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)

M.Tech (CSE)

School of Computer Science and Engineering

M.Tech (CSE)

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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School of Computer Science and Engineering

M.Tech (Computer Science and Engineering)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be engineering professionals who will engage in technology development and deployment with social awareness and responsibility.

2. Graduates will function as successful practising engineer / researcher / teacher / entrepreneur in the chosen domain of study.

3. Graduates will have holistic approach addressing technological, societal, economic and sustainability dimensions of problems and contribute to economic growth of the country.

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M. Tech Computer Science and Engineering

PROGRAMME OUTCOMES (POs)

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

PO_2 Having an ability to design a component or a product applying all the relevant standards and with realistic constraints

PO_3 Having an ability to design and conduct experiments, as well as to analyze and interpret data

PO_4 Having an ability to use techniques, skills and modern engineering tools necessary for engineering practice

PO_5 Having problem solving ability- solving social issues and engineering problems

PO_6 Having adaptive thinking and adaptability

PO_7 Having a clear understanding of professional and ethical responsibility

PO_8 Having a good cognitive load management [discriminate and filter the available data] skills

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School of Computer Science and Engineering

M.Tech(Computer Science and Engineering)

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Ability to design and develop computer programs/computer-based systems in the advanced level of areas including algorithms design and analysis, networking, operating systems design etc.

2. Ability to provide socially acceptable technical solutions to complex computer science engineering problems with the application of modern and appropriate techniques for sustainable development relevant to professional engineering practice.

3. Ability to bring out the capabilities for research and development in contemporary issues and to exhibit the outcomes as technical report.

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M. Tech Computer Science and Engineering

CREDIT STRUCTURE

Category-wise Credit distribution

Category	Credits
University Core (UC)	**27**
Programme Core (PC)	**19**
Programme Elective (PE)	**18**
University Elective (UE)	**06**
Bridge Course (BC)	**-**
Total Credits	**70**

CURRICULUM

M.Tech.-Computer Science and Engg - (2019)

Programme Core	Programme Elective	University Core	University Elective	Total Credits
19	18	27	6	70

Course Code	Course Title	Course Type	L	T	P	J	C
PROGRAMME CORE							
CSE5001	Algorithms: Design and Implementation	ETL	2	0	2	0	3
CSE5002	Operating Systems and Virtualization	ETL	2	0	2	0	3
CSE5003	Database Systems: Design and Implementation	ETLP	2	0	2	4	4
CSE5004	Computer Networks	ETL	2	0	2	0	3
CSE5005	Software Engineering and Modelling	TH	3	0	0	0	3
CSE5006	Multicore Architectures	ETL	2	0	2	0	3
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**J**	**C**
PROGRAMME ELECTIVE							
CSE6001	Bigdata Frameworks	ETLP	2	0	2	4	4
CSE6002	Information Security Foundations	ETP	3	0	0	4	4
CSE6003	Web Services	ETL	2	0	2	0	3
CSE6005	Machine Learning	ETLP	2	0	2	4	4
CSE6006	NoSQL Databases	ETLP	2	0	2	4	4
CSE6008	Distributed Systems	ETLP	2	0	2	4	4
CSE6009	IoT Technology and Applications	ETLP	2	0	2	4	4
CSE6010	Cloud Application Development and Management	ETLP	2	0	2	4	4
CSE6012	Image Processing and Analysis	ETP	3	0	0	4	4
CSE6013	Advanced Software Testing	ETLP	2	0	2	4	4
CSE6015	Mobile Application and Development	ETP	2	0	0	4	3
CSE6053	Wireless Sensor Networks	ETP	2	0	0	4	3
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**J**	**C**
UNIVERSITY CORE							
CSE6099	Masters Thesis	PJT	0	0	0	0	16
MAT5002	Mathematics for Computer Engineering	TH	3	0	0	0	3
SET5001	Science, Engineering and Technology Project - I	PJT	0	0	0	0	2
SET5002	Science, Engineering and Technology Project - II	PJT	0	0	0	0	2
EFL5097	English and Foreign Language	CDB	0	0	0	0	2
ENG5001 - Fundamentals of Communication Skills - LO							
ENG5002 - Professional and Communication Skills - LO							
FRE5001 - Francais fonctionnel - TH							
GER5001 - Deutsch fuer Anfaenger - TH							
STS6777	Soft Skills M.Tech.	CDB	0	0	0	0	2
STS5001 - Essentials of Business Etiquettes - SS							
STS5001 - Essentials of Business Etiquette and Problem Solving - SS							
STS5002 - Preparing for Industry - SS							

Course Code	Course Title	Course Type	L	T	P	J	C
STS5102 - Programming and Problem Solving Skills - SS							
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**J**	**C**
BRIDGE COURSE							
Course Code	**Course Title**	**Course Type**	**L**	**T**	**P**	**J**	**C**
NON CREDIT COURSE							

CSE5001	ALGORITHMS: DESIGN AND IMPLEMENTATION	L	T	P	J	C
		2	0	2	0	3
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. To focus on the design of algorithms in various domains

2.To provide a foundation for designing efficient algorithms.

3.To provide familiarity with main thrusts of working algorithms-sufficient to gives context for formulating and seeking known solutions to an algorithmic problem..

Expected Course Outcome:

1. Solve a problem using Algorithms and design techniques
2. Solve complexities of problems in various domains
3. Implement algorithm, compare their performance characteristics, and estimate their potentialeffectiveness in applications
4. Solve optimization problems using simplex algorithm
5. Designing approximate algorithms for graph theoretical problems
6. Application of appropriate search algorithms for graphs and trees
7. Application of computational geometry method on optimization problems

Module:1	Introduction	5 hours

Algorithm design techniques : Divide and Conquer, Brute force, Greedy, Dynamic Programming. Timecomplexity (asymptotic notation, recurrence relations)

Module:2	Network Flows	5 hours

Maximum Flows, Min-cost Flows, Max-Flow Min-Cut Theorem, Cycle Canceling Algorithms, StronglyPolynomial-time Analysis, Minimum Cuts without Flows

Module:3	Tractable and Intractable Problems	3 hours

Class complexity: P, NP, NP-Hard, NP-Complete Approximation Algorithms

Module:4	Approximation Algorithms	3 hours

Limits to Approximability, Vertex Cover problem, Set cover problem, Euclidean TSP

Module:5	Search Algorithms for Graphs and Trees	4 hours

Limits to Approximability, Vertex Cover problem, Set cover problem, Euclidean TSP

Module:6	Computational Geometry	4 hours

Line Segments, Convex hull finding algorithms

Module:7	Linear Programming	2 hours

Representing problems-shortest paths, maximum flow ,and minimum-cost flow as linear programmingproblems. Simplex algorithm		
Module:8	Recent Trends	**2 hours**
	Total Lecture hours:	**30 hours**
Text Book(s)		
Reference Books		

1. Cormen, Leiserson, Rivest and Stein, Introduction to Algorithms, 3rd edition, McGraw-Hill, 2009.
2. J.Kleinberg and E.Tardos. Algorithm Design, Pearson Education, 2009.
3. E.Horowitz,S.Sahni,S.Rajasekaran,FundamentalsofComputerAlgorithms,2nd edition,Universities Press,2011.
4. Ravindra K.Ahuja, ThomasL. Magnanti, and JamesB.Orlin, Network Flows: Theory,Algorithms, and Applications, Pearson Education,2014.
5. GeorgeT.Heineman, GaryPollice,StanleySelkow,Algorithms in a nutshell,O'ReillyMedia, 2nd edition, 2016.

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

List of Challenging Experiments (Indicative)

1.	Implementation of algorithms for problems that can be solved by one or moreof the following strategies : Divide and Conquer, Brute force, Greedy, Dynamic Programming.	2 hours
2.	Implementation of Ford Fulkerson method, Edmonds-Karp algorithm forfinding maximum flow in a flow network and applying them for solving typical problems such as railway network flow, maximum bipartite matching	2 hours
3.	Implementation of Dinics strongly polynomial algorithm for computing them maximum flow in a flow network and applying it for solving typical problems	2 hours
4.	Implementation of push-relabel algorithm of Goldberg and Tarjan for finding maximum flow in a flow network and applying it for solvingtypical problems	2 hours
5.	Applying linear programming for solving maximum flow problem	2 Hours
6.	Applying network flow algorithms for baseball elimination and airlinescheduling	2 Hours
7.	Given a flow network G=(V,E,s,t) ,where V is the vertex set, E is the edge set ,sand t are source and destination. An edge of the flow network is called critical ifa decrease in the flow over that edge results in a decrease in the total flow of theflow network. An edge of the flow network is called a bottleneck edge if an increase in the flow over that edge results in an increase in the total flow of the flow network. Assume that you are using to compute the maximum flow of the network. (a) Write a program(any language)to identify all the critical edges. (b) Write a program (any language)to identify all bottleneck edges in thenetwork.	3 Hours

8.	Implementation of solution techniques for the minimum-cost flowproblem	2 hours
9.	Design a polynomial time algorithm to compute the solution of a linear programming problem in two dimensions. Your algorithm should convert each constrain to f the problem, into a planar region. Use that algorithm to compute the solution of the following problem. Implement your algorithm in any programming language. A manufacturer of furniture makes two products: chairs and tables. Processing of these products is done on two machines M1 and M2. A chair requires 2hours on machine M1and 6hours on machine M2. A table requires5 hours on machine M1and no time on machine M2.There are 16 hours of time per day available on machine M1and30 hours on machine M2. Profits gained by manufacturer from a chair and a table are Rs.1and Rs.5 respectively. The problem is to maximize the profit for the manufacturer.	2 hours
10.	Implementation of algorithms for the vertex cover problem, set cover problem, TSP	2 hours
11.	Implementation of search algorithms for graphs and trees: fundamental algorithms, Dijkstras algorithm	2 hours
12.	Consider the problem of barricading sleeping tigers by a fence of shortest length. Forest officials have tranquilized each tiger. Suggest an algorithm for the purpose. You are allowed to assume any information required for your algorithm. Implement your algorithm in any programming language (using convex hull)	3 hours
13.	A simple polygon is defined as a flat shape consisting of straight non-intersecting line segments or sides that are joined pairwise tofromaclosedpath.Letp1,p2,....,pn be a set of points in the two dimensional plane. (a) Write a program to find the simple polygon of P. (b) Write aprogram (linear time) to convert that the simple polygon of P to a ConvexHull.	3 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment:			
Recommended by Board of Studies	**13.05.2016**		
Approved by Academic Council	41	**Date**	**17.06.2016**

CSE5002	OPERATING SYSTEMS AND VIRTUALIZATION	L	T	P	J	C
		2	0	2	0	3
Pre-requisite	**NIL**			**Syllabus version**		
				1.0		

Course Objectives:

1. To introduces Virtualization, operating systems fundamental concepts and its technologies
2. To provides skills to write programs that interact with operating systems components such as Processes,Thread, Memory during concurrent execution
3. To provide the skills and knowledge necessary to implement, provisioning and administer server anddesktop virtualization

Expected Course Outcome:

1. Study operating system layers and kernel architectures
2. Design various techniques for process management
3. Construct various address translation mechanism
4. Perform process threading and synchronization
5. Study various methods of virtualization and perform desktop and server virtualization
6. Classify the light-weight virtual machines with dockers and containers
7. Develop programs related to the simulations of operating systems and virtualization concepts

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

Computer system architecture a layered view with interfaces – Glenford Myer, Monolithic Linux HybridWindows10 kernels Layered architecture of operating system and core functionalities

Module:2	**Process**	**4 hours**

Introduction, Process Operations, States, Context switching, Data Structures (Process Control Block(PCB),Process Scheduling: Multi-Level Feedback Queue, Multi-processor Scheduling, Deadlocks and its detection

Module:3	**Memory**	**4 hours**

Introduction, Address Spaces, Memory API, Address Translation, Paging-Faster Translations (TLB), SmallerTables. Virtual Memory System inx86

Module:4	**Concurrency**	**6 hours**

Introduction, Thread Models, Thread API, Building Evaluating a Lock, Test And Set, Two phase lock,Classical problems handling using semaphore. Persistence- File Organization: The i-node, Crash Consistency
file security.

Module:5	**Virtual Machines**	**2 hours**

Process and System VMs Taxonomy of VMs

Module:6	**Types of Virtualization**	**4 hours**

Hardware Emulation, Full Virtualization with binary translation, Hardware assisted, Operating System Virtualization, OS assisted /Para virtualization.

Module:7	**Hypervisor**	**7 hours**
Type 1, Type 2, Para virtualization, Server Virtualization, Desktop Virtualization, Overview VM portability- Clones, Templates, Snapshots, OVF, Hotand Cold Cloning Protecting Increasing Availability, Light Weight Virtual machine: Container /Docker		
Module:8	**Recent Trends**	**1 hours**

	Total Lecture hours:	**30 hours**	

Text Book(s)

1. Thomas Anderson, Michael Dahlin, Operating Systems: Principles and Practice, SecondEdition, Recursive Books,2014
2. Matthew Portnoy, Virtualization Essentials, John Wiley Sons Inc; 2nd Edition, 2016

Reference Books

1. William Stallings, Operating Systems: Internals and Design Principles, 8thEdition
2. A.Silberschatz and P.Galvin. Operating System Concepts. Eight Edition, John Wiley Sons, 2008
3. Smith, Nair, Virtual Machines: Versatile Platforms for Systems and Processes, Morgan KaufmannPublishers(2005)
4. Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

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

List of Challenging Experiments (Indicative)

1.	Study of Basic Linux Commands	2 hours
2.	Shell Programming (I/O, Decision making, Looping, Multi-level branching)	2 hours
3.	Creating child process using fork() system call, Orphan and Zombieprocess creation	2 hours
4.	Simulation of CPU scheduling algorithms (FCFS, SJF, Priority and RoundRobin)	2hours
5.	Simulation of Banker s algorithm to check weather given system is in safe state or not. Also check whether addition resource requested can be granted immediately	4 hours
6.	Parallel Thread management using pthread library. Implement a data parallelism using multi-threading	4 hours
7.	Dynamic memory allocation algorithms - First-fit, Best-fit, Worst-fit algorithms	2 hours
8.	Page Replacement Algorithms FIFO, LRU and Optimal	4 hours
9.	Virtualization Setup: Type-1, Type-2 Hypervisor	4 hours
10.	Implementation of OS / Server Virtualization	4 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: ***Project/Activity***			
Recommended by Board of Studies	**13.05.2016**		
Approved by Academic Council	**41**	**Date**	**17.06.2016**

CSE5003	DATABASE SYSTEMS: DESIGN AND IMPLEMENTATION	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		1.0				

Course Objectives:

1. To emphasize the underlying principles of Relational Database Management System.
2. To model and design advanced data models to handle threat issues and counter measures.
3. To implement and maintain the structured, semi-structured and unstructured data in an efficient databasesystem using emerging trends.

Expected Course Outcome:

1. Design and implement database depending on the business requirements and considering various designissues.
2. Select and construct appropriate parallel and distributed database architecture and formulate the cost ofqueries accordingly.
3. Understand the requirements of data and transaction management in mobile and spatial database anddifferentiate those with RDBMS.
4. Categorize and design the structured, semi-structured and unstructured databases.
5. Characterize the database threats and its counter measures.
6. Review cloud, streaming and graph databases.
7. Comprehend, design and query the database management system.

Module:1	**Relational Model**	**6 hours**

Database System Architecture–EER Modeling-Indexing–Normalization–Query processing and optimization – Transaction Processing

Module:2	**Parallel Databases**	**4 hours**

Architecture, Data partitioning strategy, Interquery and Intraquery Parallelism –Parallel Query Optimization

Module:3	**Distributed Databases**	**5 hours**

Features – Distributed Database Architecture –Fragmentation –Replication- Distributed Query Processing – Distributed Transactions Processing

Module:4	**Spatial and Mobile Databases**	**3 hours**

Spatial databases-Type of spatial data–Indexing in spatial databases, Mobile Databases– Transaction Model in MDS

Module:5	**SemiStructured Databases**	**4 hours**

Semi Structured databases – XML –Schema-DTD- XPath- XQuery, Semantic Web –RDF–RDFS

Module:6	**Database Security**	**3 hours**

Introduction to Database Security Issues–Security Models–Different Threats to databases– Counter measures todeal with these problems

Module:7	**Emerging Technologies**	**3 hours**

Cloud databases – Streaming Databases - Graph Databases-New SQL

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

	Total Lecture hours:	**30 hours**	

Text Book(s)

1. AviSilberschatz,HankKorth,andS.Sudarshan,"DatabaseSystemConcepts",6thEd..McGraw Hill, 2010.
2. Ramez Elmasri B.Navathe: "Fundamentals of database systems", 7th edition, Addison Wesley,2014

Reference Books

1.S.K.Singh, "Database Systems: Concepts, Design Applications", 2nd edition, Pearson education, 2011.

2. Joe Fawcett, Danny Ayers, Liam R. E. Quin: "Beginning XML", Wiley India Private Limited5th Edition, 2012.

3. Thomas M. Connolly and Carolyn Begg "Database Systems: A Practical Approach to Design, Implementation, and Management", 6th edition, Pearson India, 2015.

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

List of Challenging Experiments (Indicative)

1.	Model any given scenario into ER/EER Model using any tool ERD Plus, ER Win,Oracle SQL developer)	1 hours
2.	Creating applications with RDBMS Table creation with constraints, alter schema, insert values, aggregate functions, simpleand complex queries with joins PLSQL-PROCEDURES, CURSORS, FUNCTIONS, TRIGGERS	3 hours
3.	Partition a given database based on the type of query and compares the execution speed of the query with/without parallelism.	3 hours
4.	Create an XML document and validate it against an XML Schema/DTD. Use XQuery toquery and view the contents of the database.	2hours
5.	Consider an application in which the results of football games are to be represented inXML,DTD and Xquery. For each game, we want to be able to represent the two teams involved ,which one was playing at home, which players scored goals(some of which may have been penalties)and the time when each was scored, and which players were shown yellow or red cards. You might use some attributes. You can check your solutions with the online demo of the Zorba XQueryengine4.	3 hours
6.	To implement parallel join and parallel sort algorithms to get marks from different collegesof the university and publish10 ranks for each discipline.	2 hours
7.	Create a distributed database scenario, insert values, fragment the database and query thedatabase.	
8.	Consider a schema that contains the following table with the key underlined: Employee (Eno,Ename, Desg, Dno). Assume that we horizontally fragment the table as follows: Employee1(Eno, Ename, Desg, Dno), where 1 <= Dno <=10, Employee2(Eno, Ename, Desg,Dno), where 11 <= Dno <=20, Employee3 (Eno, Ename, Desg, Dno), where 21 <= Dno <=30	3 hours

	In addition, assume we have 4 sites that contain the following fragments: Site1 has Employee1, Site2 has Employee2, Site3 has Employee2 and Employee3, Site4 has Employee1. Implement at least five suitable queries on Employee fragments. Add relations to the database as per your requirements.	
9.	Download a spatial dataset based on any specific theme (containing layer information) from Quantum GIS and import it into Postgres SQL(PostGIS) and Query and view thedatabase.	2 hours
10.	To investigation of some spatial analysis techniques using Toxic Release Inventory (www.epa.gov/triexplorer/) data for Massachusetts from the Environmental Protection Agency (EPA),which indicate the magnitude of the releases of toxic core chemicals into land, water and air ata site in the state. Note that these TRI locations were geo coded from a list of addresses provided by the EPA	3 hours
11.	Use sample datasets from health care domain, Visualize and interpret the results	3 hours
12.	Import the Hubway data intoNeo4jandconfigureNeo4j.Then, answer the followingquestions using the Cypher Query Language: a) List top 10 stations with most outbound trips (Show station name and number of trips) b) List top 10 stations with most inbound trips (Show station name and number of trips) c) List top 5 routes with most trips (Show starting station name, ending station name andnumber of trips) d) List the hour number (for example 13 means 1pm -2pm) and number of trips which startfrom the station" B.U.Central"	2 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: ***Project/Activity***			
Recommended by Board of Studies	**13.05.2016**		
Approved by Academic Council	**41**	**Date**	**17.06.2016**

CSE5004	COMPUTER NETWORKS	L	T	P	J	C
		2	0	2	0	3
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. Learn the division of network functionalities into layers.
2. Be familiar with the components required to build different types of networks and protocol
3. Understand the basic knowledge of software defined networks.

Expected Course Outcome:

1. Explore the basics of Computer Networks and various protocols.
2. Summarize the simple network management protocol components.
3. Interpret the characteristics of SDN controllers and their implications to learn the board aspects of security, overlay and network model.
4. Elaborate network function virtualization and network virtualization
5. Acquire the knowledge of SDN network security and network design implications of QoE/QoS.

Module:1	Introduction	6 hours

Network models, Addressing: Classful and Classless, Routing Protocols: unicast, multicast, Congestion control, Host configuration: DHCP, DNS.

Module:2	Network Management	4 hours

SNMP : Management Components, SMI, MIB, Configuration Management – Fault management – Performance Management – Accounting Management, Case studies.

Module:3	Software Defined Networks	5 hours

SDN Data plane, Control Plane, Application Plane. SDN security attack vectors and SDN Harderning, Overlay model and network model for cloud computing.

Module:4	Network Functions Virtualization	3 hours

Concepts, Benefits, requirements, Reference architecture, Management, Functionality and Infrastructure

Module:5	Network Virtualization	4 hours

Virtual LAN, Virtual Private Networks: IPSEC, MPLS, Network Virtualization Architecture and Benefits

Module:6	Security	2 hours

Security requirements, Threats to SDN, SDN security, NFV Security and its techniques

Module:7	Network Design Implications of QoS and QoE	4 hours

QoS Architectural Framework, SLA, IP Performance metrics, QoE: Strategies, Measurements, QoE/QoS Mapping models

Module:8	RECENT TRENDS	2 hours

	Total Lecture hours:	**30 hours**

Reference Books

1. William Stallings, “Data and Computer Communication”, Sixth Edition, Pearson Education, 2000.
2. Behrouz A. Forouzan, “TCP/IP Protocol Suite”,Tata McGraw Hill edition, Fourth Edition. 2015.
3. William Stallings, ”Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" Pearson,2015
4. James F. Kuross, Keith W. Ross, “Computer Networking, A Top-Down Approach Featuring the Internet”, Third Edition, Addison Wesley, 2004.
5. Andrew S. Tanenbaum, “Computer Networks”, Fourth Edition, 2003.
6. Forouzan, A. Behrouz. “Data Communications & Networking (sie)”. Tata McGraw-Hill Education, 2006.
7. Peterson and Bruce S. Davie Larry L.,”Computer Networks – A Systems approach” -, Morgan Kaufmann Publishers, Elsevier, 5th edition, 2012.

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

List of Challenging Experiments (Indicative)

1.	Study of different types of Network cables and Practically implement the cross-wired cable and straight through cable using crimping tool.	2 hours
2.	Study of Network Devices in Detail.	2 hours
3.	Study of network IP.	2 hours
4.	Web NMS (SNMP based)	2 hours
5.	Network Simulators	2 hours
6.	Implementation of routing protocols in MANETs	2 hours
7.	Network trouble shooting	2 hours
8.	Programs using network packet tracers	2 hours
9.	SDN Applications and Use Cases	2 hours
10.	Network Virtualization and Slicing	2 hours
11.	Network Function Virtualization (NFV)	2 hours
	Total Laboratory Hours	**22 hours**

Mode of assessment:

Recommended by Board of Studies	**13.05.2016**		
Approved by Academic Council	**41**	**Date**	**17.06.2016**

CSE5005	SOFTWARE ENGINEERING AND MODELLING	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	Nil	Syllabus version				
		1.1				

Course Objectives:

1.To give an overview of fundamentals of software process models and principles. 2.To describe the essentials of software Engineering concepts related to requirements, modeling, deriving distributed architecture, software validation and reuse
3.To establish foundation on concepts of aspect oriented development and recent trendsand tools.

Expected Course Outcome:

1. Apply software engineering theory, principles, tool sand processes, towards the developmentand maintenance of complex, scalable software systems.
2. Analyze requirements and model the system based on object oriented concepts anddistributed architecture concepts.
3. Design test cases to validate the software for accurate functionality
4. Emphasize on software reuse principles for software design and development.5.Explore the advanced software development concepts.
6.Learn the recent trends and tools related to software modeling.

Module:1	Software Process Models and Principles	6 hours

Software Process Models: Waterfall, V-model, Spiral iterative and incremental-Component-based development, Fourth Gen Techniques, Introduction to Agile Software Development, AgilePrinciples and Practices, Extreme Programming

Module:2	Modelling Requirements	5 hours

Software Requirements Engineering, Software Architecture: Architectural Tactics and Patterns-Architecture in the Life Cycle: Architecture and Requirements.

Module:3	Modelling Design	6 hours

Designing Architecture. Object Oriented Design, Design principles DFD, UML tools, OODmetrics, Overview of Design Patterns

Module:4	Software Validation	6 hours

Introduction to Software Verification Validation, levels of testing, types of testing, Black box design techniques, White box design techniques, statement coverage, decision coverage, condition coverage, Static Review process. Functional non-functional testing. Software
Maintenance - Software Maintenance, Software Configuration Management.

Module:5	Software Reuse	7 hours

Reuse based Software Engineering Approaches supporting software reuse Application Frame works Commercial-Of-The-Shelf(COTS) systems: COTS Solution Systems, COTS Integrated Systems. Component-Based Software Engineering (CBSE) Components, Component Models CBSE Processes: CBSE for Reuse, CBSE with Reuse Component-based Development:

Component Qualification, Adaptation, and Composition Economics of CBSE.

Module:6	**Distributed Software Engineering**	**6 hours**

Distributed Software Engineering Distributed system characteristics Design Issues Middleware Client-Server Computing Client-Server Interaction Architectural patterns for Distributed Systems: Master/Slave, Two-tier, Multi-tier, Distributed component, and Peer-to- Peer Software as a Service (SaaS) Key elements Implementation factors Configuration of a system offered as a
service.

Module:7	**Aspect Oriented Software Development**	**5 hours**

Introduction to Aspect-Oriented Software Development(AOSD): Aspect-Orientation in the Software Life cycle Developing Software components with Aspects. Insight into Mashup in Software Engineering Categorization of Mashup Enterprise Mashups - Principles of lean, Insight
into Lean software development principles. Social Software Engineering

Module:8	**RECENT TRENDS**	**2 hours**

	Total Lecture hours:	**45hours**	

Text Book(s)

1.Roger Pressman, Software Engineering: A Practitioner's Approach, 7th Edition, McGrawHill,2010.

Reference Books

1. Ian Sommerville, Software Engineering, 9th Edition, , Addision-Wesley, 2010.
2. Len Bass, Paul Clements, Rick Kazman, Software Architecture in Practice, 3rd Edition, , Addison- Wesley Professional, 2012 (SEI Series in Software Engineering).
3. Robert E. Filman, Tzilla Elrad, Siobhn Clarke, Mehmet Aksit ,Aspect-Oriented Software Development, Addison-Wesley Professional, 2004.
4. Martin Fowler ,Refactoring: Improving the design of existing code, Addison Wesley, 1999.
5.Robert C. Martin ,Agile Software Development, Principles, Patterns, and Practices, Pearson, 2011.

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

Project	
1. Projects may be given as group projects A software product in any of the following category should bedeveloped 1. Native platform-based application 2. Web-based Application 3. MobileApp 4. Web-service 5. Software component	60 hours

Recommended by Board of Studies	**13.05.2016**		
Approved by Academic Council	**41**	**Date**	**17.06.2016**

CSE5006	MULTICORE ARCHITECTURES	L	T	P	J	C
		2	0	2	0	3
Pre-requisite	**NIL**			**Syllabus version**		
						1.1

Course Objectives:

1. To provide knowledge on basics of Multi-core architectures and parallel programming models.
2. To design and develop parallel programs using parallel computing platforms such as OpenMP, CUDA.
3. To apply program optimizations on parallel programs and evaluate the performance using profiling tools.

Expected Course Outcome:

1. Outline the developments in the evolution of multi-core architectures and parallel programming paradigms feature vectors for the Images.
2. Comprehend the various programming languages and libraries for parallel computing platforms.
3. Use of profiling tools to analyse the performance of applications by interpreting the given data.
4. Compare and contrast the features of parallel programming languages such as OpenMP and CUDA.
5. Write parallel programs using OpenMP and CUDA.
6. Evaluate efficiency trade-offs among alternative parallel computing architectures for an efficient parallel Application design.
7. Analyze performance parameters such as speed-up, efficiency for parallel programs against serial programs.

Module:1	**Introduction to Multi-Core Architectures**	**2hours**

Evolution of multi-cores through Moor's Law, Comparisons of single core, multi-core, multi-processing and hyper threading

Module:2	**Parallel Computers and programming**	**5 hours**

Threading Concepts, Communication Architectures and Communication Costs, Thread Level Parallelism (TLP), Instruction Level Parallelism (ILP), Comparisons, Cache Hierarchy and Memory- level Parallelism, Cache Coherence, Parallel programming models, Shared Memory and Message
Passing, Vectorization.

Module:3	**OpenMP programming (Open multi-processing)**	**5 hours**

Introduction to OpenMP, Parallel constructs, Run-time Library routines, Work-sharing constructs, Scheduling clauses, Data environment clauses, atomic, master Nowait Clause, Barrier Construct.

Module:4	**CUDA Programming(Compute Unified Device Architecture)**	**6 hours**

Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplication in CUDA, CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features.

Module:5	**Performance Analysers**	**4 hours**
Trace analyzer and collector (ITAC), VTune Amplifier XE, Energy Efficient Performance, IntegratedPerformance Primitives (IPP).		
Module:6	**Contemporary Tools**	**3 hours**
MKL (Math Kernel Library), Threading Building Blocks, CUDA Tools.		
Module:7	**HTC and MTC**	**3 hours**
Cloud databases – Streaming Databases - Graph Databases-New SQLHTC (High Throughput Computing), MTC (Many Task Computing), Top 500 Super computers in the world, Top 10 Super Computer architectural details, Exploring Linpack.		
Module:8	**Contemporary Issues**	**2 hours**
	Total Lecture hours: **30 hours**	

Text Book(s)

1. Rob Farber, CUDA Application Design and Development, Morgan Kaufmann Publishers, 2013.
2. Shameem Akhter and Jason Roberts, Multi-Core Programming, 1st edition, Intel Press, 2012.

Reference Books

1. Rob Farber, CUDA Application Design and Development, Morgan Kaufmann
2. Robert Oshana, Multicore Software Development Techniques: Applications, Tips, and Tricks, Newnes,1 edition, 2015.
3. David B. Kirk , Wen-mei W. Hwu, Programming Massively Parallel Processors: A Hands-on Approach (Applications of GPU Computing Series), 1st edition, Morgan Kaufmann, 2010. Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

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

List of Challenging Experiments (Indicative)		
1.	Practice with Open M	2 hours
2.	OpenMP Sample Programs Time estimation Practicing sample programs Development of documentation for observations	2 hours
3.	Develop a sample program using Execution Environment Routines and write interesting observations by comparing various routines	2 hours

4.	Develop a program using following construct and describe scenario for the need of construct Parallel Construct Determining the Number of Threads for a parallel Region Work-sharing Constructs Loop construct Sections construct Single construct Schedule clause Static Dynamic Guided Data Environment Constructs Shared Clause Critical Construct Reduction Clause Master Construct No wait Clause Barrier Construct Atomic Construct	8 hours
5.	Analysis through any one of profiling tools (ITAC/VTune/EEP/IIP) Experimental setup Parallelizing given serial program into parallel Analysing parallel programs	6 hours
6.	CUDA programming Write a CUDA C/C++ program that add two array of elements and store theresult in third array How to Reverse Single Block in an Array using CUDA C/C++ CUDA C program for Matrix addition and Multiplication using Shared memory Write CUDA C/C++ program for Vector Addition. Modify your program so,that it can add two vector of arbitrary size	8 hours
	Total Laboratory Hours	**28 hours**

Mode of assessment: ***Project/Activity***			
Recommended by Board of Studies	**13.05.2016**		
Approved by Academic Council	**41**	**Date**	**17.06.2016**

CSE6001	BIG DATA FRAMEWORKS	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	NIL				Syllabus version	
					1.0	

Course Objectives:

1.To understand the need of Big Data, challenges and different analytical architectures
2.Installation and understanding of Hadoop Architecture and its ecosystems
3.Processing of Big Data with Advanced architectures like Spark.
4.Describe graphs and streaming data in Spark

Expected Course Outcome:

1.Discuss the challenges and their solutions in Big Data
2.Understand and work on Hadoop Framework and eco systems.
3. Explain and Analyse the Big Data using Map-reduce programming in Both Hadoop and Spark framework.
4. Demonstrate spark programming with different programming languages. 5.Demonstrate the graph algorithms and live streaming data in Spark
6. Lab: analyse and implement different frame work tools by taking sample data sets.
7.Project: illustrate and implement the concepts by taking an application problem.

Module:1	Introduction To Big Data	3hours

Data Storage and Analysis - Characteristics of Big Data – Big Data Analytics - Typical Analytical Architecture – Requirement for new analytical architecture – Challenges in Big Data Analytics – Need of big data frameworks

Module:2	Hadoop Framework	6 hours

Hadoop – Requirement of Hadoop Framework - Design principle of Hadoop –Comparison with other system - Hadoop Components – Hadoop 1 vs Hadoop 2 – Hadoop Daemon's – HDFS Commands – Map Reduce Programming: I/O formats, Map side join, Reduce Side Join, Secondary sorting, Pipelining MapReduce jobs

Module:3	Hadoop Ecosystem	3 hours

Introduction to Hadoop ecosystem technologies: Serialization: AVRO, Co-ordination: Zookeeper, Databases: HBase, Hive, Scripting language: Pig, Streaming: Flink, Storm

Module:4	Spark Framework	4 hours

Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplicationin CUDA, CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features.

Module:5	Data Analysis with Spark Shell	4 hours

Writing Spark Application - Spark Programming in Scala, Python, R, Java - Application Execution.

Module:6	Spark SQL and GraphX	5hours

SQL Context – Importing and Saving data – Data frames – using SQL – GraphX overview – Creating Graph – Graph Algorithms.

Module:7	Spark Streaming	3 hours

Overview – Errors and Recovery – Streaming Source – Streaming live data with spark

Module:8	**Recent Trends in Big Data Analytics**		**1 hours**
	Total Lecture hours:	**30 hours**	

Reference Books

1. Mike Frampton, "Mastering Apache Spark", Packt Publishing, 2015.
2. TomWhite,"Hadoop:TheDefinitiveGuide",O'Reilly,4thEdition,2015.
3. NickPentreath,MachineLearningwithSpark,PacktPublishing,2015.
4. Mohammed Guller, Big Data Analytics with Spark, Apress,2015
5. Donald Miner, Adam Shook, "Map Reduce Design Pattern", O'Reilly, 2012

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

List of Challenging Experiments (Indicative)

1.	HDFS Commends Map Reduce Program to show the need of Combiner	4 hours
2.	Map Reduce I/O Formats-Text, key-value Map ReduceI/O Formats – Nline, Multiline	5 hours
3.	Sequence file Input/Output Formats Secondary sorting	5 hours
4.	Distributed Cache & Map Side Join, Reduce side Join Building and Running a Spark Application Word count in Hadoop and Spark Manipulating RDD	8 hours
5.	Inverted Indexing in Spark Sequence alignment problem in Spark Implementation of Matrix algorithms in Spark Spark Sql programming,Building Spark Streaming application	8 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: ***Project/Activity***

Recommended by Board of Studies	**13.05.2016**		
Approved by Academic Council	**41**	**Date**	**17.06.2016**

CSE6002	INFORMATION SECURITY FOUNDATIONS	L	T	P	J
		3	0	0	4

Pre-requisite	Nil	Syllabus version
		1.0

Course Objectives:

1. To assess the current security landscape, including the nature of the threat, the general status of common vulnerabilities, and the likely consequences of security failures at network, server andapplication levels in CIA triad.
2. To justify the need for appropriate strategies and processes for disaster recovery and faulttolerance and propose how to implement them successfully.
3. To appraise the current information auditing, assurance, and computer forensics systems and procedures.

Expected Course Outcome:

1. Identify various vulnerabilities of computers network systems as well as the different modes ofattack.
2. Explore and design techniques to prevent security attacks.
3. Identify the security solutions for servers like DNS, DHCP, WINS, Remote Access, NAT. 4.Explore the emerging security solutions for Web and Email using Firewall, SSL, TLS, SETandIPSec.
5. Develop the disaster recovery and fault tolerance systems.
6. Identify the need of information auditing, forensics security and RFID security.

Module:1	Information Security Fundamental	7 hours

Importance of Computer and Network Security CIAAN (Confidentiality, Integrity, Availability, Authentication, Non-Repudiation) - Business Needs -Threats and Countermeasures Attackers
- Policies and Standards - Legal, Ethical and Professional Issues Authentication, Authorization and Access Control Authentication Overview Credentials Protocols - Best practices for secure authentication -Services RADIUS (Remote Authentication Dial-In User Service), TACACS (Terminal Access Controller Access Control System), LDAP (Lightweight Directory Access Protocol); Authorization and Access Control - Access control model - Implementation on
Windows -Implementation on Unix -Single Sign on

Module:2	Network Security	6 hours

VSecuring Network Transmission - Analyzing Security Requirements for Network Traffic -Defining Network Perimeters -Data Transmission Protection Protocols;

Module:3	Server Security	7 hours

Server Roles and Security Server Roles and Baselines - Securing Network Infrastructure Servers - DNS. DHCP, WINS, Remote Access Servers, NAT servers Securing Domain Controllers - Securing File and Print Servers -Securing Application Servers

Module:4	Application Security	6 hours

Web Browser Security - Email Security Firewall VPN - Transport Layer Security (TLS)Handshake Protocol Alert Message Protocol Chan

Module:5	Disaster Recovery and Fault Tolerance	6 hours
Planning for the Worst -Creating a Backup Strategy -Designing for Fault Tolerance Antivirus Software Antivirus Features Typical signature - ByteStreams Checksums - Custom Check- sums - Cryptographic Hashes Advanced Signatures - Fuzzy Hashing - Graph-Based Hashes for Executable Files		
Module:6	**Information Auditing, Forensics Security andAssurance**	**7 hours**
Managing Updates - Auditing and Logging - Secure Remote Administration - Intrusion Detec- tion - Detection and Prevention -Honeypots, Honeynets and Padded Cell Systems -Scanning and Analysis Tools - Biometric Access Controls Forensics -Incident Response Procedures		
Module:7	**Other Security(Optical Network Security RFID Security)**	**4 hours**
Introduction Protection in SONET/SDH (Synchronous Optical Network/Synchronous Digital Hierarchy) - Protection in IP Networks Optical Layer Protection Schemes RFID (Radio Frequency Identification Device) Architecture, Standards, Applications RFID Challenges RFID Protections		
Module:8	**RECENT TRENDS**	**2 hours**

	Total Lecture hours:	**45 hours**	

Text Book(s)

1.	Cole, Eric, Rachelle Reese, Ronald L. Krutz, and James Conley. Network Security Fundamentals.United Kingdom: Wiley, John Sons, 2008. (ISBN No.: 978-0-470-10192-6).
2.	Joshi, James, Bruce S. Davie, and Saurabh Bagchi. Network Security: Know It All. UnitedStates: Morgan Kaufmann Publishers In, 2008. (ISBN No.: 978-0-12-374463-0).

Reference Books

1.	Peltier, Thomas R. Information Security Fundamentals. 2nd ed. CRC Press. Boca Raton, FL:Auerbach Publications, 2014. (ISBN No.: 978-1-4398-1063-7) (R1)
2	Vacca, John R., ed. Network and System Security. United States: Syngress Media,U.S., 2010. (ISBN No. : 978-1-59749-535-6) (R2)
3	Vacca, John R. Computer and Information Security Handbook. 2nd ed. San Francisco, CA: Morgan Kaufmann Publishers In, 2013. (ISBN No.: 978-0- 12-394397-2)
4	Ciampa, Mark. Security+ Guide to Network Security Fundamentals. 4th ed. Boston, MA:Course Technology, Cengage Learning, 2011. (ISBN No. : 978-1-111-64012-5) Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
Mode of assessment:			
Recommended by Board of Studies	13.05.2016		
Approved by Academic Council	No. 41	Date	17.06.2016

CSE6003	WEB SERVICES	L	T	P	J	C
		2	0	2	0	3
Pre-requisite	**NIL**	**Syllabus version**				
		1.0				

Course Objectives:

1. To provide a basic conceptual understanding of web enterprise architectures.
2. To explore distributed remote communication.
3. To make understand the basic concepts of Service Oriented Architecture.
4. To explore XML, web services, web service security and its implementation.
5. To understand micro services and enterprise application patterns.

Expected Course Outcome:

1. To identify issues in web applications architecture
2. To apply distributed communication techniques
3. To apply Service oriented architecture to provide services to components using communication protocols
4. To build service oriented architecture for given application
5. To deploy, test and monitor micro services
6. To identify appropriate enterprise application patterns
7. To implement different web services architectures

Module:1	**Web Application Architecture**	**3hours**

Web Architecture: MVC, middleware - Design considerations, Issues in web application design: Security issues and interoperability issues (WS-I).

Module:2	**Distributed Remote Communication**	**6 hours**

RPC, Java RMI, message queuing, Data Serialization - MQTT, RabbitMQ, JMS- JSON - AVRO, Thrift, protocol buffer.

Module:3	**Service Oriented Architecture**	**3 hours**

Introducing SOA- SOA triangle, layered architecture of SOA, BPO - Business Process Outsourcing - Web service composition and coordination.

Module:4	**Building SOA**	**8hours**

Web service creation and accessing - WSDL, SOAP, UDDI, XINS, JSON-RPC, JSON-WSP, REST-full web services, mashup, SEMANTIC WEB Services - RDF, RDFS, OWL, SPARQL.

Module:5	**Microservices**	**5 hours**

Evolution, Modeling services, Integration, Deployment, Testing, Monitoring, Security. Implementation of micro services.

Module:6	**Enterprise Application Patterns**	**4hours**

Concurrency patterns, Session state patterns. Web service security – protocols.

Module: 7	**Recent Trends**	**1 hours**

	Total Lecture hours:	**30 hours**	

Reference Books

1. J.D.Meier,Alex Homer,"Web Application Architecture guide, Patterns and Practices",Microsoft 2008.
2. ThomasErl,"Service-OrientedArchitecture: Concepts,Technology,andDesign",PearsonEducation,2005.
3. AndrewS.Tenenbaum,MarteenVanSteen,"DistributedSystems,Principlesand Paradigms", Second Edition, Pearson, Prentice Hall,2007.
4. Sam Newman," Building Micro Services", O'Reilly,2015.
5. Martin Fowler, David Rice, Matthew Foemmel, Edward Hieatt, RobertMee,RandyStafford,"Patterns of Enterprise Application Architecture", AddisonWesley,2002.7.Sacha Krakowiak," Middleware Architecture with Patterns andFrameworks",2009
6. Leonard Richardson, Sam Ruby, "Restful Web Services", O'Reilly Media; First Editionedition (May 15, 2007)
7. Ben Smith," Beginning JSON", Apress,2015
8. Mark O' Neill ,"Web services security" , McGraw Hill,2003
9. KapilPant,"BusinessProcessOrchestrationforSOAusingBPMNandBPEL" ,Packt publishing,2008
10. GustavoAlonso,FabioCasati,HarumiKuno,VijayMachiraju,"WebServices-Concepts, Architectures and Applications", Springer Verlag,2004
11. Fensel, D., Facca, F.M., Simperl, E., Toma, I., "Semantic Web Services", Springer,2011

LeonShklar,RichardRosen,"WebApplicationArchitecture,Principles,Protocolsan d
Practices", John Wiley and Sons, 2003.

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

List of Challenging Experiments (Indicative)

1.	Creation of .NET web service and consumed by .NET client (console, windowand web)	2 Hours
2.	Creation of Java web service consumed by Java client.	2 Hours
3.	Interoperability in web services with java web service and .NET client.	2 Hours
4.	Interoperability in web services with .NET web service and java client	2 Hours
5.	Creation of RESTful web services.	2 Hours
6.	Consuming a real time web service.	2 Hours
7.	Creation and consuming	2 Hours
8.	Web service composition using BPEL.	4. Hours
9.	Web services with array methods.	2 Hours
10.	Web services with database connectivity methods.	2 Hours
11.	Application based on web service security.	2 Hours
12.	Creation of ontology.	4 Hours
13.	Application using SPARQL.	2 Hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: ***Project/Activity***			
Recommended by Board of Studies	**13.05.2016**		
Approved by Academic Council	**41**	**Date**	**17.06.2016**

CSE6005	MACHINE LEARNING	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	NIL	Syllabus version				
		1.0				

Course Objectives:

1. Acquire theoretical Knowledge on setting hypothesis for pattern recognition
2. Apply suitable machine learning techniques for data handling and to gain knowledge from it 3.Evaluate the performance of algorithms and to provide solution for various real-world applications

Expected Course Outcome:

1. Recognize the characteristics of Machine Learning techniques that enable to solve real world problems
2. Recognize the characteristics of machine learning strategies
3. Apply various supervised learning methods to appropriate problems
4. 4.Identify and integrate more than one techniques to enhance the performance of learning
5. Create probabilistic and unsupervised learning models for handling unknown pattern
6. Analyze the co-occurrence of data to find interesting frequent patterns

Module:1	INTRODUCTION TO MACHINE LEARNING	3 hours

Introduction, Examples of Various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces, PAC Learning, VC Dimension.

Module:2	Supervised Learning	9 hours

Decision Trees: ID3, Classification and Regression Trees, Regression: Linear Regression, Multiple Linear Regression, Logistic Regression, Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Non-Linear, Kernel Functions, K-Nearest Neighbours

Module:3	Ensemble Learning	3 hours

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

Module:4	Unsupervised Learning	5hours

Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional: K-means clustering, K-ModeClustering, Expectation Maximization, Gaussian Mixture Models

Module:5	Probabilistic Learning	3 hours

Bayesian Learning, Bayes Optimal Classifier, Naıve Bayes Classifier, Bayesian Belief Networks

Module:6	Learning Association Rules	3hours

Mining Frequent Patterns - basic concepts -Apriori algorithm, FP- Growth algorithm, Association-based Decision Trees

Module:7	Machine Learning in Practice	2 hours

Design, Analysis and Evaluation of Machine Learning Experiments, Other Issues: Handling imbalanced data sets

Module:8	Recent Trends in Big Data Analytics	2 hours
	Total Lecture hours:	**30 hours**

Text Book(s)

Reference Books

1. Ethem Alpaydin,"IntroductiontoMachineLearning",MITPress,PrenticeHallofIndia, Third Edition2014.
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of MachineLearning", MIT Press,2012.
3. Tom Mitchell, "Machine Learning", McGraw Hill, 3rdEdition,1997.
4. CharuC.Aggarwal,"DataClassificationAlgorithmsandApplications",CRCPress,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
7. Jiawei Hanand Micheline Kambers andJianPei,"DataMining Concepts andTechniques",3rd edition, Morgan Kaufman Publications, 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 Association Rule Mining using FP Growth	2 hours
11.	Classification based on association rules	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 neighbours algorithm	2 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: ***Project/Activity***

Recommended by Board of Studies	**13.05.2016**		
Approved by Academic Council	**41**	**Date**	**17.06.2016**

CSE6006	NOSQL Databases	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	**NIL**	**Syllabus version**				
		1.1				

Course Objectives:

1. Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems.
2. Understand the architectures and common features of the main types of NoSQL databases (key-value stores, document databases, column-family stores, graph databases)
3. Discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases.

Expected Course Outcome:

1. Explain the detailed architecture, Database properties and storage requirements
2. Differentiate and identify right database models for real time applications
3. Outline Keyvalue architecture and characteristics
4. Design Schema and implement CRUD operations, distributed data operations
5. Compare data ware housing schemas and implement various column store internals
6. Choose and implement Advanced columnar data model functions for the real time applications
7. Develop Application with Graph Data model

Module:1	**INTRODUCTION TO NOSQL CONCEPTS**	**4hours**

Data base revolutions: First generation, second generation, third generation, Managing Transactions and Data Integrity, ACID and BASE for reliable database transactions, Speeding performance by strategic use of RAM, SSD, and disk, Achieving horizontal scalability with database sharding, Brewers CAP theorem.

Module:2	**NOSQL DATA ARCHITECTURE PATTERNS**	**4 hours**

NoSQL Data model: Aggregate Models- Document Data Model- Key-Value Data Model- Columnar Data Model, Graph Based Data Model Graph Data Model, NoSQL system ways to handle big data problems, Moving Queries to data, not data to the query, hash rings to distribute the data on clusters, replication to scale reads, Database distributed queries to data nodes.

Module:3	**KEY VALUE DATA STORES**	**5 hours**

From array to key value databases, Essential features of key value Databases, Properties of keys, Characteristics of Values, Key-Value Database Data Modeling Terms, Key-Value

Architecture and implementation Terms, Designing Structured Values, Limitations of Key-Value Databases, Design Patterns for Key-Value Databases, Case Study: Key-Value Databases for Mobile Application Configuration

Module:4	**DOCUMENT ORIENTED DATABASE**	**4hours**

Document, Collection, Naming, CRUD operation, querying, indexing, Replication, Sharding, Consistency Implementation: Distributed consistency, Eventual Consistency, Capped Collection, Case studies: document oriented database: MongoDB and/or Cassandra

Module:5	**COLUMNAR DATA MODEL**	**4 hours**
Data warehousing schemas: Comparison of columnar and row-oriented storage, Column-store Architectures: C-Store and Vector-Wise, Column-store internals and, Inserts/updates/deletes, Indexing, Adaptive Indexing and Database Cracking.		
Module:6	**COLUMNAR DATA MODEL**	**3hours**
Advanced techniques: Vectorized Processing, Compression, Write penalty, Operating Directly on Compressed Data Late Materialization Joins , Group-by, Aggregation and Arithmetic Operations, Case Studies		
Module:7	**DATA MODELING WITH GRAPH**	**4 hours**
Comparison of Relational and Graph Modeling, Property Graph Model Graph Analytics: Link analysis algorithm- Web as a graph, Page Rank- Markov chain, page rank computation, Topic specific page rank (Page Ranking Computation techniques: iterative processing, Random walk distribution Querying Graphs: Introduction to Cypher, case study: Building a Graph Database Application- community detection		
Module:8	**Contemporary issues**	**1 hours**
	Total Lecture hours:	**30 hours**

Reference Books

1. An introduction to Information Retrieval, Christopher D.manning, Prabhakar Raghavan,Hinrich Schutze
2. TheDesignandImplementationofModernColumn-OrientedDatabaseSystems,Daniel Abadi Yale University
3. Next Generation database: NoSQL and big data by Guy Harrison

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

List of Challenging Experiments (Indicative)		
1.	Import the Hubway data into Neo4jandconfigureNeo4j. Then, answer the following questions using the Cypher Query Language: a) List top 10 stations with most outbound trips (Show station name andnumber of trips) b) List top 10 stations with most inbound trips (Show station name and number of trips) c) List top 5 routes with most trips (Show starting station name, ending station nameand number of trips) d) List the hour number(for example13 means1pm-2pm) and number of trips which start from the station ”B.U.Central” e) List the hour number(forexample13means1pm-2pm)and number of trips	3 hours

	which end at the station ”B.U. Central”	
2.	Download a zip code dataset at http://media.mongodb.org/zips.json .Use mongo import to import the zip code dataset into MongoDB. After importing the data, answer the following questions by using aggregation pipelines: (1) Find all the states that have a city called ”BOSTON”. Find all the states and cities whose names include the string ”BOST”. Each city has several zip codes. Find the city in each state with the mostnumber of zip codes and rank those cities along with the states using the city populations. MongoDB can query on spatial information.	3 hours
3.	Create a database that stores road cars. Cars have a manufacturer ,a type. Each car has a maximum performance and a maximum torque value. Do the following: Test Cassandras replication schema and consistency models.	3 hours
4.	Master Data Management using Neo4j Manage your master data more effectively The world of master data is changing. Data architects and application developers are swapping their relational databases with graph databases to store their master data. This switch enables them to use a data store optimized to discover new insights in existing data, provide a 360-degree view of master data and answer questions about data relationships in real time.	3 hours
5.	Shopping Mall case study using cassendra, where we have many customers ordering items from themal land we have suppliers who deliver them their ordered items.	3 hours
	Total Laboratory Hours	**30 hours**

Mode of assessment: ***Project/Activity***			
Recommended by Board of Studies	**13.05.2016**		
Approved by Academic Council	**41**	**Date**	**17.06.2016**

CSE6008	Distributed systems	L	T	P	J	C
		2	0	2	4	4
Pre-requisite		**Syllabus version**				
		1.0				

Course Objectives:

1. To learn the principles, architectures, algorithms and programming models used in distributed systems.
2. To examine state-of-the-art distributed systems, such as Google File System.
3. To design and implement sample distributed systems.

Expected Course Outcome:

1. Students will identify the core concepts of distributed systems: the way in which several machines orchestrate to correctly solve problems in an efficient, reliable and scalable way.
2. Students will examine how existing systems have applied the concepts of distributed systems in designing large systems, and will additionally apply these concepts to develop sample systems.

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

Overview of distributed system – examples of distributed systems: client -server architecture – WWW peer to peer – Napster –Bit torrent - mobile and ubiquitous computing –System Model : Physical model – architectural model – fundamental models

Module:2	**Inter process communication, Distributed objects and Remote invocation**	**5 hours**	

External data representation- marshalling – unmarshalling- Message passing- group communication:
Publish-subscribe system – message queues – shared memory approach. Remote procedure call – distributed objects-communication between distributed objects – RMI – JSON-RMI

Module:3	**Time-Global states:**	**4 hours**	

Process – Events- states – partial and total ordering – Synchronizing- physical clock synchronizat ion- Christians algorithm- Berkeley algorithm – NTP – logical clocks – scalar and vector clock – lamport logical clock for partial and total ordering – consistent cut – inconsistent cut – global states – lamport global snap shot algorithm.

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

Distributed deadlock – Resource allocation model - requirements and performance metrics - classification of distributed deadlock detect ion algorithm – Lamport - Haas- Misra Edge chasing distributed deadlock detection algorithm.

Module:5	**Coordination agreement**	**4 hours**	

Distributed Mutual exclusion – requirements and performance metrics of distributed mutual exclusion algorithm- Distributed mutual exclusion algorithm : token based –Raymond tree algorithm– quorum based : mekawa' svoting algorithm message based – Ricart Agrwala algorithm –Election – ring based election – bully elect ion algorithm – Multicast communication.

Module:6	**Distributed Transaction and Security**	**4 hours**	

Optimistic and pessimistic transactions -Two – phase commit protocol – three phase commit protocol – Transact ion recovery - Replication – fault tolerant services- the gossip architecture-

Module:7	**Name Services and Distributed File system**	**4 hours**	

Name services: DNS – Di rectory Services: X.500 protocol – Distributed file System –File service Architecture- NFS - GFS –Distributed locking mechanism- Distributed shared memory – Sequential and Release consistency

Module:8	**Recent Trends**	**2 hours**	
Case studies			
	Total Lecture hours:	**30 hours**	

Text Book(s)

1. Randy Chow and Theodore Johnson, "Distributed Operating Systems and Algorithms", Addison - Wesley, - Fourth Impression - 2012.

Reference Books

1. G. Coulouris, J. Dollimore , and T. Kindberg , "Distributed Systems : Concepts and Designs ", 5 th edition, Addison Wesley, 2011.
2. Mukesh singhal and N.G. Shivaratri , "Advanced Concept sin Operating Systems, Distributed, Database, and Multiprocessor Operating Systems ", 1st edition, McGraw Hill, 1994.
3. Vijay K. Garg, "Elements of Distributed Computing ", 1st edition, Wiley & Sons, 2002.

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

List of Challenging Experiments (Indicative)

1.	Lab experiments to be taught to the students using (environment) i) Simulate the algorithms on multiprocess ii) Algorithms can be implemented using Data cluster/compute cluster Realize the differences between various protocols a. Construct a reliable point-to-point basic file transfer tool using UDP/IP. b. Construct a reliable multicast tool using UDP/IP. The reliable multicast will assume no network partitions or processor crashes, but it WILL handle all kinds of message omissions over a local area network.	3 hours
2.	Design an application using RMI for distributed computation. Also, Idealize with an illustration, the marshaling and remarshaling of data in distributed applications.	3 hours
3.	Illustrate the message passing Interface for remote computation in distributed applications.	3 hours
4.	Design a socket programming for client server communication. An integer should be passed from client to server and the server should returns the factorial value back. Use RPC to implement the scenario.	3 hours
5.	Design a distributed application which consist of a Agent program that program travels in the network and performs a given task on the targeted node. You may assign any task to the agent for example to carry out a file reading/processing at the remote machine and so on.	2 hours
6.	Implementation of distributed deadlock detection algorithm.	2 hours

7.	Idealize the working concepts behind distributed mutual exclusion algorithms through simulations.	1 hour
8.	Global snapshot –Lamport - Chandy algorithm – implementation.	3 hours
9.	Token ring election algorithm	2 hours
10.	Bully election algorithm	2 hours
11.	Design a web serive using SOAP and XML	2 hours
12.	Sample application on CORBA	2 hours
13.	Implementation of shared memory concept	2 hours
	Total Laboratory Hours	30 hours

Mode of evaluation:			
Recommended by Board of Studies	13.05.2016		
Approved by Academic Council	No. 41	Date	17-06-2016

CSE6009	IOT TECHNOLOGY AND APPLICATIONS	L	T	P	J	C
		2	0	2	4	4
Pre-requisite	**NIL**			**Syllabus version**		
				1.0		

Course Objectives:

1.Introduction to fundamentals of IoT

2.Application of IoT in various domain

3.Hardware and software that enable IoT

4.Upload data on cloud for further analysis and visualisation

5.Access the IoT data from cloud using mobile computing devices.

6.Learn to use of tools such as Apache servers, WebAPI,

7.Design product for automation various domain such as for Home, Industry.

Expected Course Outcome:

1. Describe the technology that enables IoT.
2. Describe Hardware and software required to design and build IoT 3.Interface with sensors and actuators and other IoT devices
4. Set up the servers to upload IoT data to cloud for further analysis
5. Design and Develop program mobile computing device to access IoT data from cloud and to interact with devices.

Module:1	**Introduction to IoT**	**3hours**

Things in IoT, IoT protocols, IoT communication model, IoT communication APIs, IoT enabling Technologies

Module:2	**Application of IoT**	**4 hours**

Home, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health, Life style, M2M Machine to Machine, Difference between IoT and M2M. Industry 4.0 concepts - cyber physical system, Security aspects in IoT

Module:3	**IOT Supported hardware**	**5 hours**

Introduction to wireless sensor network, RFID, Sensors, Overview of IoT supported Hardware platforms (Any two hardware can be handled) Raspberry pi, Arduino and Intel Galileo boards, Beaglebone, ARM Cortex Processors

Module:4	**Communication in IOT**	**7hours**

Interface protocol , Serial, SPI, I2C, 6LoWPAN, 802.11wifi, 802.15 Bluetooth, 802.15.4 Zigbee, RTLS, GPS, CoAp Constrained application protocol, RPL routing protocol for lossy networks.

Module:5	**IOT Software development**	**5 hours**

Linux, Networking configurations in Linux, Accessing Hardware Device Files interactions, Python packages: JSON, XML, HTTPLib, URLLib, SMTPLib, XMPP, Contiki OS,

Module:6	**IoT Physical Servers and Cloud Offerings**	**3hours**

Introduction to Cloud Storage Models and Communication APIs, PHP and MySQL for data processing ,WAMP, Python Web Application Framework , Designing a RESTful Web API, MQTT, Amazon Web Services for IoT (Any three topics can be covered)			
Module:7	**Application Development for mobile Platforms**		**3hours**
Overview of Android, IOS App Development tools, CSS and jQuery for UI Designing			
Module:8	**Recent Trends**		**2 hours**
	Total Lecture hours:	**30 hours**	
Reference Books			
	1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on Approach, UniversityPress, 2015 (1 stedition) 2. AdrianMcEwenHakimCassimally,DesigningtheInternetofThings,Wiley,Nov2013,(1st edition) 3. ClaireRowland,ElizabethGoodman,MartinCharlier,AnnLight,AlgredLui,Designing ConnectedProducts:UXfortheconsumerinternetofthings,OReilly,(1stedition),2015		
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar			
List of Challenging Experiments (Indicative)			
1.	Connect Arduino board and glow LED, Read analog and digital sensors suchas relay, temperature, Humidity.		1 hours
2.	Load the OS in Raspberry pi		3 hours
3.	Interface with Bluetooth and transmit sensor data to other node		3 hours
4.	Interface with Zigbee and transmit sensor data to other node		3 hours
5.	Interface with 6LoWPAN and transmit sensor data to other node		3 hours
6.	Store sensor data in cloud		2 hours
7.	Mobile app to display cloud data		3 hours
8.	Measure the light intensity in the room and output data to the web API		2 hours
9.	Control your home power outlet from any where using raspberry pi, zigbeeand arduino		2 hours
10.	Build a web based application to automate door that unlocks itself usingfacial recognition		2 hours
11.	Conference room occupancy using Pi and Azure to send data to iOS/ Android		2 hours
12.	Internet of Trees Soil Saturation Monitor Using Particle, Azure, and Power Bi		2 hours
13.	Drinking water monitoring and analytics, consists of IoT device, cloud, andmobile and web app		3 hours
		Total Laboratory Hours	**30 hours**
Mode of assessment: ***Project/Activity***			

Recommended by Board of Studies	**13.05.2016**		
Approved by Academic Council	**41**	**Date**	**17.06.2016**

CSE6010	Cloud Application Development and Management	L	T	P	J	C
		2	0	2	4	4
Pre-requisite		Syllabus version				
		1.0				

Course Objectives:

1. To enable student to develop and launch applications in the cloud Environment.
2. To understand the various frameworks and APIs that can be used for developing cloud based applications.
3. To use Cloud application management and management tools are used to analyze digital service ecosystems and digital product life-cycles.

Expected Course Outcome:

1. Design, Develop & Deploy real-world applications in the cloud computing platforms they have learnt.
2. Demonstrate the ability to access the various cloud platforms used.
3. Describe the standardization process of cloud platform and various API's
4. Describe the methods for managing the data in cloud and demonstrate the concepts of automation, provisioning using puppet tool.
5. Develop Applications in the cloud platform
6. Analyze and use of an appropriate framework and APIs for the task
7. Design dashboards for management across cloud based service

Module:1	Basic concepts & techniques	4 hours

Business case for implementing cloud application, Requirements collection for cloud application development, Cloud service models and deployment models, Open challenges in Cloud Computing: Cloud interoperability and standards, scalability and fault tolerance, security, trust and privacy.

Module:2	Application development framework	6 hours

Accessing the clouds: Web application vs Cloud Application, Frameworks: Model View Controller (MVC), Struts, Spring. Cloud platforms in Industry – Google AppEngine, Microsoft Azure, Openshift, CloudFoundry

Module:3	Cloud service delivery environment and API	5 hours

Storing objects in the Cloud, Session management, Working with third party APIs: Overview of interconnectivity in Cloud ecosystems. Facebook API, Twitter API, Google API.

Module:4	Cloud applications	6 hours

Best practices in architecture cloud applications in AWS cloud, Amazon Simple Queue Service (SQS), RabbitMQ, Amazon Simple Notification Service (Amazon SNS), multi-player online game hosting on cloud resources, Building content delivery networks using clouds

Module:5	Managing the data in cloud	4 hours

Securing data in the cloud, ACL, OAuth, OpenID, XACML, securing data for transport in the cloud, scalability of applications and cloud services.

Module:6	**Automation and provisioning tool**	**4 hours**
Puppet and Chef – steps for automation: Introduction, files and packages, services and subscriptions, exec and notify, facts, conditional statements and logging.		
Module:7	**Recent Trends**	**1 hours**
Module content		
	Total Lecture hours:	**30hours**

Text Book(s)

One or two books published after 2010 (preferably after 2015) to be given (please give complete bibliography)
Authors, book title, year of publication, edition number, press, place

Reference Books

Rajkumar buyya, Christian vecchiola, S Thamarai Selvi , "Mastering cloud computing", Tata McGraw Hill Education Private Limited, 2013
Anthony T .Velte, Toby J. Velte, Robert Elsenpeter, "Cloud Computing a Practical Approach", Tata McGraw-HILL, 2010 Edition.
Barrie sosinsky, "Cloud computing bible, Wiley publishing
James Loope, "Managing Infrastructure with puppet", O'REILLY , June 2011
https://cloud.google.com/appengine/docs
https://www.chef.io/solutions/cloud-management/
https://aws.amazon.com/documentation
https://dev.twitter.com/overview/documentation
https://developers.facebook.com/
https://www.cloudfoundry.org/
https://puppet.com/blog/implement-a-message-queue-your-cloud-applicati

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

List of Challenging Experiments (Indicative)

1.	**Software / API / Tools** JDK 1.7/1.8, Eclipse IDE, Dropbox API, Apache tomcat server 7.0/8.0, Google AppEngine API, Servlets, Struts, Spring framework. Design and Development of Web applications using MVC Framework.	2 hours
2.	Installing and Configuring required platform for Google App Engine	2 hours
3.	Studying the feature of GAE PaaS model.	2 hours
4.	Creating and running Web applications (Guest book, MVC) on local host and deploying the same in Google App Engine	2 hours
5.	Design and Development of Web applications using Struts.	2 hours
6.	Design and Development of Web applications using Spring framework.	2 hours
7.	Developing an ASP.NET based web application on Azure platform	2 hours
8.	Creating an application in Dropbox to store data securely. Develop a source code using Dropbox API for updating and retrieving files.	2 hours
9	Installing Cloud Foundry in a local host and exploring CF commands.	2 hours
10	Cloud application development using IBM Bluemix Cloud.	2 hours
11	Installing and Configuring Dockers in local host and running multiple images on a Docker Platform.	2 hours
12	Configuring and deploying VMs/Dockers using Chef/Puppet automation tool.	2 hours
	Total Laboratory Hours	**30 hours**

Mode of evaluation:			
Recommended by Board of Studies	**13-05-2016**		
Approved by Academic Council	**No. 41**	**Date**	**17-06-2016**

CSE6012	Image Processing and Analysis	L	T	P	J	C
		3	0	0	4	4
Pre-requisite		**Syllabus version**				
		1.0				

Course Objectives:

1. To impart knowledge on the basic principles and concepts in digital image processing.
2. To explore the application of image analysis towards image interpretation.

Expected Course Outcome:

1. Apply principles and techniques of digital image processing in applications related to imaging system
2. Acquire an appreciation for the image processing issues and techniques and be able to apply these techniques to real world problems.
3. Be able to conduct independent study and analysis of image processing problems and techniques
4. Get broad exposure to and understanding of various applications of image processing in industry, medicine and defence

Module:1	Introduction	10 hours	

Image Basics Basic steps of Image processing system – Pixel relationship- Image Transforms-. Image Enhancement- Spatial filtering, Frequency Domain filtering – Image Segmentation – Image Compression

Module:2	Feature Extraction	7 hours	

Binary object feature - Area, Centroid, Axis of Least Second Moment, Projections, Euler Number, Thinness Ratio, Eccentricity, Aspect Ratio, Moments, Boundary Descriptors - Chain Code, Freeman Code, and Shape Number, Signatures, Fourier Descriptors. Histogram-based (Statistical) Features, Intensity features- Hough transforms

Module:3	Texture Analysis	7 hours	

Concepts and classification, statistical, structural and spectral analysis, Co-occurrence matrices - Edge frequency - Multiscale texture description - wavelet domain approaches, Texture categorization and Texture segmentation.

Colour Image Processing – Gray Level to Color Transformations Histogram Processing- Color Image Smoothing and Sharpening Color Noise Reduction Color-Based Image Segmentation Color Edge Detection

Module:4	Object Recognition	5 hours	

Patterns and pattern class, Bayes' Parametric classification, Feature Selection and Boosting, Template-Matching – based object recognition, Scene and Object Discrimination, Object Modelling, Model based object recognition

Module:5	Digital video processing techniques	6 hours	

Fundamentals of Motion Estimation and Motion Compensation General Methodologies in Motion Estimation - Motion Representation, Motion Estimation Criteria, Optimization Methods. Motion Estimation Algorithms - Exhaustive Search Block Matching Algorithm, Fast Algorithms, Hierarchical Block Matching Algorithm, Phase Correlation Method.

Module:6	**Video Enhancement and Applications**	**4 hours**	
Video Enhancement and Noise Reduction- Noise Reduction in Video, Interframe Filtering Techniques – Remote Sensing – Surveillance- Microscopy- Robotics			
Module:7	**Content Based Image Retrieval**	**4 hours**	
The Semantic Gap-Representation and Indexing -Similarity and Search – SVM, SVD, Contourlet Transform, Exact Legendre Moments (ELMs) - Interaction and Learning			
Module:8	**RECENT TRENDS**	**2 hours**	
	Total Lecture hours:	**45 hours**	

Text Book(s)	
1.	One or two books published after 2010 (preferably after 2015) to be given (please give complete bibliography) Authors, book title, year of publication, edition number, press, place
Reference Books	
1.	Oge Marques, "Practical Image and Video Processing Using MATLAB", Wiley-IEEE Press,2011
2.	Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Ed., Prentice-Hall, 2008.
3.	Yu Jin Zhang, "Image Engineering: Processing, Analysis and Understanding", Tsinghua University Press, 2009
4.	Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012
5.	Boguslaw Cyganek,"Object Detection and Recognition in Digital Images: Theory and Practice",Wiley, 2013 Chanamallu Srinivasa Rao, Samayamantula Srinivas Kumar, "Content Based Image Retrieval
6.	Fundamentals & Algorithms - Basics, Concepts, and Novel Algorithms", Lap Lambert Academic Publishing, 2012
	Authors, book title, year of publication, edition number, press, place
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	

List of Challenging Experiments (Indicative)		
1.	Projects may be given as group projects Sample projects that can be given to students to be implemented using MATLAB/OpenCV/Python/Octave/C/Java etc: 1. Image enhancement applications	hours
2.	Object/image recognition applications based on digital image transforms	hours
3.	Digital image restoration applications	hours
4.	Quantitative and structural image analysis applications based on binary and grey scale morphology.	hours
5.	Region based image segmentation.	hours
6.	Image analysis systems for visual inspection tasks (object recognition)	
7.	Image compression	
8.	Image Steganography	
9.	Applications of Image Intelligence in: a. Medicine - such as detecting cancer in a mammography scan. b. Microscopy - such as counting the germs in a swab. c. Remote sensing - such as detecting intruders in a house, and producing land cover/land use maps.	

	d. Astronomy- such as calculating the size of a planet. e. Materials science - such as determining if a metal weld has cracks. f. Machine vision - such as to automatically count items in a factory conveyor belt. g. Security - such as detecting a person's eye colour or hair colour. h. Robotics - such as to avoid steering into an obstacle. i. Optical character recognition - such as automatic license plate detection. j. Metallography - such as determining the mineral content of a rock sample. k. Defence – Surveillance **Links for image database:** http://homepages.inf.ed.ac.uk/rbf/CVonline/Imagedbase.htm https://www.cs.cmu.edu/~cil/v-images.html http://www.imageprocessingplace.com/root_files_V3/image_data bases.htm	
	Total Laboratory Hours	**hours**

Mode of evaluation:			
Recommended by Board of Studies	**13-05-2016**		
Approved by Academic Council	**No. 41**	**Date**	**17-06-2016**

CSE6013	Advanced Software Testing	L	T	P	J	C
		2	0	2	4	4
Pre-requisite		**Syllabus version**				
		1.0				

Course Objectives:

1. To learn the fundamentals of software Testing and principles.
2. To evaluate the essentials of Software Engineering concepts – Requirements, Modelling and validation
3. To apply software Testing principles across cross-disciplines

Expected Course Outcome:

1. Emphasis the understanding of software testing process, planning, strategy, criteria, and testing methods, as well as software quality assurance concepts & control process.
2. Work on various test models, test design techniques, integration, regression, and system

Module:1	BASIC CONCEPTS IN SOFTWARE TESTING	4 hours

Overview of Testing Techniques–Creating Test Plans and Test Cases – Test Scenarios – Test Data – Test Scripts, Test Requirements Specification and gathering – Creating TRS and Test Procedure

Module:2	SOFTWARE TEST PLAN AND MANAGEMENT	6 hours

Pre-Planning Activities: Success Criteria/Acceptance Criteria, Test Objectives, Assumptions, Entrance Criteria/Exit Criteria
Test Planning: Test Plan, Requirements/Traceability, Estimating, Scheduling, Staffing, Approach, Test Check Procedures
Post-Planning Activities: Change Management, Versioning (change control/change management / configuration management)
Software Test Management : Risk and Testing - Test Organization – Test progress monitoring and control

Module:3	SOFTWARE TESTING AND STRATEGIES	3 hours

Functional Testing: Automated Unit Testing – Test Plan & Scripts – Creating Automated Test Procedures and Reports – Integration Testing – Order of Integration – Creating & Maintaining Tested Databases- Test Metrics Non-Functional Testing : Performance Testing – Load Testing – Endurance Testing – Scalability Testing –Internationalization Testing– Performance Analysis and Reporting

Module:4	Full-Lifecycle Object-Oriented Testing (FLOOT) :	3 hours

Developing Test Cases in Object-oriented Testing - Object-oriented Testing Methods: Fault-based Testing, Scenario based Testing - Challenges and

Module:5	SOFTWARE TESTING ENVIRONMENT	3 hours

Creating an environment supportive of software testing – Building Software Testing Process – Selecting and Installing Software Testing Tools – Building Software Tester Competency

Module:6	TOOLS AND ITS APPLICATION IN SPECIFIC TESTINGS	6 hours

Automated Testing Tools – Functional Testing - Rational Functional Tester – Selenium – Cucumber - JUnit, Performance Testing Tools - Rational Performance Tester – HP Load Runner, Test Management Tools - Quality Center, Performance Center Reports and Control Issues – Types of Review – Component of Review Plans – Reporting Review Results – Evaluation of Software Quality		
Module:7	**ADVANCED CONCEPTS IN SOFTWARE TESTING**	**5 hours**
Test Process Optimization, Empirical Software Testing and Analysis, Mobile Testing, SOA Testing , Data Warehouse Testing, Cloud Testing, BigData Testing, WebApps Testing, IoT Testing		
Module:8	**Emerging Trends**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)

1.	One or two books published after 2010 (preferably after 2015) to be given (please give complete bibliography) Authors, book title, year of publication, edition number, press, place

Reference Books

1.	Srinivasan Desikan, Gopalaswamy Ramesh "Software Testing – Principles and practices ",Pearson Education, 2006
2.	Nick Jenkins "A Software Testing Primer – An Introduction to Software Testing" 2008.
3	Scott W. Ambler "The Object Primer: Agile Model-Driven Development with UML 2.0" Third Edition, Cambridge University Press, March 2010.
4.	"Software Testing – An ISTQB-BCS Certified Tester Foundation Guide", Third Edition,BCS,2015

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

List of Challenging Experiments (Indicative)

1.	Understanding the Architecture of Web Applications - Test Requirements Gatherings and Specifications	2 hours
2.	Creating Test Plans, Test Cases, Test Scenarios and Test Data	2 hours
3.	Preparing Test Environment – Requirements, Design Coding, Datapool, Verification Points	2 hours
4.	Unit Testing with JUnit, Interface Testing with Rational Functional Tester	2 hours
5.	Functional Testing with Rational Functional Tester	2 hours
6.	Web Application Testing with Selenium	2 hours
7.	Schedules, Scenarios, Virtual User Environment in Rational Performance Tester	2 hours
8.	Load Testing, Stress Testing with Rational Performance Tester,	2 hours
9.	Endurance, Volume Testing with Load Runner	2 hours
10	Web Service Testing with SoapUI	2 hours
11	Testing as a service in cloud	2 hours
12	Cloud Testing	2 hours
13	Big Data Testing	2 hours
14	Coverage analysis	2 hours
15	Assertions	2 hours
	Total Laboratory Hours	**30 hours**

Mode of evaluation:			
Recommended by Board of Studies	**13-05-2016**		
Approved by Academic Council	**No. 41**	**Date**	**17-06-2017**

CSE6015	Mobile Application and Development	L	T	P	J	C
		2	0	0	4	3
Pre-requisite					**Syllabus version**	
					1.0	

Course Objectives:

1. This Course provides a comprehensive overview of how to integrate mobile technology. This course focuses on developing multiplatform mobile applications using the Web skills.
2. The hybrid application framework to develop and target multiple mobile platforms with a single codebase.
3. The Ionic framework is one of fastest growing mobile application framework

Expected Course Outcome:

1. Get exposed to technology and business trends impacting mobile applications
2. Able to build mobile applications targeting multiple platforms with a single codebase
3. Able to explore features of the Ionic framework to build hybrid mobile applications

Module:1	**Introduction to Mobile Devices**	**4 hours**
Introduction-Mobile vs. Desktop devices -App Store, Google Play, Windows Store -Development environments-PhoneGAP- Native vs. web applications – Mobile Connectivity Evolution		
Module:2	**Hybrid Mobile App Development Frameworks:**	**4 hours**
Introduction to CSS3.HTML5-Full-Stack Web Development: -Hybrid Mobile App Development: Ionic and AngularJS, node.JS- Task scheduling, Middleware-Energy aware resource allocation.		
Module:3	**Mobile OS Architecture**	**3 hours**
Mobile architectures: Android, iOS and Windows-Underlying OS (Darwin vs. Linux vs. Win 8) - Kernel structure and native level programming –Runtime More Ionic CSS and JavaScript		
Module:4	**Ionic Forms and Modals-Ionic Lists:**	**3 hours**
Advanced Features-Popups, Popovers, Action Sheets, Loading and Gestures		
Module:5	**APP deployment:**	**5 hours**
Angular ui-router and Resolve-Using Local Storage(Sqlite,iosDB,)-Databases- mongoDB ,MySQL-Ionic Adding Platforms-Building and Deploying the App- Hybrid Mobile Development and IBM BlueMix		
Module:6	**Accessing Native Capabilities of Devices**	**4 hours**
Resource sharing-Loud speakers, Microphones-Image Sensors, Displays- (Augmented Reality(AR) -Web and AR-User interface-Mobile A Revaluation of A R-standardization-GPS-Accelerometer - Camera –Mobile malware -Device protections)-Cordova and ngCordova, Camera Plugin Mobile Security -Mobile app vulnerability detection and security Mobile threat landscape- advanced threats		
Module:7	**Security issues**	**5 hours**
Different level of security, Security issues- - Mobile security solution targeted attacks-mobile malware –device protection		
Module:8	**Recent Trends**	**2 hours**
	Total Lecture hours:	**30 hours**

Text Book(s)				
1.	One or two books published after 2010 (preferably after 2015) to be given (please give complete bibliography) Authors, book title, year of publication, edition number, press, place			
Reference Books				
1. 2. 3. 4. 5.	Brian Fling, "Mobile Design and Development" O'Reilly Media,2009 Maximiliano Firtman "Programming the Mobile Web" , O'Reilly Media, 2010. Valentino Lee, Heather Schneider, and Robbie Schell, "Mobile Applications: Architecture, Design, and Development",PrenticeHall,2004 Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, "Android SDK3 for Dummies",Wiley 2011 Christian Crumlish and Erin Malone Designing Social Interfaces, O'Reilly Media , 2009			
	Authors, book title, year of publication, edition number, press, place			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
List of Challenging Experiments (Indicative)				
1.	Vehicle Tracking Using Driver Mobile Gps Tracking			
2.	Android Employee Tracker			
3.	Develop a MIDlet that has a Text Field and Label GUI components.			
4.	Missing Letter Game			
	Total Laboratory Hours			
Mode of evaluation:				
Recommended by Board of Studies	**13-05-2016**			
Approved by Academic Council	**No. 41**	**Date**	**17-06-2016**	

CSE6053	WIRELESS SENSOR NETWORKS	L	T	P	J	C
		2	0	0	4	3
Pre-requisite	Nil	**Syllabus version**				
		1.0				

Course Objectives:

1. To introduce the characteristics, basic concepts and systems issues in Wireless sensor networks.
2. To illustrate architecture and protocols in wireless sensor networks.
3. To identify the trends and latest development of the technologies in the area.
4. To provide a broad coverage of challenges and latest research results related to the design and management of wireless sensor networks.

Expected Course Outcome:

1. Architect sensor networks for various applications and explore wireless transmission technology and systems.
2. Determine suitable medium access protocols, localization techniques and routing protocols.
3. Identify suitable energy conservation mechanism for wsn.
4. Interpret the suitable OS for wsn.
5. Illustrate various platform and tools for wsn.
6. Design new solution for real world wsn problems.

Module:1	**Introduction to Wireless Sensor Networks**	**4 hours**

Introduction, Applications of Wireless Sensor Networks, WSN Standards, IEEE 802.15.4, Zigbee. Network Architectures and Protocol Stack – Network architectures for WSN, classification of WSN, protocol stack for WSN.

Module:2	**Wireless Transmission Technology and Systems**	**4 hours**

Wireless Transmission Technology and Systems – Radio Technology, Available Wireless Technologies.
Wireless Sensor Technology - Sensor Node Technology, Hardware and Software, Sensor Taxonomy, WN Operating Environment

Module:3	**Medium Access Control Protocols for Wireless Sensor Networks**	**5 hours**

Fundamentals of MAC Protocols, MAC Protocols for WSNs, Contention-Based protocols: Power Aware Multi-Access with Signaling - Data-Gathering MAC, Contention-Free Protocols: Low-Energy Adaptive Clustering Hierarchy, B-MAC, S-MAC. Dissemination Protocol for Large Sensor Network.

Module:4	**Deployment and Configuration**	**6 hours**

Target tracking, Localization and Positioning, Coverage and Connectivity, Single-hop and Multi-hop Localization, Self-Configuring Localization Systems.
Routing Protocols and Data Management for Wireless Sensor Networks - Routing Challenges and Design Issues in Wireless Sensor Networks, Routing Strategies in Wireless Sensor Networks, Routing protocols: data centric, hierarchical, location based energy efficient routing etc. Querying, Data Dissemination and Gathering.

Module:5	**Energy Efficiency and Power control**	**3 hours**

Need for energy efficiency and power control in WSN, passive power conservation mechanisms, active power conservation mechanisms

Module:6	**Operating Systems For Wireless Sensor Networks**	**3 hours**

Operating System Design Issues, TinyOS, Contiki – Task management, Protothreads, Memory and IO management			
Module:7	**Sensor Network Platforms And Tools**		**3 hours**
Sensor Node Hardware – Tmote, Micaz, Programming Challenges, Node-level Software Platforms, Node-level Simulators, State-centric Programming.			
Module:8	**Recent trends**		**2 hours**
	Total Lecture hours:	**30 hours**	

Text Book(s)	
Reference Books	
1.	Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks, Technology, Protocols and Applications", Wiley, 2007
2.	Holger Karl, Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
3.	Jun Zheng, Abbas Jamalipour, "Wireless Sensor Networks: A Networking Perspective", Wiley, 2009.
4.	Ian F. Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks", Wiley, 2010
5.	Ibrahiem M. M. El Emary, S. Ramakrishnan, "Wireless Sensor Networks: From Theory to Applications", CRC Press Taylor & Francis Group, 2013
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar	
Mode of assessment:	

Recommended by Board of Studies	**13-05-2016**		
Approved by Academic Council	**41**	**Date**	**17-06-2016**

MAT5002	Mathematics for Computer Engineering	L	T	P	J	C
		3	0	0	0	3
Pre-requisite	**Nil**	**Syllabus version**				
		1.0				

Course Objectives:

The course is aimed at
1. Enhancing the basic understanding of Application of Mathematics in Computer Science.
2. Imparting design thinking capability in logical systems
3. Developing design skills of models for Random and Non-deterministic problems

Expected Course Outcome:

At the end of the course the student should be able to
1. Apply Logics in system design
2. Apply Linear Algebra in Image processing
3. Apply Number theory in Cryptography
4. Use Probability, Statistics to analyse Big-data
5. Apply sampling theory and queuing models in engineering problems

Module:1	Proof Techniques	6hours

Implications, equivalences, converse, inverse, contrapositive, negation, contradiction, structure, direct proofs, disproofs, natural number induction, structural induction,
weak/string induction, recursion, well orderings

Module:2	Linear algebra:	6 hours

Eigenvalues and eigenvectors-Gerschgorin Circles– Rutishauser method, Rotation and Reflection matrices- Face Recognition application.

Module:3	Number Theory	6hours

Divisibility -division algorithm -Euclidean algorithm- Definitions and basic properties of congruences - Solving linear congruences and quadratic congruences, Applications of congruences: The Chinese remainder theorem, Euler's theorem and Fermat's little theorem- Primarily checking

Module:4	Probability	6hours

Introduction to random variable -Binomial and Poisson distributions – Normal distribution, Weibull, exponential and Gamma distributions Performance modeling
application

Module:5	Statistical Measures	6hours

Correlation and regression- Covariance– partial and multiple correlation- multiple regression – Time Series data Analysis application.

Module:6	Sampling Theory	8hours

small sample tests- student's t –test ,F-test, chi-square test, goodness of fit , independence of attributes, Basic principles of experimentation, Analysis of variance –

application using Monte-Carlo methods and decision trees

Module:7	**Queuing Theory**	**5hours**
Introduction-Markov Process-Poisson Process-Pure Berth Process-Death Process-Birth-death processes- Queue notation-Little's theorem-Queuing models M/M/1; M/M/c; M/M/∞		
Module:8	**Expert Lecture**	**2hours**
Modular arithmetic-Applications to cryptosystem		
	Total Lecture hours:	**45 hours**

Text Book(s)

Reference Books

1. Neal Koblitz, A course in number theory and cryptography, Springer reprint (2002).
2. J. P. Tremblay and R Manohar Discrete Mathematical Structures with applications to Computer Science, Tata McGraw Hill (2001).
3. Ronald E. Walpole , Raymond H. Myers Sharon L. Myers Keying E. Ye, Probability and Statistics for Engineers and Scientists (9^{th} Edition),
4. H. A .Taha Operations Research, 9^{th} Edition, PHI (2010).
5. Narasingh Deo, Graph Theory, PHI, 23^{rd} Indian reprint (2002).

Mode of assessment:			
Recommended by Board of Studies	**09-03-2016**		
Approved by Academic Council	**No. 40**	**Date**	

SET5001	SCIENCE, ENGINEERING AND TECHNOLOGY PROJECT– I	L	T	P	J	C
						2
Pre-requisite		**Syllabus Version**				
Anti-requisite		1.0				

Course Objectives:

1. To provide opportunity to involve in research related to science / engineering
2. To inculcate research culture
3. To enhance the rational and innovative thinking capabilities

Expected Course Outcome:

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

1. Identify problems that have relevance to societal / industrial needs
2. Exhibit independent thinking and analysis skills
3. Demonstrate the application of relevant science / engineering principles

Modalities / Requirements

1. Individual or group projects can be taken up
2. Involve in literature survey in the chosen field
3. Use Science/Engineering principles to solve identified issues
4. Adopt relevant and well-defined / innovative methodologies to fulfill the specified objective
5. Submission of scientific report in a specified format (after plagiarism check)

Student Assessment : Periodical reviews, oral/poster presentation

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

SET5002	SCIENCE, ENGINEERING AND TECHNOLOGY PROJECT– II	L	T	P	J	C
						2
Pre-requisite		**Syllabus Version**				
Anti-requisite		1.0				

Course Objectives:

1. To provide opportunity to involve in research related to science / engineering
2. To inculcate research culture
3. To enhance the rational and innovative thinking capabilities

Expected Course Outcome:

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

4. Identify problems that have relevance to societal / industrial needs
5. Exhibit independent thinking and analysis skills
6. Demonstrate the application of relevant science / engineering principles

Modalities / Requirements

6. Individual or group projects can be taken up
7. Involve in literature survey in the chosen field
8. Use Science/Engineering principles to solve identified issues
9. Adopt relevant and well-defined / innovative methodologies to fulfill the specified objective
10. Submission of scientific report in a specified format (after plagiarism check)

Student Assessment : Periodical reviews, oral/poster presentation

Recommended by Board of Studies	17-08-2017		
Approved by Academic Council	No. 47	Date	05-10-2017

ENG5001	Fundamentals of Communication Skills	L	T	P	J	C
		0	0	2	0	1
Pre-requisite	Not cleared EPT (English Proficiency Test)	**Syllabus version**				
		1.0				

Course Objectives:

1. To enable learners learn basic communication skills - Listening, Speaking, Reading and Writing
2. To help learners apply effective communication in social and academic context
3. To make students comprehend complex English language through listening and reading

Expected Course Outcome:

1. Enhance the listening and comprehension skills of the learners
2. Acquire speaking skills to express their thoughts freely and fluently
3. Learn strategies for effective reading
4. Write grammatically correct sentences in general and academic writing
5. Develop technical writing skills like writing instructions, transcoding etc.,

Module:1	Listening	**8 hours**

Understanding Conversation
Listening to Speeches
Listening for Specific Information

Module:2	Speaking	**4 hours**

Exchanging Information
Describing Activities, Events and Quantity

Module:3	Reading	**6 hours**

Identifying Information
Inferring Meaning
Interpreting text

Module:4	Writing: Sentence	**8hours**

Basic Sentence Structure
Connectives
Transformation of Sentences
Synthesis of Sentences

Module:5	Writing: Discourse	**4hours**

Instructions
Paragraph
Transcoding

	Total Lecture hours:	**30 hours**

Text Book(s)

1. Redston, Chris, Theresa Clementson, and Gillie Cunningham. *Face2face Upper Intermediate Student's Book.* 2013, Cambridge University Press.

Reference Books

1. Chris Juzwiak .*Stepping Stones: A guided approach to writing sentences and Paragraphs (Second Edition)*, 2012, Library of Congress.
2. Clifford A Whitcomb & Leslie E Whitcomb, *Effective Interpersonal and Team Communication Skills for Engineers*, 2013, John Wiley & Sons, Inc., Hoboken: New Jersey.
3. ArunPatil, Henk Eijkman &Ena Bhattacharya, *New Media Communication Skills for Engineers and IT Professionals,*2012, IGI Global, Hershey PA.
4. Judi Brownell, *Listening: Attitudes, Principles and Skills*, 2016, 5th Edition, Routledge:USA
5. John Langan, Ten Steps to Improving College Reading Skills, 2014, 6th Edition, Townsend Press:USA

6.	Redston, Chris, Theresa Clementson, and Gillie Cunningham. *Face2face Upper Intermediate Teacher's Book*. 2013, Cambridge University Press.	
	Authors, book title, year of publication, edition number, press, place	
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar		
List of Challenging Experiments (Indicative)		
1.	Familiarizing students to adjectives through brainstorming adjectives with allletters of the English alphabet and asking them to add an adjective that starts with the first letter of their name as a prefix.	2 hours
2.	Taking students identify their peer who lack Pace, Clarity and Volume duringpresentation and respond using Symbols.	4 hours
3.	Using Picture as a tool to enhance learners speaking and writing skills	2 hours
4.	Using Music and Songs as tools to enhance pronunciation in the target language / Activities through VIT Community Radio	2 hours
5.	Making students upload their Self- introduction videos in Vimeo.com	4 hours
6.	Brainstorming idiomatic expressions and making them use those in to their writings and day to day conversation	4 hours
7.	Making students Narrate events by adding more descriptive adjectives and add flavor to their language / Activities through VIT Community Radio	4 hours
8	Identifying the root cause of stage fear in learners and providing remedies to make their presentation better	4 hours
9	Identifying common Spelling & Sentence errors in Letter Writing and other day to day conversations	2 hours
10.	Discussing FAQ's in interviews with answers so that the learner gets a betterinsight in to interviews / Activities through VIT Community Radio	2 hours
	Total Laboratory Hours	**32 hours**
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 24-8-2017

ENG5002	Professional and Communication Skills	L	T	P	J	C
		0	0	2	0	1
Pre-requisite	ENG5001	**Syllabus version**				
		1.1				

Course Objectives:

1. To enable students to develop effective Language and Communication Skills
2. To enhance students' Personal and Professional skills
3. To equip the students to create an active digital footprint

Expected Course Outcome:

1. Improve inter-personal communication skills
2. Develop problem solving and negotiation skills
3. Learn the styles and mechanics of writing research reports
4. Cultivate better public speaking and presentation skills
5. Apply the acquired skills and excel in a professional environment

Module:1	**Personal Interaction**	**2hours**
Introducing Oneself- one's career goals Activity: SWOT Analysis		
Module:2	**Interpersonal Interaction**	**2 hours**
Interpersonal Communication with the team leader and colleagues at the workplace Activity: Role Plays/Mime/Skit		
Module:3	**Social Interaction**	**2 hours**
Use of Social Media, Social Networking, gender challenges Activity: Creating LinkedIn profile, blogs		
Module:4	**Résumé Writing**	**4 hours**
Identifying job requirement and key skills Activity: Prepare an Electronic Résumé		
Module:5	**Interview Skills**	**4 hours**
Placement/Job Interview, Group Discussions Activity: Mock Interview and mock group discussion		
Module:6	**Report Writing**	**4 hours**
Language and Mechanics of Writing Activity: Writing a Report		
Module:7	**Study Skills: Note making**	**2hours**
Summarizing the report Activity: Abstract, Executive Summary, Synopsis		
Module:8	**Interpreting skills**	**2 hours**
Interpret data in tables and graphs Activity: Transcoding		
Module:9	**Presentation Skills**	**4 hours**
Oral Presentation using Digital Tools Activity: Oral presentation on the given topic using appropriate non-verbal cues		
Module:10	**Problem Solving Skills**	**4 hours**
Problem Solving & Conflict Resolution Activity: Case Analysis of a Challenging Scenario		
	Total Lecture hours:	**30hours**

Text Book(s)

1	Bhatnagar Nitin and Mamta Bhatnagar, *Communicative English For Engineers And Professionals*, 2010, Dorling Kindersley (India) Pvt. Ltd.

Reference Books				
1	Jon Kirkman and Christopher Turk, *Effective Writing: Improving Scientific, Technical and Business Communication*, 2015, Routledge			
2	Diana Bairaktarova and Michele Eodice, *Creative Ways of Knowing in Engineering*, 2017, Springer International Publishing			
3	Clifford A Whitcomb & Leslie E Whitcomb, *Effective Interpersonal and Team Communication Skills for Engineers*, 2013, John Wiley & Sons, Inc., Hoboken: New Jersey.			
4	ArunPatil, Henk Eijkman &Ena Bhattacharya, *New Media Communication Skills for Engineers and IT Professionals,*2012, IGI Global, Hershey PA.			
Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar				
List of Challenging Experiments (Indicative)				
1.	WOT Analysis – Focus specially on describing two strengths and two weaknesses			2 hours
2.	ole Plays/Mime/Skit -- Workplace Situations			4 hours
3.	se of Social Media – Create a LinkedIn Profile and also write a page or two on areas of interest			2 hours
4.	prepare an Electronic Résumé and upload the same in vimeo			2 hours
5.	Group discussion on latest topics			4 hours
6	Report Writing – Real-time reports			2 hours
7	Writing an Abstract, Executive Summary on short scientific or research articles			4 hours
8	Transcoding – Interpret the given graph, chart or diagram			2 hours
9	Oral presentation on the given topic using appropriate non-verbal cues			4 hours
10	Problem Solving -- Case Analysis of a Challenging Scenario			4 hours
			Total Laboratory Hours	**32 hours**
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. 47	Date	05-10-2017	

FRE5001	FRANCAIS FONCTIONNEL	L	T	P	J	C
		2	0	0	0	2

Pre-requisite	Syllabus version
Nil	1.0

Course Objectives:

The course gives students the necessary background to:

1. demonstrate competence in reading, writing, and speaking basic French, including knowledge ofvocabulary (related to profession, emotions, food, workplace, sports/hobbies, classroom and family).
2. achieve proficiency in French culture oriented view point.

Expected Course Outcome:

The Students will be able to

1. remember the daily life communicative situations via personal pronouns, emphatic pronouns,salutations, negations, interrogations etc.
2. create communicative skill 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 writtenmaterials.
5. demonstrate a clear understanding of the French culture through the language studied.

Module:1	Saluer, Se présenter, Etablir des contacts	**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 réguliers, La conjugaison des verbes irréguliers- avoir /
être / aller / venir / faire etc.

Module:2	**Présenter quelqu'un, Chercher un(e)correspondant(e), Demander des nouvelles d'une personne.**	**3 hours**

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

Module:3	**Situer un objet ou un lieu, Poser des questions**	**4 hours**

L'article (défini/ indéfini), Les prépositions (à/en/au/aux/sur/dans/avec etc.), L'article contracté, Les heures en français, La Nationalité du Pays, 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.,

Module:4	**Faire des achats, Comprendre un texte court, Demander et indiquer le chemin.**	**6 hours**

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

Module:5	**Trouver les questions, Répondre aux questions générales en français.**	**5 hours**

L'article Partitif, Mettez les phrases aux pluriels, Faites une phrase avec les mots donnés, Exprimez les
phrases données au Masculin ou Féminin, Associez les phrases.

Module:6	**Comment ecrire un passage**	**3 hours**

Décrivez :
La Famille /La Maison, /L'université /Les Loisirs/ La Vie quotidienne etc.

Module:7	**Comment ecrire un dialogue**	**4 hours**
Dialogue: a) Réserver un billet de train		

b) Entre deux amis qui se rencontrent au café c) Parmi les membres de la famille d) Entre le client et le médecin			
Module:8	**Invited Talk: Native speakers**		**2 hours**
	Total Lecture hours:	**30 hours**	

Text Book(s)	
1.	Echo-1, Méthode de français, J. Girardet, J. Pécheur, Publisher CLE International, Paris 2010.
2	Echo-1, Cahier d'exercices, J. Girardet, J. Pécheur, Publisher CLE International, Paris 2010.
Reference Books	
1.	CONNEXIONS 1, Méthode de français, Régine Mérieux, Yves Loiseau,Les Éditions Didier, 2004.
2	CONNEXIONS 1, Le cahier d'exercices, Régine Mérieux, Yves Loiseau, Les Éditions Didier, 2004.
3	ALTER EGO 1, Méthode de français, Annie Berthet, Catherine Hugo, Véronique M. Kizirian,Béatrix Sampsonis, Monique Waendendries , Hachette livre 2006.

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

GER5001	Deutsch für Anfänger	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. Enable students to read and communicate in German in their day to day life
2. Become industry-ready
3. Make them understand the usage of grammar in the German Language.

Expected Course Outcome:

The students will be able to

6. Create The Basics Of German Language In Their Day To Day Life.
7. understand the conjugation of different forms of regular/irregular verbs.
8. understand the rule to identify the gender of the Nouns and apply articles appropriately.
9. apply the German language skill in writing corresponding letters, E-Mails etc.
10. create the talent of translating passages from English-German and vice versa and To frame simple dialogues based on given situations.

Module:1	**3 hours**

Einleitung, Begrüssungsformen, Landeskunde, Alphabet, Personalpronomen, Verb Konjugation, Zahlen (1-100), W-fragen, Aussagesätze, Nomen – Singular und Plural

Lernziel:

Elementares Verständnis von Deutsch, Genus- Artikelwörter

Module:2	**3 hours**

Konjugation der Verben (regelmässig /unregelmässig) die Monate, die Wochentage, Hobbys, Berufe, Jahreszeiten, Artikel, Zahlen (Hundert bis eine Million), Ja-/Nein- Frage, Imperativ mit Sie

Lernziel :

Sätze schreiben, über Hobbys erzählen, über Berufe sprechen usw.

Module:3	**4 hours**

Possessivpronomen, Negation, Kasus- AkkusatitvundDativ (bestimmter, unbestimmterArtikel), trennnbare verben, Modalverben, Adjektive, Uhrzeit, Präpositionen, Mahlzeiten, Lebensmittel, Getränke

Lernziel :

Sätze mit Modalverben, Verwendung von Artikel, über Länder und Sprachen sprechen, über eine Wohnungbeschreiben.

Module:4	**6 hours**

Übersetzungen : (Deutsch – Englisch / Englisch – Deutsch)

Lernziel :

Grammatik – Wortschatz - Übung

Module:5	**5 hours**

Leseverständnis,Mindmap machen,Korrespondenz- Briefe, Postkarten, E-Mail

Lernziel :

Wortschatzbildung und aktiver Sprach gebrauch

Module:6	.	**3 hours**
Aufsätze : Meine Universität, Das Essen, mein Freund oder meine Freundin, meine Familie, ein Fest in Deutschland usw		
Module:7		**4 hours**
Dialoge: e) Gespräche mit Familienmitgliedern, Am Bahnhof, f) Gespräche beim Einkaufen ; in einem Supermarkt ; in einer Buchhandlung ; g) in einem Hotel - an der Rezeption ;ein Termin beim Arzt. Treffen im Cafe		
Module:8		**2 hours**
Guest Lectures/Native Speakers / Feinheiten der deutschen Sprache, Basisinformation über die deutschsprachigen Länder		
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	**Studio d A1 Deutsch als Fremdsprache, Hermann Funk, Christina Kuhn, Silke Demme : 2012**
Reference Books	
1	etzwerk Deutsch als Fremdsprache A1, Stefanie Dengler, Paul Rusch, Helen Schmtiz, Tanja Sieber, 2013
2	Lagune ,Hartmut Aufderstrasse, Jutta Müller, Thomas Storz, 2012.
3	eutsche SprachlehrefürAUsländer, Heinz Griesbach, Dora Schulz, 2011
4	hemenAktuell 1, HartmurtAufderstrasse, Heiko Bock, MechthildGerdes, Jutta Müller und Helmut Müller, 2010
	ww.goethe.de irtschaftsdeutsch.de ber.de, klett-sprachen.de ww.deutschtraning.org

Mode of Evaluation: CAT / Assignment / Quiz / FAT			
Recommended by Board of Studies			
Approved by Academic Council	No. 41	Date	17-06-2016

STS5001	Essentials of Business Etiquettes	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:

- Enabling students to use relevant aptitude and appropriate language to express themselves
- To communicate the message to the target audience clearly

Module:1	**Business Etiquette: Social and Cultural Etiquette and Writing Company Blogs and Internal Communications and Planning and Writing press release and meeting notes**	**9 hours**

Value, Manners, Customs, Language, Tradition, Building a blog, Developing brand message, FAQs', Assessing Competition, Open and objective Communication, Two way dialogue, Understanding the audience, Identifying, Gathering Information,. Analysis, Determining, Selecting plan, Progress check, Types of planning, Write a short, catchy headline, Get to the Point –summarize your subject in the first paragraph., Body – Make it relevant to your audience,

Module:2	**Study skills – Time management skills**	**3 hours**

Prioritization, Procrastination, Scheduling, Multitasking, Monitoring, Working under pressure and adhering to deadlines

Module:3	**Presentation skills – Preparing presentation and Organizing materials and Maintaining and preparing visual aids and Dealing with questions**	**7 hours**

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

Module:4	**Quantitative Ability -L1 – Number properties and Averages and Progressions and Percentages and Ratios**	**11 hours**

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

Module:5	**Reasoning Ability-L1 – Analytical Reasoning**	**8 hours**

Data Arrangement(Linear and circular & Cross Variable Relationship), Blood Relations, Ordering/ranking/grouping, Puzzle test, Selection Decision table		
Module:6	**Verbal Ability-L1 – Vocabulary Building**	**7 hours**
Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentence completion,Analogies		
	Total Lecture hours:	**45 hours**

Reference Books	
1.	Kerry Patterson, Joseph Grenny, Ron McMillan, Al Switzler(2001) Crucial Conversations: Tools forTalking When Stakes are High. Bangalore. McGraw-Hill Contemporary
2.	Dale Carnegie,(1936) How to Win Friends and Influence People. New York. Gallery Books
3.	Scott Peck. M(1978) Road Less Travelled. New York City. M. Scott Peck.
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

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:

- 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 and mensuration and Trigonometry and Logarithms and Functions and Quadratic Equations and Set Theory**	**14 hours**

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**	**7 hours**

	Data Analysis and Interpretation	
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 Usean 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
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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		
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