep Avoiding (Like C)", First Edition. Addison Wesley. ISBN: 978-0-321-88492-3. September 2015.
3.	Richard M. Reeses, "Understanding and Using C Pointers", First Edition. O'Reilly Publishers, ISBN: 9781449344184. January 2013.
4.	A.R. Bradley, "Programming for Engineers", Springer, Berlin, Heidelberg. First Edition. ISBN: 978-3-642-23303-6, 2011.
5.	A. Forouzan and Richard F. Gilberg, "Computer Science: A Structured Programming Approach Using C", CENGAGE LEARNING (RS), Third Edition.ISBN: 978-8131503638, 2007.

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

List of Challenging Experiments (Indicative)		**CO: 7**
1.	Programs to demonstrate the use of various data types and storage classes.	2 hours
2.	Programs to understand various control structures.	2 hours
3.	Programs for Manipulating Arrays (One dimensional and Two dimensional)	4 hours
4.	Programs to understand memory allocations using pointers (simple and arrays)	2 hours
5.	Programs using pointers to arrays including strings (One dimensional and two dimensional)	6 hours
6.	Programs to explore different kinds of macros.	2 hours
7.	Programs to manipulate different records (employee, students, HR) using structures (with and without pointers)	6 hours
8.	Programs to manipulate different files (sequential and random)	6 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	Course title	L	T	P	J	C
ECE3051	ANALOG AND DIGITAL SIGNAL PROCESSING	3	0	2	0	4
Pre-requisite		Syllabus version				
		v. 1.0				

Course Objectives:

1. To Characterize the concepts of signals, systems in time and frequency domain
2. To analyze the analog and digital system using Laplace and Z Transforms
3. To instruct students the design of analog and digital infinite impulse response (IIR), finite impulse response (FIR) filters.
4. To teach students the usage of appropriate tools for realizing signal processing modules

Course Outcomes:

1. Comprehend, classify and analyze the continuous and discrete time signals and systems
2. Analyze the continuous and discrete time systems using Fourier Analysis
3. Ability to analyze the stability of the system using Laplace and Z Transforms
4. Ability to simplify the Fourier transform computations using fast algorithms
5. Comprehend the various analog filter design techniques and their digitization.
6. Ability to design the digital FIR and IIR filters.
7. Ability to analyze and exploit the real-time signal processing applications

Module:1	Introduction to Signals and Systems	7 hours

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

Continuous-time and Discrete-time Systems: Continuous-time convolution, Convolution sum, Correlation between signals, Cross correlation, Autocorrelation, Classification of systems - Static and dynamic, Linear and non-linear, Time-variant and time-invariant, Causal and non-causal, Stable and unstable, Impulse response and step response of systems.

Module:2	Frequency Analysis of Continuous Time Systems	6 hours

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

Module:3	Frequency Analysis of Discrete Time Systems	6 hours

Fourier Series representation of discrete time periodic signals (DTFS), Properties of DTFS, Discrete-time Fourier transform, Properties, Inverse discrete-time Fourier transform, Frequency response-System analysis, Comparison between CTFT and DTFT.

Module:4	System Analysis Using Laplace and Z transforms	7 hours

Relation between Laplace and Fourier transforms, Properties, Inverse Laplace transform, Solution to differential equations using Laplace transform, Region of convergence, Stability analysis for continuous time systems.

Z-transform, Properties, s-plane to z-plane mapping, Inverse z-transform, Solution to difference equations using z-transform, Region of convergence, Stability analysis for discrete time systems

Module:5	Discrete Fourier Transform	6 hours

Frequency domain sampling- Band limited discrete time signals- Phase and group delay- DFT-Properties. Frequency analysis of signals using DFT-FFT Algorithm-Radix-2 FFT algorithms-Applications of FFT

Module:6	**Filter Design**	**5 hours**
Design techniques for analog low pass filter -Butterworth and Chebyshev approximations, frequency transformation, Properties -Constant group delay and zero phase filters		
Module:7	**Digital FIR and IIR Filter design**	**6 hours**
IIR filter design: Bilinear and Impulse Invariant Techniques- Spectral transformation of Digital filters. **FIR Filter Design:** Design characteristics of FIR filters with linear- phase – Frequency response of linear phase FIR filters – Design of FIR filters using window functions (Rectangular, Hamming, Hanning and Blackmann).		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1.	Alan. V. Oppenheim, Alan. S. Willsk and S. Hamid Nawab, Signals and Systems, 2nd Edition, Pearson Education India, 2015.

Reference Books

1.	S Simon Haykin and Barry VanVeen, Signals and systems, 2nd Edition, Wiley ,2007
2.	Oppenhiem V.A.V and Schaffer R.W, Discrete – time Signal Processing, 3rd edition, Prentice Hall, New Jersey, US,2013
3.	Lyons, Understanding Digital Signal Processing, 1st edition, Pearson Edition, Noida, India,2013

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

List of Experiments (Indicative)

1	Introduction to MATLAB	2 hours
2	Time domain representation and Basics operation on Continuous and Discrete time signals	4 hours
3	Frequency domain analysis of the continuous and discrete time signals	6 hours
4	Frequency domain analysis of the continuous and discrete time systems	6 hours
5	Stability Analysis of the continuous and discrete time signals	6 hours
6	Signal processing mechanisms for IoT applications - simulation, optimization and implementation.	6 hours
	Total Laboratory Hours	**30 hours**

Mode of Evaluation: CAT /FAT.

Recommended by Board of Studies		11-02-2021	
Approved by Academic Council	No. 61	Date	18-02-2021

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 andunderstanding 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

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

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 timeapplications.
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

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

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 engineeringproblems
3. To develop intelligent systems by assembling solutions to concretecomputational 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 realworld 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.

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

CSE3022	SOFT COMPUTING	L	T	P	J	C
		3	0	0	4	4

Pre-requisite	**NIL**
Objective of the course	The objective of this course is to introduce methods for handling imprecise and uncertain data using Rough sets, Neuro Fuzzy Systemsand foster their abilities in designing and implementing optimal solutions for real-world and engineering problems using derivative freeoptimization techniques.
Expected Outcome	After successfully completing the course the student should be able to Expected • Have a general understanding of soft computing methodologies, to deal with imprecise and uncertain data • Develop computational neural network models for some simple biological systems • Develop fuzzy models for engineering systems, particularly forcontrol systems; • Apply derivative free optimization methods to solve real worldproblems • Demonstrate some applications of computational intelligence

Module	Topics	L Hrs
1	Introduction to Soft Computing Soft Computing Overview – Uncertainty in data, Hard vs Soft Computing	2
2	Neural Networks Introduction, RBF Networks, Self-Organizing Map, Boltzmann Machines, Convolutional Neural Networks	7
3	Fuzzy Systems Fuzzy Sets, Fuzzy Relations, and Membership functions,Properties of Membership functions, Fuzzification and Defuzzification	7
4	Fuzzy logic Fuzzy Rule based systems, Fuzzy Decision making, Fuzzy Classification, Fuzzy C-Means Clustering	7
5	Rough Sets Rough Sets – Definition, Upper and Lower Approximations, Boundary Region, Decision Tables and Decision Algorithms. Properties of Rough Sets. Rough K-means clustering, Rough Support Vector Clustering	7
6	Optimization Techniques Introduction, Genetic Algorithm, Memetic Algorithms, ParticleSwarm Optimization, Ant Colony Optimization, Frog-Leaping.Hybrid	8

	Systems	
7	GA Based Back Propagation Networks, Fuzzy Back Propagation Networks, Evolutionary Ensembles	5
8	**Recent trends**	2
	Total hours	45

Reference Books

1. S.N. Sivanandham and S.N.Deepa, "Principles of Soft Computing", 2nd Edition, Wiley Publications.
2. Andries P. Engelbrecht, "Computational Intelligence: An Introduction", John Wiley &Sons,2007
3. Laurene V. Fausett "Fundamentals of Neural Networks: Architectures, Algorithms And Applications", Pearson, 1993
4. Simon Haykin "Neural Networks and Learning Machines" Prentice Hall, 2008.
5. Timothy Ross, "Fuzzy Logic with Engineering Applications", Third Edition, Wiley, 2010
6. S. N. Sivanandam,S. Sumathi and S. N. Deepa, "Introduction to Fuzzy Logic usingMatlab"– Springer, 2007.
7. Samir Roy, Udit Chakraborty, "Introduction to Soft Computing Neuro Fuzzy Geneticalgorithms", Pearson Education, 2013.
8. Witold Pedrycz, Andrzej Skowron, Vladik Kreinovich "Handbook of GranularComputing", Wiley, 2008

Approved by Academic Council	No. 41	Date	19-06-2016

Project J Component:

Generally a team project consists of four to six members60
Down to earth application and innovative idea should have been attemptedNon# Report in Digital format with all drawings using software package to be Contactsubmitted.Hours
Assessment on a continuous basis with a min of 3 reviews.

The following is the sample project that can be given to students to beimplemented in any programming languages.

- □ Develop Fuzzy Decision-Making for Job Assignment Problem
- □ Implement TSP using Optimization Techniques
- □ Develop a suitable method for Health Care Application using Neuro-Fuzzy systems
- □ Develop a suitable method for Face Recognition System
- □ Layout Optimization using Genetic Algorithms
- □ Fault Diagnosis using rough set theory
- □ Software safety analysis using rough sets

A Neuro-fuzzy Approach to Bad Debt Recovery in Healthcare

Course Code	Course Title	L	T	P	J	C
CSE3034	NATURE INSPIRED COMPUTING	3	0	0	0	3
Pre-requisite		Syllabus Version				
		v1.0				

Course Objectives:

1. To establish basic knowledge in NP hard problems and understand the need for approximation algorithms.
2. Design algorithms that include operators, representations, fitness functions and potential hybridizations for non-trivial problems.
3. Design algorithms that utilize the collective intelligence of simple organisms to solve problems.
4. Design and implement an artificial neural network that employs learning to solve non-trivial problems.

Expected Course Outcome:

1. Understand fundamental concepts of NP-hardness and computational complexity
2. Understand the strengths, weaknesses and appropriateness of nature-inspired algorithms.
3. Apply nature-inspired algorithms to optimization, design and learning problems.
4. Analyze the Behavior systems of nature inspired algorithm applied in real world problems.
5. Understand the theory behind the design of immune networks and DNA computing and their potential applications.

Module:1	Introduction to Computational Problems	3 hours

Computational Problems, Decision Problem, Optimization Problem, Hardness in Optimization Problems, NP class, NP-Hard, examples for NP-Hard problems, tackling NP-Hard problems, Rationale for seeking inspiration from nature

Module:2	Evolutionary Systems	7 hours

Pillars of Evolutionary Theory, The Genotype , Artificial Evolution, Genetic representations, Initial Population ,Fitness Functions, Selection and Reproduction ,Genetic Operators ,Evolutionary Measures ,Types of Evolutionary Algorithms

Module:3	Collective Systems	7 hours

Particle Swarm Optimization Algorithm, Hybrid PSO algorithms, Ant Colony Optimization, Artificial Bee Colony, Firefly Algorithm

Module:4	Artificial Neural Networks	6 hours

History, Mathematical model of neuron, ANN architectures, Learning rules Backpropagation network, Backpropagation learning and its applications, Variants of BPA.

Module:5	Behavioral systems	7 hours

Behavior in Cognitive Science , Behavior in Artificial Intelligence , Behavior-Based Robotics , Biological Inspiration for Robots , Robots as Biological Models, Robot Learning , Evolution of Behavioral Systems Evolution and Learning in Behavioral Systems , Evolution and Neural Development in Behavioral Systems.

Module:6	**Immuno Computing**	**6 hours**
Introduction- Immune System, Physiology and main components, Immune Network Theory- Danger Theory, Evaluation Interaction- Immune Algorithms, Bone Marrow Models , Forest's Algorithm, Artificial Immune Networks.		
Module:7	**DNA Computing**	**7 hours**
DNA Computing: Motivation, DNA Molecule , Adleman's experiment , Test tube programming language, Universal DNA Computers , PAM Model , Splicing Systems , Lipton's Solution to SAT Problem , Scope of DNA Computing , From Classical to DNA Computing.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture Hours:	**45 hours**

Text Book(s)	
1.	Xin-She Yang, "Nature-Inspired Computation and Swarm Intelligence Algorithms, Theory and Applications", Elsevier, Academic Press, 2020.
Reference Books	
1.	Leandro Nunes de Castro, "Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007.
2.	Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008.
3.	Licheng Jiao, Ronghua Shang , Fang Liu , Weitong Zhang , Brain and Nature-Inspired Learning, Computation and Recognition, Elsevier, 2020.

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course Code	Course Title	L	T	P	J	C
CSE3044	CRYPTOGRAPHY AND NETWORK SECURITY	3	0	0	0	3
Pre-requisite	Nil	Syllabus Version				
		v1.0				

Course Objectives:

1. To acquaint students with the basic concepts in security mechanism, classical and traditional Encryption techniques.
2. To teach students the significance of message authentication and digital signature in cryptography.
3. To acquaint the students to the different types of network security and its significance

Expected Course Outcome:

1. Learn to analyze the security of the in-built cryptosystems.
2. Know the fundamental mathematical concepts related to security.
3. Develop cryptographic algorithms for information security.
4. Comprehend the various types of data integrity and authentication schemes.
5. Understand the various types of network security, threats and attacks.

Module:1	Introduction to Security	5 hours

Security properties (confidentiality, integrity and availability), security vulnerabilities, threats and attacks, security models, policies and mechanisms Security Services and Mechanisms, Encryption Techniques, Basic notions of security protocol

Module:2	Number Theory Concepts	8 hours

Number theory - Group, Rings, Fields, Galois field, Euclidean algorithm, Principles of Pseudorandom Number Generation, Fermat's and Euler's Theorems, The Chinese Remainder Theorem, Discrete Logarithms, Elliptic Curve Arithmetic

Module:3	Symmetric Ciphers	6 hours

Block Ciphers - DES, AES, Blowfish, modes of operation, Stream Ciphers-RC4, Linear and Differential cryptanalysis, Homomorphic encryption, PALISADE, SEAL, and HElib.

Module:4	Asymmetric Ciphers	6 hours

Public-Key Cryptography – RSA - Diffie-Hellman Key Exchange, ElGamal Cryptosystem, Elliptic Curve Cryptography, PKI, Privacy Preservation, Perturbation, K-anonymity, L-diversity, Randomization, Taxonomy tree, Condensation, and Cryptographic approach

Module:5	Data Integrity and Key Management	6 hours

Data Integrity in storage - Mirroring – RAID parity- Check summing - Access control for maintenance of integrity – Role based Access control- Discretionary Access control and Rule based access control - Cryptographic Hash Functions, Message Authentication Codes, SHA-3 algorithm, Digital Signatures-DSA algorithm, Key Management and Distribution, User Authentication Protocols, Kerberos – Key Distribution Centre- Trust Management

Module:6	Network Security	6 hours

E-Mail Security-PGP,S/MIME, Transport-Level Security, IP Security, WLAN Security – Firewalls, Web Security

Module:7	**Threats & Attacks**	**6 hours**
Buffer overflow, DoS, DDoS, birthday attack, Intrusion Detection and Prevention, SQL Injections- Phishing-Password Attacks – Computer Virus		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Stallings, William, "Cryptography and network security: principles and practice", Pearson, 2017.
2	Behrouz A.Forouzan : Cryptography & Network Security – The McGraw Hill Company, 2010.
Reference Books	
1	Wade Trappe, Lawrence C. Washington, Introduction to Cryptography with Coding Theory, 3rd Edition, Pearson, 2020.
2	Neal Koblitz, A course in number theory and cryptography, Springer, 1994.
3	Shreya Dey, Ashraf Hossain, "Session-Key Establishment and Authentication in a Smart Home Network Using Public Key Cryptography", IEEE Sensors Letters, Volume: 3, Issue: 4, April 2019.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Mode of evaluation: Project/Activity			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course Code	Course Title	L	T	P	J	C
CSE3055	DEEP LEARNING	3	0	0	4	4
Prerequisite:	Nil	Syllabus Version				
Antirequisite:		v1.0				

Course Objectives:

1. To present theoretical foundations, algorithms, methodologies, and applications of neural networks and deep Learning.
2. To design and develop an application-specific deep learning models and to provide the practical knowledge
3. To apply the deep learning models in various real world applications.

Expected Course Outcomes:

1. Recognize the characteristics of deep learning models that are useful to solve real-world problems.
2. Understand different methodologies to create application-specific Deep Neural Networks
3. Identify and apply appropriate deep learning algorithms for analyzing the data for variety of problems.
4. Design and Implement different deep learning algorithms.
5. Develop deep learning models to encode the original data and reconstruct data.
6. Generate the generative models for unsupervised learning task and choose appropriate models for real world problems.

Module:1	Machine Learning Basics	4 hours

Learning algorithms, Maximum likelihood estimation, Building machine learning algorithm, Neural Networks Multilayer Perceptron, Back-propagation algorithm and its variants Stochastic gradient decent, Curse of Dimensionality

Module:2	Introduction to Deep Learning & Architectures	8 hours

Machine Learning Vs. Deep Learning, Representation Learning, Width Vs. Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Regularization- dropout, drop connect, optimization methods for neural networks- Adagrad, adadelta, rmsprop, adam, NAG.

Module:3	Convolutional Neural Networks & Transfer Learning	8 hours

Architectural Overview – Motivation - Layers – Filters – Parameter sharing – Regularization, Popular CNN Architectures: LeNet, ResNet, Vggnet, AlexNet. Transfer learning Techniques - DenseNet, PixelNet.

Module:4	Training Neural Networks	9 hours

Deep Learning Hardware and Software - CPUs, GPUs, TPUs, PyTorch, TensorFlow, Dynamic vs Static computation graphs, Data Preprocessing-Data Augmentation, batch normalization, Transfer Learning- Deep Transfer Learning Strategies, Update rules, hyperparameter tuning, Learning rate scheduling, variants of CNN- ResNet, GoogleNet, Xception, etc

Module:5	Sequence Modelling – Recurrent and Recursive Nets	6 hours

Recurrent Neural Networks, Bidirectional RNNs – Encoder-decoder sequence to sequence

architechures - Backpropagation Through Time for training RNN, Long Short Term Memory Networks.		
Module:6	**Auto Encoders**	**6 hours**
Under complete Autoencoders, Regulraized Autoencoders, Sparse Autoencoders, Denoising Autoencoders, Representational Power, Layer, Size, and Depth of Autoencoders, Stochastic Encoders and Decoders – Contractive Encoders.		
Module:7	**Deep Generative Models**	**2 hours**
Deep Belief networks – Boltzmann Machines – Deep Boltzmann Machine - Generative Adversial Networks.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture Hours:	**45 hours**
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		

Text Books	
1.	**Ian Goodfellow**, **Yoshua Bengio** and **Aaron Courville, " Deep Learning"**, MIT Press, 2017.
2.	Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
Reference Books	
1.	Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012.
2.	Ethem Alpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.
3.	Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.

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

Project Component:

The following is the sample project that can be given to students to be implemented:

1. Applying the Convolution Neural Network on computer vision problems
2. Applying the Deep Learning Models in the field of Natural Language Processing
3. Applying the Autoencoder algorithms for encoding the real-world data
4. Applying Generative Adversial Networks for image generation and unsupervised tasks.

Mode of evaluation: Project/Activity

Recommended by Board of Studies		11-02-2021	
Approved by Academic Council	No. 61	Date	18-02-2021

CSE3053	BIG DATA ANALYTICS	L	T	P	J	C
		3	0	0	4	4
Pre-requisite	**NIL**	**Syllabus Version**				
		v1.0				

Course Objectives:

1. To understand the need of Hadoop framework to process the Big Data
2. Introduction to theoretical techniques and practical tools used in data analytics
3. Applications in various engineering and scientific domains.

Expected Course Outcome:

1. Discuss the challenges and their solutions in Big Data and work on Hadoop Framework
2. Understand the concepts of R programming and its applications.
3. Implement different statistical methods on sample data using R Programming library.
4. Analyse the Big Data using Map-reduce programming in Both Hadoop and Spark framework.
5. Demonstrate spark programming with different programming languages.
6. Lab: Practice different analytics tools and implement data analysis applications/models by taking sample data sets.

Module:1	**Introduction Big Data**	**3 hours**

Data Storage and Analysis - Characteristics of Big Data – Big DataAnalytics - Typical Analytical Architecture – Requirement fornew analytical architecture – Challenges in Big Data Analytics – Need of big data frameworks, Introduction to Hadoop ecosystems.

Module:2	**Hadoop Framework**	**6 hours**

Hadoop Framework: Hadoop – Requirement of Hadoop Framework - Design principle of Hadoop –Comparison with other system - Hadoop Components –Hadoop Daemon's – Working with HDFS Commands

Module:3	**Mapreduce Programming**	**7 hours**

Map Reduce working principle, Map Reduce types and formats, MapReduce features, Combiner optimization,Map side join, Reduce SideJoin, Secondary sorting, Pipelining MapReduce jobs.

Module:4	**R Programming**	**6 hours**

History and overview of R , Install and configuration of R programming environment , Basic language elements and data structures, Data input/output, Data storage formats , Subsettingobjects.

Module:5	**Visualization Using R**	**7 hours**

Vectorization, Control structures, Functions, Scoping Rules, Loop functions, R Graphs and visualization using lattice, ggplot2

Module:6	**Spark Framework**	**7 hours**

Overview of Spark – Hadoop vs Spark – Cluster Design – ClusterManagement – performance,Application Programming interface(API): Spark Context, Resilient Distributed Datasets, Creating RDD,RDD Operations, Saving RDD - Lazy Operation – Spark Jobs-spark ML library.

Module:7	**Data Analysis Models**	**7 hours**
Association and correlation analysis- regression models- Predictive analytics -Exploratory analysis. Prescriptive analysis.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture Hours:	**45 hours**

Text Book(s)

1. Garrett Grolemund, "Hands-On Programming with R" , O'Reilly Media, Inc, 2014.
2. Seema Acharya, SubhashiniChellapan, "Big Data and Analytics", Wiley, 2015.
3. Mike Frampton, "Mastering Apache Spark", Packt Publishing, 2015.

Reference Books

1. Nick Pentreath, Machine Learning with Spark, Packt Publishing, 2015.
2. Donald Miner, Adam Shook, "MapReduce Design Pattern", O'Reilly, 2012
3. Raj Kamal, PreetiSaxena ,"Big Data Analytics:Introduction to Hadoop, Spark, and Machine-Learning", McGraw-Hill Education, 2019.

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

Project Component:
Projects may be given as group projects.

The project component should be taken as real time applications like e-commerce, social medial, streaming data and so on . The students should use the technologies learnt in theory to develop and implement the project.

Mode of assessment: Project/Activity

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

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 deeplearning based NLP

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

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.

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	

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 enhancementtechniques 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.

Module:1	**Introduction - Digital Image, its Representation**	**6 hours**

Image Representation and Image Processing Paradigm - Elements of digital image processing-Image model. Sampling and quantization-Relationships between pixels- Connectivity, Distance Measures between pixels - Color image (overview, various color models)-Various image formats bmp, jpeg, tiff, png, gif, etc.

Module:2	**Digital Image Properties - Operations on Digital Images**	**6 hours**

Topological Properties of Digital Images-Histograms, Entropy, Eigen Values-Image Quality Metrics-Noise in Images Sources, types. Arithmetic operations - Addition, Subtraction, Multi-plication, Division-Logical operations NOT, OR, AND, XOR-Set operators-Spatial operations Single pixel, neighbourhood, geometric-Contrast Stretching-Intensity slicing-Bit plane slicing Power Law transforms

Module:3	**Image Enhancement**	**6 hours**

Spatial and Frequency domain-Histogram processing-Spatial filtering-Smoothening spatial filters-Sharpening spatial filters- Discrete Fourier Transform-Discrete Cosine Transform-Haar Trans-form -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
		2	0	2	4	4
Pre-requisite	**Nil**	**Syllabus version**				
		v1.0				

Course Objectives:

1. Ability to comprehend the concept of supervised and unsupervised learning techniques
2. Differentiate regression, classification and clustering techniques and to implement their algorithms.
3. To analyze the performance of various machine learning techniques and to select appropriate features for training machine learning algorithms.

Expected Course Outcome:

1. Recognize the characteristics of machine learning that makes it useful to solve real-world problems.
2. Provide solution for classification and regression approaches in real-world applications.
3. Gain knowledge to combine machine learning models to achieve better results.
4. Choose an appropriate clustering technique to solve real world problems.
5. Realize methods to reduce the dimension of the dataset used in machine learning algorithms.
6. Choose a suitable machine learning model, implement and examine the performance of the chosen model for a given real world problems.
7. Understand cutting edge technologies related to machine learning applications.

Module:1	**Introduction to Machine Learning**	**3 hours**

What is Machine Learning, Examples of Various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces, PAC Learning

Module:2	**Supervised Learning - I**	**4 hours**

Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Generalization error bounds: VC Dimension, Decision Trees: ID3, Classification and Regression Trees, Regression: Linear Regression, Multiple Linear Regression, Logistic Regression.

Module:3	**Supervised Learning - II**	**5 hours**

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

Module:4	**Ensemble Learning**	**3 hours**

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

Module:5	**Unsupervised Learning - I**	**7 hours**

Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional : K-means clustering, K-Mode Clustering, Self-Organizing Map, Expectation Maximization, Gaussian Mixture Models

Module:6	**Unsupervised Learning - II**	**3 hours**

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

Module:7	**Machine Learning in Practice**	**3 hours**

Machine Learning in Practice Design, Analysis and Evaluation of Machine Learning Experiments, Feature selection Mechanisms, Other Issues: Imbalanced data, Missing Values, Outliers

Module:8	**Recent Trends**	**2 hours**

Industry Expert talk

	Total Lecture hours:	**30 hours**	

Text Book(s)	
1.	Ethem Alpaydin, Introduction to Machine Learning , MIT Press, Prentice Hall of India, Third Edition 2014
Reference Books	
1.	Sergios Theodoridis, Konstantinos Koutroumbas, Pattern Recognition, Academic Press, 4th edition, 2008, ISBN:9781597492720.
2.	Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar ”Foundations of Machine Learning, MIT Press, 2012
3.	Tom Mitchell, Machine Learning, McGraw Hill, 3rd Edition,1997.
4	Charu C. Aggarwal, Data Classification Algorithms and Applications , CRC Press, 2014
5	Charu C. Aggarwal, DATA CLUSTERING Algorithms and Applications, CRC Press, 2014
6	Kevin P. Murphy ”Machine Learning: A Probabilistic Perspective”, The MIT Press, 2012
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)		
1.	Implement Decision Tree learning.	2 hours
2.	Implement Logistic Regression.	2 hours
3.	Implement classification using Multilayer perceptron.	2 hours
4.	Implement classification using SVM	2 hours
5.	Implement Adaboost	2 hours
6.	Implement Bagging using Random Forests	2 hours
7.	Implement K-means Clustering to Find Natural Patterns in Data.	2 hours
8.	Implement Hierarchical clustering.	2 hours
9.	Implement K-mode clustering	2 hours
10.	Implement Principle Component Analysis for Dimensionality Reduction.	2 hours
11.	Implement Multiple Correspondence Analysis for Dimensionality Reduction.	2 hours
12.	Implement Gaussian Mixture Model Using the Expectation Maximization.	2 hours
13.	Evaluating ML algorithm with balanced and unbalanced datasets.	2 hours
14.	Comparison of Machine Learning algorithms.	2 hours
15.	Implement k-nearest neighbors algorithm	2 hours
	Total Laboratory Hours	30 hours

Mode of assessment: Project/Activity			
Recommended by Board of Studies	04-04-2014		
Approved by Academic Council	No. 37	Date	16-06-2015

CSE3501	INFORMATION SECURITY ANALYSIS AND AUDIT	L	T	P	J	C
	Job Role: SSC/Q0901	2	0	2	4	4
Pre-requisite	Computer Networks	Syllabus version				
		v.1.0				

Objective of the course

1. Explore system security related incidents and gain insight on potential defenses and counter measures against common threat/vulnerabilities.
2. Install, configure and troubleshoot information security devices
3. Gain experience using tools and common processes in information security audits and analysis of compromised systems.

Expected Outcome

After successfully completing the course the student should be able to

- Contribute to managing information security
- Co-ordinate responses to information security incidents
- Install and configure information security devices
- Contribute to information security audits
- Support teams to prepare for and undergo information security audits
- Manage their work to meet requirements
- Work effectively with colleagues
- Maintain a healthy, safe and secure working environment
- Provide data/information in standard formats
- Develop their knowledge, skills and competence

1	**Information Security Fundamentals**	7 hours
Definitions & challenges of security, Attacks & services, Security policies, Security Controls, Access control structures, Cryptography, Deception, Ethical Hacking, Firewalls, Identify and Access Management (IdAM).		
2	**System Security**	6 hours
System Vulnerabilities, Network Security Systems, System Security, System Security Tools, Web Security, Application Security, Intrusion Detection Systems.		
3	**Information Security Management**	3 hours
Monitor systems and apply controls, security assessment using automated tools, backups of security devices, Performance Analysis, Root cause analysis and Resolution, Information Security Policies, Procedures, Standards and Guidelines		
4	**Incident Management**	5 hours
Security requirements, Risk Management, Risk Assessment, Security incident management, third party security management, Incident Components, Roles.		
5	**Incident Response**	4 hours
Incident Response Lifecycle, Record, classify and prioritize information security incidents using standard templates and tools, Responses to information security incidents, Vulnerability Assessment, Incident Analysis.		
6	**Conducting Security Audits**	3 hours
Common issues in audit tasks and how to deal with these, Different systems and structures that may need information security audits and how they operate, including: servers and storage devices, infrastructure and networks , application hosting and content management, communication routes such as messaging, Features, configuration and specifications of information security systems and devices and associated processes and architecture, Common audit techniques, Record and report audit tasks, Methods and techniques for testing compliance.		
7	**Information Security Audit Preparation**	2 hours

Establish the nature and scope of information security audits, Roles and responsibilities, Identify the procedures/guidelines/checklists, Identify the requirements of information security, audits and prepare for audits in advance, Liaise with appropriate people to gather data/information required for information security audits.		
8	**Self and Work Management**	2 hours
Establish and agree work requirements with appropriate people, Keep the immediate work area clean and tidy, utilize time effectively, Use resources correctly and efficiently, Treat confidential information correctly, Work in line with organization's policies and procedures, Work within the limits of their job role.		
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	William Stallings, Lawrie Brown, Computer Security: Principles and Practice, 3rd edition, 2014.
2.	Nina Godbole, Information Systems Security: Security Management, Metrics, Frameworks and Best Practices, Wiley, 2017
3.	Nina Godbole, Sunit Belapure, Cyber Security- Understanding cyber-crimes, computer forensics and legal perspectives, Wiley Publications, 2016
4.	Andrew Vladimirov Michajlowski, Konstantin, Andrew A. Vladimirov, Konstantin V. Gavrilenko, Assessing Information Security: Strategies, Tactics, Logic and Framework, IT Governance Ltd, O'Reilly, 2010

Reference Books

1.	Charles P. Pfleeger, Security in Computing, 4th Edition, Pearson, 2009.
2.	Christopher J. Alberts, Audrey J. Dorofee , Managing Information Security Risks, Addison-Wesley Professional, 2004
3.	Peter Zor, The Art of Computer Virus Research and Defense, Pearson Education Ltd, 2005
4.	Lee Allen, Kevin Cardwell, Advanced Penetration Testing for Highly-Secured Environments - Second Edition, PACKT Publishers, 2016
5.	Chuck Easttom , System Forensics Investigation and Response, Second Edition, Jones & Bartlett Learning, 2014
6.	David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni, Metasploit The Penetration Tester's Guide, No Starch Press, 2014
7	Practical Malware Analysis by Michael Sikorski and Andrew Honig, No Starch Press, 2015 Ref Links:
8.	https://www.iso.org/isoiec-27001-information-security.html https://csrc.nist.gov/publications/detail/sp/800-55/rev-1/final
9.	https://www.sans.org/reading-room/whitepapers/threats/paper/34180 https://www.sscnasscom.com/qualification-pack/SSC/Q0901/

List of Experiments (Indicative)

	• Install and configure information security devices • Security assessment of information security systems using automated tools. • Vulnerability Identification and Prioritization • Working with Exploits • Password Cracking • Web Application Security Configuration • Patch Management • Bypassing Antivirus Software • Static Malware Analysis • Dynamic Malware Analysis • Penetration Testing • MySQL SQL Injection • Risk Assessment • Information security incident Management • Exhibit Security Analyst Role	
	Total Laboratory Hours	**30 hours**

Recommended by Board of Studies	05-FEB-2020		
Approved by Academic Council	58	Date	26-FEB-2020

CSE3502	INFORMATION SECURITY MANAGEMENT	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	Computer Networks	**Syllabus version**				
		v.1.0				

Objective of the course

1. Explore system security related incidents and gain insight on potential defenses and counter measures against common threat/vulnerabilities.
2. Install, configure and troubleshoot information security devices
3. Gain experience using tools and common processes in information security audits and analysis of compromised systems.

Expected Outcome

After successfully completing the course the student should be able to

- Contribute to managing information security
- Co-ordinate responses to information security incidents
- Install and configure information security devices
- Contribute to information security audits
- Support teams to prepare for and undergo information security audits
- Manage their work to meet requirements
- Work effectively with colleagues
- Maintain a healthy, safe and secure working environment
- Provide data/information in standard formats
- Develop their knowledge, skills and competence

1	**Information Security Devices**	5 hours
Identify And Access Management (IdAM), Networks (Wired And Wireless) Devices, Endpoints/Edge Devices, Storage Devices, Servers, Infrastructure Devices (e.g. Routers, Firewall Services) , Computer Assets, Servers And Storage Networks, Content management, IDS/IPS		
2	**Security Device Management**	6 hours
Different types of information security devices and their functions, Technical and configuration specifications, architecture concepts and design patterns and how these contribute to the security of design and devices.		
3	**Device Configuration**	5 hours
Common issues in installing or configuring information security devices, Methods to resolve these issues, Methods of testing installed/configured information security devices.		
4	**Information Security Audit Preparation**	5 hours
Establish the nature and scope of information security audits, Roles and responsibilities, Identify the procedures/guidelines/checklists, Identify the requirements of information security, audits and prepare for audits in advance, Liaise with appropriate people to gather data/information required for information security audits. **Security Audit Review -** Organize data/information required for information security audits using standard templates and tools, Audit tasks, Reviews, Comply with the organization's policies, standards, procedures, guidelines and checklists, Disaster Recovery Plan		
5	**Team Work and Communication**	2 hours
Communicate with colleagues clearly, concisely and accurately , Work with colleagues to integrate their work effectively, Pass on essential information to colleagues in line with organizational requirements, Identify any problems they have working with colleagues and take the initiative to solve these problems, Follow the organization's policies and procedures for working with colleagues		
6	**Managing Health and Safety**	2 hours
Comply with organization's current health, safety and security policies and procedures, Report any identified breaches in health, safety, and Security policies and procedures, Identify, report and correct any hazards, Organization's emergency procedures, Identify and recommend opportunities for improving health, safety, and security.		
7	**Data and Information Management**	3 hours

Fetching the data/information from reliable sources, Checking that the data/information is accurate, complete and up-to-date, Rule-based analysis of the data/information, Insert the data/information into the agreed formats, Reporting unresolved anomalies in the data/information.		
8	**Learning and Self Development**	2 hours
Identify accurately the knowledge and skills needed, Current level of knowledge, skills and competence and any learning and development needs, Plan of learning and development activities to address learning needs, Feedback from appropriate people, Review of knowledge, skills and competence regularly and appropriate action taken		
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	Information Systems Security: Security Management, Metrics, Frameworks and Best Practices, Nina Godbole, Wiley, 2017
2.	Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition, . Information Security Management: Concepts and Practice. New York, McGraw-Hill, 2013.
3.	Christopher J. Alberts, Audrey J. Dorofee , Managing Information Security Risks, Addison-Wesley Professional, 2004

Reference Books

1.	Andrew Vladimirov Michajlowski, Konstantin, Andrew A. Vladimirov, Konstantin V. Gavrilenko, Assessing Information Security: Strategies, Tactics, Logic and Framework, IT Governance Ltd, O'Reilly 2010
2.	Christopher J. Alberts, Audrey J. Dorofee , Managing Information Security Risks, Addison-Wesley Professional, 2004 Chuck Easttom , System Forensics Investigation and Response, Second Edition, Jones & Bartlett Learning, 2014
3.	David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni, Metasploit The Penetration Tester's Guide, No Starch Press, 2014
4.	Ref Links:
5.	https://www.iso.org/isoiec-27001-information-security.html https://www.sans.org/reading-room/whitepapers/threats/paper/34180 https://csrc.nist.gov/publications/detail/sp/800-40/version-20/archive/2005-11-16 https://www.sscnasscom.com/qualification-pack/SSC/Q0901/

List of Experiments (Indicative)

1.	• Install and configure information security devices • Penetration Testing • MySQL SQL Injection • Information security incident Management • Intrusion Detection/Prevention • Port Redirection and Tunneling • Exploring the Metasploit Framework • Working with Commercial Tools like HP Web Inspect and IBM AppScan etc., • Explore Open Source tools like sqlmap, Nessus, Nmap etc • Documentation with Security Templates from ITIL • Carry out backups of security devices and applications in line with information security policies, procedures and guidelines • Information security audit Tasks - Procedures/guidelines/checklists for the audit tasks	
	Total Laboratory Hours	**30 hours**

Recommended by Board of Studies	05-FEB-2020		
Approved by Academic Council	58	Date	26-FEB-2020

UNIVERSITY CORE

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.

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

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

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

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

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

CHY1701	Engineering Chemistry	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

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

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

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

MAT1011	Calculus for Engineers	L	T	P	J	C
		3	0	2	0	4

Pre-requisite		Syllabus Version
		1.0

Course Objectives :

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

Expected Course Outcomes:

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

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

Module:1	Application of Single Variable Calculus	9 hours

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

Module:2	Laplace transforms	7 hours

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

Module:3	Multivariable Calculus	4 hours

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

Module:4	Application of Multivariable Calculus	5 hours

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

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

Text Book(s)

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

Reference Books

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

Mode of Evaluation

Digital Assignments, Quiz, Continuous Assessments, Final Assessment Test

List of Challenging Experiments (Indicative)		
1.	Introduction to MATLAB through matrices, and general Syntax	3 hours
2	Plotting and visualizing curves and surfaces in MATLAB –	3 hours
	Symbolic computations using MATLAB	
3.	Evaluating Extremum of a single variable function	3 hours
4.	Understanding integration as Area under the curve	3 hours
5.	Evaluation of Volume by Integrals (Solids of Revolution)	3 hours
6.	Evaluating maxima and minima of functions of several variables	3 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		**30 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

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

ESP1001	ESPAÑOL FUNDAMENTAL	L	T	P	J	C
		2	0	0	0	2
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

The course gives students the necessary background to:

1. Demonstrate Proficiency in reading, writing, and speaking in basic Spanish. Learning vocabulary related to profession, education centres, day today activities, food, culture, sports and hobby, family set up, workplace, market and classroom activities is essential.
2. Demonstrate the ability to describe things and will be able to translate into English and vice versa.
3. Describe in simple terms (both in written and oral form) aspects of their background, immediate environment and matters in areas of immediate need.

Expected Course Outcome:

The students will be able to

1. Remember greetings, giving personal details and Identify genders by using correct articles
2. Apply the correct use of SER, ESTAR and TENER verb for describing people, place and things
3. Create opinion about time and weather conditions by knowing months, days and seasons in Spanish
4. Create opinion about people and places by using regular verbs
5. Apply reflexive verbs for writing about daily routine and create small paragraphs about hometown, best friend and family

Module: 1	Abecedario, Saludos y Datos personales: Origen, Nacionalidad, Profesión	**3 hours**
Competencia Gramática: Vocales y Consonantes. Artículos definidos e indefinidos (Numero y Genero). Competencia Escrita: Saludos y Datos personales		
Module: 2	Edad y posesión. Números (1-20)	**3 hours**
Competencia Gramática: Pronombres personales. Adjetivos. Los verbos SER y TENER. Competencia Escrita: Escribe sobre mismo/a y los compañeros de la clase		
Module: 3	Vocabulario de Mi habitación. Colores. Descripción de lugares y cosas	**5 hours**
Competencia Gramática: Adjetivos posesivos. El uso del verbo ESTAR. Diferencia entre SER y ESTAR. Competencia Escrita: Mi habitación		
Module: 4	Mi familia. Números (21-100). Direcciones.Expresar la hora. Los meses del año.	**5hours**
Competencia Gramática: Frases preposicionales. Uso del HAY. La diferencia entre MUY y MUCHO. Uso del verbo GUSTAR Competencia Escrita: Mi familia. Dar opiniones sobre tiempo		
Module: 5	Expresar fechas y el tiempo. Dar opiniones sobre personas y lugares.	**5 hours**
Competencia Gramática: Los verbos regulares (-AR, -ER, -IR) en el presente. Adjetivos demostrativos. Competencia Escrita: Mi mejor amigo/a. Expresar fechas. Traducción ingles a español y Español a Ingles.		
Module: 6	Describir el diario. Las actividades cotidianas.	**3 hours**
Competencia Gramática: Los Verbos y pronombres reflexivos. Los verbos pronominales con e/ie, o/ue, e/i, u/ue. Competencia Escrita: El horario. Traducción ingles a español y Español a Ingles.		

Module: 7	Dar opiniones sobre comidas y bebidas. Decir lo que está haciendo. Describir mi ciudad y Ubicar los sitios en la ciudad.	**4 hours**
Competencia Gramática: Los verbos irregulares. Estar + gerundio. Poder + Infinitivo. Competencia Escrita: Conversación en un restaurante. Traducción ingles a español y Español a Ingles.Mi ciudad natal. Mi Universidad. La clase.Mi fiesta favorita.		
Module: 8	**Guest Lectures / Native Speakers**	**2 hours**
Total Lecture hours		**30 hours**

Text Book(s)	
1.	Text Book: "Aula Internacional 1", Jaime Corpas, Eva Garcia, Agustin Garmendia, Carmen Soriano Goyal Publication; reprinted Edition, (2010)
Reference Books	
1.	"¡Acción Gramática!" Phil Turk and Mike Zollo, Hodder Murray, London 2006. "Practice makes perfect: Spanish Vocabulary", Dorothy Richmond, McGraw Hill Contemporary, USA,2012.
2.	"Practice makes perfect: Basic Spanish", Dorothy Richmond, McGraw Hill Contemporary, USA 2009.
3.	"Pasaporte A1 Foundation", Matilde Cerrolaza Aragón, Óscar Cerrolaza Gili, Begoña Llovet Barquero, Edelsa Grupo, España, 2010.

Recommended by Board of Studies	22.02.2016		
Approved by Academic Council	41st ACM	**Date**	17.06.2016

ESP2001	ESPAÑOL INTERMEDIO	L	T	P	J	C
		2	0	2	0	3
Pre-requisite		**Syllabus version**				
		1.0				

Course Objectives:

The course gives students the necessary background to:

1. enable students to read, listen and communicate in Spanish in their day to day life.
2. enable students to describe situations by using present, past and future tenses in Spanish.
3. enable to develop the comprehension skill in Spanish language.

Expected Course Outcome:

The students will be able to

1. create sentences in near future and future tenses and correctly using the prepositions like POR and PARA
2. create sentences in preterito perfecto and correctly use the direct and indirect object pronouns
3. create sentences related to likes and dislikes and also give commands in formal and informal way
4. create sentences in past tense by using imperfecto and idefinido forms and describe past events
5. create conversations in Spanish at places like restaurants, hotels, Shops and Railway stations
6. understand about different Spanish speaking countries and its culture and traditions.

Module:1	**Números (101 – 1 millón). Expresar los planes futuros. Los números ordinales.**	**7 hours**

Competencia Gramática: Futuros cercanos (Ir+a+Infinitivo). Futuros (Verbos regulares e irregulares). Uso del POR y PARA.
Competencia Escrita: Traducción ingles a español y español a Ingles.
Comprensión - Los textos y Videos

Module:2	**Las ropas, colores y tamaños. Costar, valer, descuentos y rebajas**	**8 hours**

Competencia Gramática: Pronombres objetivos directos e indirectos. El verbo Gustar y Disgustar.
Competencia Escrita: Traducción ingles a español y español a Ingles. Comprensión - Los textos y Videos

Module:3	**Escribir un Correo electrónico formal e informal.**	**7 hours**

Competencia Gramática: Imperativos formales e informales. Pretérito perfecto.
Competencia Escrita: Traducción ingles a español y español a Ingles.
Comprensión - Los textos y Videos

Module:4	**Currículo Vitae. Presentarse en una entrevista informal.**	**6 hours**
Competencia Gramática: Pretérito imperfecto. Pretérito indefinido. Competencia Escrita: Traducción ingles a español y español a Ingles. Comprensión - Los textos y Videos		
Module:5	**Introducción personal, Expresar los planes futuros.**	**5 hours**
Comprensión oral: Introducción personal, Expresar los planes futuros. ¿Qué vas a hacer en las próximas vacaciones? Comprensión auditiva: Las preguntas sobre un cuento auditivo. Relacionar el audio con las imágenes. Las preguntas basadas en canciones. Medio de transporte: Comprar y Reservar billetes.		
Module:6	**Diálogos entre dos**	**5 hours**
Comprensión oral: Diálogos entre dos (cliente y tendero de ropas, pasajero y empleado, en un restaurante, Reservación de habitación en un hotel). Presentación en una entrevista. Comprensión auditiva: Las preguntas basadas en canciones. Las preguntas basadas en diálogos.		
Module:7	**Presentación de los países hispánicos.**	**5 hours**
Comprensión oral: Dialogo entre un médico y paciente. Presentación de los países hispánicos. Describir su infancia. Describir vacaciones últimas o las actividades de último fin de semana. Comprensión auditiva: Rellenar los blancos del cuento en pasado. Las preguntas basadas en el cuento. Las preguntas basadas en un anuncio		
Module:8	**Guest Lectures/ Native Speakers**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	"Aula Internacional 1", Jaime Corpas, Eva Garcia, Agustin Garmendia, Carmen Soriano Goyal Publication; reprinted Edition, Delhi (2010)
Reference Books	
1.	"¡AcciónGramática!", Phil Turk and Mike Zollo, Hodder Murray, London 2006.
2.	"Practice makes perfect: Spanish Vocabulary", Dorothy Richmond, McGraw Hill Contemporary, USA,2012.
3.	"Practice makes perfect: Basic Spanish", Dorothy Richmond, McGraw Hill Contemporary, USA 2009.
4.	"Pasaporte A1 Foundation", Matilde Cerrolaza Aragón, Óscar Cerrolaza Gili, Begoña Llovet Barquero, Edelsa Grupo, España, 2010.
	Authors, book title, year of publication, edition number, press, place

Recommended by Board of Studies	DD-MM-YYYY		
Approved by Academic Council	No.41	Date	17.06.2016

FRE1001	FRANÇAIS QUOTIDIEN	L	T	P	J	C
		2	0	0	0	2
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

The course gives students the necessary background to:

1. Learn the basics of French language and to communicate effectively in French in their day to day life.
2. Achieve functional proficiency in listening, speaking, reading and writing
3. Recognize culture-specific perspectives and values embedded in French language.

Expected Course Outcome:

The students will be able to :

1. Identify in French language the daily life communicative situations via personal pronouns, emphatic pronouns, salutations, negations and interrogations.
2. Communicate effectively in French language via regular / irregular verbs.
3. Demonstrate comprehension of the spoken / written language in translating simple sentences.
4. Understand and demonstrate the comprehension of some particular new range of unseen written materials
5. Demonstrate a clear understanding of the French culture through the language studied

Module: 1	Expressions simples	3 hours

Les Salutations, Les nombres (1-100), Les jours de la semaine, Les mois de l'année, Les Pronoms Sujets, Les Pronoms Toniques, La conjugaison des verbes irréguliers- avoir / être / aller / venir / faire etc.

Savoir-faire pour:Saluer, Se présenter, Présenter quelqu'un, Etablir des contacts

Module: 2	La conjugaison des verbes réguliers	3 hours

La conjugaison des verbes réguliers, La conjugaison des verbes pronominaux, La Négation, L'interrogation avec 'Est-ce que ou sans Est-ce que'.

Savoir-faire pour:

Chercher un(e) correspondant(e), Demander des nouvelles d'une personne.

Module: 3	La Nationalité du Pays, L'article (défini/ indéfini), Les prépositions	6 hours

La Nationalité du Pays, L'article (défini/ indéfini), Les prépositions (à/en/au/aux/sur/dans/avec etc.), L'article contracté, Les heures en français, L'adjectif (La Couleur, L'adjectif possessif, L'adjectif démonstratif/ L'adjectif interrogatif (quel/quelles/quelle/quelles), L'accord des adjectifs avec le nom, L'interrogation avec Comment/ Combien / Où etc.

Savoir-faire pour:

Poser des questions, Dire la date et les heures en français,

Module: 4	La traduction simple	4 hours

La traduction simple :(français-anglais / anglais –français),

Savoir-faire pour :

Faire des achats, Comprendre un texte court, Demander et indiquer le chemin.

Module: 5	L'article Partitif, Mettez les phrases aux pluriels	5 hours

L'article Partitif, Mettez les phrases aux pluriels, Faites une phrase avec les mots donnés, Trouvez les questions.

Savoir-faire pour :

Répondez aux questions générales en français, Exprimez les phrases données au Masculin ou au Féminin, Associez les phrases.

Module: 6	Décrivez :	3 hours

Décrivez: La Famille / La Maison / L'université / Les Loisirs / La Vie quotidienne etc.				
Module: 7	Dialogue			**4 hours**
Dialogue: 1. Décrire une personne. 2. Des conversations à la cafeteria. 3. Des conversations avec les membres de la famille 4. Des dialogues entre les amis.				
Module: 8	**Guest lecures**			**2 hours**
Guest lectures / Natives speakers				
Total Lecture hours				**30 hours**
Text Book(s)				
1.	Fréquence jeunes-1, Méthode de français, G. Capelle et N.Gidon, Hachette, Paris, 2010.			
2.	Fréquence jeunes-1, Cahier d'exercices, G. Capelle et N.Gidon, Hachette, Paris, 2010.			
Reference Books				
1.	CONNEXIONS 1, Méthode de français, Régine Mérieux, Yves Loiseau,Les Éditions Didier, 2010.			
2.	CONNEXIONS 1, Le cahier d'exercices, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2010			
3.	ALTER EGO 1, Méthode de français, Annie Berthet, Catherine Hugo, Véronique M. Kizirian, Béatrix Sampsonis, Monique Waendendries, Hachette livre Paris 2011			
4.	ALTER EGO 1, Le cahier d'activités, Annie Berthet, Catherine Hugo, Béatrix Sampsonis, Monique Waendendries, Hachette livre, Paris 2011			
Mode of Evaluation: CAT / Assignment / Quiz / Seminar / FAT				
Recommended by Board of Studies		26.02.2016		
Approved by Academic Council		41st ACM	**Date**	17.06.2016

FRE2001	Français Progressif	L	T	P	J	C
		2	0	1	0	3

Pre-requisite	Français quotidien	Syllabus version
		1.0

Course Objectives:

The course gives students the necessary background to:

1. understand isolated sentences and frequently used expressions in relation to immediate priority areas (personal or family information, shopping, close environment, work).
2. communicate in simple and routine tasks requiring only a simple and direct exchange of information on familiar and habitual topics.
3. enable students to describe with simply means his training, his immediate environment and evoke familiar and habitual subjects, evoke subjects that correspond to immediate needs.

Expected Course Outcome:

The students will be able to :

1. understand expressions in French.
2. create senteces by using frequent lexicon related to himself, his family, his close environment (family, shopping, work, school, etc).
3. understand simple, clear messages on internet, authentic documents.
4. analyse predictable information in common documents, such as advertisements, flyers, menus, schedules, simple personal letters.
5. create simple and routine tasks.
6. create simple and direct exchange of information on familiar activities and topics.

Module:1	Expressions simples	8 hours

La vie quotidiennes - Le verbe pronominal - Le passé composé avec l'auxiliaire - avoir et être- le passé récent : venir de + infinitif - Le comparatif - Le superlatif - Les mots interrogatifs (les trois formes)
Savoir-faire pour : Faire des achats, faire des commandes dans un restaurant, poser des questions.

Module:2	Les activitiés quotidiennes	6 hours

La vie privée et publique (Les achats, Les voyages, les transports-La nourriture, etc.) - Les lieux de la ville - Les mots du savoir-vivre - Les pronoms indéfinis - Les pronoms démonstratifs - Les pronoms compléments objets directs/ indirects - La formation du future simple et future proche
Savoir-faire pour : Réserver les billets pour le voyage, réserver les chambres dans un hôtel, S'informer sur les lieux de la ville, indiquer la direction à un étranger.

Module:3	Les activités de loisirs	7 hours

Les loisirs (sports/spectacles/activités) - Les moments de la journée, de l'année- La fête indienne et française – Les goûts - L'impératif - La négation de l'impératif-La place du pronom à l'impératif avec un verbe pronominal.
Savoir-faire pour : Parler de ses goûts, raconter les vacances, formuler des phrases plus compliquées, Raconter les souvenirs de l'enfance, parler sur la tradition de son pays natal.

Module:4	**La Francophonie**	**7 hours**
L'espace francophone - Première approche de la société française – La consommation alimentaire – caractériser un objet – décrire une tenue - Le pronom relatif (qui/que/dont/où) **Savoir-faire pour :** Articles de la presse-Portrait d'une personne-Cartes et messages d'invitation, d'acceptation ou de refus - Article de presse - rédaction d'un événement.		
Module:5	**La culture française**	**5 hours**
Parler de ses activités quotidiennes - les fêtes en France – Parler de sa famille – réserver un billet à l'agence - la gastronomie française		
Module:6	**La description**	**5 hours**
Décrire physiquement une personne – les vacances – les achats – réserver une chambre dans un hôtel – les plus grands français - raconter des évènements passés		
Module:7	**S'exprimer**	**5 hours**
Parler du climat - parcours francophone – placer une commande au restaurant –- la mode - parler de son projet d'avenir.		
Module:8	**Guest lecures**	**2 hours**
Guest lecures/ Natives speakers		

	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Alter Ego 1, Méthode de français, Annie Berthet, Hachette, Paris 2010.
2.	Alter Ego 1, Cahier d'exercices, Annie Berthet, Hachette, Paris 2010.
Reference Books	
1.	CONNEXIONS 1, Méthode de français, Régine Mérieux, Yves Loiseau,Les Éditions Didier, 2010.
2	CONNEXIONS 1, Le cahier d'exercices, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2010
3	Fréquence jeunes-1, Méthode de français, G. Capelle et N.Gidon, Hachette, Paris, 2010.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies			
Approved by Academic Council	No.41	Date	17.06.2016

GRE1001	Modern Greek	L	T	P	J	C
		2	0	0	0	2

Pre-requisite	NIL	Syllabus version
		1.0

Course Objectives:

1. To master the Greek terminology widely used in their subjects of specialization
2. To communicate in Modern Greek in their day to day life
3. To provide general information about Greece (e.g. geography, weather, food etc.)

Expected Course Outcomes:

Students will be able:

1. To correctly pronounce Greek symbols and words, being more conscious and confident in the usage of their English vocabulary derived from Greek.
2. To make use of Modern Greek language in simple everyday conversation.
3. To understand contents from scientific texts that make use of Greek symbols and words, becoming familiar with fundamental linguistic aspects of the International Scientific Vocabulary as well as becoming able to formulate hypotheses about unknown compound words derived from Greek.
4. To be more aware about the evolution of Modern European languages, understanding the important connections between English and Greek/Neo-Latin languages.
5. To understand important socio-economic issues in contemporary Europe, developing their aptitude for critical thinking.

Programme Outcomes :	2, 11

Module:1	Greek Alphabet: Correct usage and Pronunciation of Greek symbols	4 hours	2

Module content: vowels and phonetic rules of diphthongs: alpha-iota / epsilon-iota / omicron-iota / and upsilon / epsilon-upsilon; consonants and their correct pronunciation; double consonants and digraphs.

alpha- Grammar skills: correct pronunciation of the 24 Greek letters; correct pronunciation of diphthongs digraphs.

Module:2	Greetings, introducing oneself; Proper Nouns and Proper Greek Names	3 hours	2, 11

Communicative functions: using formal and informal greetings; introducing oneself using affirmative form.

Grammar skills: nominative case and vocative case (singular), personal pronouns, verbs είμαι (to be) and μελένε (to be called).

Written communication skills: introducing oneself using Greek letters and words.

Module:3	Nationality and Provenance	5 hours	2, 11

Communicative functions: providing personal details such as nationality, address and telephone number;

Being able to name a few relevant landmarks in a city.

Grammar skills: Common nouns (masculine in -ος/-ης/-ας; feminine in -α/-η; neuter in -ο/-ι); από / σε + accusative case; cardinal numerals from 1 to 10; verb μένω (simple present).

Written communication skills: introducing oneself providing specific details about country and city of origin, address, telephone number.

Module:4	Family	5 hours	2, 11

Communicative functions: describing one's family and describing elementary physical traits (μικρός/μεγάλος – μελαχρινός/ξανθός – ψηλός/κοντός).

Grammar skills: possessive pronouns (singular/plural); word accent

Written communication skills: describing family and family members.

Module:5	**In the classroom: introducing others, languages and nationality adjectives**	**4 hours**	**2, 11**
Ccommunicative functions: introducing others by providing information on their nationality and spoken language(s); naming the objects in a classroom.			
Grammar skills: verb μιλώ (simple present); nationality adjectives.			
Written communication skills: introducing friends and relatives providing specific information about the language they speak.			
Module:6	**Months and seasons of the year; days of the week; time and weather**	**4 hours**	**2**
Communicative functions: defining time and date; talking about weather conditions.			
Grammar skills: cardinal numerals from 11 to 100; interrogative pronoun (ποιος-ποια-ποιο/τι);			
time adverbials (τώρα, σήμερα, χθες, αύριο, φέτος πέρσι, τουχρόνου, πότε); syntax: υποκείμενο/άμεσο αντικείμενο			
Written communication skills: describing weather conditions, defining time and date.			
Module:7	**Daily routine**	**3 hours**	**2, 11**
Module content: communicative functions: describing one's daily routine and activities/hobbies.			
Grammar skills: verbs πάω, ακούω, λέω, τρώω, μπορώ (simple present); plural nouns (nominative case).			
Written communication skills: writing a simple letter describing a daily routine.			
Module:8	**Contemporary issues:**	**2 hours**	**2, 11**
Social and Economic aspects of the 2009-2017 Greek government-debt crisis and of the 2015-2018 European Refugee Crisis.			
	Total Lecture hours:	**30 hours**	

Text Book(s):	
1.	Maria Karakirgiou, V. Panagiotidou, Jay Schwartz, *Kliksta Ellinika* (A1), Center for the Greek Language Publishing, Thessaloniki & Athens, 2014.
Reference Book(s):	
1.	Maria Kaliambou (Yale University, USA), *The Routledge Modern Greek Reader*, Routledge 2015.
2.	E. Georgantzi, E. Raftopoulou, *Greek for You* (Greek – English bilingual edition), Neohel, Athens, 2016.

Recommended by Board of Studies	31.10.2018		
Approved by Academic Council	No. 53	Date	13.12.18

JAP1001	JAPANESE FOR BEGINNERS	L	T	P	J	C
		2	0	0	0	2
Pre-requisite	Nil	Syllabus version				
		1.0				

Course Objectives:

The course gives students the necessary background to:

1. Develop four basic skills related to reading, listening, speaking and writing Japanese language.
2. Instill in learners an interest in Japanese language by teaching them culture and general etiquettes.
3. Recognize, read and write Hiragana and Katakana.

Expected Course Outcomes:

Students will be able to:

1. Remember Japanese alphabets and greet in Japanese.
2. Understand pronouns, verbs form, adjectives and conjunctions in Japanese.
3. Remember time and dates related vocabularies and express them in Japanese.
4. Create simple questions and its answers in Japanese.
5. Understand the Japanese culture and etiquettes.

Module: 1	Introduction to Japanese syllables and Greetings	4 hours

Introduction of Japanese language, alphabets; Hiragana, katakana, and Kanji Pronunciation, vowels and consonants.

Hiragana – writing and reading; Vocabulary: 50 Nouns and 20 pronouns, Greetings.

Module: 2	Demonstrative Pronouns	4 hours

Grammar: N1 wa N2 desu, Japanese Numerals, Demonstrative pronoun - Kore, Sore, Are and Dore

(This, That, Over there, which) Kono, sono, Ano and Dono (this, that, over there, which) Kochira, Sochira, Achira and

Dochira. this way...) Koko, Soko, Asoko and Doko (Here, There…. location)

Module: 3	Verbs and Sentence formation	4 hours

Classification of verbs Be verb desu Present and Present negative Basic structure of sentence (Subject+ Object+

Verb) Katakana-reading and writing

Module: 4	Conjunction and Adjectives	4 hours

Conjunction - Ya…..nado Classification of Adjectives 'I' and 'na' - ending Set phrase – Onegaishimasu –

Sumimasen,

wakarimasen Particle –Wa, Particle - Ni 'Ga imasu' and 'Ga arimasu' for Existence of living things and non-living things

Particle - Ka, Ni, Ga

Module: 5	Vocabulary and its Meaning	4 hours

Days/ Months /Year/Week (Current, Previous, Next, Next to Next) ; Nation, People and Language Relationship of

family (look and learn); Simple kanji recognition

Module: 6	Forming questions and giving answers	4 hours

Classification of Question words (Dare, Nani, Itsu, Doyatte, dooshite, Ikutsu, Ikura); Classification of Te forms, Polite

form of verbs

Module: 7	Expressing time, position and directions	4 hours

Classification of question words (Doko, Dore, Dono, Dochira); Time expressions (Jikan), Number of hours, Number of months, calendar of a month; Visit the departmental store, railway stations, Hospital (Byoki), office and University			
Module: 8	**Guest Lecture by Experts**		**2 hours**
Total Lecture hours			**30 hours**
Text Book(s):			
1.	The Japan Foundation (2017), Marugoto Japanese Language and Culture Starter A1 Coursebook For Communicative Language Competences, New Delhi: Goyal Publishers (9788183078047)		
2.	Banno, Eri et al (2011), Genki: An Integrated Course in Elementary Japanese I [Second Edition], Japan: The Japan Times.		
Reference Book(s):			
1.	Japanese for Busy people (2011) video CD, AJALT, Japan.		
2.	Carol and Nobuo Akiyama (2010), The Fast and Fun Way, New Delhi: Barron's Publication		
Mode of Evaluation: CAT , Quiz and Digital Assignments			
Recommended by Board of Studies	24.10.2018		
Approved by Academic Council	53rd ACM	**Date**	13.12.2018

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

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

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

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

Harassment – Types - Prevention of harassment, Violence and Terrorism

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

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

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

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

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

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

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

Dishonesty - Stealing - Malpractices in Examinations – Plagiarism

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

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

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

Guest lectures by Experts

	Total Lecture hours:	**30 hours**	

Reference Books

1.	Dhaliwal, K.K , “Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts,2016, Writers Choice, New Delhi, India.			
2.	Vittal, N, “Ending Corruption? - How to Clean up India?”, 2012, Penguin Publishers, UK.			
3.	Pagliaro, L.A. and Pagliaro, A.M, “Handbook of Child and Adolescent Drug and Substance Abuse: Pharmacological , Developmental and Clinical Considerations”, 2012Wiley Publishers, U.S.A.			
4.	Pandey, P. K (2012), “Sexual Harassment and Law in India”, 2012, Lambert Publishers, Germany.			
Mode of Evaluation: CAT, Assignment, Quiz, FAT and Seminar				
Recommended by Board of Studies		26-07-2017		
Approved by Academic Council		No. 46	Date	24-08-2017

Course code	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

	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 programmingfeatures
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 entitiesas 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 featuresto 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..

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

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

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

CSE1901	Technical Answers for Real World Problems (TARP)	L	T	P	J	C
		1	0	0	4	2

Pre-requisite	PHY1999 and 115 Credits Earned	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 usingengineering principles and arrive at innovative solutions

Module:1 **15 hours**

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

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

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

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

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

CSE1903	Comprehensive Examination	L	T	P	J	C
		0	0	0	0	1
Pre-requisite		**Syllabus version**				
		1.00				

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 specificproblemstatementsfor ill-defined real life problemswithreasonable assumptions and constraints.
2. Perform literature search and /or patent search in the area of interest.
3. Conductexperiments / Design and Analysis / solution iterations and documentthe results.
4. Perform error analysis / benchmarking / costing
5. Synthesise the results and arrive at scientific conclusions / products / solution
6. Document the results in the form of technical report / presentation

Contents

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

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

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

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

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

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

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

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

STS1001	Introduction to Soft skills	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	**None**	**Syllabus version**				
		2.0				

Course Objectives:

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

Expected Course Outcome:

1. Enabling students to know themselves and interact better with self and environment

Module:1	**Lessons on excellence**	**10 hours**

Ethics and integrity

Importance of ethics in life, Intuitionism vs Consequentialism, Non-consequentialism, Virtue ethics vs situation ethics, Integrity - listen to conscience, Stand up for what is right

Change management

Who moved my cheese?, Tolerance of change and uncertainty, Joining the bandwagon, Adapting change for growth - overcoming inhibition

How to pick up skills faster?

Knowledge vs skill, Skill introspection, Skill acquisition, "10,000 hours rule" and the converse

Habit formation

Know your habits, How habits work? - The scientific approach, How habits work? - The psychological approach, Habits and professional success, "The Habit Loop", Domino effect, Unlearning a bad habit

Analytic and research skills.

Focused and targeted information seeking, How to make Google work for you, Data assimilation

Module:2	**Team skills**	**11 hours**

Goal setting

SMART goals, Action plans, Obstacles -Failure management

Motivation

Rewards and other motivational factors, Maslow's hierarchy of needs, Internal and external motivation

Facilitation

Planning and sequencing, Challenge by choice, Full Value Contract (FVC), Experiential learning cycle, Facilitating the Debrief

Introspection

Identify your USP, Recognize your strengths and weakness, Nurture strengths, Fixing weakness, Overcoming your complex, Confidence building

Trust and collaboration

Virtual Team building, Flexibility, Delegating, Shouldering responsibilities

Module:3	**Emotional Intelligence**	**12 hours**

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

Module:4	**Adaptability**	**12 hours**

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

	Total Lecture hours:	**45 hours**	

Text Book(s)

1.	Chip Heath, How to Change Things When Change Is Hard (Hardcover),2010,First Edition,Crown Business.
2.	Karen Kindrachuk, Introspection**,** 2010, 1st Edition.
3.	Karen Hough, The Improvisation Edge: Secrets to Building Trust and Radical Collaboration at Work, 2011, Berrett-Koehler Publishers

Reference Books

1.	Gideon Mellenbergh, A Conceptual Introduction to Psychometrics: Development, Analysis and Application of Psychological and Educational Tests,2011, Boom Eleven International.
2.	Phil Lapworth, An Introduction to Transactional Analysis, 2011, Sage Publications (CA)

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

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

STS1002	Introduction to Business Communication	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	**None**	**Syllabus version**				
		2.0				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	**Study skills**	**10 hours**

Memory techniques

Relation between memory and brain, Story line technique, Learning by mistake, Image-name association, Sharing knowledge, Visualization

Concept map

Mind Map, Algorithm Mapping, Top down and Bottom Up Approach

Time management skills

Prioritization - Time Busters, Procrastination, Scheduling, Multitasking, Monitoring

6. Working under pressure and adhering to deadlines

Module:2	**Emotional Intelligence (Self Esteem)**	**6 hours**

Empathy

Affective Empathy and Cognitive Empathy

Sympathy

Level of sympathy (Spatial proximity, Social Proximity, Compassion fatigue)

Module:3	**Business Etiquette**	**9 hours**

Social and Cultural Etiquette

Value, Manners, Customs, Language, Tradition

Writing Company Blogs

Building a blog, Developing brand message, FAQs', Assessing Competition

Internal Communications

Open and objective Communication, Two way dialogue, Understanding the audience

Planning

Identifying, Gathering Information, Analysis, Determining, Selecting plan, Progress check, Types of planning

Writing press release and meeting notes

Write a short, catchy headline, Get to the Point –summarize your subject in the first paragraph, Body – Make it relevant to your audience

Module:4	**Quantitative Ability**	**4 hours**

Numeracy concepts

Fractions, Decimals, Bodmas, Simplifications, HCF, LCM, Tests of divisibility

Beginning to Think without Ink

Problems solving using techniques such as: Percentage, Proportionality, Support of answer choices, Substitution of convenient values, Bottom-up approach etc.

Math Magic

Puzzles and brain teasers involving mathematical concepts

Speed Calculations

Square roots, Cube roots, Squaring numbers, Vedic maths techniques

Module:5	**Reasoning Ability**	**3 hours**

Interpreting Diagramming and sequencing information

Picture analogy, Odd picture, Picture sequence, Picture formation, Mirror image and water image

Logical Links

Logic based questions-based on numbers and alphabets

Module:6	**Verbal Ability**	**3 hours**

Strengthening Grammar Fundamentals

Parts of speech, Tenses, Verbs(Gerunds and infinitives)

Reinforcements of Grammar concepts

Subject Verb Agreement, Active and Passive Voice, Reported Speech

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

Writing

Writing formal & informal letters, How to write a blog & knowing the format, Effective ways of writing a blog, How to write an articles & knowing the format, Effective ways of writing an articles, Designing a brochures

Speaking skills

How to present a JAM, Public speaking

Self managing

Concepts of self management and self motivation, Greet and Know, Choice of words, Giving feedback, Taking criticism

	Total Lecture hours:	**45 hours**	

Text Book(s)

1.	FACE, Aptipedia, Aptitude Encyclopedia, 2016, First Edition, Wiley Publications, Delhi.
2.	ETHNUS, Aptimithra, 2013, First Edition, McGraw-Hill Education Pvt. Ltd.

Reference Books

1.	Alan Bond and Nancy Schuman, 300+ Successful Business Letters for All Occasions, 2010, Third Edition, Barron's Educational Series, New York.

2.	Josh Kaufman, The First 20 Hours: How to Learn Anything ... Fast , 2014, First Edition, Penguin Books, USA.		
Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)			
Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45th AC	Date	15/06/2017

STS1101	Fundamentals of Aptitude	L	T	P	J	C
		3	0	0	0	1

Pre-requisite	None	Syllabus version
		1.0

Course Objectives:

1. To enhance the logical reasoning skills of the students and improve the problem-solving abilities
2. To strengthen the ability to solve quantitative aptitude problems
3. To enrich the verbal ability of the students

Expected Course Outcome:

1. Students will be introduced to basic concepts of Quantitative Aptitude, Logical reasoning and Verbal ability
2. Students will be able to read and demonstrate good comprehension of text in areas of the student's interest
3. Students will be able to demonstrate the ability to resolve problems that occur in their field.

Module:1	Lessons on excellence	2hours

Skill introspection, Skill acquisition, consistent practice

Module:2	Logical Reasoning	16 hours

Thinking Skill

- Problem Solving
- Critical Thinking
- Lateral Thinking

Taught through thought-provoking word and rebus puzzles, and word-link builder questions

Coding & decoding, Series, Analogy, Odd man out and Visual reasoning

- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

Sudoku puzzles

Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfort with numbers

Attention to detail

Picture and word driven Qs to develop attention to detail as a skill

Module:3	Quantitative Aptitude	14 hours

Speed Maths

- **Addition and Subtraction of bigger numbers**
- **Square and square roots**
- **Cubes and cube roots**
- **Vedic maths techniques**
- **Multiplication Shortcuts**
- **Multiplication of 3 and higher digit numbers**

- **Simplifications**
- **Comparing fractions**
- **Shortcuts to find HCF and LCM**
- **Divisibility tests shortcuts**

Algebra and functions

Module:4	**Recruitment Essentials**	**5hours**

Looking at an engineering career through the prism of an effective resume

- Importance of a resume - the footprint of a person's career achievements
- How a resume looks like?
- An effective resume vs. a poor resume: what skills you must build starting today and how?

Impression Management

Getting it right for the interview:

- Grooming, dressing
- Body Language and other non-verbal signs
- Displaying the right behaviour

Module:5	**Verbal Ability**	**8hours**

Essential grammar for placements:

- Nouns and Pronouns
- Verbs
- Subject-Verb Agreement
- Pronoun-Antecedent Agreement
- Punctuations

Verbal Reasoning

	Total Lecture hours:	**45 hours**

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

Text Book(s):

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. **SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.**
4. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS1102	**Arithmetic Problem Solving**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**1**

Pre-requisite	**None**	**Syllabus version**
		1.0

Course Objectives:

- To enhance the logical reasoning skills of the students and improve the problem-solving abilities
- To strengthen the ability to solve quantitative aptitude problems
- To enrich the verbal ability of the students for academic purpose

Expected course outcome:

- Students will be able to show more confidence in solving problems of Quantitative Aptitude
- Students will be able to show more confidence in solving problems of Logical Reasoning
- Students will be able to show more confidence in understanding the questions of Verbal Ability

Module:1	**Logical Reasoning**	**11 hours**

Word group categorization questions

Puzzle type class involving students grouping words into right group orders of logical sense

Cryptarithmetic

Data arrangements and Blood relations

- Linear Arrangement
- Circular Arrangement
- Multi-dimensional Arrangement
- Blood Relations

Module:2	**Quantitative Aptitude**	**18 hours**

Ratio and Proportion

- Ratio
- Proportion
- Variation
- Simple equations
- Problems on Ages
- Mixtures and alligations

Percentages, Simple and Compound Interest

- Percentages as Fractions and Decimals
- **Percentage Increase / Decrease**
- **Simple Interest**
- **Compound Interest**
- **Relation Between Simple and Compound Interest**

Number System

- **Number system**
- **Power cycle**
- **Remainder cycle**
- **Factors, Multiples**
- **HCF and LCM**

Module:3	**Verbal Ability**	**16hours**

Essential grammar for placements

- Prepositions
- Adjectives and Adverbs
- Tenses
- Forms and Speech and Voice
- Idioms and Phrasal Verbs
- Collocations, Gerund and Infinitives

Reading Comprehension for placements

- Types of questions
- Comprehension strategies
- Practice exercises

Articles, Prepositions and Interrogatives

- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

Vocabulary for placements

- Exposure to solving questions of
- Synonyms
- Antonyms
- Analogy
- Confusing words
- Spelling correctness

	Total Lecture hours:	**45 hours**

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

Text Book(s):

1. **FACE, Aptipedia Aptitude Encyclopedia, 2016, 1stEdition, Wiley Publications, Delhi.**
2. **ETHNUS, Aptimithra, 2013, 1stEdition, McGraw-Hill Education Pvt.Ltd.**
3. **SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.**
4. **R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition,**
   S. Chand Publishing, Delhi.

Reference Book(s):

Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS1201	Introduction to Problem Solving	L	T	P	J	C
		3	0	0	0	1

Pre-requisite	None	Syllabus version
		1.0

Course Objectives:

- To enhance the logical reasoning skills of the students and improve the problem-solving abilities
- To strengthen the ability to solve quantitative aptitude problems
- To enrich the verbal ability of the students for academic purpose

Expected Course Outcome:

- Students will be introduced to basic concepts of Quantitative Aptitude, Logical reasoning and Verbal ability
- Students will be able to read and demonstrate good comprehension of text in areas of the student's interest
- Students will be able to demonstrate the ability to resolve problems that occur in their field.

Module:1	Lessons on excellence	2hours

Skill introspection, Skill acquisition, consistent practice

Module:2	Logical Reasoning	18 hours

Thinking Skill

- Problem Solving
- Critical Thinking
- Lateral Thinking

Taught through thought-provoking word and rebus puzzles, and word-link builder questions

Coding & decoding, Series, Analogy, Odd man out and Visual reasoning

- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

Sudoku puzzles

Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfort with numbers

Attention to detail

Picture and word driven Qs to develop attention to detail as a skill

Module:3	Quantitative Aptitude	14 hours

Speed Maths

- Addition and Subtraction of bigger numbers
- Square and square roots
- Cubes and cube roots
- Vedic maths techniques
- Multiplication Shortcuts
- Multiplication of 3 and higher digit numbers
- Simplifications
- Comparing fractions
- Shortcuts to find HCF and LCM
- Divisibility tests shortcuts

Algebra and functions

Module:4	**Recruitment Essentials**	**5hours**

Looking at an engineering career through the prism of an effective resume

- Importance of a resume - the footprint of a person's career achievements
- How a resume looks like?
- An effective resume vs. a poor resume: what skills you must build starting today and how?

Impression Management

Getting it right for the interview:

- Grooming, dressing
- Body Language and other non-verbal signs
- Displaying the right behaviour

Module:5	**Verbal Ability**	**6hours**

Grammar challenge

A practice paper with sentence based and passage-based questions on grammar discussed. Topics covered in questions are Nouns and Pronouns, Verbs, Subject-Verb Agreement, Pronoun-Antecedent Agreement, Punctuations

Verbal reasoning

	Total Lecture hours:	**45 hours**

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

Text Book(s):

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. **SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.**
4. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition,

S. Chand Publishing, Delhi.			
Reference Book(s): Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.			
Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS1202	Introduction to Quantitative, Logical and Verbal Ability	L	T	P	J	C
		3	0	0	0	1

Pre-requisite	None	Syllabus version
Cleared the cut-off in end-of-sem 1 assessment		1.0

Course Objectives:

- To enhance the logical reasoning skills of the students and improve the problem-solving abilities
- To strengthen the ability to solve quantitative aptitude problems
- To enrich the verbal ability of the students for academic purpose

Expected Course Outcome:

- Students will be able to show more confidence in solving problems of Quantitative Aptitude
- Students will be able to show more confidence in solving problems of Logical Reasoning
- Students will be able to show more confidence in understanding the questions of Verbal Ability

Module:1	Logical Reasoning	12 hours

Word group categorization questions

Puzzle type class involving students grouping words into right group orders of logical sense

Cryptarithmetic

Data arrangements and Blood relations

- Linear Arrangement
- Circular Arrangement
- Multi-dimensional Arrangement
- Blood Relations

Module:2	Quantitative Aptitude	20 hours

Ratio and Proportion

- Ratio
- Proportion
- Variation
- Simple equations
- Problems on Ages
- Mixtures and alligations: Problems involving multiple iterations of mixtures

Percentages, Simple and Compound Interest

- Percentages as Fractions and Decimals
- Percentage Increase / Decrease
- Simple Interest
- Compound Interest
- Relation Between Simple and Compound Interest

Number System

- Number system
- Power cycle
- Remainder cycle
- Factors, Multiples
- HCF and LCM

Module:3	**Verbal Ability**	**13 hours**

Reading Comprehension – Advanced

Grammar - application and discussion

A practice paper with sentence based and passage-based questions on grammar discussed. Topics covered in questions are Prepositions, Adjectives and Adverbs, Tenses, Forms and Speech and Voice, Idioms and Phrasal Verbs, Collocations, Gerund and Infinitives

Articles, Prepositions and Interrogatives

- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

Vocabulary – Advanced

Exposure to challenging placement questions on vocabulary

	Total Lecture hours:	**45 hours**

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

Text Book(s):

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. **SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.**
4. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s): Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.			
Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS2001	Reasoning Skill Enhancement	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	**None**	**Syllabus version**				
		2.0				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Social Interaction and Social Media	6 hours

Effective use of social media

Types of social media, Moderating personal information, Social media for job/profession, Communicating diplomatically

Networking on social media

Maximizing network with social media, How to advertise on social media

Event management

Event management methods, Effective techniques for better event management

Influencing

How to win friends and influence people, Building relationships, Persistence and resilience, Tools for talking when stakes are high

Conflict resolution

Definition and strategies ,Styles of conflict resolution

Module:2	Non Verbal Communication	6 hours

Proximecs

Types of proximecs**,** Rapport building

Reports and Data Transcoding

Types of reports

Negotiation Skill

Effective negotiation strategies

Conflict Resolution

Types of conflicts

Module:3	Interpersonal Skill	8 hours

Social Interaction

Interpersonal Communication,Peer Communication, Bonding,Types of social interaction

Responsibility

Types of responsibilities**,** Moral and personal responsibilities

Networking

Competition, Collaboration, Content sharing

Personal Branding

Image Building, Grooming, Using social media for branding

Delegation and compliance

Assignment and responsibility, Grant of authority, Creation of accountability

Module:4	**Quantitative Ability**	**10 hours**

Number properties

Number of factors, Factorials, Remainder Theorem, Unit digit position, Tens digit position

Averages

Averages, Weighted Average

Progressions

Arithmetic Progression, Geometric Progression, Harmonic Progression

Percentages

Increase & Decrease or successive increase

Ratios

Types of ratios and proportions

Module:5	**Reasoning Ability**	**8 hours**

Analytical Reasoning

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

Module:6	**Verbal Ability**	**7 hours**

Vocabulary Building

Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies

	Total Lecture hours:	**45 hours**	

Text Book(s)

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, First Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, First Edition, McGraw-Hill Education Pvt.Ltd.
3. Mark G. Frank, David Matsumoto, Hyi Sung Hwang, Nonverbal Communication: Science and Applications, 2012, 1st Edition, Sage Publications, New York.

Reference Books

1. Arun Sharma, Quantitative aptitude, 2016, 7th edition, Mcgraw Hill Education Pvt. Ltd.

2.	Kerry Patterson, Joseph Grenny, Ron McMillan, Al Switzler, Crucial Conversations: Tools for Talking When Stakes are High, 2001,1st edition McGraw Hill Contemporary, Bangalore.		
3.	Dale Carnegie, How to Win Friends and Influence People, Latest Edition,2016. Gallery Books, New York.		
Mode of evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)			
Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45th AC	Date	15/06/2017

STS2002	Introduction to Etiquette	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	None	Syllabus version				
		2.0				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Impression Management	8 hours

Types and techniques

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

Non-verbal communication and body language

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

Module:2	Thinking Skills	4 hours

Introduction to problem solving process

Steps to solve the problem, Simplex process

Introduction to decision making and decision making process

Steps involved from identification to implementation**,** Decision making model

Module:3	**Beyond Structure**		**4 hours**
Art of questioning How to frame questions, Blooms questioning pyramid, Purpose of questions **Etiquette** Business, Telephone etiquette, Cafeteria etiquette, Elevator etiquette, Email etiquette, Social media etiquette			
Module:4	**Quantitative Ability**		**9 hours**
Profit and Loss Cost Price & Selling Price, Margins & Markup **Interest Calculations** Simple Interest, Compound Interest, Recurring **Mixtures and solutions** Ratio & Averages, Proportions **Time and Work** Pipes & Cisterns, Man Day concept, Division Wages **Time Speed and Distance** Average speed, Relative speed, Boats and streams. **Proportions & Variations**			
Module:5	**Reasoning Ability**		**11 hours**
Logical Reasoning Sequence and series, Coding and decoding, Directions **Visual Reasoning** Abstract Reasoning, Input Type Diagrammatic Reasoning, Spatial reasoning, Cubes **Data Analysis And Interpretation** DI-Tables/Charts/Text			
Module:6	**Verbal Ability**		**9 hours**
Grammar Spot the Errors, Sentence Correction, Gap Filling Exercise, Sentence Improvisations, Misc. Grammar Exercise			

	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	Micheal Kallet, Think Smarter: Critical Thinking to Improve Problem-Solving and Decision-Making Skills, April 7, 2014, 1st Edition, Wiley, New Jersey.
2.	MK Sehgal, Business Communication, 2008, 1st Edition, Excel Books, India.
3.	FACE, Aptipedia Aptitude Encyclopedia, 2016, First Edition, Wiley Publications, Delhi.
4.	ETHNUS, Aptimithra, 2013, First edition, McGraw-Hill Education Pvt. Ltd, Banglore.
Reference Books	
1.	Andrew J. DuBrin, Impression Management in the Workplace: Research, Theory and Practice, 2010, 1st edition, Routledge.
2.	Arun Sharma, Manorama Sharma, Quantitative aptitude, 2016, 7th edition, McGraw Hill Education Pvt. Ltd, Banglore.
3.	M. Neil Browne, Stuart M. Keeley, Asking the right questions, 2014, 11th Edition, Pearson, London.
Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)	

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

STS2101	Getting Started to Skill Enhancement	L	T	P	J	C
		3	0	0	0	1

Pre-requisite	None	Syllabus version
		1.0

Course Objectives:

- To develop the students' logical thinking skills and apply it in the real-life scenarios
- To learn the strategies of solving quantitative ability problems
- To enrich the verbal ability of the students

Expected Course Outcome:

- Students will be able to demonstrate critical thinking skills, such as problem solving related to their subject matters
- Students will be able to demonstrate competency in verbal, quantitative and reasoning aptitude
- Students will be able to perform good written communication skills

Module:1	Logical Reasoning	11 hours

Clocks, calendars, Direction sense and Cubes

- Clocks
- Calendars
- Direction Sense
- Cubes

Data interpretation and Data sufficiency

- Data Interpretation – Tables
- Data Interpretation - Pie Chart
- Data Interpretation - Bar Graph
- Data Sufficiency

Module:2	Quantitative Aptitude	18 hours

Time and work

- Work with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

Time, Speed and Distance

- Basics of time, speed and distance
- Relative speed
- Problems based on trains
- Problems based on boats and streams

- Problems based on races

Profit and loss, Partnerships and averages

- Basic terminologies in profit and loss
- Partnership
- Averages
- Weighted average

Module:3	**Verbal Ability**	**13hours**

Sentence Correction

- Subject-Verb Agreement
- Modifiers
- Parallelism
- Pronoun-Antecedent Agreement
- Verb Time Sequences
- Comparisons
- Prepositions
- Determiners

Sentence Completion and Para-jumbles

- Pro-active thinking
- Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues)
- Fixed jumbles
- Anchored jumbles

Module:4	**Writing skills for placements**	**3 hours**

Essay writing

- Idea generation for topics
- Best practices
- Practice and feedback

	Total Lecture hours:	**45 hours**

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

Text Book(s):

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. **SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.**
4. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS2102	Enhancing Problem Solving Skills	L	T	P	J	C
		3	0	0	0	1

Pre-requisite	None	Syllabus version
		1.0

Course Objectives:

- To develop the students' logical thinking skills and apply it in the real-life scenarios
- To learn the strategies of solving quantitative ability problems
- To enrich the verbal ability of the students
- To strengthen the basic programming skills for placements

Expected Course Outcome:

- The students will be able to interact confidently and use decision making models effectively
- The students will be able to deliver impactful presentations
- The students will be able to be proficient in solving quantitative aptitude and verbal ability questions effortlessly

Module:1	Logical Reasoning	5 hours

Logical connectives, Syllogism and Venn diagrams

- Logical Connectives
- Syllogisms
- Venn Diagrams – Interpretation

Venn Diagrams – Solving

Module:2	Quantitative Aptitude	11 hours

Logarithms, Progressions, Geometry and Quadratic equations

- Logarithm
- Arithmetic Progression
- Geometric Progression
- Geometry
- Mensuration
- Coded inequalities
- Quadratic Equations

Permutation, Combination and Probability

- Fundamental Counting Principle
- Permutation and Combination
- Computation of Permutation
- Circular Permutations
- Computation of Combination

Probability

Module:3	**Verbal Ability**	**4 hours**

Critical Reasoning

- Argument – Identifying the Different Parts (Premise, assumption, conclusion)
- Strengthening statement
- Weakening statement
- Mimic the pattern

Module:4	**Recruitment Essentials**	**7 hours**

Cracking interviews - demonstration through a few mocks

Sample mock interviews to demonstrate how to crack the:

- HR interview
- MR interview
- Technical interview

Cracking other kinds of interviews

- Skype/ Telephonic interviews
- Panel interviews
- Stress interviews

Resume building – workshop

A workshop to make students write an accurate resume

Module:5	**Problem solving and Algorithmic skills**	**18 hours**

- Logical methods to solve problem statements in Programming
- Basic algorithms introduced

	Total Lecture hours:	**45 hours**

Mode of Evaluation: FAT, Assignments, Mock interviews, 3 Assessments with Term End FAT (Computer Based Test)

Text Book(s):

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. **SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.**
4. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS2201	**Numerical Ability and Cognitive Intelligence**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**0**	**0**	**1**
Pre-requisite	**None**	**Syllabus version**				

		1.0

Course Objectives:

- To develop the students' logical thinking skills and apply it in the real-life scenarios
- To learn the strategies of solving quantitative ability problems
- To enrich the verbal ability of the students

Expected Course Outcome:

- Students will be able to demonstrate critical thinking skills, such as problem solving related to their subject matters
- Students will be able to demonstrate competency in verbal, quantitative and reasoning aptitude
- Students will be able to perform good written communication skills

Module:1	**Logical Reasoning**	**10 hours**

Clocks, calendars, Direction sense and Cubes

- Clocks
- Calendars
- Direction Sense
- Cubes

Practice on advanced problems

Data interpretation and Data sufficiency - Advanced

- Advanced Data Interpretation and Data Sufficiency questions of CAT level
- Multiple chart problems
- Caselet problems

Module:2	**Quantitative Aptitude**	**19 hours**

Time and work – Advanced

- Work with different efficiencies
- Pipes and cisterns: Multiple pipe problems
- Work equivalence
- Division of wages
- Advanced application problems with complexity in calculating total work

Time, Speed and Distance - Advanced

- Relative speed
- Advanced Problems based on trains
- Advanced Problems based on boats and streams
- Advanced Problems based on races

Profit and loss, Partnerships and averages - Advanced

- Partnership
- Averages
- Weighted average

Advanced problems discussed

Number system - Advanced

Advanced application problems on Numbers involving HCF, LCM, divisibility tests, remainder and power cycles.

Module:3	**Verbal Ability**	**13 hours**

Sentence Correction - Advanced

- Subject-Verb Agreement
- Modifiers
- Parallelism
- Pronoun-Antecedent Agreement
- Verb Time Sequences
- Comparisons
- Prepositions
- Determiners

Quick introduction to 8 types of errors followed by exposure to GMAT level questions

Sentence Completion and Para-jumbles - Advanced

- Pro-active thinking
- Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues)
- Fixed jumbles
- Anchored jumbles

Practice on advanced GRE/ GMAT level questions

Reading Comprehension – Advanced

Exposure to difficult foreign subject-based RCs of the level of GRE/ GMAT

Module:4	**Writing skills for placements**	**3 hours**		

Essay writing

- Idea generation for topics
- Best practices
- Practice and feedback

	Total Lecture hours:	**45 hours**

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

Text Book(s):

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. **SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.**
4. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS2202	Advanced Aptitude and Reasoning Skills	L	T	P	J	C
		3	0	0	0	1

Pre-requisite	None	Syllabus version
		1.0

Course Objectives:

1. To develop the students' logical thinking skills and apply it in the real-life scenarios
2. To learn the strategies of solving quantitative ability problems
3. To enrich the verbal ability of the students
4. To strengthen the basic programming skills for placements

Expected Course Outcome:

- The students will be able to interact confidently and use decision making models effectively
- The students will be able to deliver impactful presentations
- The students will be able to be proficient in solving quantitative aptitude and verbal ability questions effortlessly

Module:1	Logical Reasoning	4 hours

Logical Reasoning puzzles - Advanced

Advanced puzzles:

1. Sudoku
2. Mind-bender style word statement puzzles
3. Anagrams
4. Rebus puzzles

Logical connectives, Syllogism and Venn diagrams

1. Logical Connectives
2. Advanced Syllogisms - 4, 5, 6 and other multiple statement problems
3. Challenging Venn Diagram questions: Set theory

Module:2	Quantitative Aptitude	10 hours

Logarithms, Progressions, Geometry and Quadratic equations - Advanced

1. Logarithm
2. Arithmetic Progression
3. Geometric Progression
4. Geometry
5. Mensuration
6. Coded inequalities
7. Quadratic Equations

Concepts followed by advanced questions of CAT level

Permutation, Combination and Probability - Advanced

- Fundamental Counting Principle
- Permutation and Combination
- Computation of Permutation - Advanced problems
- Circular Permutations
- Computation of Combination - Advanced problems
- Advanced probability

Module:3	Verbal Ability	5 hours

Image interpretation

1. Image interpretation: Methods
2. Exposure to image interpretation questions through brainstorming and practice

Critical Reasoning - Advanced

1. Concepts of Critical Reasoning
2. Exposure to advanced questions of GMAT level

Module:4	Recruitment Essentials	8 hours

Mock interviews

Cracking other kinds of interviews

Skype/ Telephonic interviews
Panel interviews
Stress interviews

Guesstimation

1. Best methods to approach guesstimation questions
2. Practice with impromptu interview on guesstimation questions

Case studies/ situational interview

1. Scientific strategies to answer case study and situational interview questions
2. Best ways to present cases
3. Practice on presenting cases and answering situational interviews asked in recruitment rounds

Module:5	Problem solving and Algorithmic skills	18 hours

1. Logical methods to solve problem statements in Programming
2. Basic algorithms introduced

	Total Lecture hours:	45 hours

Mode of Evaluation: FAT, Assignments, Mock interviews, 3 Assessments with Term End FAT (Computer Based Test)

Text Book(s):

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.

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ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.
R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

</td></tr>
<tr><td colspan="4">Reference Book(s):
Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.</td></tr>
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<tr><td>Approved by Academic Council</td><td>No. 53rd AC</td><td>Date</td><td>13.12.2018</td></tr>
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STS3001	Preparedness for External Opportunities	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	**None**	**Syllabus version**				
		2.0				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Interview Skills	3 hours

Types of interview

Structured and unstructured interview orientation, Closed questions and hypothetical questions, Interviewers' perspective, Questions to ask/not ask during an interview

Techniques to face remote interviews

Video interview, Recorded feedback , Phone interview preparation

Mock Interview

Tips to customize preparation for personal interview, Practice rounds

Module:2	Resume Skills	2 hours

Resume Template

Structure of a standard resume**,** Content, color, font

Use of power verbs

Introduction to Power verbs and Write up

Types of resume

Quiz on types of resume

Customizing resume

Frequent mistakes in customizing resume, Layout - Understanding different company's requirement, Digitizing career portfolio

Module:3	Presentation Skills	6 hours

Preparing presentation

10 tips to prepare PowerPoint presentation**,** Outlining the content, Passing the Elevator Test

Organizing materials

Blue sky thinking, Introduction , body and conclusion, Use of Font, Use of Color, Strategic presentation

Maintaining and preparing visual aids

Importance and types of visual aids, Animation to captivate your audience, Design of posters

Dealing with questions

Setting out the ground rules, Dealing with interruptions, Staying in control of the questions, Handling difficult questions

Module:4	**Quantative Ability**	**14 hours**

Permutation-Combinations

Counting, Grouping, Linear Arrangement, Circular Arrangements

Probability

Conditional Probability, Independent and Dependent Events

Geometry and Mensuration

Properties of Polygon, 2D & 3D Figures, Area & Volumes

Trigonometry

Heights and distances, Simple trigonometric functions

Logarithms

Introduction, Basic rules

Functions

Introduction, Basic rules

Quadratic Equations

Understanding Quadratic Equations, Rules & probabilities of Quadratic Equations

Set Theory

Basic concepts of Venn Diagram

Module:5	**Reasoning Ability**	**7 hours**

Logical reasoning

Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic

Data Analysis and Interpretation

Data Sufficiency

Data interpretation-Advanced Interpretation tables, pie charts & bar chats

Module:6	**Verbal Ability**	**8 hours**

Comprehension and Logic

Reading comprehension

Para Jumbles

Critical Reasoning :

Premise and Conclusion, Assumption & Inference, Strengthening & Weakening an Argument

Module:7	**Writing Skills**	**5 hours**

Note making

What is note making, Different ways of note making

Report writing

What is report writing, How to write a report, Writing a report & work sheet **Product description** Designing a product, Understanding it's features, Writing a product description **Research paper** Research and its importance, Writing sample research paper			
	Total Lecture hours:	**45 hours**	
Text Book(s)			
1.	Michael Farra, Quick Resume & Cover letter Book, 2011, 1st Edition, JIST Editors, Saint Paul.		
2.	Daniel Flage, An Introduction to Critical Thinking, 2002, 1st Edition, Pearson, London.		
Reference Books			
1.	FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.		
2.	ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt. Ltd.		
Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)			
Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45th AC	Date	15/06/2017

STS3004	Data Structures and Algorithms	L	T	P	J	C
		3	0	0	0	1

Pre-requisite	None	Syllabus version
		1.0

Course Objectives:

1. To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
2. To develop logics which will help them to create programs, applications in C.
3. To learn how to design a graphical user interface (GUI) with Java Swing.

Expected Course Outcome:

1. Clear knowledge about problem solving skills in DS & Algorithms concepts

Module:1	Data Structures	10 hours

Introduction to data structures, Array, Linked List, Stack, Queue, Trees.

Module:2	Algorithms	15 hours

Introduction to Algorithms, Searching Algorithms, Sorting Algorithms, Greedy Algorithm, Divide and Conquer, Analysis of Algorithm.

Module:3	C Programming	10 hours

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

Module:4	C++ Programming	5 hours

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

Module:5	JAVA	5 hours

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

	Total Lecture hours:	45 hours	

Reference Books

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

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

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

STS3005	Code Mithra	L	T	P	J	C
		3	0	0	0	1

Pre-requisite	None	Syllabus version
		1.0

Course Objectives:

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

Expected Course Outcome:

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

Module:1	C Programming	15 hours

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

Module:2	C++ Programming	15 hours

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

Module:3	JAVA	10 hours

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

Module:4	Database	5 hours

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

	Total Lecture hours:	45 hours	

Reference Books

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

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

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

STS3006	Preparedness for External Opportunities	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	None	Syllabus version				
		1.0				

Course Objectives:

1. To enhance the problem solving skills.
2. To check if candidates have the adequate writing skills that are needed in an organization.
3. To reason, model, and draw conclusions or make decisions with mathematical, statistical, and quantitative information.

Expected Course Outcome:

1. Students will be able to solve mathematical, reasoning and verbal questionnaires

Module:1	Quantitative Ability	12 hours

Time and Work, Time Speed and Distance, Number System, Equations, Percentages, Profit and Loss, Permutation and Combination, Probability, Geometry and Mensuration, Averages, Progression, Allegations and Mixtures, Ages

Module:2	Reasoning Ability	12 hours

Data Arrangement - Linear, Circular and Cross Variable Relationship**,** Data Sufficiency, Data Interpretation-Advanced Interpretation Tables**,** Coding and Decoding, Abstract Reasoning, Input Type Diagrammatic Reasoning, Spatial Reasoning, Cubes, Clocks and Calendar

Module:3	Verbal Ability	21 hours

Vocabulary Building

Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies, Cloze Test.

Comprehension and Logic

Reading comprehension

Para Jumbles

Critical Reasoning

Premise and Conclusion, Assumption & Inference, Strengthening & Weakening an Argument.

Sentence Correction

Modifiers, parallelism, Verb time sequences, Comparison, Determiners.

Building personal lexicon

Benefits of becoming a logophile, Etymology – Root words, Prefix and suffix.

Grammar

Spot the Errors, Sentence Correction, Gap Filling Exercise.

Text Book(s)

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.

3.	R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.		
Reference Books			
1.	Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.		
Mode of evaluation: Assignments, Projects, Case studies, FAT (Computer Based Test)			
Recommended by Board of Studies			
Approved by Academic Council	No.49	Date	15/03/2018

STS3007	Preparedness for Career Opportunities	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	**None**	**Syllabus version**				
		1.0				

Course Objectives:

1. To enrich the logical thinking ability for better analysis and decision making
2. To hone the competence in solving problems and reasoning skills
3. To build a good vocabulary and use it in effective communication

Expected Course Outcome:

1. Students will be able to solve mathematical, reasoning and verbal questionnaires

Module:1	**Quantitative Ability**	**15 hours**

Time and Work, Time Speed and Distance, Number System, Equations, Percentages, Profit and Loss, Permutation and Combination, Probability, Geometry and Mensuration, Averages, Progression, Allegations and Mixtures, Ages

Module:2	**Reasoning Ability**	**12 hours**

Data Arrangement - Linear, Circular and Cross Variable Relationship**,** Data Sufficiency, Data Interpretation-Advanced Interpretation Tables**,** Coding and Decoding, Abstract Reasoning, Input Type Diagrammatic Reasoning, Spatial Reasoning, Cubes, Clocks and Calendar

Module:3	**Verbal Ability**	**18 hours**

Vocabulary Building

Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies, Cloze Test.

Comprehension and Logic

Reading comprehension

Para Jumbles

Critical Reasoning :

Premise and Conclusion, Assumption & Inference, Strengthening & Weakening an Argument.

Sentence Correction

Modifiers, parallelism, Verb time sequences, Comparison, Determiners.

Building personal lexicon

Benefits of becoming a logophile, Etymology – Root words, Prefix and suffix.

Text Book(s)

1.	FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2.	ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3.	R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Books			
1.	Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.		
Mode of evaluation: Assignments, Projects, Case studies, FAT (Computer Based Test)			
Recommended by Board of Studies			
Approved by Academic Council	No.49	Date	15/03/2018

STS3101	Introduction to Programming Skills	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	**None**	**Syllabus version**				
		1.0				

Course Objectives:

- Ability to translate vast data into abstract concepts and to understand JAVA concepts
- To have a clear understanding of subject related concepts
- To develop computational ability in Java programming language

Expected Course Outcome:

- Clear Knowledge about problem solving skills in JAVA concepts
- Students will be able to write codes in Java

Module:1	**Object and Class, Data types**	**8 hours**

Types of programming
Disadvantages of functional programming
Class & Objects
Attributes
Methods
Objects
Solving MCQs based on Objects and Classes
Solving tricky questions based on encapsulation
Solving frequently asked object-based questions

Data types
Data
Why data type
Variables
Available data types
Numeric – int, float, double
Character – char, string
Solving MCQs based on type casting, data types
Solving debugging based MCQs

Module:2	**Basic I / O, Decision Making, Loop Control**	**8 hours**

Printing
Getting input from user during run time
Command line arguments
Solving programming questions based on CLA
Solving MCQs questions based on CLA

Need for control statement
if..else
if..else if..else
Nested if..else
Switch case
Common mistakes with control statements (like using = instead of ==)
Solving frequently asked questions on decision making

Types of looping statements
Entry Controlled
For
While
Exit Controlled
do while
break and continue
Demo on looping
Common mistakes with looping statements (like using; at the end of the loop)
Solving pattern programming problems, series problems
Solving predict the output questions

Module:3	**String, Date, Array**	**10 hours**

String handling, date handling
Solving problems based on arrays like searching, sorting, rearranging, iteration)
Multi-dimensional arrays
Solving pattern problems using 2D arrays
Real time application based on 2D arrays

Module:4	**Inheritance, Aggregation & Associations**	**12 hours**

Need
Is A – Inheritance
Types of inheritance supported
Diagrammatic representation
Demo on inheritance
Has A – Aggregation
Diagrammatic representation
Demo on aggregation
Uses A - Association
Diagrammatic representation
Demo on association
Assignment on relationships
Solving MCQs based on relationships between classes

Module:5	**Modifiers, Interface & Abstract classes (Java specific), Packages**	**7 hours**

Types of access specifiers
Demo on access specifiers

Assignment on access modifiers Instance Members Solving MCQs based on modifiers Abstract Classes Need Abstract Classes Abstract Methods Interfaces Assignment on abstract classes and interface Need for packages Access specifiers & packages Import classes from other packages

	Total Lecture hours:	**45 hours**

Reference Books	
1.	Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2.	Introduction to Programming with Java: A Problem-Solving Approach by John Dean

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

Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS3104	Enhancing Programming Ability	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	**None**	**Syllabus version**				
		1.0				

Course Objectives:

- Ability to translate vast data into abstract concepts and to understand JAVA concepts
- To have a clear understanding of subject related concepts
- To develop computational ability in Java programming language

Expected Course Outcome:

- Clear Knowledge about problem solving skills in JAVA concepts
- Students will be able to write codes in Java

Module:1	**Collections**	**12 hours**

ArrayList, LinkedList, List Interface, HashSet, Map Interface, HashMap, Set
Programming questions based on collections
Real world problems based on data structure

Module:2	**Threads, Exceptions, LinkedList, Arrays**	**6 hours**

Need of threads
Creating threads
Wait
Sleep
Thread execution

Need for exception handling
try, catch, throw, throws
Creating own exception (Java, Python)
Handling own exceptions

Solving programming questions based on linked list and arrays

Module:3	**Stack and Queue, Trees**	**7 hours**

Solving programming questions based on stacks and queues
How to implement a stack using queue?
How to implement a queue using stack?

Solving programming questions based on trees, binary trees, binary search trees

Module:4	**JDBC Connectivity, JDBC Data**	**10 hours**

JDBC Overview
Database Setup

Install the MySQL Database Create New Database User in MySQL Workbench Selecting data from tables Inserting Data into the Database Updating Data in the Database Deleting Data from the Database Creating Prepared Statements		
Module:5	**Networking with Java**	**10 hours**
Working with URLs Sending HTTP Requests Processing JSON data using Java Processing XML data using Java		
	Total Lecture hours:	**45 hours**

Reference Books	
1.	Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2.	Introduction to Programming with Java: A Problem-Solving Approach by John Dean

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

Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS3105	Computational Thinking	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	**None**	**Syllabus version**				
		1.0				

Course Objectives:

- Ability to translate vast data into abstract concepts and to understand JAVA concepts
- To have a clear understanding of subject related concepts
- To develop computational ability in Java programming language

Expected Course Outcome:

- Clear Knowledge about problem solving skills in JAVA concepts
- Students will be able to write codes in Java

Module:1	**Date, Array**	**10 hours**

date handling
Solving problems based on arrays like searching, sorting, rearranging, iteration)
Multi-dimensional arrays
Solving pattern problems using 2D arrays
Real time application based on 2D arrays

Module:2	**Inheritance, Aggregation & Associations**	**15 hours**

Need
Is A – Inheritance
Types of inheritance supported
Diagrammatic representation
Demo on inheritance
Has A – Aggregation
Diagrammatic representation
Demo on aggregation
Uses A - Association
Diagrammatic representation
Demo on association
Assignment on relationships
Solving MCQs based on relationships between classes

Module:3	**Modifiers, Interface & Abstract classes (Java specific)**	**10 hours**

Types of access specifiers
Demo on access specifiers
Assignment on access modifiers
Instance Members
Solving MCQs based on modifiers

Abstract Classes Need Abstract Classes Abstract Methods Interfaces Assignment on abstract classes and interface		
Module:4	**Packages**	**5 hours**
Need for packages Access specifiers & packages Import classes from other packages		
Module:5	**Exceptions**	**5 hours**
Need for exception handling try, catch, throw, throws Creating own exception (Java, Python) Handling own exceptions		
	Total Lecture hours:	**45 hours**

Reference Books	
1.	Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2.	Introduction to Programming with Java: A Problem-Solving Approach by John Dean

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

Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS3201	Programming Skills for Employment	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	None	Syllabus version				
		1.0				

Course Objectives:

- Ability to translate vast data into abstract concepts and to understand JAVA concepts
- To have a clear understanding of subject related concepts
- To develop computational ability in Java programming language

Expected Course Outcome:

- Clear Knowledge about problem solving skills in JAVA concepts
- Students will be able to write codes in Java

Module:1	Object and Class, Data types, Basic I / O	8 hours

Types of programming
Disadvantages of functional programming
Class & Objects
Attributes
Methods
Objects
Solving MCQs based on Objects and Classes
Solving tricky questions based on encapsulation
Solving frequently asked object based questions

Data types
Data
Why data type
Variables
Available data types
Numeric – int, float, double
Character – char, string
Solving MCQs based on type casting, data types
Solving debugging based MCQs

Printing
Getting input from user during run time
Command line arguments
Solving programming questions based on CLA
Solving MCQs questions based on CLA

Module:2	Decision Making, Loop Control, String, Date, Array	10 hours

Need for control statement
if..else
if..else if..else
Nested if..else
Switch case
Common mistakes with control statements (like using = instead of ==)
Solving frequently asked questions on decision making

Types of looping statements
Entry Controlled
For
While
Exit Controlled
do while
break and continue
Demo on looping
Common mistakes with looping statements (like using ; at the end of the loop)
Solving pattern programming problems, series problems
Solving predict the output questions

String handling, date handling
Solving problems based on arrays like searching, sorting, rearranging, iteration)
Multi-dimensional arrays
Solving pattern problems using 2D arrays
Real time application based on 2D arrays

Module:3	Inheritance, Aggregation & Associations	10 hours

Need
Is A – Inheritance
Types of inheritance supported
Diagrammatic representation
Demo on inheritance
Has A – Aggregation
Diagrammatic representation
Demo on aggregation
Uses A - Association
Diagrammatic representation
Demo on association
Assignment on relationships
Solving MCQs based on relationships between classes

Module:4	Modifiers, Interface & Abstract classes (Java specific), Packages	7 hours

Types of access specifiers

Demo on access specifiers Assignment on access modifiers Instance Members Solving MCQs based on modifiers Abstract Classes Need Abstract Classes Abstract Methods Interfaces Assignment on abstract classes and interface Need for packages Access specifiers & packages Import classes from other packages			
Module:5	**Collections**		**10 hours**
ArrayList, LinkedList, List Interface, HashSet, Map Interface, HashMap, Set Programming questions based on collections Real world problems based on data structure			
	Total Lecture hours:		**45 hours**
Reference Books			
1.	Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd		
2.	Introduction to Programming with Java: A Problem-Solving Approach by John Dean		
Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)			
Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS3204	JAVA Programming and Software Engineering Fundaments	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	None	Syllabus version				
		1.0				

Course Objectives:

- Ability to translate vast data into abstract concepts and to understand JAVA concepts
- To have a clear understanding of subject related concepts
- To develop computational ability in Java programming language

Expected Course Outcome:

- Clear Knowledge about problem solving skills in JAVA concepts
- Students will be able to write codes in Java

Module:1	Threads, Exceptions, LinkedList, Arrays, Stack and Queue	8 hours

Need of threads
Creating threads
Wait
Sleep
Thread execution

Need for exception handling
try, catch, throw, throws
Creating own exception (Java, Python)
Handling own exceptions

Solving programming questions based on linked list and arrays

Solving programming questions based on stacks and queues
How to implement a stack using queue?
How to implement a queue using stack?

Module:2	Trees, JDBC Connectivity	7 hours

Solving programming questions based on trees, binary trees, binary search trees
JDBC Overview
Database Setup
Install the MySQL Database
Create New Database User in MySQL Workbench

Module:3	JDBC Data	6 hours

Selecting data from tables Inserting Data into the Database Updating Data in the Database Deleting Data from the Database Creating Prepared Statements		
Module:4	**Networking with Java**	**12 hours**
Working with URLs Sending HTTP Requests Processing JSON data using Java Processing XML data using Java		
Module:5	**Advanced programming**	**12 hours**
File Operations CSV Operations Encoder & Decoders Encryption & Decryption Hashes Loggers		
	Total Lecture hours:	**45 hours**

Reference Books	
1.	Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2.	Introduction to Programming with Java: A Problem-Solving Approach by John Dean

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

Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS3205	Advanced JAVA Programming	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	**None**	**Syllabus version**				
		1.0				

Course Objectives:

- Ability to translate vast data into abstract concepts and to understand JAVA concepts
- To have a clear understanding of subject related concepts
- To develop computational ability in Java programming language

Expected Course Outcome:

- Clear Knowledge about problem solving skills in JAVA concepts
- Students will be able to write codes in Java

Module:1	**Associations, Modifiers**	**9 hours**

Uses A - Association
Diagrammatic representation
Demo on association
Assignment on relationships
Solving MCQs based on relationships between classes

Types of access specifiers
Demo on access specifiers
Assignment on access modifiers
Instance Members
Solving MCQs based on modifiers

Module:2	**Interface & Abstract classes (Java specific), Packages**	**10 hours**

Abstract Classes
Need
Abstract Classes
Abstract Methods
Interfaces
Assignment on abstract classes and interface

Need for packages
Access specifiers & packages
Import classes from other packages

Module:3	**Exceptions**	**7 hours**

Need for exception handling
try, catch, throw, throws

Creating own exception (Java, Python) Handling own exceptions			
Module:4	**Collections**		**15 hours**
ArrayList, LinkedList, List Interface, HashSet, Map Interface, HashMap, Set Programming questions based on collections Real world problems based on data structure			
Module:5	**LinkedList, Arrays**		**4 hours**
Solving programming questions based on linked list and arrays			
	Total Lecture hours:		**45 hours**
Reference Books			
1.	Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd		
2.	Introduction to Programming with Java: A Problem-Solving Approach by John Dean		
Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)			
Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS3301	JAVA for Beginners	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	**None**	**Syllabus version**				
		1.0				

Course Objectives:

- Ability to translate vast data into abstract concepts and to understand JAVA concepts
- To have a clear understanding of subject related concepts
- To develop computational ability in Java programming language

Expected Course Outcome:

- Clear Knowledge about problem solving skills in JAVA concepts
- Students will be able to write codes in Java

Module:1	**Introduction to Programming**	**10 hours**

Introduction to Flow Charts
Pseudo code
Program Development Steps & Algorithms
Computer Operations & Data Types
Comparison Operators
Single Selection
Dual Selection
Three or More Choices
Nested Ifs
Boolean Operators
Loops

Module:2	**Object and Class**	**10 hours**

Types of programming
Disadvantages of functional programming
Class & Objects
Attributes
Methods
Objects
Solving MCQs based on Objects and Classes
Solving tricky questions based on encapsulation
Solving frequently asked object based questions

Module:3	**Data types, Basic I / O**	**10 hours**

Data types
Data
Why data type

Variables
Available data types
Numeric – int, float, double
Character – char, string
Solving MCQs based on type casting, data types
Solving debugging based MCQs

Printing
Getting input from user during run time
Command line arguments
Solving programming questions based on CLA
Solving MCQs questions based on CLA

Module:4	**Decision Making, Loop Control**	**10 hours**

Need for control statement
if..else
if..else if..else
Nested if..else
Switch case
Common mistakes with control statements (like using = instead of ==)
Solving frequently asked questions on decision making

Types of looping statements
Entry Controlled
For
While
Exit Controlled
do while
break and continue
Demo on looping
Common mistakes with looping statements (like using ; at the end of the loop)
Solving pattern programming problems, series problems
Solving predict the output questions

Module:5	**String**	**5 hours**

String handling

	Total Lecture hours:	**45 hours**

Reference Books

1. Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2. Introduction to Programming with Java: A Problem-Solving Approach by John Dean

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

Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS3401	Foundation to Programming Skills	L	T	P	J	C
		3	0	0	0	1
Pre-requisite	**None**	**Syllabus version**				
		1.0				

Course Objectives:

- Ability to translate vast data into abstract concepts and to understand JAVA concepts
- To have a clear understanding of subject related concepts
- To develop computational ability in Java programming language

Expected Course Outcome:

- Clear Knowledge about problem solving skills in JAVA concepts
- Students will be able to write codes in Java

Module:1	**Object and Class**	**8 hours**

Types of programming
Disadvantages of functional programming
Class & Objects
Attributes
Methods
Objects
Solving MCQs based on Objects and Classes
Solving tricky questions based on encapsulation
Solving frequently asked object based questions

Module:2	**Data types, Basic I / O**	**8 hours**

Data types
Data
Why data type
Variables
Available data types
Numeric – int, float, double
Character – char, string
Solving MCQs based on type casting, data types
Solving debugging based MCQs

Printing
Getting input from user during run time
Command line arguments
Solving programming questions based on CLA
Solving MCQs questions based on CLA

Module:3	Decision Making, Loop Control	9 hours
Need for control statement if..else if..else if..else Nested if..else Switch case Common mistakes with control statements (like using = instead of ==) Solving frequently asked questions on decision making Types of looping statements Entry Controlled For While Exit Controlled do while break and continue Demo on looping Common mistakes with looping statements (like using ; at the end of the loop) Solving pattern programming problems, series problems Solving predict the output questions		
Module:4	**String, Date, Array**	**10 hours**
String handling, date handling Solving problems based on arrays like searching, sorting, rearranging, iteration) Multi-dimensional arrays Solving pattern problems using 2D arrays Real time application based on 2D arrays		
Module:5	**Inheritance, Aggregation**	**10 hours**
Need Is A – Inheritance Types of inheritance supported Diagrammatic representation Demo on inheritance Has A – Aggregation Diagrammatic representation Demo on aggregation Solving MCQs based on relationships between classes		
	Total Lecture hours:	**45 hours**

Reference Books

1.	Java The Complete Reference, 2014, 9th Edition by By Herbert Schildt, McGraw-Hill Education Pvt Ltd
2.	Introduction to Programming with Java: A Problem-Solving Approach by John Dean

Mode of Evaluation: FAT, Assignments, 3 Assessments with Term End FAT (Computer Based Test)			
Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS5002	Preparing for Industry	L	T	P	J	C
		3	0	0	0	1
Pre-requisite		**Syllabus version**				
		2.0				

Course Objectives:

1. To develop the students' logical thinking skills
2. To learn the strategies of solving quantitative ability problems
3. To enrich the verbal ability of the students
4. To enhance critical thinking and innovative skills

Expected Course Outcome:

1. Enabling students to simplify, evaluate, analyze and use functions and expressions to simulate real situations to be industry ready.

Module:1	**Interview skills – Types of interview and Techniques to face remote interviews and Mock Interview**	**3 hours**

Structured and unstructured interview orientation, Closed questions and hypothetical questions, Interviewers' perspective, Questions to ask/not ask during an interview, Video interview, Recorded feedback, Phone interview preparation, Tips to customize preparation for personal interview, Practice rounds

Module:2	**Resume skills – Resume Template and Use of power verbs and Types of resume and Customizing resume**	**2 hours**

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

Module:3	**Emotional Intelligence - L1 – Transactional Analysis and Brain storming and Psychometric Analysis and Rebus Puzzles/Problem Solving**	**12 hours**

Introduction, Contracting, ego states, Life positions, Individual Brainstorming, Group Brainstorming, Stepladder Technique, Brain writing, Crawford's Slip writing approach, Reverse brainstorming, Star bursting, Charlette procedure, Round robin brainstorming, Skill Test, Personality Test, More than one answer, Unique ways

Module:4	**Quantitative Ability-L3 – Permutation-Combinations and Probability and Geometry**	**14 hours**

	and mensuration and Trigonometry and Logarithms and Functions and Quadratic Equations and Set Theory	
Counting, Grouping, Linear Arrangement, Circular Arrangements, Conditional Probability, Independent and Dependent Events, Properties of Polygon, 2D & 3D Figures, Area & Volumes, Heights and distances, Simple trigonometric functions, Introduction to logarithms, Basic rules of logarithms, Introduction to functions, Basic rules of functions, Understanding Quadratic Equations, Rules & probabilities of Quadratic Equations, Basic concepts of Venn Diagram		
Module:5	**Reasoning ability-L3 – Logical reasoning and Data Analysis and Interpretation**	**7 hours**
Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic, Data Sufficiency, Data interpretation-Advanced, Interpretation tables, pie charts & bar chats		
Module:6	**Verbal Ability-L3 – Comprehension and Logic**	**7 hours**
Reading comprehension, Para Jumbles, Critical Reasoning (a) Premise and Conclusion, (b) Assumption & Inference, (c) Strengthening & Weakening an Argument		
	Total Lecture hours:	**45 hours**

Reference Books	
1.	Michael Farra and JIST Editors(2011) Quick Resume & Cover Letter Book: Write and Use an Effective Resume in Just One Day. Saint Paul, Minnesota. Jist Works
2.	Daniel Flage Ph.D(2003) The Art of Questioning: An Introduction to Critical Thinking. London. Pearson
3.	David Allen(2002) Getting Things done : The Art of Stress -Free productivity. New York City. Penguin Books.
4.	FACE(2016) Aptipedia Aptitude Encyclopedia.Delhi. Wiley publications
5.	ETHNUS(2013) Aptimithra. Bangalore. McGraw-Hill Education Pvt. Ltd.
Websites:	
1.	www.chalkstreet.com
2.	www.skillsyouneed.com
3.	www.mindtools.com
4.	www.thebalance.com

5.	www.eguru.ooo		
Mode of Evaluation: FAT, Assignments, Projects, Case studies, Role plays, 3 Assessments with Term End FAT (Computer Based Test)			
Recommended by Board of Studies	09/06/2017		
Approved by Academic Council	No. 45th AC	Date	15/06/2017

STS1102	Arithmetic Problem Solving	L	T	P	J	C
		3	0	0	0	1

Pre-requisite	None	Syllabus version
		1.0

Course Objectives:

- To enhance the logical reasoning skills of the students and improve the problem-solving abilities
- To strengthen the ability to solve quantitative aptitude problems
- To enrich the verbal ability of the students for academic purpose

Expected course outcome:

- Students will be able to show more confidence in solving problems of Quantitative Aptitude
- Students will be able to show more confidence in solving problems of Logical Reasoning
- Students will be able to show more confidence in understanding the questions of Verbal Ability

Module:1	Logical Reasoning	11 hours

Word group categorization questions

Puzzle type class involving students grouping words into right group orders of logical sense

Cryptarithmetic

Data arrangements and Blood relations

- Linear Arrangement
- Circular Arrangement
- Multi-dimensional Arrangement
- Blood Relations

Module:2	Quantitative Aptitude	18 hours

Ratio and Proportion

- Ratio
- Proportion
- Variation
- Simple equations
- Problems on Ages
- Mixtures and alligations

Percentages, Simple and Compound Interest

- Percentages as Fractions and Decimals

- Percentage Increase / Decrease
- Simple Interest
- Compound Interest
- Relation Between Simple and Compound Interest

Number System

- Number system
- Power cycle
- Remainder cycle
- Factors, Multiples
- HCF and LCM

Module:3	**Verbal Ability**	**16hours**

Essential grammar for placements

- Prepositions
- Adjectives and Adverbs
- Tenses
- Forms and Speech and Voice
- Idioms and Phrasal Verbs
- Collocations, Gerund and Infinitives

Reading Comprehension for placements

- Types of questions
- Comprehension strategies
- Practice exercises

Articles, Prepositions and Interrogatives

- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

Vocabulary for placements

- Exposure to solving questions of
- Synonyms
- Antonyms
- Analogy
- Confusing words
- Spelling correctness

	Total Lecture hours:	**45 hours**

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

Text Book(s):

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. **SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.**
4. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

STS2201	Numerical Ability and Cognitive Intelligence	L	T	P	J	C
		3	0	0	0	1

Pre-requisite	None	Syllabus version
		1.0

Course Objectives:

- To develop the students' logical thinking skills and apply it in the real-life scenarios
- To learn the strategies of solving quantitative ability problems
- To enrich the verbal ability of the students

Expected Course Outcome:

- Students will be able to demonstrate critical thinking skills, such as problem solving related to their subject matters
- Students will be able to demonstrate competency in verbal, quantitative and reasoning aptitude
- Students will be able to perform good written communication skills

Module:1	Logical Reasoning	10 hours

Clocks, calendars, Direction sense and Cubes

- Clocks
- Calendars
- Direction Sense
- Cubes

Practice on advanced problems

Data interpretation and Data sufficiency - Advanced

- Advanced Data Interpretation and Data Sufficiency questions of CAT level
- Multiple chart problems
- Caselet problems

Module:2	Quantitative Aptitude	19 hours

Time and work – Advanced

- Work with different efficiencies
- Pipes and cisterns: Multiple pipe problems
- Work equivalence
- Division of wages
- Advanced application problems with complexity in calculating total work

Time, Speed and Distance - Advanced

- Relative speed
- Advanced Problems based on trains
- Advanced Problems based on boats and streams

- Advanced Problems based on races

Profit and loss, Partnerships and averages - Advanced

- Partnership
- Averages
- Weighted average

Advanced problems discussed

Number system - Advanced

Advanced application problems on Numbers involving HCF, LCM, divisibility tests, remainder and power cycles.

Module:3	**Verbal Ability**	**13 hours**

Sentence Correction - Advanced

- Subject-Verb Agreement
- Modifiers
- Parallelism
- Pronoun-Antecedent Agreement
- Verb Time Sequences
- Comparisons
- Prepositions
- Determiners

Quick introduction to 8 types of errors followed by exposure to GMAT level questions

Sentence Completion and Para-jumbles - Advanced

- Pro-active thinking
- Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues)
- Fixed jumbles
- Anchored jumbles

Practice on advanced GRE/ GMAT level questions

Reading Comprehension – Advanced

Exposure to difficult foreign subject-based RCs of the level of GRE/ GMAT

Module:4	**Writing skills for placements**	**3 hours**		

Essay writing

- Idea generation for topics
- Best practices
- Practice and feedback

	Total Lecture hours:	**45 hours**

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

Text Book(s):

1. FACE, Aptipedia Aptitude Encyclopedia, 2016, 1st Edition, Wiley Publications, Delhi.
2. ETHNUS, Aptimithra, 2013, 1st Edition, McGraw-Hill Education Pvt.Ltd.
3. **SMART, PlaceMentor, 2018, 1st Edition, Oxford University Press.**
4. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.

Reference Book(s):

Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.

Recommended by Board of Studies			
Approved by Academic Council	No. 53rd AC	Date	13.12.2018

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 1st Year of B.Tech. in order to orient them towards independent, systemic thinking and be innovative.

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

Expected Course Outcome: Students will be able to

1. 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

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

SPECIALIZATION ELECTIVE

Course code	Course title	L	T	P	J	C
BCT3004	PRIVACY AND SECURITY IN IOT	3	0	0	4	4
Pre-requisite				Syllabus version		
				v. 1.0		

Course Objectives:

1. To know the state-of-the-art methodologies in Cyber Physical system.
2. To impart knowledge on Model threats and countermeasures.
3. To explore the Privacy Preservation and Trust Models in Internet of Things (IoT)
4. To apply the concept of Internet of Things Security in the real world scenarios

Expected Course Outcome:

1. Identify the areas of cyber security for the Internet of Things.
2. Assess different Internet of Things technologies and their applications.
3. Model IoT to business
4. Customize real time data for IoT applications.
5. Solve IoT security problems using light weight cryptography
6. Build security systems using elementary blocks

Module:1	Introduction to IoT –Cyber Physical Systems	3 hours

IoT and cyber-physical systems, IoT security (vulnerabilities, attacks, and countermeasures), security engineering for IoT development, IoT security lifecycle.

Module:2	IoT as Interconnection of Threats	5 hours

Network Robustness of Internet of Things- Sybil Attack Detection in Vehicular Networks- Malware Propagation and Control in Internet of Things- Solution-Based Analysis of Attack Vectors on Smart Home Systems

Module:3	Crypto Foundations	7 hours

Block ciphers, message integrity, authenticated encryption, hash functions, Merkle trees, elliptic curves, public-key crypto(PKI), signature algorithms

Module:4	Block Chains	7 hours

Crypto-currencies, Bitcoin P2P network, distributed consensus, incentives and proof-of-work, mining, script and smart contracts, wallets: hot and cold storage, anonymity, altcoins.

Module:5	Privacy Preservation for IoT	7 hours

Privacy Preservation Data Dissemination- Privacy Preservation Data Dissemination- Social Features for Location Privacy Enhancement in Internet of Vehicles- Lightweight and Robust Schemes for Privacy Protection in Key Personal IoT Applications: Mobile WBSN and Participatory Sensing

Module:6	Trust Models for IoT	7 hours

Authentication in IoT- Computational Security for the IoT- Privacy-Preserving Time Series Data Aggregation- Secure Path Generation Scheme for Real-Time Green Internet of Things- Security Protocols for IoT Access Networks- Framework for Privacy and Trust in IoT- Policy-Based Approach for Informed Consent in Internet of Things.

Module:7	Internet of Things Security	7 hours

Security and Impact of the Internet of Things (IoT) on Mobile Networks- Networking Function Security-IoT Networking Protocols, Secure IoT Lower Layers, Secure IoT Higher Layers, Secure Communication Links in IoTs, Back-end Security -Secure Resource Management, Secure IoT Databases, Security Products-Existing

Test bed on Security and Privacy of IoTs, Commercialized Products.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Hu, Fei. Security and privacy in Internet of things (IoTs): Models, Algorithms, and Implementations, 1st edition,CRC Press, 2016.
2.	Russell, Brian, and Drew Van Duren. Practical Internet of Things Security, 1st edition, Packt Publishing Ltd, 2016.
Reference Books	
1.	Whitehouse O. Security of things: An implementers' guide to cyber-security for internet of things devices and beyond, 1st edition, NCC Group, 2014
2.	DaCosta, Francis, and Byron Henderson. Rethinking the Internet of Things: a scalable approach to connecting everything, 1st edition, Springer Nature, 2013.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Project Component: Students shall be able to design a prototype which includes IoT, Crypto Foundations, Block Chains and Cyber Physical system concepts to address the various Security issues. The objective is to select the appropriate trust model and IoT networking protocols to develop a system to secure the IoT network, authenticate the IoT devices and secure IoT apps. Students will analyze the various models and try to implement Privacy Preservation for IoT system and get familiar with the state-of- the art IoT technology.			
Mode of evaluation: Project/Activity			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	FUNDAMENTALS OF FOG AND EDGE COMPUTING	L	T	P	J	C
BCT3005		3	0	0	4	4
Pre-requisite	Principles of Cloud Computing	Syllabus version				
		v. 1.0				

Course Objectives

1. Introduce cloud computing and enabling technologies
2.Explore the need for fog and edge computation
3.Impart the knowledge to log the sensor data and to perform further data analytics

Expected Course Outcome

1. Understand the principles, architectures of fog computing
2. Understand the communication and management of fogs
3. Understand storage and computation in fogs
4. Design and Implement Internet of Everything (IoE) applications through fog computing architecture
5. Analysis the performance of the applications developed using fog architecture
6. Understand the security and privacy issues of fog computing

Module:1	Internet of Things (IoT) and New Computing Paradigms	6 hours

Introduction-Relevant Technologies-Fog and Edge Computing Completing the Cloud-Hierarchy of Fog and Edge Computing-Business Models-Opportunities and Challenges

Module:2	Challenges in Federating Edge Resources	6 hours

Introduction-Methodology-Integrated C2F2T Literature by Modeling Technique-Integrated C2F2T Literature by Use-Case Scenarios-Integrated C2F2T Literature by Metrics-Future Research Directions

Module:3	Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds	6 hours

Introduction-Background-Network Slicing-Network Slicing in Software-Defined Clouds-Network Slicing Management in Edge and Fog- Internet of Vehicles : Architecture, Protocol and Security-Seven layered model architecture for Internet of Vehicles- IoV: Network Models, Challenges and future aspects

Module:4	Optimization Problems in Fog and Edge Computing	6 hours

Preliminaries-The Case for Optimization in Fog Computing-Formal Modeling Framework for Fog Computing-Metrics-Further Quality Attributes-Optimization Opportunities along the Fog Architecture-Optimization Opportunities along the Service Life Cycle-Toward a Taxonomy of Optimization Problems in Fog Computing

Module:5	Middleware for Fog and Edge Computing: Design Issues	6 hours

Need for Fog and Edge Computing Middleware-Design Goals-State-of-the-Art Middleware Infrastructures-System Model-Proposed Architecture-Case Study Example

Module:6	Technologies in Fog Computing	7 hours

Fog Data Management-Motivating Example: Smart Building-Predictive Analysis with FogTorch-Machine Learning in Fog Computing-Data Analytics in the Fog-Data Analytics in the Fog-Architecture-Configurations

Module:7	**Applications and Issues**	**6 hours**
Exploiting Fog Computing in Health Monitoring-Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking-Fog Computing Model for Evolving Smart Transportation Applications-Testing Perspectives of Fog-Based IoT Applications-Legal Aspects of Operating IoT Applications in the Fog		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Buyya, Rajkumar, and Satish Narayana Srirama, eds, Fog and edge computing: principles and paradigms, 1st edition, John Wiley & Sons, 2019.
2. John Mutumba Bilay , Peter Gutsche, Mandy Krimmel and Volker Stiehl ,SAP Cloud Platform Integration: The Comprehensive Guide, 2nd edition, Rheinwerg publishing, 2019

Reference Books

1. Bahga, Arshdeep, and Vijay Madisetti. Cloud computing: A hands-on approach, 1st edition, CreateSpace Independent Publishing Platform, 2013.
2. Ovidiu Vermesan, Peter Friess, Internet of Things –From Research and Innovation to Market Deployment, 1st edition,River Publishers, 2014
3. Michael Missbach, Thorsten Staerk, Cameron Gardiner, Joshua McCloud, Robert Madl, Mark Tempes, George Anderson, SAP on Cloud, 1st edition, Springer, 2016

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

Project Component:

Exploring topics such as developing scalable architectures, moving from closed systems to open systems, and ethical issues rising from data sensing, addresses both the challenges and opportunities that Fog and Edge computing presents. Students can harness federating Edge resources, middleware design issues, data management and predictive analysis, smart transportation and surveillance applications, and more. A coordinated and integrated solutions can be provided by thorough knowledge of the foundations, applications, and issues that are central to Fog and Edge computing. They can also examine methods to optimize virtualized, pooled, and shared resources and identify potential technical challenges and offers suggestions for possible solutions

Mode of evaluation: Project/Activity

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	INDUSTRIAL AND MEDICAL IOT	L	T	P	J	C
BCT3006		2	0	0	4	3
Pre-requisite		Syllabus version				
		v. 1.0				

Course Objectives:

1. To develop knowledge in Industrial Internet of Things (IIoT) fundamentals.
2. To gain conceptual understanding of networking and wireless communication protocols used in IIoT deployments
3. To Understand the various Internet of Things (IoT) Protocols like COAP, MQTT.etc

Expected Course Outcome:

1. Develop conceptual design of Medical and Industrial IoT architecture.
2. Apply sensors and various protocols for industry standard solutions
3. Articulate privacy and security measures for industry standard solutions.
4. Study about Internet of Medical Things (IoMT) and its applications in Healthcare industry.
5. Design various applications using IoT in Healthcare Technologies.
6. Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing.

Module:1	Industrial IOT Introduction	4 hours

Introduction to IOT, What is IIOT? IOT Vs. IIOT, History of IIOT, Components of IIOT - Sensors, Interface, Networks, Key terms – IOT Platform, Interfaces, API, clouds, Data Management Analytics, Mining &Manipulation; Role of IIOT in Manufacturing Processes Use of IIOT in plant maintenance practices, Sustainability through Business excellence tools Challenges & Benefits in implementing IIOT

Module:2	IIoT Architecture	4 hours

IOT components ;Various Architectures of IOT and IIOT, Advantages & disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IOT

Module:3	Sensors and Protocols	5 hours

Introduction to sensors, Roles of sensors in IIOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Need of protocols; Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, Bacnet, BLE, Modbus, SPI , I2C, IIOT protocols –COAP, MQTT, 6lowpan, lwm2m, AMPQ. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet.

Module:4	Privacy and Security	5 hours

Introduction to web security, Conventional web technology and relationship with IIOT, Vulnerabilities of IoT, Privacy, Security requirements, Threat analysis, Trust, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability

Module:5	IoMT Introduction	3 hours

What are IoMT and its working? Tracking assets and resources, Internet of things in hospitals, collection and integration of clinical data, Major benefits of IoT in healthcare, Disadvantages of IoT in healthcare.

Module:6	**Healthcare Technologies**	**4 hours**
Home Monitoring System for Aged Care, Smart Medicinal Packages for Medication Adherence, Smart Drug Delivery System for Automated Drug Dispensation, Connected Rural Healthcare Consultation, Population and Environment Monitoring of Infectious Diseases		
Module:7	**Application Design & Case Study**	**3 hours**
Application Design & Case Study: Wireless Patient Monitor system, Wearable Fitness & Activity Monitor Application Design: Design of IOT based pulse oximeter, Reliability of IoT-Aware BPNM Healthcare process.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	Veneri, Giacomo, and Antonio Capasso. Hands-on Industrial Internet of Things: Create a Powerful Industrial IoT Infrastructure Using Industry 4.0, 1st edition, Packt Publishing Ltd, 2018.
2	Reis, Catarina I., and Marisa da Silva Maximiano, eds. Internet of Things and advanced application in healthcare, 1st edition, IGI Global, 2016.

Reference Books

1.	Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, 1st Edition, Apress, 2017
2.	Aboul Ella Hassanien, Nilanjan Dey and Sureaka Boara, Medical Big Data and Internet of Medical Things: Advances, Challenges and Applications, 1st edition, CRC Press, 2019.

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

Project Component:

The recent advancements in technology and the availability of the Internet make it possible to connect various devices that can communicate with each other and share data. The Internet of Things (IoT) is a new concept that allows users to connect various sensors and smart devices to collect real-time data from the environment. However, it has been observed that a comprehensive platform is still missing in the e-Health and m-Health architectures to use smartphone sensors to sense and transmit important data related to a patient's health. m-Health and e-Health are providing different services remotely, such as prevention and diagnosis against disease, risk assessment, monitoring patient health, education and treatment to users. This is why e-Health and m-Health is being widely accepted in the society. The emerging of state of the art tools and technologies of IoT can be really beneficial for e-Health and m-Health. Different e-Health and m-Health architectures for IoT have been developed which handle an emergency situation efficiently. However, the existing e-Health and m-Health architectures do not use smart phone sensors to sense and transmit important data related to the patients' health. Hence a innovative framework has to be proposed for e-Health and m-Health which makes use of smart phone sensors and body sensors to obtain, process and transmit patient health related data to centralize storage in the cloud.

This stored data could be retrieved by patients' and other stakeholders in the future.			
Mode of evaluation: Project/Activity			
Recommended by Board of Studies	DD-MM-YYYY		
Approved by Academic Council	No. xx	Date	DD-MM-YYYY

Course code	Course title	L	T	P	J	C
BCT3007	PROGRAMMING FOR IOT BOARDS	2	0	2	4	4
Pre-requisite	Microprocessor and Microcontrollers & Embedded System architecture and design					Syllabus version
						v. 1.0

Course Objectives:

1.To introduce Internet of Things (IoT) environment and its technologies for designing smart systems
2.To explore open-source computer hardware/software platform, development and debugging environment, programming constructs and necessary libraries
3.To learn embedded programming constructs and real time systems

Expected Course Outcome:

1. Investigate various challenges in designing IoT devices
2. Use open source hardware prototyping platform for building digital devices and interactive objects that can sense and control the physical world around them
3. Understand basic circuits, sesors and interfacing, data conversion process and shield libraries to interface with the real world
4. Program SBC for practical IoT devices using Python
5. Explore protocols, data conversion process, Api and expansion boards for real world interaction
6. Learn embedded programming constructs and constraints real time systems
7. Illustrate IoT prototyping for real world socio-economic problems

Module:1	IoT and Embedded Systems	3 hours

IoT- Introduction and Characteristics, Things, Architecture, Enabling Technologies, Challenges, Levels; Embedded Systems - Embedded vs General Computing System, Classification, Design Challenges, MCU Architecture - 8051, PIC, ARM

Module:2	Introduction to IoT Boards	4 hours

Environment - board, IDE, shields; Programming - syntax, variables, types, operators, constructs and functions; sketch - skeleton, compile and upload, accessing pins; debugging - UART communication protocol and serial library

Module:3	Interfacing with IoT Boards	5 hours

Circuits - design, wiring, passive components; sensors and actuators, interfacing, read and write; software libraries to handle complicated hardware; shields, interfacing and libraries

Module:4	Single Board Computers and Python	4 hours

Board schematic, setup, configure and use, OS implications; linux - basics, file system and processes, shell CLI, GUI; python - basics, API's RPi.GPIO, PWM library to access pins, Tkinter

Module:5	Interfacing with Single Board Computers	5 hours

Networking - Internet Connectivity, Standard Internet Protocols, MQTT, CoAP, Networking Socket Interface; Cloud - Public APIs and SDK's for accessing cloud services, Twitter API using Twython package; Interfacing - sensors and actuators, Pi Camera, Servo, A/D, D/A

Module:6	Embedded Programming and RTOS	4 hours

MCU - GPIO, WDT, timers/counters, IO, A/D, D/A, PWM, Interrupts, Memory, serial communication- UART, I2C, SPI, Peripheral Interfacing
OS - basics, types, tasks, process, threads (POSIX Threads),thread preemption, Preemptive Task Scheduling Policies, Priority Inversion, Task communication, Task Synchronization issues - racing and deadlock, binary

and counting semaphores (Mutex example), choosing RTOS		
Module:7	**Real World Projects**	**3 hours**
IoT Integrated Primary Health Care, Large Scale Face Detection by AI Powered Street Lights, Cloud IoT Systems for Smart Agriculture, Smart Home Gadgets, Autonomous Car Features – speed and horn intensity control.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	Yamanoor, Sai, and Srihari Yamanoor. Python Programming with Raspberry Pi, 1st edition, Packt Publishing Ltd, 2017.
2.	Donald Norris, The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black, 1st edition,McGraw Hill Education, 2015

Reference Books

1.	Marco Schwartz, Home Automation with Arduino, 3rd edition, Open Home Automation 2014.
2.	Schwartz, Marco. Internet of things with arduino cookbook, 1st edition, Packt Publishing Ltd, 2016.
3.	Kooijman, Matthijs. Building Wireless Sensor Networks Using Arduino, 1st edition, Packt Publishing Ltd, 2015.

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

List of Experiments (Indicative)

1.	Introduction to IoT Development Kit and Development Environment	4 hours
2.	Internet Controlled LEDs	3 hours
3.	Temperature Logger	3 hours
4.	Home Automation	3 hours
5.	Soil Moisture Sensor	2 hours
6.	Light Color Control	3 hours
7.	Home Security System	3 hours
8.	Parking Sensor	3 hours
9.	Motor Control	2 hours
10.	Water Level Control	2 hours
11.	Street Light Control	2 hours
	Total Laboratory Hours	**30 hours**

Mode of evaluation: Mode of Evaluation: CAT/ FAT

Project Component:

Students should able to design, create and deploy IoT device using Arduino and Raspberry Pi platforms to solve a socio-economic problem. The objective is to get specialization in embedded systems, the raspberry pi platform, and the Arduino environment for building devices that can control the physical world. Student should select appropriate components and interfacing mechanisms to design, build and test micro-controller based embedded system to solve the problem identified. Students can use any cloud platforms for data storage and analytics.

Mode of evaluation: Project/Activity			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	SOFTWARE DEFINED NETWORKS	L	T	P	J	C
BCT3008		3	0	0	4	4
Pre-requisite		Syllabus version				
		v. 1.0				

Course Objectives:

1.To develop knowledge in networking fundamentals
2.To gain conceptual understanding of Software Defined Networks (SDN)
3.To study industrial deployment use-cases of SDN

Expected Course Outcome:

1.Examine the challenges and opportunities associated with adopting SDN compared to traditional approaches to networking
2. Analyse the functions and components of the SDN architecture
3. Discuss the major requirements of the design of an SDN protocol.
4. Design and create an SDN network consisting of SDN switches and a centralized controller.
5. Analyze the performance of the SDN network by using verification and troubleshooting techniques.
6. Evaluate the emerging SDN applications.

Module:1	SDN Introduction	6 hours

Overview; History and evolution of SDN; Architecture of SDN; SDN Flavours; Scalability (Data Centres, Service provider networks, ISP Automation); Reliability (QoS, and Service Availability); Consistency (Configuration management, and Access Control Violations); Opportunities and Challenges;

Module:2	SDN Architecture	6 hours

Network Operating System (NOS). SDN Architecture. Planes - data, management and control. Interfaces - northbound and southbound.

Module:3	SDN Protocols	6 hours

SDN Protocol specifications: Border Gateway Protocol (BGP); Cisco Application Centric Infrastructure (ACI); OpenFlow. OpenFlow versions. Components of an OpenFlow Switch. Flow and group tables. Rule matching. Action handling. Table misses. Counters, metering and metadata.

Module:4	SDN Design and Development	8 hours

Languages and functions available for programming SDNs, northbound API. Mininet. Software vs. Hardware SDN switch implementations - Open vSwitch, WhiteBox, ONL. Controller implementations - POX, NOX, Beacon, Floodlight. Special Purpose controllers - Flowvisor, RouteFlow.

Module:5	SDN Programming	6 hours

Network Programmability - Network Function Virtualization - NetApp Development, Network Slicing, SDX; Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs.

Module:6	SDN Applications	6 hours

Network Virtualization, Network Topology and Topological Information Abstraction, Data Centric Traffic Management, Wide Area Traffic Management, Wireless networks.

Module:7	**SDN Usecases**	**5 hours**
Data Centers, Internet Exchange Points, Backbone Networks, Home Networks, Traffic Engineering.Failures and Robustness Issues of SDN, SDN Security		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours	**45 hours**

Text Book(s)

1. Goransson, Paul, Chuck Black, and Timothy Culver. Software defined networks: a comprehensive approach, 1st edition, Morgan Kaufmann, 2016.
2. Nadeau, Thomas D., and Ken Gray. SDN: Software Defined Networks: an authoritative review of network programmability technologies, 1st edition, O'Reilly Media, Inc., 2013.

Reference Books

1. Stallings, William. Foundations of modern networking: SDN, NFV, QoE, IoT, and Cloud, 1st edition, Addison-Wesley Professional, 2015.
2. Oswald Coker, Siamak Azodolmolky. Software-Defined Networking with OpenFlow - Second Edition, Packt Publishing, 2017

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

Project Component:
Students should identify suitable topics related to SDN for project work. The goal is to design, create and debug an SDN network consisting of multiple network elements (SDN switches and controller). SDN offers efficient configuration, higher flexibility and also better performance to accommodate innovative network design. Students can use SDN programming on Ryu controller platform or Pyretic platform for their project work.

Mode of Evaluation: Project/Acivity

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	SENSORS AND ACTUATOR DEVICES	L	T	P	J	C
BCT4001		3	0	2	0	4
Pre-requisite	BCT3001- Wireless Ad-hoc and Sensor Networks	Syllabus version				
		v. 1.0				

Course Objectives:

1.Understand Internet of Things (IoT) sensors and technological challenges faced by IoT devices, with a focus on wireless, energy, power, RF and sensing modules
2.Market forecast for IoT devices with a focus on sensors
3.Learn the Sensors and Actuators used in Automotive Industry and Security

Expected Course Outcome:

1. Identify the IoT networking components with respect to sensors.
2. Build schematic for IoT solutions with sensors.
3. Design and develop IoT based sensor systems.
4. Select the appropriate sensors for various industrial applications
5. Evaluate the wireless sensor technologies for IoT.
6. Learning the programing in Raspberry Pi
7. Design and develop an IoT Prototype projects using Raspberry Pi

Module:1	Introduction to sensors for IoT	6 hours

Internet of Things Promises–Definition– Scope–Sensors for IoT Applications–Structure of IoT–IoT Map Device

Module:2	Sensors and actuator	7 hours

Introduction to Sensors and Actuator- Sensor and Actuator Characteristics- Primary factors driving the deployment of sensor technology

Module:3	Seven generations of IoT sensors	7 hours

Industrial sensors – Description & Characteristics–First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics–Sensors' Swarm – Description & Characteristics–Printed Electronics – Description & Characteristics–IoT Generation Roadmap

Module:4	Energy Harvesting Technologies	5 hours

Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module

Module:5	Sensors for Automotive Vehicle and Security applications	6 hours

Tyre pressure monitoring systems - Two wheeler and Four wheeler security systems - Parking guide systems - Anti-lock braking system - Future safety technologies- Vehicle diagnostics and health monitoring

Module:6	Sensor and Actuators in smart cities	5 hours

Sensors in Home activity monitoring, human activity recognition, road traffic management,

Module:7	Developing an IoT based Applications	7 hours

Smart Energy Monitor Based on IoT, Develop a Face Recognizing Robot, Build an IoT-based Smart Home System, IoT Based Air Quality Index Monitoring, IoT Based Contactless Body Temperature Monitor.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Timothy Chou,. Precision: Principles, Practices and Solutions for the Internet of Things, Cloudbook Inc., USA. April-13 2020
2	Maggie Lin and Qiang Lin., Internet of Things Ecosystem: 2nd Edition,. January 19, 2021., independently published
Reference Books	
1.	Patranabis, Sensors and Actuators, 2nd edition, PHI, 2013
2	D. Patranabis, Sensors and Transducers, 1st edition, PHI Learning Private Limited,2013
3.	Monk, Simon. Programming the Raspberry Pi: getting started with Python, 1st edition, McGraw-Hill Education, 2016.

Mode of Evaluation: Exam, Digital Assignment, Quiz

List of Experiments		
1	Using Temperature Sensors Calculate the temperature of the filament when the light bulb is lit.	2 hours
2	By using Pyroelectric motion sensor or PIR Sensors detect the motion of a body within the Lab.	2 hours
3	By Using pressure sensor measure the air pressure and its characteristics	2 hours
4	Design a the digital response an IR motion sensor and to determine its range.	2 hours
5	Design a motion sensitive intruder alarming system	2 hours
6	Calculate the distance of an object using SONAR principle by ultrasonic proximity sensor also determine the accuracy of the instrument	2 hours
7	By Using DHT sensors calculate the humidity and accuracy of the system	2 hours
8	By Using Soil Moister sensors calculate the soil Moister and accuracy of the system	2 hours
9	Calculate the corrosion rate by using corrosion rate sensors also calculate the resistance.	2 hours
10	Calculate the velocity by using Fluid velocity sensor in a channel	3 hours
11	Calculate Stress and strain produced by an ultrasonic actuator also the test the cracks in the contacting metal.	3 hours
12	By using Carbon monoxide sensor calculate CO in a home and provide an alarm for concentrations greater than 50 ppm	3 hours
13	Design a network to monitor water quality using water quality monitoring sensors	3 hours
	Total Laboratory Hours	**30 hours**

Recommended by Board of Studies	12.02.2021		
Approved by Academic Council	No. 61	Date	18.02.2021

Course Code:	ARCHITECTING SMART IOT DEVICES	L	T	P	J	C
BCT4002		3	0	0	4	4
Pre-requisite	Embedded System Architecture and Design & BCT3001	Syllabus version				
		v. 1.0				

Course Objectives:

1. To understand the architectural overview of Internet of Things (IoT).
2. To acquire skills on data acquisition and communication in IoT.
3. To understand the threats of IoT.

Expected Course Outcome:

1. Understand how the IoT is different from traditional systems
2. Demonstrate the revolution of internet in mobile and cloud
3. Examine the architecture and operation of IoT
4. Explore various tools and programming paradigms for IoT applications
5. Develop an IoT prototype for real time scenario
6. Understand the building blocks of IoT and security aspects

Module:1	**Design Principles of IoT**	**6 hours**

Design principles of connected devices, data acquiring organizing and analytics in IoT, system architecture of IoT

Module:2	**Prototyping the Embedded Devices for IoT**	**6 hours**

System hardware and prototyping, sensors and actuators for IoT, Radio module and wireless sensor network, gateways internet and web, software components

Module:3	**Embedded Programming for IoT**	**7 hours**

Programming connected devices, C and python for IoT, Case study: Temperature controller, Smart irrigation system.

Module:4	**Embedded RTOS**	**6 hours**

Program structure and real time, multitasking and scheduling, RTOS services, signals, semaphores, Nucleus SE, application timers, interrupts in nucleus ES, Nucleus SE initialization and startup

Module:5	**Tools for IoT**	**6 hours**

Introduction, chef, puppet, NETCONF-YANG case studies

Module:6	**IoT physical Devices**	**6 hours**

Basic building blocks of an IoT device and endpoints, family of IoT devices, pcDuino, Beagle bone black, cubie board, domain specific IoTs

Module:7	**Threats of IoT**	**6 hours**

Attack, defense and network robustness of IoT, Sybil attack, malware propagation and control in IoT. Trust and trust models for the IoT, self-organizing Things, preventing unauthorized to sensor data, Authentication in IoT, Security protocols for IoT access network.

Module:8	**Recent Trends and applications**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Raj Kamal, Internet of Things, Architecture and Design Principles, 1st edition, McGraw Hill Education, May 2017
2.	Arsheep Baga and Vijay Madisetti , Internet of Things: A Hands-On Approach, 1st Edition, Universities press, 2015

Reference Books	
1.	David Etter, IoT(Internet of Things Programming: A simple and fast way of Learning IoT, Kindle edition 2016,
2.	Fei HU, Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, 1st Edition ,CRC Press,2016
3.	Colin Walls, Embedded RTOS Design Insights and Implementation. 1st edition. Elsevier. December 2020.

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

Project component:

Embedded Systems are so ubiquitous that some of us take them for granted: we find them in smartphones, GPS systems, airplanes and so on. In this course, students will learn about the characteristics of embedded systems: the possibilities, dangers, complications and recipes for success. The projects will be based on the framework of a flourishing embedded systems field: the Internet of Things, where billions of intercommunicating devices could enable unprecedented, innovative products and services.

Sample Project Titles:

(1) IoT based home automation system
(2) IoT based water level control system
(3) Factory automation using IoT
(4) Secure data communication
(5) IoT based assistive device for aged persons

Mode of Evaluation: Project/Activity

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	WEARABLE COMPUTING	L	T	P	J	C
BCT4003		3	0	0	4	4
Pre-requisite	Sensors and Actuator Devices	Syllabus version				
		v. 1.0				

Course Objectives:

1. To understand advanced and emerging technologies in wearable computing
2. To learn how to use software programs to perform varying and complex tasks
3. Expand upon the knowledge learned and apply it to solve real world problems

Expected Course Outcome:

1. Develop Android and Wear applications for Android phone and wearable device, including handling and making device data ready for Google Fi
2. Learn about software, hardware tools, protocols and component's required for Wearable Computing
3. Enable to explore innovations with Wearable's
4. Learn about the requirement's to design Frameworks for Wearable Computing
5. Exploring regulatory systems—their structures, constraints, and possibilities
6. Able to learn about I/O communication protocols
7. Gain insights into Augmented Reality Space Wearable technologies Through case studies.

Module:1	Introduction to Wearable Components	6 hours

Introduction – History - Open Source Platforms – PIC - Arduino, Sketch, Raspberry Pi, Iterative coding methodology – Python Programming - Mobile phones and similar devices - Arm Devices - Basic Electronics (circuit theory, measurements, parts identification)

Module:2	Building Blocks for Wearable Computing	6 hours

Bluetooth Low Energy (BLE), Embedded Software Programming, Sensors for Wearables, Data from Wearable Device Android Wear, Apple WatchKit, Cloud Services, Google Fit, Apple Health Kit

Module:3	Innovation with Wearables	6 hours

Process for Lifestyle Innovation, Prototyping and Modelling, Working with a Wearable Device, Three-Tier Architecture for Wearables, Useful Design Patterns and Methods, Multi-threading and Concurrency for Wearables, Performance Tuning Retrieval and Analysis of Sensor Data

Module:4	Frameworks for Wearable Computing	7 hours

Software: open Frameworks (C/C++) - "Arduino" Language (C/C++) - Hardware: Desktop / Laptop /Raspberry Pi - Representing "reality" with computers. Digital vs. Analog circuits, audio, communication, Analog to Digital Conversion - Digital to Analog Conversion)– Microcontrollers - Communication – Serial& Parallel - Hardware to Hardware Communication - I2C/IIC (Inter-Integrated Circuit) - SPI (Serial Peripheral Interface)

Module:5	Cybernetics	7 hours

Wearables - Augmented Reality – Mixed Reality. Case studies, Oculus Rift (2012, 2013), AR versus VR - IoT and Wearables: Smart Cites and Wearable Computing as a form of urban design - Advanced I/O – open Frameworks: Live Network feeds (push and pull), Data persistence (saving data and preferences)

Module:6	Body Area Networks	6 hours

Typical m-Health System Architecture- Hardware Architecture of a Sensor Node- Communication Medium, Power Consumption Considerations, Communication Standards- Network Topologies- Commercial Sensor Node Platforms- Bio-physiological Signals and Sensors, BSN Application Domains- Developing BSN Applications- Programming Abstractions- Requirements for BSN Frameworks- BSN Programming Frameworks		
Module:7	**Wearable Technologies – Case Studies**	**5 hours**
Soft Skin simulation for Wearable Haptic Rendering, Design Challenges for real wearable computers, Collaboration with wearable computers.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)

1. Linowes Jonathan, Augmented Reality for Developers, 1st edition, Packt Publishing Limited, 2017
2. Fortino, Giancarlo, Raffaele Gravina, and Stefano Galzarano, Wearable computing: from modeling to implementation of wearable systems based on body sensor networks, 1st edition, John Wiley & Sons, 2018.

Reference Books

1. Simon Monk , Programming the Raspberry Pi: Getting Started with Python 2nd edition, 2016
2. Barfield, Woodrow, ed. Fundamentals of wearable computers and augmented reality, 1st edition, CRC press, 2015.

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

Project Component:

Wearable technology offers many opportunities which trigger the thoughts and imaginations of people of all fields. In this age of technology, the dependence on computers and other interfaces required them to be omnipresent. This requirement paved way for the development of wearable technology, computers which can assist specialized professionals in personal activities by aiding and augmenting everyday life with the tech savvy world. In reality obstacles imposed by factors such as battery life, processor power, display brightness, network coverage and form factor have led to the delay in the widespread introduction of wearable computers. Students will engage in iterative design projects to explore application of wearable technologies in health monitoring devices, data analysis, real-time analysis techniques and machine learning. Perform review that explore open research areas in wearable computing

Mode of Evaluation: Project/Activity

Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	DESIGN OF SMART CITIES	L	T	P	J	C
BCT4005		3	0	0	4	4
Pre-requisite	BCT3001 and Principles of Cloud Computing	Syllabus version				
		v. 1.0				

Course Objectives:

1. To acquire specific scripting knowledge to develop interactive applications.
2. To understand the basics of android application development.
3. To apply the programming skills in developing application pertaining to Industrial, medical, agricultural, etc.

Expected Course Outcome:

1. Design dynamic systems to process user & sensor data
2. On a profound level to implement hardware & software for wireless sensor networks in day to day life
3. Implement secured application using android Software Development Kit
4. Solve the need for smart systems in a distributed environment
5. Understand the Internet of Things (IoT) architecture and building blocks for various domains
6. Devise multidisciplinary case to case modelling and execute wide range of application

Module:1	Smart City – Introduction	6 hours

Introduction, Smart City, Complexities of Smart Cities, Urban Network, Sensor Network, Role of Urban Networks, Trends in Urban Development, Community Resource Sensing.

Module:2	Urban Planning	6 hours

Urban Planning, Databases, Principles of Urban Planning, Data Organization, Role of Planning in Smart Cities, Case Studies.

Module:3	Energy Sustainability in Smart Cities	6 hours

Energy, Decision Making, Energy as a catalyst for Sustainable Transformation, Cohesion and efficiency of smart cities.

Module:4	Security, Privacy and Ethics in Smart Cities	6 hours

Security challenges in Internet of Things, Security threats in IoT, IoT related safety measures for a safer smart city.

Module:5	Smart Cities Planning and Development	6 hours

City Planning, Understanding Smart Cities, Dimensions of Smart Cities, Global standards and performance benchmark of smart cities, Financing smart cities development, Governance of smart cities.

Module:6	Project Management in Smart Cities	6 hours

Philosophy and project management, Phases and Stages of Project, Work Breakdown Structure, Project Organization Structure, Planning, Scheduling, Case studies on project management of smart cities – web application and mobile based implementation

Module:7	Process Control and Stabilization in Smart Cities, IoV, ITS	7 hours

Structural concept, Specific applications, Structural health monitoring-Process control and stabilization, Internet of Vehicle (IoV) Importance, Applications, Security issues, Perspectives on Intelligent Transport Systems (ITS), ITS Highway safety perspective, Environmental aspects of

ITS.		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Fadi Al-Turjman, Intelligence in IoT-enabled Smart Cities,1st edition, CRC Press ,2019.
2.	Giacomo Veneri, and Antonio Capasso , Hands-on Industrial Internet of Things: Create a powerful industrial IoT infrastructure using Industry 4.0 , 1st edition, Packt Publishing,2018
Reference Books	
1.	John Dean, Web Programming with HTML5, CSS and JavaScript, 1st edition, Jones and Bartlett Publishers Inc.,. 2018
2.	Subhas Chandra Mukhopadhyay, Smart Sensing Technology for Agriculture and Environmental Monitoring, 1st edition, Springer, 2012
3.	Mashrur A. Chowdhury, and Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, Inc., 2003.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Project Component: Students should identify an application that provides the solution for a smart city. The goal is to select appropriate models and model specifications and apply the respective methods to enhance city to the smart innovation-based products. Students will identify the potential use of the proposed solution, formulate the solution, identify the right sources of data, analyze data, and prescribe actions to improve not only the process of a smart city. Students can use any tools and methods to develop a smart city.			
Mode of evaluation: Project/Activity			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	COGNITIVE IOT	L	T	P	J	C
BCT4006		3	0	0	0	3
Pre-requisite		Syllabus version				
		v. 1.0				

Course Objectives:

1. To emphasis the students from shifting their mindset from theoretical to practical multi-disciplinary skills through installing the know-how of actual practice in industry field
2. Impart the knowledge to log the sensor data and to perform further data analytics
3. Make the students to apply Internet of Things (IoT) data for business solution in various domain in secured manner

Expected Course Outcome:

1. Integrate the aspects of human cognitive processes in the system design
2. Comprehend the underlying cognitive process can have many abstractions of a cognitive cycle such as 'Sense', 'Understand', 'Decide' and 'Act'.
3. Detect any failures of system components and re-configure itself which provides a graceful degradation through self-healing.
4. Accomplish knowledge about the application, system architecture, resources, system state and behavior
5. Incorporate recent advancements in the machine learning including deep learning in IOT
6. Analyze security issues in IoT applications

Module:1	Cognitive IoT – Introduction	5 hours

Cognitive IoT, Need for Cognitive IoT, Current and Future trends of IoT, Cognitive computing and applications.

Module:2	Data Analytics of Cognitive IoT	7 hours

Data Analytics for IoT Regression, Data Analytics for IoT ANN Classification, Data Analytics for IoT Modern DNN's.

Module:3	Cloud and Edge Computing in IoT	5 hours

Decentralized Computing, Cloud computing, Cloudlets and fog computing, Cloud and edge computing for large scale IoT applications.

Module:4	Introduction to GPU	5 hours

Introduction to GPU's Parallel programming for GPU, Parallel programming in CUDA, CNN Inference in GPU, CNN Training in GPU.

Module:5	FPGA for Internet of Things	5 hours

Benefits of FPGA, Interfacing FPGAs with IoT-based edge devices, IoT-FPGA based applications, Microsemi's SmartFusion2 SoC FPGA.

Module:6	IoT Enabling Technologies and Devices	9 hours

Big data, Digital twin, Cloud Computing, Sensors, Communications, Analytical software, Edge Devices.

Module:7	Security in Cognitive IoT	7 hours

Security in Cognitive IoT, Security Issues in IoT, A hardware assisted approach for security, Architectural level overview for providing security, Security threats.

Module:8	Recent Trends	2 hours
	Total Lecture hours:	45 hours

Text Book(s)

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg, Sebastian Lange and Stefan Meissner, Enabling things to talk –Designing IoT solutions with the IoT Architecture Reference Model, 1st edition ,Springer Open, 2016
2. Matin, Mohammad Abdul, ed. Towards Cognitive IoT Networks, 1st edition ,Springer International Publishing, 2020.

Reference Books

1. Arshdeep Bahga and Vijay Madisetti, Cloud Computing: A Hands-on Approach, 1st edition, CreateSpace Independent Publishing Platform, 2013.
2. John Mutumba Bilay, Peter Gutsche, Mandy Krimmel and Volker Stiehl, SAP Cloud Platform Integration: The Comprehensive Guide, 2nd edition, Rheinwerg publishing.2019.
3. Mahalle, Parikshit Narendra, and Poonam N. Railkar, Identity management for internet of things, 1st edition , River Publishers, 2015.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	APPLICATIONS OF IOT IN ROBOTICS	L	T	P	J	C
BCT4007		3	0	0	0	3
Pre-requisite		Syllabus version				
		v. 1.0				

Course Objectives:

1. To learn basics of Internet of Things (IoT), and its execution using multiple robotic sensors
2. To understand Internet of Robotic Things (IoRT) and its various implementations in industry and automation
3. To implement IoT and Robotics application in autonomous driving and health care

Expected Course Outcome:

1. Understand IoT ecosystem in robotic paradigm
2. Analyze IoT infrastructure and develop IoRT applications
3. Apply IoT in robotics over different platforms
4. Implement Cloud robotics in automations
5. Implement automated applications using multiple robotic sensors

Module:1	Introduction to IoT and Vision systems	5 hours

History and evolution of IoT, AI, ML, Machine Vision, optoelectronic sensors, 3D & 2D machine vision technologies, robot navigation, control schemes, motion controllers, intelligent algorithms and vision systems.

Module:2	Robotic Sensors	6 hours

Optical sensors and actuators; Mechanical sensors and actuators; Acoustic sensors and actuators; Performance characteristics of sensors and actuators.

Module:3	Internet of Robotic Things	6 hours

Communication architecture for IoRT; Decentralized and automated IoT infrastructure using Blockchain; IoRT Platforms Architecture, IoRT applications.

Module:4	Autonomous Vehicle Systems	6 hours

Introduction to Autonomous Driving; Perception in Autonomous Driving; Robot Operating System (ROS) Overview - Client Systems for Autonomous Driving - Decision planning and control in autonomous vehicle systems - Cloud Platform for Autonomous Driving.

Module:5	Industrial Internet of Things	7 hours

IIoT Architecture; IIoT Applications and Challenges; IIoT Standards and Frameworks; IIoT security concerns

Module:6	IoMT and Robotics in Healthcare	6 hours

IoMT Driven connected healthcare, Efficient design for IoMT based healthcare design, Robotics in healthcare,

Module:7	Cloud Robotics and Industrial Automation	7 hours

Components of Cloud Robotics; Limitations and challenges of Cloud Robotics; Applications: Autonomous mobile robots, Cloud medical robots, Industrial robots.

Module:8	Recent Trends	2 hours
	Total Lecture hours:	45 hours

Text Book(s)

1. Vermesan, Ovidiu, and Joël Bacquet, eds.,Cognitive Hyperconnected Digital Transformation: Internet of Things Intelligence Evolution, 1st edition, River Publishers, 2017.
2. A.K.Gupta, S.K.Arora, and J.Riescher, Industrial Automation and Robotics, 1st edition ,Mercury Learning and Information LLC,2017

Reference Books

1. A.K Dubey, A.Kumar, and S.R Kumar., AI and IoT-based Intelligent Automation in Robotics, 1st edition. Wiley, 2020
2. A.E.Hassanien, N.Dey, and S.Borra, Medical Big Data and Internet of Medical Things: Advances, Challenges and Applications, 1st edition ,Taylor & Francis Group,2019
3. S.Liu, L.Li and J.Tang, Creating Autonomous Vehicle Systems, Synthesis Lectures on Computer Science, 1st edition ,Morgan & Claypool,2018
4. Nathan Ida, Sensors, Actuators, and Their Interfaces: A multidisciplinary introduction, 2nd edition The Institution of Engineering and Technology, 2017

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

Course code	IOT ARCHITECTURES AND PROTOCOLS	L	T	P	J	C
BCT4009		3	0	0	0	3
Pre-requisite		Syllabus version				
Anti-requisite	ECE5061	v. 1.0				

Course Objectives:

1. To impart knowledge on the infrastructure, sensor technologies and networking technologies of Internet of Things (IoT).
2. To analyze, design and develop IoT solutions.
3. To explore the entrepreneurial aspect of the Internet of Things
4. To apply the concept of Internet of Things in the real world scenarios.

Expected Course Outcome:

1. Identify the main components of Internet of Things
2. Program the sensors and controller as part of IoT
3. Assess different Internet of Things technologies and their applications.
4. To learn basic circuits, sensors and interfacing, data conversion process and shield libraries to interface with the real world
5. To understand various challenges in designing IoT devices
6. Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing.

Module:1	IoT Fundamentals	5 hours

Definition & Characteristics of IoT - Challenges and Issues - Physical Design of IoT, Logical Design of IoT - IoT Functional Blocks, Security.

Module:2	IoT Reference Architecture, Software Design	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	5 hours

Four pillars of IOT paradigm, - RFID, Wireless Sensor Networks, SCADA (Supervisory Control and Data Acquisition), M2M - IOT Enabling Technologies - BigData Analytics, Cloud Computing, Embedded Systems.

Module:4	Programming the microcontroller for IoT	5 hours

Working principles of sensors – IOT deployment for Raspberry Pi /Arduino/Equivalent platform – Reading from Sensors, Communication: Connecting microcontroller with mobile devices – communication through Bluetooth, wifi and USB - Contiki OS- Cooja Simulator.

Module:5	Resource management in IoT	5 hours

Clustering, Clustering for Scalability, Clustering for routing, Clustering Protocols for IOT

Module:6	From the internet of things to the web of things	9 hours

The Future Web of Things – Set up cloud environment –Cloud access from sensors– Data Analytics for IOT- Rest Architectures- The web of Things, Resource Identification and Identifier- Richardson Maturity Model

Module:7	Applications of IoT	7 hours

Business models for IoT, Green energy buildings and infrastructure, Smart farming, Smart retailing and Smart fleet management

Module:8	**Recent trends**	**2 hours**
	Total Lecture hours:	**45 hours**

Text Book(s)	
1.	Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri. Internet of Things: Architectures, Protocols and Standards, 1st edition, Wiley Publications, 2019.
2.	Bahga, Arshdeep, and Vijay Madisetti. Internet of Things: A hands-on approach, 1st edition, University press, 2014.
Reference Books	
1.	Vermesan, Ovidiu, and Peter Friess, eds. Internet of things-from research and innovation to market deployment, 1st edition, Aalborg: River publishers, 2014.
2.	Tsiatsis, Vlasios, Tsiatsis, Vlasios, Stamatis Karnouskos, Jan Holler, David Boyle, and Catherine Mulligan, Internet of Things: technologies and applications for a new age of intelligence, 2nd edition, Academic Press, 2018.

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	11-02-2021		
Approved by Academic Council	No. 61	Date	18-02-2021

NON CREDIT COURSES

Course Code	Course Title	L	T	P	J	C
CHY1002	Environmental Sciences	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 aswell as enter a career in an environmental profession or higher education.

Module:1	Environment and Ecosystem	7 hours

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

Module:2	Biodiversity	6 hours

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

Module:3	Sustaining Natural Resources and Environmental Quality	7 hours

Environmental hazards – causes and solutions. Biological hazards – AIDS, Malaria, Chemical hazards- BPA, PCB, Phthalates, Mercury, Nuclear hazards- Risk and evaluation of hazards. Water footprint; virtual water, blue revolution. Water quality management and its conservation. Solid and hazardous waste – types and waste management methods.		
Module:4	**Energy Resources**	**6 hours**
Renewable - Non renewable energy resources- Advantages and disadvantages - oil, Natural gas,Coal, Nuclear energy. Energy efficiency and renewable energy. Solar energy, Hydroelectric power, Ocean thermal energy, Wind and geothermal energy. Energy from biomass, solar- Hydrogen revolution.		
Module:5	**Environmental Impact Assessment**	**6 hours**
Introduction to environmental impact analysis. EIA guidelines, Notification of Government of India (Environmental Protection Act – Air, water, forest and wild life). Impact assessment methodologies. Public awareness. Environmental priorities in India.		
Module:6	**Human Population Change and Environment**	**6 hours**
Urban environmental problems; Consumerism and waste products; Promotion of economic development – Impact of population age structure – Women and child welfare, Women empowerment. Sustaining human societies: Economics, environment, policies and education.		
Module:7	**Global Climatic Change and Mitigation**	**5 hours**
Climate disruption, Green house effect, Ozone layer depletion and Acid rain. Kyoto protocol,Carbon credits, Carbon sequestration methods and Montreal Protocol. Role of Information technology in environment-Case Studies.		
Module:8	**Contemporary issues :** Lecture by Industry Experts	**2 hours**
Total Lecture hours:		**45 hours**
Text Books		
1.	G. Tyler Miller and Scott E. Spoolman (2016), Environmental Science, 15th Edition, Cengage learning.	
2.	George Tyler Miller, Jr. and Scott Spoolman (2012), Living in the Environment – Principles, Connections and Solutions, 17th Edition, Brooks/Cole, USA.	
Reference Books		
1.	David M.Hassenzahl, Mary Catherine Hager, Linda R.Berg (2011), Visualizing Environmental Science, 4thEdition, John Wiley & Sons, USA.	
Mode of evaluation: Internal Assessment (CAT, Quizzes, Digital Assignments) & FAT		
Recommended by Board of Studies	**12.08.2017**	
Approved by Academic Council	**No. 46**	**Date** **24.08.2017**

Course code	Course title	L	T	P	J	C
ENG1000	Foundation English - I	0	0	4	0	2
Pre-requisite	Less than 50% EPT score	Syllabus Version				
		v. 1.0				

Course Objectives:

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

Expected Course Outcome:

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

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

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

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

Vocabulary development; One word substitution
Activity: Elementary vocabulary exercises

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

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

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

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

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

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

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

Wings of Fire -Autobiography of APJ Abdul Kalam (Excerpts) Activity: Enrich vocabulary by reading and analyzing the text		
Module:7	**Correspondence**	**3 Hours**
Letter, Email, Application Writing Activity: Compose letters; Emails, Leave applications		
Module:8	**Listening for Understanding**	**4 Hours**
Listening to simple conversations & gap fill exercises Activity: Simple conversations in Received Pronunciation using audio-visual materials.		
Module:9	**Speaking to Convey**	**6 Hours**
Self-introduction; role-plays; Everyday conversations Activity**:** Identify and communicate characteristic attitudes, values, and talents; Working and interacting within groups		
Module:10	**Reading for developing pronunciation**	**6 Hours**
Loud reading with focus on pronunciation by watching relevant video materials Activity: Practice pronunciation by reading aloud simple texts; Detecting syllables; Visually connecting to the words shown in relevant videos		
Module:11	**Reading to Contemplate**	**4 Hours**
Reading short stories and passages Activity: Reading and analyzing the author's point of view; Identifying the central idea.		
Module:12	**Writing to Communicate**	**6 Hours**
Paragraph Writing; Essay Writing; Short Story Writing Activity: Writing paragraphs, essays and short- stories		
Module:13	**Interpreting Graphical Data**	**6 Hours**
Describing graphical illustrations; interpreting basic charts, tables, and formats Activity: Interpreting and presenting simple graphical representations/charts in the form of PPTs		
Module:14	**Overcoming Mother Tongue Influence (MTI) in Pronunciation**	**5 Hours**
Practicing common variants in pronunciation Activity: Identifying and overcoming mother tongue influence.		
	Total Laboratory Hours	**60 Hours**
Text Book / Workbook		
1.	Wren, P.C., & Martin, H. (2018).High School English Grammar & Composition N.D.V. PrasadaRao (Ed.). NewDelhi: S. Chand & Company Ltd.	

2.	McCarthy, M. O'Dell, F.,& Bunting, J.D. (2010).Vocabulary in Use(High Intermediate students book with answers). Cambridge University Press
Reference Books	
1.	Watkins, P.(2018).Teaching and Developing Reading Skills: Cambridge Handbooks for Language teachers. Cambridge University Press.
2.	Mishra, S., &Muralikrishna, C. (2014).Communication Skills for Engineers. Pearson Education
	India
3	Lewis, N. (2011).Word Power Made Easy. Goyal Publisher
4	https:/americanliterature.com/short-short-stories
5	Tiwari, A., &Kalam, A. (1999).Wings of Fire - An Autobiography of Abdul Kalam. Universities Press (India) Private Limited.

Mode of Evaluation: Quizzes, Presentation, Discussion, Role Play, Assignments

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

Mode of Evaluation: Quizzes, Presentation, Discussion, Role Play, Assignments

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

Course code	Course title	L	T	P	J	C
ENG2000	Foundation English - II	0	0	4	0	2
Pre-requisite	51% - 70% EPT Score / Foundation English I	Syllabus version				
		v.1.0				

Course Objectives:

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

Expected Course Outcome:

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

Module:1	Grammatical Aspects	4 hours

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

Module:2	Vocabulary Enrichment	4 hours

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

Module:3	Phonics in English	4 Hours

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

Module:4	Syntactic and Semantic Errors	2 Hours

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

Module:5	Stylistic errors	2 Hours

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

Module:6	Listening and Note making	6 Hours

Intensive and Extensive Listening - Scenes from plays of Shakespeare (Eg: Court scene in *The Merchant of Venice*, Disguise Scene in *The Twelfth Night*, Death of Desdemona in *Othello*, Death scene in *Julius Caesar* and Balcony scene from *Romeo and Juliet*) Activity : Summarizing; Note-making and drawing inferences from Short videos		
Module:7	**Art of Public Speaking**	**6 Hours**
Impromptu, Importance of Non-verbal Communication, Technical Talks, Dynamics of Professional Presentations – Individual & Group Activity : Ice Breaking; Extempore speech; Structured technical talk and Group presentation		
Module:8	**Reading Comprehension Skills**	**4 Hours**
Skimming, scanning, comprehensive reading, guessing words from context, understanding text organization, recognizing argument and counter-argument; distinguishing between main information and supporting detail, fact and opinion, hypothesis versus evidence; summarizing and note-taking, Critical Reasoning Questions – Reading and Discussion Activity: Reading of Newspapers Articles and Worksheets on Critical Reasoning from web resources		
Module: 9	**Creative Writing**	**4 Hours**
Structure of an essay, Developing ideas on analytical/ abstract topics Activity: Movie Review, Essay Writing on suggested Topics, Picture Descriptions		
Module: 10	**Verbal Aptitude**	**6 hours**
Word Analogy, Sentence Completion using Appropriate words, Sentence Correction Activity: Practicing the use of appropriate words and sentences through web tools.		
Module: 11	**Business Correspondence**	**4 hours**
Formal Letters- Format and purpose: Business Letters - Sales and complaint letter Activity: Letter writing- request for Internship, Industrial Visit and Recommendation		
Module: 12	**Career Development**	**6 hours**
Telephone Etiquette, Resume Preparation, Video Profile Activity: Preparation of Video Profile		
Module: 13	**Art of Technical Writing - I**	**4 hours**
Technical Instructions, Process and Functional Description Activity: Writing Technical Instructions		
Module: 14	**Art of Technical Writing – II**	**4 hours**
Format of a Report and Proposal Activity: Technical Report Writing, Technical Proposal		

			Total Lecture hours:	**60 hours**
Text Book / Workbook				
1.	Sanjay Kumar & Pushp Lata, Communication Skills, 2nd Edition, OUP, 2015			
2	Wren & Martin, High School English Grammar & Composition, Regular ed., ND: Blackie ELT Books, 2018			
Reference Books				
1	Peter Watkins, Teaching and Developing Reading Skills: Cambridge Handbooks for Language Teachers, Cambridge, 2018			
2	Aruna Koneru, Professional Speaking Skills, OUP, 2015.			
3	J.C.Nesfield, English Grammar English Grammar Composition and Usage, Macmillan. 2019.			
4	Richard Johnson-Sheehan, Technical Communication Today, 6th edition, ND: Pearson, 2017.			
5	Balasubramaniam, Textbook of English Phonetics For Indian Students, 3rd Edition , S. Chand Publishers, 2013.			
Web Resources				
1. https://www.hitbullseye.com/Sentence-Correction-Practice.php 2. https://hitbullseye.com/Critical-Reasoning-Practice-Questions.php				
Mode of Evaluation: Presentation, Discussion, Role Play, Assignments , FAT				
List of Challenging Experiments (Indicative)				
1.	Reading and Analyzing Critical Reasoning questions			8 hours
2.	Listening and Interpretation of Videos			12 hours
3.	Letter to the Editor			6 hours
4.	Developing structured Technical Talk			12 hours
5.	Drafting SOP (Statement of Purpose)			10 hours
6.	Video Profile			12 hours
			Total Laboratory Hours	**60 hours**
Mode of Evaluation: Presentation, Discussion, Role Play, Assignments , FAT				
Recommended by Board of Studies	**08.06.2019**			
Approved by Academic Council	**55**	**Date**	**13-06-2019**	

BRIDGE COURSES

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 formaland informal contexts

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 RevisedEdition]. Oxford: Oxford University Press.

Reference Books

1.	Sanjay Kumar and Puspalata. Communication Skills. 2015. [Second Edition] Print. NewDelhi: Oxford University Press.
2.	John Seely. Oxford Guide to Effective Writing and Speaking. 2013. [Third Edition].NewDelhi: 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