UNIVERSITYOFMUMBAI

Revised syllabus (Rev- 2016) from Academic Year 2016 -17
Under

FACULTY OF TECHNOLOGY

Information Technology

Second Year with Effect from **AY 2017-18**

Third Year with Effect from **AY 2018-19**

Final Year with Effect from **AY 2019-20**

As per **Choice Based Credit and Grading System**

with effect from the AY 2016–17

Co-ordinator, Faculty of Technology's Preamble:

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Technology of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Technology, University of Mumbai, in one of its meeting unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated Institutes to add few (PEO's). It is also resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while revising the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of engineering education.

Choice based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. University of Mumbai has taken a lead in implementing the system through its affiliated Institutes and Faculty of Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

Choice based Credit and grading system is implemented from the academic year 2016-17 through optional courses at department and institute level. This will be effective for SE, TE and BE from academic year 2017-18, 2018-19 and 2019-20 respectively.

Dr. S. K. Ukarande

Co-ordinator,

Faculty of Technology,

Member - Academic Council

University of Mumbai, Mumbai

Preamble

It is an honor and a privilege to present the revised syllabus of Bachelor of Engineering in Information Technology (effective from year 2016-17) with inclusion of cutting edge technology.

Information Technology is comparatively a young branch among other engineering disciplines in the University of Mumbai. It is evident from the placement statistics of various colleges affiliated to the University of Mumbai that IT branch has taken the lead in the placement. The branch also provides multi-faceted scope like better placement and promotion of entrepreneurship culture among students, and increased Industry Institute Interactions.

Industries views are that, only 16 % graduates are directly employable. One of the reasons is a syllabus which is not in line with the latest technologies. Our team of faculties has tried to include all the latest technologies in the syllabus. Also the first time we are giving the choice of elective from fifth semester such that students will be master in one of the IT domain.

The syllabus is peer reviewed by experts from reputed industries and as per their suggestions it covers future trends in IT technology and research opportunities available due to these trends.

I would like to thank senior faculties of IT department of all colleges affiliated to Mumbai University for significant contribution in framing the syllabus. Also behalf of all faculties I thank all the industry experts for their valuable feedback and suggestions.

I sincerely hope that the revised syllabus will help all graduate engineers to face the future challenges in the field of information and technology

Program Outcome for graduate Program in Information Technology
1. Apply Core Information Technology knowledge to develop stable and secure IT system.
2. Design, IT infrastructures for an enterprise using concepts of best practices in information Technology management and security to enterprise processes.
3. Manage IT projects using written and oral communication skills in collaborative environments by Participating on teams that address solutions for IT management challenges.
4. Identify and discuss professional, individual, organizational, societal, and regulatory implications of Information systems and technology.
5. Assess Security of the IT Systems and able to respond to any breach in IT system
6. Ability to work in multidisciplinary projects and make it IT enabled.
7. Ability to propose the system to reduce carbon footprint.
8. Ability to adapt the lifelong learning process to be in sync with trends in Information Technology

Dr. Deven Shah

Chairman (Ad-hoc Board Information Technology)
University of Mumbai)

University of Mumbai

Program Structure B.E. Information Technology, (Rev. 2016)

T. E. Information Technology (Semester-V)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC501	Microcontroller and Embedded Programming	4	-	-	4	-	-	4
ITC502	Internet Programming	4	-	-	4	-	-	4
ITC503	Advanced Data Management Technology	4	-	-	4	-	-	4
ITC504	Cryptography & Network Security	4	-	-	4	-	-	4
ITDLO-I	Department Level Optional Course-I	4	-	-	4	-	-	4
ITL501	Internet Programming Lab	-	2	-	-	1		1
ITL502	Security Lab	-	2	-	-	1	-	1
ITL503	OLAP Lab	-	2	-	-	1	-	1
ITL504	IOT (Mini Project) Lab	-	2	-	-	1	-	1
ITL505	Business Communication and Ethics	-	2+2*	-	-	2	-	2
	Total	**20**	**14**	**-**	**20**	**7**	**-**	**26**

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
ITC501	Microcontroller and Embedded Programming	20	20	20	80	3	-		-	100
ITC502	Internet Programming	20	20	20	80	3	-		-	100
ITC503	Advanced Data Management Technology	20	20	20	80	3	-		-	100
ITC504	Cryptography & Network Security	20	20	20	80	3	-		-	100
ITDLO-I	Department Level Optional Course-I	20	20	20	80	3	--		-	100
ITL501	Internet Programming Lab	-	-	-	-	-	25	--	25	50
ITL502	Security Lab	-	-	-	-	-	25	25	--	50
ITL503	OLAP Lab	-	-	-	-	-	25	25	--	50

ITL504	IOT (Mini Project) Lab	-	-	-	-	-	25	25	--	50
ITL505	Business Communication and Ethics	-	-	-	-	-	50	--	--	50
	Total	100	100	100	400	-	150	75	25	750

 # Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester V. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

(DLO-I subjects will have no Labs only Theory)

Subject Code	Department Level Optional Course (DLO)
Semester V	
ITDLO5011	Advanced Data Structures & Analysis of Algorithms
ITDLO5012	Image Processing
ITDLO5013	E-Commerce & E-Business
ITDLO5014	IT Enabled Services
ITDLO5015	Computer Graphics & Virtual Reality

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC501	Microcontroller and Embedded Programming	04	--		04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC501	Microcontroller and Embedded Programming	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1. The concepts and architecture of embedded systems
2. Basic of microcontroller 8051.
3. The concepts of microcontroller interface.
4. The concepts of ARM architecture
5. The concepts of real-time operating system
6. Different design platforms used for an embedded systems application

Course Outcomes: Students will be able to:

1. Explain the embedded system concepts and architecture of embedded systems
2. Describe the architecture of 8051 microcontroller and write embedded program for 8051 microcontroller.
3. Design the interfacing for 8051 microcontroller.
4. Understand the concepts of ARM architecture.
5. Demonstrate the open source RTOS and solve the design issues for the same.
6. Select elements for an embedded systems tool.

Prerequisite: COA, Microprocessors and Assembly Programming languages

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Revision of microcomputer system terminologies, High level, Machine level and Assembly level programming language , difference between microprocessor and microcontroller	02	

I	Introduction to Embedded systems	Overview of Embedded System Architecture, Application areas, Categories of embedded systems, specialties of embedded systems. Recent trends in embedded systems. Brief introduction to embedded microcontroller cores CISC, RISC, ARM, DSP and SoC.	05	CO1
II	The Microcontroller Architecture and Programming of 8051:	Introduction to 8051 Microcontroller, Architecture, Pin configuration, Memory organization, Input /Output Ports, Counter and Timers, Serial communication, Interrupts. Instruction set, Addressing modes, Development tools, Assembler Directives, Programming based on Arithmetic & Logical Operations, I/O parallel and serial ports, Timers & Counters, and ISR.	14	CO2
III	Interfacing with 8051Microcontroller	Interfacing ADC, DAC, Stepper motor, LCD, KBD matrix, 8255 PPI	06	CO3
IV	ARM 7 Architecture	Architectural inheritance, Detailed study of Programmer's model, ARM Development tools, Instruction set: Data processing, Data Transfer, Control flow. Addressing modes. Writing simple assembly language programs. Pipelining, Brief introduction to exceptions and interrupts handling.	10	CO4
V	Open source RTOS	Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, differences between general purpose OS & RTOS, basic architecture of an RTOS, scheduling systems, inter-process communication, performance Matrix in scheduling models, interrupt management in RTOS environment, memory management, file systems, I/O systems, advantage and disadvantage of RTOS. POSIX standards, RTOS issues – selecting a Real Time Operating System, RTOS comparative study.	07	CO5
VI	Introduction to Embedded target boards	Introduction to Arduino, Raspberry Pi, ARM Cortex, Intel Galileo etc. Open-source prototyping platforms. Basic Arduino programming; Extended Arduino libraries; Arduino-based Internet communication; Raspberry pi; ARM	08	CO6

		Cortex Processors; Intel Galileo boards; Sensors and Interfacing: Temperature, Pressure, Humidity		

Text Books:

1. M. A. Mazidi, J. G. Mazidi, R. D., McKinlay ,"The 8051 microcontroller & Embedded systems Using Assembly and C", Pearson, 3rd edition
2. Embedded / real – time systems: concepts, design & programming, Black Book, Dr. K. V. K. K. Prasad, Dreamtech press, Reprint edition 2013
3. Shibu K. V., "Introduction to embedded systems", McGraw Hil

References:

1. Laya B. Das, "Embedded systems an integrated approach", Pearson, Third impression, 2013
2. Steve Furber, "ARM System on chip Architecture", Pearson, edition second
3. Michael Margolis, "Arduino Cookbook", O'reilly
4. Simon Monk," Raspberry Pi Cookbok", O'reilly
5. Raspberry Pi User Guide.
6. Massimo Banzi, "Getting Started with Arduino: The Open Source Electronics Prototyping Platform (Make)", O'Reilly Media.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:
- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC502	Internet Programming	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC502	Internet Programming	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1 To get familiar with basics of the Internet Programming.
2. To acquire knowledge and skills for creation of web site considering both client and server side programming
3. To gain ability to develop responsive web applications
4. To explore different web extensions and web services standards
5. To learn characteristics of RIA –Web Mashup Eco System
6. To be familiarized with Python web framework-Django.

Course Outcomes: Students will be able to:

1. Implement interactive web page(s) using HTML,CSS and JavaScript.
2. Design a responsive web site using HTML5 and CSS3.
3. Demonstrate Rich Internet Application .
4. Build Dynamic web site using server side PHP Programming and Database connectivity.
5. Describe and differentiate different Web Extensions and Web Services.
6. Demonstrate web application using Python web Framework-Django

Prerequisite: Basic Java Programming and Python Programming.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	**Introduction to web technologies**: Introduction to OSI layers,	02	---
I	Client Side Programming :HTML, CSS and JavaScript	**Basic of HTML:** Web System architecture-1,2,3 and n tier architecture, URL, domain name system, overview of HTTP and FTP, Cross browser compatibility issues, W3C Validators. Formatting and Fonts, Anchors, images, lists, tables, frames and forms. **Introduction to CSS**: Evolution of CSS, Syntax of CSS, Exploring CSS Selectors, Inserting CSS in an HTML Document, Defining Inheritance in CSS. **Introduction to JavaScript:** JavaScript language constructs, Objects in JavaScript- Built in, Browser objects and DOM objects, event handling, form validation and cookies.	09	CO1
II	HTML5 and Responsive Web Design with CSS3	**HTML 5 :** Fundamental Syntax and Semantics, Native Audio and Video, Micro data and Custom data, Accessibility, Geo-location, Canvas **CSS3 and Responsive Web Design** Media Queries: Supporting Differing Viewports, Embracing Fluid Layout. CSS3: Selectors, Typography and color Modes, Stunning Aesthetics with CSS3, CSS3 Transitions, Transformations and Animations, Conquer Forms HTML5 and CSS3	12	CO1 CO2
III	Rich Internet Application(RIA)	Characteristics of RIA, **Introduction to AJAX** :AJAX design basics, AJAX vs Traditional Approach, , Rich User Interface using Ajax. **Working with JavaScript Object Notation(JSON)**: Create data in JSON format, JSON Parser .	09	CO3

		Web Mashup Eco Systems –Mashup Techniques: Mashing on the Web Server, Mashing with JSON		
IV	Server Side Programming: PHP	Introduction to PHP- Data types, control structures, built in functions, Building web applications using PHP- tracking users, PHP and Mysql database connectivity with example. Introduction to PHP Framework.	08	CO4
V	Web Extensions and Web Services	**Web Extensions**: Introduction to XML, Introducing XSL. Web services: Evolution and differences with Distributed computing, WSDL, SOAP, UDDI. REST-ful web services, Resource Oriented Architecture	07	CO5
VI	Python Web Framework: Django	Introduction, Web Frameworks, Introduction to Django ,Projects and Apps, "Hello World" Application.	05	CO6

Text Books:

1**.** HTML 5 Black Book: Kogent Learning solutions
2. "Learning PHP 5", David Sklar, O'Reilly Publication
3. Rich Internet Application AJAX and Beyond WROX press
4. Responsive Web Design with HTML5 and CSS3, Ben Frain, PACKT Publication

References:

1. "Web Technologies: Black Book", Dreamtech publication
2. HTML5 Cookbook, By Christopher Schmitt, Kyle Simpson, O'Reilly Media
3. Core Python Applications Programming by Wesley J Chun Third edition Pearson Publication
4. Advanced Internet Technologies (includes practicals), Deven Shah, Dreamtech publication

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:
- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC503	Advanced Data Management Technology	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITC503	Advanced Data Management Technology	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1. To introduce advanced concepts of transaction management and recovery techniques.
2. To impart knowledge related to query processing and query optimizer phases of a database management system
3. To introduce concepts of advanced access control techniques like role based and discretionary methods
4. To introduce advanced database models like distributed databases.
5. To impart an overview of emerging data models like temporal, mobile and spatial databases.
6. To create awareness of how enterprise can organize and analyze large amounts of data by creating a Data Warehouse.

Course Outcomes: Students will be able to:

1. Explain and understand the concept of a transaction and how ACID properties are maintained when concurrent transaction occur in a database
2. Measure query costs and design alternate efficient paths for query execution**.**
3. Apply sophisticated access protocols to control access to the database.
4. Implement alternate models like Distributed databases and Design applications using advanced models like mobile, spatial databases**.**
5. Organize strategic data in an enterprise and build a data Warehouse.
6. Analyze data using OLAP operations so as to take strategic decisions.

Prerequisite: Database Management System.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Reviewing basic concepts of a Relational database, SQL concepts	02	
I	Query Processing and Optimization:	Overview, Measures of Query Cost Selection Operation, Sorting, Join Operation, Other Operations Evaluation of Expressions. Query Optimization Overview, Transformation of Relational Expressions Estimating Statistics of Expression Results Choice of Evaluation Plans	06	CO1
II	Transactions Management and Concurrency:	Transaction concept, Transaction states, ACID properties, Implementation of atomicity and durability, Concurrent Executions, Serializability, Recoverability, Implementation of isolation, Concurrency Control: Lock-based, Time-stamp based Deadlock handling, Recovery System: Failure Classification, Storage structure, Recovery & atomicity, Log based recovery, Checkpoints, Shadow Paging, ARIES Algorithm.	10	CO2
III	Advanced Data Management techniques	Advanced Database Access protocols: Discretionary Access Control Based on Granting and Revoking Privileges; Mandatory Access Control and Role-Based Access Control. Overview of Advanced Database models like Mobile databases, Temporal databases, Spatial databases.	09	CO3 CO4
IV	Distributed Databases	Introduction : Distributed Data Processing, What is a Distributed Database System? Design Issues . Distributed DBMS Architecture. Distributed Database Design : Top-Down Design Process, Distribution Design Issues, Fragmentation , Allocation . Overview of Query Processing : Query Processing Problem, Objectives of Query Processing, Complexity of Relational Algebra Operations, Characterization of Query Processors, Layers of Query Processing, Query Optimization in Distributed Databases;	09	CO4

		Overview of Transaction Management in DDB; Overview of Concurrency Control in DDB; Overview of Recovery in DDB		
V	Data Warehousing, Dimensional Modeling and OLAP	The Need for Data Warehousing; Data Warehouse Defined; Benefits of Data Warehousing ; Features of a Data Warehouse; Data Warehouse Architecture; Data Warehouse and Data Marts; Data Warehousing Design Strategies. Dimensional Model Vs ER Model; The Star Schema; How Does a Query Execute? The Snowflake Schema; Fact Tables and Dimension Tables; Factless Fact Table; Updates To Dimension Tables, Primary Keys, Surrogate Keys & Foreign Keys; Aggregate Tables; Fact Constellation Schema or Families of Star Need for Online Analytical Processing; OLTP vs OLAP; OLAP Operations in a cube: Roll-up, Drill-down, Slice, Dice, Pivot ; OLAP Models: MOLAP, ROLAP, HOLAP.	10	CO5
VI	ETL Process	Challenges in ETL Functions; Data Extraction; Identification of Data Sources; Immediate Data Extraction, Deferred Data Extraction; Data Transformation: Tasks Involved in Data Transformation, Techniques of Data Loading, Loading the Fact Tables and Dimension Tables	06	CO6

Text Books:
1. Korth, Slberchatz,Sudarshan, :"Database System Concepts", 6th Edition, McGraw – Hill
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON Education.
3. Theraja Reema, "Data Warehousing", Oxford University Press, 2009.
4. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems" 3rd Edition - McGraw Hill

References:

1. Paulraj Ponniah, "Data Warehousing: Fundamentals for IT Professionals", Wiley India.
2. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom "Database System Implementation", Pearson Ltd. 1/ e
3. Thomas M. Connolly Carolyn Begg, Database Systems : A Practical Approach to Design, Implementation and Management, 4/e, Pearson Ltd.
4. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit: The Definitive Guide To Dimensional Modeling", 3rd Edition. Wiley India.
5. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:
- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC504	Cryptography & Network Security	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. of two Tests					
ITC504	Cryptography & Network Security	20	20	20	80	--	--	--	100

Course Objectives: Students will try to learn:

1. The concepts of classical encryption techniques and concepts of finite fields and number theory.
2. And explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms
3. And explore the design issues and working principles of various authentication protocols, PKI standards.
4. And explore various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.
5. The ability to use existing cryptographic utilities to build programs for secure communication.
6. The concepts of cryptographic utilities and authentication mechanisms to design secure applications

Course Outcomes: Students will be able to:

1. Identify information security goals, classical encryption techniques and acquire fundamental knowledge on the concepts of finite fields and number theory.
2. Understand, compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication
3. Apply the knowledge of cryptographic checksums and evaluate the performance of different message digest algorithms for verifying the integrity of varying message sizes
4. Apply different digital signature algorithms to achieve authentication and create secure applications
5. Apply network security basics, analyze different attacks on networks and evaluate the performance of firewalls and security protocols like SSL, IPSec, and PGP.
6. Apply the knowledge of cryptographic utilities and authentication mechanisms to design secure applications

Prerequisite: Computer Networks

Detailed syllabus:

Sr No	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Basic concepts of OSI Layer	02	--
I	Introduction & Number Theory	Services, Mechanisms and attacks-the OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, mono-alphabetic and poly-alphabetic substitution techniques: Vignere cipher, playfair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers, steganography).	09	CO1
II	Block Ciphers & Public Key Cryptography	Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm. Public key cryptography: Principles of public key cryptosystems-The RSA algorithm, The knapsack algorithm, El-Gamal Algorithm. Key management – Diffie Hellman Key exchange	09	CO2 CO6
III	Cryptographic Hashes, Message Digests and Digital Certificates	Authentication requirement – Authentication function , Types of Authentication, MAC – Hash function – Security of hash function and MAC –MD5 – SHA – HMAC – CMAC, Digital Certificate: X.509, PKI	09	CO3
IV	Digital signature schemes and authentication Protocols	Digital signature and authentication protocols : Needham Schroeder Authentication protocol, Digital Signature Schemes – RSA, EI Gamal and Schnorr, DSS.	07	CO4
V	Network Security	Network security basics: TCP/IP vulnerabilities (Layer wise), Packet Sniffing, ARP spoofing, port scanning, IP spoofing, TCP syn flood, DNS Spoofing. Denial of Service: Classic DOS attacks, Source Address spoofing, ICMP flood, SYN flood, UDP flood, Distributed Denial of Service, Defenses against Denial of Service Attacks.	10	CO5

		Firewalls, Intrusion Detection Systems: Host Based and Network Based IDS, Honey pots.		
VI	Network Security Applications	Authentication Applications, Kerberos, Internet Security Protocols: SSL, TLS, IPSEC:AH, ESP, Secure Email: PGP and S/MIME, Key Management.	06	CO5 CO6

Text Books:

1. Mark Stamp's Information Security Principles and Practice, Wiley
2. William Stallings, Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson Education, March 2013
3. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill
4. Bernard Menezes, "Cryptography & Network Security", Cengage Learning

Reference Books:

1. Applied Cryptography, Protocols Algorithms and Source Code in C, Bruce Schneier, Wiley.
2. Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW /Practical	Tutorial	Total
ITL501	Internet Programming Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test 1	Test 2	Avg. of two Tests				
ITL501	Internet Programming Lab	--	--	--	--	25	25	50

Lab Objectives: Students will try:

1. To Acquire knowledge and Skills for creation of Web Site considering both client- and server-side Programming.
2. To create Web application using tools and techniques used in industry.
3. To learn the characteristics of RIA
4. To Demonstrate Amazon/Google or Yahoo mashup
5. To be well versed with XML and web services Technologies.
6. To be familiarized with open source Frameworks for web development.

Lab Outcomes: Students will learn to;

1. Design a basic web site using HTML5 and CSS3 to demonstrate responsive web design.
2. Implement dynamic web pages with validation using JavaScript objects by applying different event handling mechanism.
3. Use AJAX Programming Technique to develop RIA
4. Develop simple web application using server side PHP programing and Database Connectivity using MySQL.
5. Build well-formed XML Document and implement Web Service using Java.
6. Demonstrate simple web application using Python Django Framework.

Hardware and Software requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel Core i3/i5/i7 Processor 2. 4 GB RAM 3. 500 GB Harddisk	1. Windows or Linux Desktop OS 2. HTML5 compatible web browsers(Chrome, Opera, Firefox, Safari etc) 3. HTML,CSS editors like Dreamweaver, Notepad++ etc. 4. Netbeans or Eclipse IDE 5. XAMPP	1. Internet Connection installation of web frameworks

Prerequisite: Basics of Java and Python Programming

Guidelines

1. The mini project work is to be conducted by a group of three students

2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.

3. The students may do will visit different websites to identify their website topic for the mini project.

4. Each group will identify the Hardware and software requirement for their mini project problem statement.

5. Mini Project consists of Responsive Website Development.

6. Which includes following points

   a. Introduction to RWD frame work?

   b. Identify tools

   c. CSS preprocessor

   d. Construction and design of skeleton for website

   e. Enhancing CSS3 and HTML5 in website

   f. Server Side Programming: website using server side scripting in PHP and database connectivity using MySQL (PHP framework like Laravel/Joomla can be used)

   g. XML ,XSL and Web Services

h. Developing RIA using AJAX including -A browser built-in XMLHttpRequest object (to request data from a web server) and JavaScript and HTML DOM (to display or use the data) Building Amazon/Yahoo /Google Web Mashups for the website.

i. Website Security

j. Develop full website and launch it.

7. Each group may present their work in various project competitions and paper presentations.

8. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Responsive Web Design by Example Beginner's Guide by Thoriq Firdaus, PACKT
2. Responsive Web Design with HTML5 and CSS3 PACKT
3. Professional Rich Internet Application : AJAX and Beyond WROX press

References:

1. Laravel: Up and Running, By Matt Stauffer O'Reilly Media.
2. Advanced Internet Technologies (includes practicals) ,Deven Shah ,Dreamtech publication
3. Django By Example By Antonio Melé,Pakt Publication

Term Work:
Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW /Practical	Tutorial	Total
ITL502	Security Lab	--	2	-	--	1	-	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL502	Security Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To be able to apply the knowledge of symmetric cryptography to implement simple ciphers
2. To be able to analyze and implement public key algorithms like RSA and El Gamal
3. To analyze and evaluate performance of hashing algorithms
4. To explore the different network reconnaissance tools to gather information about networks
5. To explore and use tools like sniffers, port scanners and other related tools for analyzing packets in a network.
6. To be able to set up firewalls and intrusion detection systems using open source technologies and to explore email security.

Lab Outcome: Students will learn to:

1. Apply the knowledge of symmetric cryptography to implement simple ciphers
2. Analyze and implement public key algorithms like RSA and El Gamal
3. Analyze and evaluate performance of hashing algorithms
4. Explore the different network reconnaissance tools to gather information about networks
5. Use tools like sniffers, port scanners and other related tools for analyzing packets in a network.
6. Apply and set up firewalls and intrusion detection systems using open source technologies and to explore email security.

Hardware and Software requirements:

Hardware Requirements	Software Requirements
PC With following Configuration 1. Intel Core i3/i5/i7 Processor 2. 4 GB RAM 3. 500 GB Harddisk	1. Windows or Linux Desktop OS 2. wireshark 3. ARPWATCH 4. Kismet, NetStumbler 5. NESSUS

Prerequisite: Computer Networks, Operating System, Basics of Java and Python Programming

Detail Syllabus:

Module No.	Description	Hours	CO mapping
I	a) Design and Implementation of a product cipher using Substitution and Transposition ciphers b) Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA/El Gamal	4	LO1 LO2
II	a) Implementation of Diffie Hellman Key exchange algorithm b) For varying message sizes, test integrity of message using MD-5, SHA-1, and analyse the performance of the two protocols. Use crypt APIs c) Exploring wireless security tools like Kismet, NetStumbler etc.	4	LO2 LO3
III	a) Study the use of network reconnaissance tools like WHOIS, dig,traceroute, nslookup to gather information about networks and domain registrars. b)Study of packet sniffer tools wireshark, :- **1**. Observer performance in promiscuous as well as non-promiscuous mode. **2**. Show the packets can be traced based on different filters.	4	LO4 LO5
IV	Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, etc.	4	LO5
V	a) Detect ARP spoofing using nmap and/or open source tool ARPWATCH and wireshark. b) Simulate DOS attack using Hping and other tools c) Use the NESSUS/ISO Kaali Linux tool to scan the network for vulnerabilities.	6	LO4 LO5

		a) Set up IPSEC under LINUX.	4	
VI		b) Set up Snort and study the logs.		LO6
		c) Explore the GPG tool of linux to implement email security		

Text Books:

1. Build your own Security Lab, Michael Gregg, Wiley India

2. CCNA Security, Study Guide, TIm Boyles, Sybex

Reference Books:

1. Network Security Bible, Eric Cole, Wiley India

Term Work:
Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITL503	OLAP Lab	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test	Test2	Avg. of two Tests					
ITL503	OLAP Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To introduce advanced concepts of transaction management and recovery techniques.
2. To impart knowledge related to query processing and query optimizer phases of a database management system
3. To initiate awareness about the potential security threats that exists in database systems and how to tackle them.
4. To introduce advanced database models like distributed databases.
5. To impart an overview of emerging data models like temporal, mobile and spatial databases.
6. To create awareness of how enterprise can organize and analyze large amounts of data by creating a Data Warehouse.

Lab Outcomes: Student should be able:
1. Implement simple query optimizers and design alternate efficient paths for query execution**.**
2. Simulate the working of concurrency protocols, recovery mechanisms in a database
3. Design applications using advanced models like mobile, spatial databases**.**
4. Implement a distributed database and understand its query processing and transaction processing mechanisms
5. Build a data warehouse
6. Analyze data using OLAP operations so as to take strategic decisions.

Hardware and Software requirements:

Hardware Requirements	Software Requirements
PC With following Configuration 1. Intel Core i3/i5/i7	1. ETL tools 2. Warehouse tools 3. Java/Python compiler

	Processor	
2. 4 GB RAM		
3. 500 GB Harddisk		

Prerequisite: DBMS.

Detailed syllabus:

Module No.	Detailed Content	Hours	CO Mapping
I	a) Implementation of any Query optimizer (Java/Python) b) Assignments for query evaluation path expressions.	4	LO 2
II	c) Simulation of Concurrency Control Algorithm, Recovery Algorithm (Java/Python)	4	LO1
III	a) Design of a distributed database for a real life application - Fragmentation, Query Processing b) Simulation of Recovery methods.	4	LO 4
IV	**Advanced Database Models** Case study based assignments for Temporal, Mobile or Spatial databases	4	LO 3
V	**Data Warehouse Construction** a) Real life Problem to be defined for Warehouse Design b) Construction of star schema c) ETL Operations.	6	LO 4
VI	**OLAP Exercise** a) Construction of Cubes b) OLAP Operations, OLAP Queries	4	LO 6

Text Books:
1. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON Education.
2. Theraja Reema, "Data Warehousing", Oxford University Press, 2009.
3. Data Warehousing, Data Mining, & OLAP by Alex Berson McGraw Hill.

References:
1. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom "Database System Implementation", Pearson Ltd. 1/ e
2. Thomas M. Connolly Carolyn Begg, Database Systems : A Practical Approach to Design, Implementation and Management, 4/e Pearson Ltd

3. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit: The Definitive Guide To Dimensional Modeling", 3rd Edition. Wiley India.

Term Work:
Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITL504	IOT (Mini Project) Lab	--	2	--	--	1	--	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL504	IOT (Mini Project) Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try to:

1. Address the real world problems and find the required solution.
2. Design the problem solution as per the requirement analysis done.
3. Study the basic concepts of programming/ hardware/ emulator for Raspberry pi/Arduino/ ARM Cortex/ Intel Galileo etc.
4. Fabricate and implement the mini project intended solution for project based learning.
5. Build and test the mini project successfully.
6. Improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Identify the requirements for the real world problems.
2. Conduct a survey of several available literatures in the preferred field of study.
3. Study and enhance software/ hardware skills.
4. Demonstrate and build the project successfully by hardware requirements, coding, emulating and testing.
5. To report and present the findings of the study conducted in the preferred domain
6. Demonstrate an ability to work in teams and manage the conduct of the research study.

Guidelines

1. The mini project work is to be conducted by a group of three students

2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.

3. The students may do survey for different application using Raspberry pi/Arduino/ ARM Cortex/ Intel Galileo etc topics for the mini project.

University of Mumbai, B. E. (Information Technology), Rev 2016

4. Each group will identify the Hardware and software requirement for their mini project problem statement.

5. Prototype/Design your own circuit board using Raspberry pi/Arduino/ ARM Cortex/ Intel Galileo etc.

6. Installation, configure and manage your Raspberry pi/Arduino/ ARM Cortex/ Intel Galileo etc board/kit.

7. Work with operating system and do coding to for input devices on board.

8. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Programme.

9. Create and interface using Web to publish or remotely access the data on Internet.

10. Each group along with the concerned faculty shall identify a potential problem statement, on which the study and implementation is to be conducted.

11. Each group may present their work in various project competitions and paper presentations.

12. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Massimo Banzi,"Getting Started with Arduino",O'reilly, 2nd edition
2. Simon Monk," Raspberry Pi Cookbok", O'reilly
3. Raspberry Pi User Guide

References:

1. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , Arshdeep Bahga

Term Work:
Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITL505	Business Communication and Ethics	2	2*	--	--	2	--	2

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL505	Business Communication and Ethics	--	--	--	--	50	--	--	50

* Batch wise practical's

Pre-requisite
- Communication Skills

Course Objective: Students will try:
1. To inculcate professional and ethical attitude at the workplace
2. To enhance effective communication and interpersonal skills
3. To build multidisciplinary approach towards all life tasks
4. To hone analytical and logical skills for problem-solving

Course Outcomes: Students will learn to:

1. Design a technical document using precise language, suitable vocabulary and apt style.

2. Develop the life skills/ interpersonal skills to progress professionally by building stronger relationships.

3. Demonstrate awareness of contemporary issues knowledge of professional and ethical responsibilities.

4. Apply the traits of a suitable candidate for a job/higher education, upon being trained in the techniques of holding a group discussion, facing interviews and writing resume/SOP.

5. Deliver formal presentations effectively implementing the verbal and non-verbal skills.

Module	Detailed Contents	Hrs.
01	**Report Writing**	**05**
1.1	Objectives of Report Writing	
1.2	Language and Style in a report	
1.3	Types : Informative and Interpretative (Analytical, Survey and Feasibility)and Formats of reports (Memo, Letter, Short and Long Report)	
02	**Technical Writing**	**03**
2.1	Technical Paper Writing (IEEE Format)	
2.2	Proposal Writing	
03	**Introduction to Interpersonal Skills**	**08**
3.1	Emotional Intelligence	
3.2	Leadership and Motivation	
3.3	Team Building	
3.4	Assertiveness	
3.5	Conflict Resolution and Negotiation Skills	
3.6	Time Management	
3.7	Decision Making	
04	**Meetings and Documentation**	**02**
4.1	Strategies for conducting effective meetings	
4.2	Notice, Agenda and Minutes of a meeting	
4.3	Business meeting etiquettes	
05	**Introduction to Corporate Ethics**	**02**
5.1	Professional and work ethics (responsible use of social media - Facebook, WA, Twitter etc.)	
5.2	Introduction to Intellectual Property Rights	
5.4	Ethical codes of conduct in business and corporate activities (Personal ethics, conflicting values, choosing a moral response and making ethical decisions)	
06	**Employment Skills**	**06**

6.1	Group Discussion	
6.2	Resume Writing	
6.3	Interview Skills	
6.4	Presentation Skills	
6.5	Statement of Purpose	
		26

1. Report Writing (Theory)
2. Technical Proposal
3. Technical Paper Writing (Paraphrasing a published IEEE Technical Paper)
4. Interpersonal Skills (Group activities and Role plays)
5. Interpersonal Skills (Documentation in the form of soft copy or hard copy)
6. Meetings and Documentation (Notice, Agenda, Minutes of Mock Meetings)
7. Corporate ethics (Case studies, Role plays)
8. Writing Resume and Statement of Purpose

1. **Term Work:**
2. Term work shall consist of all assignments from the list. The distribution of marks for term
3. work shall be as follows:
4. Book Report…………………………………………..(10) Marks
5. Assignments ………………………………………… (10) Marks
6. Project Report Presentation…………………………….. (15) Marks
7. Group Discussion.………………………………………… (10) Marks
8. Attendance …………………………………………………(05) Marks
9. **TOTAL: …………………………………………(50) Marks**

The final certification and acceptance of term work ensures the satisfactory performance of work assigned and minimum passing in the term work.

References
1. Fred Luthans, *"Organizational Behavior",* McGraw Hill, edition
2. Lesiker and Petit, *"Report Writing for Business",* McGraw Hill, edition
3. Huckin and Olsen, *"Technical Writing and Professional Communication",* McGraw Hill

4. Wallace and Masters, *"Personal Development for Life and Work"*, Thomson Learning, 12th edition

5. Heta Murphy, *"Effective Business Communication"*, Mc Graw Hill, edition

6. Sharma R.C. and Krishna Mohan, *"Business Correspondence and Report Writing"*, Tata McGraw-Hill   Education

7. Ghosh, B. N., *"Managing Soft Skills for Personality Development"*, Tata McGraw Hill. Lehman,

8. Dufrene, Sinha, "BCOM", Cengage Learning, 2nd edition

9. Bell, Smith, "Management Communication" Wiley India Edition, 3rd edition.

10. Dr. Alex, K., "Soft Skills", S Chand and Company

11. Subramaniam, R., "Professional Ethics" Oxford University Press.

12. Robbins Stephens P., "Organizational Behavior", Pearson Education

13. https://grad.ucla.edu/asis/agep/advsopstem.pdf

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITDLO5011	Advanced Data Structures & Analysis of Algorithms	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5011	Advanced Data Structures & Analysis of Algorithms	20	20	20	80	--	--	100

Course Objectives: Students will try:
1. To learn mathematical background for analysis of algorithm
2. To learn various advanced data structures.
3. To understand the concept of designing an algorithm.
4. To learn dynamic programming and greedy method.
5. To understand the concept of pattern matching
6. To learn advanced tree and graph applications.

Course Outcomes:
1. Students will be able to choose appropriate advanced data structure for given problem.
2. Students will be able to calculate complexity.
3. Students will be able to select appropriate design techniques to solve real world problems.
4. Students will able to apply the dynamic programming technique to solve the problems.
5. Students will be able to apply the greedy programming technique to solve the problems.
6. Students will be able to select a proper pattern matching algorithm for given problem.

Prerequisite: Knowledge Any Programming Language, Data structures and Analysis

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Data structures and analysis	02	--

I	Introduction	Introduction
		
		• Introduction to advanced data structures:
		
		• Introduction/Fundamentals of the analysis of algorithms
		  o Recurrences:
		    ▪ The substitution method
		    ▪ Recursive tree method
		    ▪ Masters method
		  o Probabilistic analysis
		  o Amortized analysis
		  o Randomized algorithms
		  o Mathematical aspects and analysis of algorithms
			10	CO1
				CO2

II	Advanced Data Structures	• Introduction • AVL tree • Huffman algorithm • B/B+ tree • 2-3 tree operations • Red-Black Trees • tries • Heap operations • Implementation of priority queue using heap • Topological sort Analysis of All problems	11	CO1 CO2 CO3
III	Divide and Conquer	• Introduction • Binary search • Finding the minimum and maximum • Merge sort • Quick sort • Strassen's matrix multiplication Analysis of All problems	7	CO2 CO3
IV	Greedy algorithms	• Introduction • Knapsack problem • Job sequencing with deadlines • Minimum cost spanning trees	8	CO2 CO3

				CO5
		○ Kruskal's algorithm ○ Prim's algorithm • Optimal storage on tapes • Optimal merge pattern • Subset cover problem • Container loading problem Analysis of All problems		
V	Dynamic algorithms And NP-Hard and NP-Complete	Introduction Dynamic algorithms • All pair shortest path • 0/1 knapsack • Travelling salesman problem • Coin Changing Problem • Matrix Chain Multiplication • Flow shop scheduling • Optimal binary search tree (OBST) • Analysis of All problems • Introduction to NP-Hard And NP-Complete Problems	8	CO2 CO3 CO4
VI	String Matching	• introduction • The naïve string matching algorithm • Rabin Karp algorithm • Knuth-Morris-Pratt algorithm (KMP) • Longest common subsequence(LCS) • Analysis of All problems • Genetic algorithms	6	CO2 CO3 CO6

Text Books:
1. Introduction to ALGORITHMS, Cormen, Leiserson, Rivest, Stein, PHI.
2. Algorithms: Design and Analysis, Harsh Bhasin, OXFORD.
3. Fundamentals of Computer Algorithms, Horowitz, Sahani, Rajsekaran, Universities Press.
4. C and Data structures, Deshpande, Kakde, Dreamtech Press.

Reference Books:
1. Data Structures and Algorithms in C++, Goodritch, Tamassia, Mount, WILEY.
2. Data Structures using C, Reema Thareja, OXFORD.
3. Data Structures and Algorithm Analysis in C, Mark A. Weiss, Pearson.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:
- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITDLO5012	Image Processing	04	--	--	04	--	--	04

Subject Code	Subject Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5012	Image Processing	20	20	20	80	--	--	100

Course Objectives: The course will help the students to get familiar with

1. Fundamental concepts of a digital image processing system.
2. Concepts of image enhancement techniques.
3. Various Image Transforms.
4. Compression techniques and Morphological concepts
5. Various segmentation techniques, and object descriptors.
6. Color models and various applications of image processing.

Course Outcomes: Students should be able to:

1. Remember the fundamental concepts of image processing.
2. Explain different Image enhancement techniques
3. Understand and review image transforms
4. Analyze the basic algorithms used for image processing &image compression with morphological image processing.
5. Contrast Image Segmentation and Representation
6. Design & Synthesize Color image processing and its real world applications.

Prerequisite: Mathematics and Statistics.

Detail Syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	As images are two dimensional signals, the single dimensional Digital Signal Processing fundamentals.	02	

I	Introduction to digital image processing system	Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships between Pixels.	07	CO 1
II	Image enhancement	Intensity Transformations and Spatial Filtering, Histogram processing, Filtering in Frequency Domain	09	CO 2
III	Image transforms	Discrete Fourier transform - Properties of two dimensional DFT, DCT, DST, Walsh, Hadamard, Haar Transform and their properties.	07	CO 3
IV	Image compression and morphological image processing	Fundamentals of compression, Basic compression Methods, Huffman Coding, Arithmetic Coding , LZW Coding , Run-Length Coding , Symbol-Based Coding, Bit-Plane Coding, Block Transform Coding , Predictive Coding. Image morphology, Opening & Closing, Hit or Miss Transform, Basic Morphological Algorithms	11	CO 4
V	Image segmentation and representation	The detection of discontinuities - Point, Line and Edge detections , Hough Transform, Thresholding Region based segmentation Chain codes, Polygon approximation, Shape numbers, Fourier descriptors, statistical Moments.	08	CO 5

VI	Color Image Processing and Applications	Color Fundamentals and Models, Pseudocolor Image Processing, Smoothing and Sharpening, Image Segmentation Based on Color. Biometric Authentication, Digital watermarking, Content Base Image Retrieval. Vector quantization	08	CO 6

Text Books:

1. Rafael C. Gonzalez and Richard E.woods, "Digital Image Processing", Addition - Wesley Publishing Company, New Delhi, Third Edition, 2007.
2. William K. Pratt, "Digital Image Processing", John Wiley, NJ, Fourth Edition 2007.

Reference Books:

1. Sid Ahmed M.A., "Image Processing Theory, Algorithm and Architectures", McGraw-Hill, 1995.
2. Kenneth R Castleman, "Digital Image Processing", Prentice Hall, New Delhi, 1996.
3. Anil.K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India Pvt Ltd., New Delhi, 1995.
4. S. Sridhar, " Digital Image Processing", second Edition, Oxford university press, New Delhi, 2016.
5. S. Jayaraman, S. Esakkirajan, T. Veerakumar " Digital Image Processing", McGraw-Hill, 2016

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:
- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITDLO5013	E-Commerce & E-Business	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5013	E-Commerce	20	20	20	80	--	--	100

Course Objectives: Students will try to :

1**.** Understand concept of Ecommerce and its types.
2. Be familiarized with technologies for Ecommerce.
3. Understand different types of Online Payment systems**.**
4. Understand Selling and marketing on web.
5. Be familiarized with concept of E-business and E-business Models.
6. Understand various E-business Strategies.

Course Outcomes: Students will be able to:

1. Define and differentiate various types of E-commerce.
2. Describe Hardware and Software Technologies for E-commerce.
3. Explain payment systems for E -commerce.
4. Describe the process of Selling and Marketing on web.
5. Define and Describe E-business and its Models.
6. Discuss various E-business Strategies.

Prerequisite: Internet Technologies, Internet Security, Middleware technologies, web services

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Internet Technologies, Internet Security, Middleware technologies, web services	02	
I	Introduction to E	E –commerce :Definition of e commerce , different types of E-commerce ,Examples	04	CO1

	–commerce	of E- commerce, E-commerce trade cycle , advantages and disadvantages of E-commerce , Traditional commerce Vs E - commerce		
II	Overview of Hardware and Software Technologies for Ecommerce	Overview of Client side programming (Dream weaver , Front page) Hardware and , Server side Programming (PHP) , Database Software connectivity , session tracking, middleware technologies for ecommerce perspective and security aspects with respect to e commerce, integration of web services	08	CO2
III	Payment System for Ecommerce	Traditional payment model , Characteristics of payment, Online Payment Basics, Payment Cards, Electronic Cash, Electronic Wallets, Stored-Value Cards, SET Protocol for credit card payment, Internet Technologies and the Banking Industry	10	CO3
IV	Selling and Marketing on Web	Selling on the Web: Revenue Models and Building a Web Presence: Revenue Models, Revenue Models in Transition, Revenue Strategy Issues, Creating an Effective Web Presence, Web Site Usability, Connecting with Customers Marketing on the Web: Web Marketing Strategies, Communicating with Different Market Segments, Beyond Market Segmentation: Customer Behavior and Relationship Intensity, Advertising on the Web, E-Mail Marketing, Technology-Enabled Customer Relationship Management, Creating and Maintaining Brands on the Web Online Auctions, Virtual Communities, and Web Portals	10	CO4
V	E business :- Introduction to e business and Developing E-business models	Definition of e- business , Characteristics , elements of e business , e business roles , Impact of e business , challenges of e business , difference between e business and e commerce , E-business structure, Evolution of E –business and stages , E –business models , Characteristics of Internet based software and e business solutions	10	CO5
VI	E business strategies	Strategic planning process, SCM , CRM , ERP , procurement	08	CO6

Text Books:

1 E -Commerce Fundamentals and application (Henry Chan) Wiley publication
2. Electronics Commerce (Gary Schneider) Thomson Course technology
3.E –Business , Parag Kulkarni , Sunita Jahirabadkar, Pradip Chande , Oxford Higher Education , Oxford University Press
4. E –business and E –commerce Management , Dave Chaffey , Pearson , 3rd edition
5. E commerce by Laudon

References:

1. E-Commerce Strategies, Technology and applications (David Whitley) Tata McGrawHill
2. Introduction to E-commerce Elias Awad

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:
- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/ Practical	Tutorial	Total
ITDLO5014	IT Enabled Services	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO5014	IT Enabled Services	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand importance of IT enabled services and challenges for the same.
2. To understand strategic IT planning for industries.
3. To develop enterprise IT architecture for Information technology.
4. To encourage the use of Information Technology so as to enable students to improve their skills, knowledge and job prospects and enable them to obtain employment in sunrise industries.
5. To develop the ability to integrate various resources for optimization in the industry as well as for strategic utilization of IT enabled services and functions.
6. To develop competence in global sourcing: strategy and management to gain a perspective on the global services sourcing landscape: past, present, and future.

Course Outcomes: Students will be able to:

1. Describe the importance of IT enabled services and challenges.
2. Identify strategic IT planning for software development.
3. Recognize enterprise IT architecture for Information technology.
4. Use of Information Technology so as to enable them for job in sunrise industries.
5. Illustrate various IT web services for betterment of knowledge.
6. Use their skills to find out various current IT trends in ITES.

Prerequisite: Internet Programming.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Information Technology and Project Management, Web Engineering and Technology.	02	
I	Business strategy: challenges and opportunities for IT	Business Strategy: Challenges and Opportunities in the Globalized, Interconnected, Convergent World, Establish Principles before Practice, IT Strategy, Application Strategy, Technology Strategy for IT, IT Management Strategy, Developing IT Strategy for Competitive Advantage, Stages of IT Strategy Development and Implementation, Challenges of IT and Business Strategy Alignment, Inhibitors of Business and IT Strategy Alignment, Three-D Framework for Business and IT Strategy Alignment.	09	CO1
II	Strategic IT planning	Business Implications for IT Strategic and Planning, Strategic IT Planning Motivations, SITP Process: Prevalent Planning Approaches, Difficulties in Developing and Executing SITP, Best Practices for Achieving Good SITP, SITP Approaches-Prevalent Researches.	09	CO2
III	Enterprise IT architecture	Defining EITA, Contents of a Typical Enterprise IT Architecture, Standard for Enterprise IT Architecture, Technology Management strategy Framework, Prevalent Technology Reference Architectures Framework and Standards, Program Management, Benefits of PMO, Desired Qualities of a Program Office Manager, Maturity of PMO, Implementation of PMO Strategy, Measuring PMO Performance, Success Factors for PMO, Project Scope Management, PMO Dashboard and Reporting.	08	CO3

IV	IT service management strategy	Information Technology Infrastructure Library (ITIL), ITIL Overview, ITIL Service Support Processes, Incident Management, Problem Management, Service Delivery, Service Level Management, Financial Management, Capacity Management, IT Service Continuity Management (ITSCM), Availability Management, Imperatives for Outsourcing, IT Management Layers, Variants of Outsourcing, Business Process Outsourcing, In sourcing.	08	CO4
V	IT enabled web services	Overview of basic features of PHP: arrays, functions and state management, working with PHP forms, More advanced PHP, OOP's concept in PHP, Portable database supported with different, exception handling, concepts of UDDI, WSDL, SOAP.	08	CO5
VI	Current trends in ITES	Current Employment in the IT and ITES industry: Newly emerging area and requirement of IT enabled service sector. Industry Oriented Human Resource Requirement: Outlook of the IT and ITES Industry. Barriers to Trade in ITES Role of International Bodies (WTO & UNCTAD) in facilitating Trade in ITEST/ITES, experiences and Case studies of ITES-call centers, ERP, google.	08	CO6

Text Books:

1. Sanjiva Shankar Dubey, " IT strategy and Management", PHI.
2. K. Venkatesh, " Marketing of Information Technology",TMH.
3. Steve Suehring, Timconverse, Joyoe Park , "PHP 6 and MySQL Bible", Wiley.

References:

1. Shiro Uesugi, "IT Enabled Services", Springer; 2013 edition, 2013.
2. Sanjiva Shankar Dubey, "IT Services Business Management: Concepts, Processes and Practices", PHI, 2012.
3. Nikhil Treebhoohu, "Promoting IT Enabled Services", Addison-Wesley, 2013.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:
- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	TW/Practical	Tutorial	Total
ITDLO5015	Computer Graphics & Virtual Reality	04	--	---	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work		Total
		Internal assessment			End Sem. Exam		Oral & Practical	
		Test1	Test2	Avg. of two Tests				
ITDLO5015	Computer Graphics & Virtual Reality	20	20	20	80	----	--	100

Course Objectives: Students will try:

1. To introduce the use of the components of a graphics system and become familiar with building approach of graphics system components and algorithms related with them.
2. To learn the basic principles of 3-dimensional computer graphics.
3. Provide an understanding of how to scan convert the basic geometrical primitives, how to transform the shapes to fit them as per the picture definition.
4. Provide an understanding of mapping from a world coordinates to device coordinates, clipping, and projections.
5. To be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.
6. To comprehend and analyze the fundamentals of animation, virtual reality, underlying technologies, principles, and applications.

Course Outcomes: Students will be able to:

1. To list the basic concepts used in computer graphics.
2. To implement various algorithms to scan, convert the basic geometrical primitives, transformations, Area filling, clipping.
3. To describe the importance of viewing and projections.
4. To define the fundamentals of animation, virtual reality and its related technologies.
5. To understand a typical graphics pipeline
6. To design an application with the principles of virtual reality

Prerequisite: Basic Mathematics

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Knowledge of Mathematics	2	
I.	Introduction to Computer graphics and Output primitives	**Introduction**: Display Devices, Bitmap and Vector based graphics, Overview of Coordinate System. **Scan Conversion** of: point, line using Digital differential analyzer & Bresenham's algorithm, circle using midpoint approach, **Curve Generation**: Bezier and B-Spline curves. **Introduction to fractals**: generation procedure, classification, dimension and Koch Curve.	7	C01
II.	Area Filling, Transformations (2D and 3D)	**Area filling**: Inside/Outside Test, Scan line Polygon Fill Algorithm, Boundary Fill and Flood Fill algorithm. **Basic Geometrical 2D Transformations:** Translation, Rotation, Scaling, Reflection, Shear, their homogeneous Matrix representation and Composite transformation. **Three Dimensional transformations:** Translation, Scaling, Rotations, Composite.	8	CO1 CO2
III.	Viewing (2D and 3D) Projection and Clipping	**Viewing**: Introduction, Viewing Pipeline, View Coordinate reference frame, Window to viewport transformation. **Three-Dimensional Viewing:** 3D Pipeline, Viewing transformation, **Projections**: Parallel (Oblique and orthographic), Perspective (one Point) **Clipping**: Point clipping, Line clipping**:** Cohen Sutherland Algorithm, Liang Barsky algorithms, Polygon clipping: Sutherland Hodgeman polygon clipping and Weiler Atherton. Text Clipping.	10	CO1 CO2 CO3

IV.	Introduction To Animation	**Animation**: Key Frame Animation, Animation Sequence, Motion Control Methods, **Morphing**, **Warping**- Mesh Warping.	4	CO1 CO2 CO4 CO5
V.	Introduction to Virtual Reality	**Virtual Reality:** Basic Concepts, Overview and perspective on virtual reality, Human sensation and perception. Classical Components of VR System, Types of VR Systems, Three-Dimensional Position Trackers, Navigation and Manipulation Interfaces, Gesture Interfaces, Input Devices, Graphical Display, Sound displays, and Haptic Feedback. Graphical Rendering Pipeline, Haptic Rendering Pipeline, Open GL rendering pipeline. **Applications** of Virtual Reality.	9	CO1 CO2 CO4 CO6
VI.	VR Modeling and Programming	**Geometric Modeling**: Virtual Object Shape, Object Visual Appearance. **Kinematics Modeling**: Object Position, Transformation Invariants, Object Hierarchies, **Physical Modeling**: Collision Detection, Surface Deformation, Force Computation. **Behavior Modeling**. Programming through **VRML/X3D**: Defining and Using Nodes and Shapes, VRML Browsers, **Java 3D, OpenCV** for augmented reality	12	CO1 CO2 CO4 CO6

Text Books

1 Donald Hearn and M. Pauline Baker, "Computer Graphics", Pearson Education.
2 R. K Maurya, "Computer Graphics with Virtual Reality", Wiley India.

Reference Books

1. Grigore Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley.
2. Steven Harrington, "Computer Graphics", McGraw Hill.
3. Rogers, "Procedural Elements of Computer Graphics", Tata McGraw Hill.
4. Vince, "Virtual Reality Systems", Pearson Education.
5. F.S. Hill, Stephen M. Kelley , "Computer Graphics using Open GL" Prentice Hall
6. Samyak Datta , "Learning OpenCV 3 Application Development", Packt

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

University of Mumbai

Program Structure B.E. Information Technology, (Rev. 2016)

T. E. Information Technology (Semester-VI)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut	Theory	TW/ Pract	Tut	Total
ITC601	Software Engineering with Project Management	4	-	-	4	-	-	4
ITC602	Data Mining and Business Intelligence	4	-	-	4	-	-	4
ITC603	Cloud Computing & Services	4	-	-	4	-	-	4
ITC604	Wireless Networks	4	-	-	4	-	-	4
ITDLO-II	Department Level Optional Course -II	4	-	-	4	-	-	4
ITL601	Software Design Lab	-	2	-	-	1	-	1
ITL602	Business Intelligence Lab	-	2	-	-	1	-	1
ITL603	Cloud Service Design Lab	-	2	-	-	1	-	1
ITL604	Sensor Network Lab	-	2	-	-	1	-	1
ITM605	Mini-project	-	4	-	-	2	-	2
	Total	**20**	**12**	-	**20**	**6**	-	**26**

Course Code	Course Name	Examination Scheme								
		Theory					TW	Oral	Oral & Pract	Total
		Internal Assessment			End Sem. Exam	Exam Duration (in Hrs)				
		Test 1	Test 2	Avg.						
ITC601	Software Engineering with Project Management	20	20	20	80	3	-	-	-	100
ITC602	Data Mining and Business Intelligence	20	20	20	80	3	-	-	-	100
ITC603	Cloud Computing & Services	20	20	20	80	3	-	-	-	100
ITC604	Wireless Networks	20	20	20	80	3	-	-	-	100
ITDLO-II	Department Level Optional Course -II	20	20	20	80	3	-	-	-	100
ITL601	Software Design Lab	-	-	-	-	-	25	25	--	50
ITL602	Business Intelligence Lab	-	-	-	-	-	25	25	--	50
ITL603	Cloud Service Design Lab	-	-	-	-	-	25	25	--	50
ITL604	Sensor Network Lab	-	-	-	-	-	25	25	--	50
ITM605	Mini-Project	-	-	-	-	-	25	25	--	50
Total		100	100	100	400	-	125	125	--	750

Department Level Optional Course (DLO)

Every student is required to take one Department Elective Course for Semester VI. Different sets of courses will run in both the semesters. Students can take these courses from the list of department electives, which are closely allied to their disciplines.

(DLO-I subjects will have no Labs only Theory)

Subject Code	Department Level Optional Course (DLO)
Semester VI	
ITDLO6021	Advance Internet Programming
ITDLO6022	Software Architecture
ITDLO6023	Digital Forensics
ITDLO6024	Multimedia Systems
ITDLO6025	Green IT

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC601	Software Engineering with Project Management	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC601	Software Engineering with Project Management	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand the nature of software development and software life cycle process models, agile software development, SCRUM and other agile practices.
2. To Explain methods of capturing, specifying, visualizing and analyzing software requirements.
3. To understand concepts and principles of software design and user-centric approach and principles of effective user interfaces.
4. To know basics of testing and understanding concept of software quality assurance and software configuration management process.
5. To understand need of project management and project management life cycle.
6. To understand project scheduling concept and risk management associated to various type of projects.

Course Outcomes: Students will be able to:

1. Define various software application domains and remember different process model used in software development.
2. Explain needs for software specifications also they can classify different types of software requirements and their gathering techniques.
3. Convert the requirements model into the design model and demonstrate use of   software and user-interface design principles.
4. Distinguish among SCM and SQA and can classify different testing   strategies and tactics and compare them.
5. Justify role of SDLC in Software Project Development and they can   evaluate importance of Software Engineering in PLC.
6. Generate project schedule and can construct, design and develop   network diagram for different type of Projects. They can also organize different activities of project as per Risk impact factor.

Prerequisite: Programming and Networking.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Nature of Software, Software Definition, Software Characteristics, Software Application Domains	02	
I	The Software Process	Generic view of Process, Prescriptive Models: Waterfall Model, Incremental-RAD Model, Evolutionary Process Model- Prototyping, Spiral and Concurrent Development Model, Specialized Models: Component based, Aspect Oriented Development, Agile Methodology, Scrum and Extreme Programming	07	CO1
II	Requirements Engineering and Cost Estimation	Requirement, Types of Requirements, Requirement gathering, Requirement Engineering Task, Identifying Stakeholders, Multiple viewpoints, SRS (Software Requirement Specification) Project Estimation, LOC based, FP based and Use case based estimation.	07	CO1 CO2
III	Analysis and Design Engineering	Introduction of Analysis elements, Scenario based, Flow based, behavior and class based Design Concepts and Principles, Architecture Design, Component Level Design, System Level Design, User Interface Design**.**	09	CO1 CO2 CO3
IV	Quality & Configuration Management	Need for Testing, Testing Tactics, Testing strategies, McCall's Quality Factor, Software Configuration Management, SCM Process	07	CO4
V	IT Project Management	Introduction, 4 P's, W5HH Principle, Need for Project Management, Project Life cycle and ITPM, Project Feasibility, RFP, PMBOK Knowledge areas, Business Case, Project Planning, Project Charter and Project Scope.	10	CO5

VI	Project Scheduling and Risk Management	WBS, Developing the Project Schedule, Network Diagrams (AON, AOA), CPM and PERT, Gantt Chart, Risk Identification, Risk Projection and RMMM	10	CO1
				CO2
				CO3
				CO4
				CO6

Text Books:

1. Roger S Pressman "Software Engineering : A Practitioner's Approach" 7th Edition Mcgraw-Hill ISBN:0073375977
2. Jack T. Marchewka, "Information Technology Project Management" 4th Edition ,Wiley India

References:

1. "Software Engineering : A Precise Approach" Pankaj Jalote , Wiley India
2. Ian Sommerville " Software Engineering" 9th edition Pearson Education SBN-13: 978-0- 13-703515-1, ISBN-10: 0-13-703515-2
3. John M. Nicholas, Project Management for Business and Technology, 3rd edition, Pearson Education.
4. Software Project management by Bob Hughes, Mike Cotterell , Rajib Mall

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:
- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC602	Data Mining and Business Intelligence	04		--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC602	Data Mining and Business Intelligence	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To introduce the concept of data Mining as an important tool for enterprise data management and as a cutting edge technology for building competitive advantage.
2. To enable students to effectively identify sources of data and process it for data mining
3. To make students well versed in all data mining algorithms, methods of evaluation.
4. To impart knowledge of tools used for data mining
5. To provide knowledge on how to gather and analyze large sets of data to gain useful business understanding.
6. To impart skills that can enable students to approach business problems analytically by identifying opportunities to derive business value from data.

Course Outcomes: Student will be able to:

1. Demonstrate an understanding of the importance of data mining and the principles of business intelligence
2. Organize and Prepare the data needed for data mining using pre preprocessing techniques
3. Perform exploratory analysis of the data to be used for mining.
4. Implement the appropriate data mining methods like classification, clustering or Frequent Pattern mining on large data sets.
5. Define and apply metrics to measure the performance of various data mining algorithms.
6. Apply BI to solve practical problems : Analyze the problem domain, use the data collected in enterprise apply the appropriate data mining technique, interpret and visualize the results and provide decision support.

Prerequisite: Database Management System, Advanced Data Management Technology.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	Knowledge of databases, and Date warehousing, OLAP	02	--
I	Introduction to Data Mining	What is Data Mining; Kind of patterns to be mined; Technologies used; Major issues in Data Mining	03	CO1
II	Data Exploration and Data Preprocessing	Types of Attributes; Statistical Description of Data; Data Visualization; Measuring similarity and dissimilarity. Why Preprocessing? Data Cleaning; Data Integration; Data Reduction: Attribute subset selection, Histograms, Clustering and Sampling; Data Transformation & Data Discretization: Normalization, Binning, Histogram Analysis and Concept hierarchy generation.	09	CO2 CO3
III	Classification	Basic Concepts; Classification methods: 1. Decision Tree Induction: Attribute Selection Measures, Tree pruning. 2. Bayesian Classification: Naïve Bayes‟ Classifier. Prediction: Structure of regression models; Simple linear regression, Multiple linear regression. Accuracy and Error measures, Precision, Recall, Holdout, Random Sampling, Cross Validation.	09	CO4 CO5
IV	Clustering	Cluster Analysis: Basic Concepts; Partitioning Methods: K-Means, K-Mediods; Hierarchical Methods: Agglomerative, Divisive, BIRCH; Density-Based Methods: DBSCAN What are outliers? Types, Challenges; Outlier Detection Methods: Supervised, Semi Supervised, Unsupervised, Proximity based, Clustering Based.	10	CO4 CO5
V	Frequent Pattern	Market Basket Analysis, Frequent Itemsets, Closed Itemsets, and	10	CO4

	Mining	Association Rules; Frequent Pattern Mining, Efficient and Scalable Frequent Itemset Mining Methods, The Apriori Algorithm for finding Frequent Itemsets Using Candidate Generation, Generating Association Rules from Frequent Itemsets, Improving the Efficiency of Apriori, A pattern growth approach for mining Frequent Itemsets; Mining Frequent itemsets using vertical data formats; Introduction to Mining Multilevel Association Rules and Multidimensional Association Rules; From Association Mining to Correlation Analysis, lift, ; Introduction to Constraint-Based Association Mining.		CO5
VI	Business Intelligence	What is BI? Business intelligence architectures; Definition of decision support system; Development of a business intelligence system using Data Mining for business Applications like Fraud Detection, Clickstream Mining, Market Segmentation, retail industry, telecommunications industry, banking & finance CRM etc.	09	CO6

Text Books:

1. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.
2. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
3. Business Intelligence: Data Mining and Optimization for Decision Making by Carlo Vercellis ,Wiley India Publications.
4. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", 2nd Edition, Wiley India.

References:

1. Michael Berry and Gordon Linoff "Data Mining Techniques", 2nd Edition Wiley Publications.
2. Michael Berry and Gordon Linoff "Mastering Data Mining- Art & science of CRM", Wiley Student Edition.
3. Vikram Pudi & Radha Krishna, "Data Mining", Oxford Higher Education.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**

Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC603	Cloud Computing & Services	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC603	Cloud Computing & Services	20	20	20	80	--	--	100

Course Objectives: Students will try to learn:

1. Basics of cloud computing.
2. Key concepts of virtualization.
3. Different Cloud Computing services
4. Cloud Implementation, Programming and Mobile cloud computing
5. Key components of Amazon Web Services
6. Cloud Backup and solutions

Course Outcomes: Students should be able to:

1. Define Cloud Computing and memorize the different Cloud service and deployment models
2. Describe importance of virtualization along with their technologies.
3. Use and Examine different cloud computing services
4. Analyze the components of open stack & Google Cloud platform and understand Mobile Cloud Computing
5. Describe the key components of Amazon web Service
6. Design & develop backup strategies for cloud data based on features.

Prerequisite Subjects: Computer Network, Operating System

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisites	OSI Layers, Basics of OS.	02	--
I	Introduction	Defining Cloud Computing, Cloud and other similar configurations, Components of Cloud	06	CO1

		Computing, Cloud types: NIST and Cloud Cube Models, Cloud Deployment Models and Service Models, Cloud computing architecture, Advantages and Disadvantages of Cloud Computing.		
II	Virtualization	Virtualization: Characteristics of virtualized environment, Understanding the importance of Hypervisors, Type I & Type II Hypervisors, Taxonomy of virtualization, Implementation Levels of Virtualization, Virtualization of CPU, Memory and I/O Devices , Virtualization and Cloud Computing, Pros and Cons of virtualization, Technology Examples: KVM, Xen, Vmware and HyperV	10	CO2
III	Cloud Computing Services	Exploring Cloud Computing Services: SPI Model: Software as a service, Platform as a service, and Infrastructure as a service. Anything as a service or Everything as a service (XaaS): Security as a Service, Identity management as a Service, Database as a Service, Storage as a Service, Collaboration as a Service, Compliance as a Service, Monitoring as a Service, Communication as a Service, Network as a Service, Disaster recovery as a service, Analytics as a Service, Backup as a Service.	09	CO1 CO2 CO3
IV	Cloud Implementation, Programming and Mobile Cloud Computing	Open Stack Cloud Architecture: Feature of Open stack, Components of Open stack, mode of operations. Programming support for Google apps engine-GFS, Bigtables, Chubby, Google APIs. Mobile Cloud Computing: Definition, architecture, benefits and challenges of mobile	09	CO1 CO2 CO3 CO4

		cloud computing		
V	Exploring the Components of Amazon Web Services	AWS cloud computing Platform, a) Elastic Compute Cloud(EC2): Compute Basics, Instance types, Life cycle of instances. b) Simple Storage Service (S3): Basics and Operations, Features, Amazon Glacier, Glacier vs S3. c) Elastic Block Storage (EBS):Basics and Types of EBS Volumes d)Amazon Virtual Private Cloud (Amazon VPC): Subnets, Route tables, Elastic IP Addresses (EIP), Elastic Network Interfaces (ENIs) & Security groups & ACL. e) Exploring Elastic Load Balancing (ELB): Basics, Types of load balancers, Configuring Elastic Load Balancing, Basics of Cloud Watch & Auto Scaling.	11	CO1 CO2 CO3 CO4 CO5
VI	Cloud Backup & Solutions	Cloud Backup Solutions and their features, Cloud data management interface (CDMI), Cloud Storage gateways (CSG), Comparison between different cloud platforms: Amazon web services & Open stack (Based on Type of deployment, Services supported and their components).	05	CO1 CO2 CO3 CO4 CO5 CO6

Text Books:

1. Barrie Sosinsky ,"Cloud Computing Bible",Wiley Publication.
2. Kailash Jayaswal, Jagannath Kallalurchi, Donald J. Houde, Dr. Deven Shah, "Cloud Computing Black Book", Dreamtech Press.
3. Joe Baron et.al ,"AWS certified solution Architect", Sybex publication.
4. Mastering Cloud Computing, Rajkumar Buyya, MGH publication

Reference Books:

1. Thomas Erl,Robert Cope,Amin naserpour,"Cloud Computing Design Patterns",Pearson Publication.
2. Judith Hurwitz ,"Cloud Computing for Dummies" , Wiley Publication.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Oral & Practical	Tutorial	Total
ITC604	Wireless Network	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITC604	Wireless Network	20	20	20	80	--	--	100

Course Objectives: Students will try to:

1 Understand the fundamentals of wireless networks.
2 Learn and analyze the different wireless technologies.
3 Evaluate Ad-hoc networks and wireless sensor networks.
4 Understand and evaluate emerging wireless technologies and standards
5 Understand design considerations for wireless networks
6 Learn and analyze and evaluate the security threats and related security standards

Course Outcomes: Students will be able to:

1. Explain the basic concepts of wireless network and wireless generations.
2. Demonstrate the different wireless technologies such as CDMA, GSM, GPRS etc
3. Appraise the importance of Ad-hoc networks such as MANET and VANET and Wireless Sensor networks
4. Describe and judge the emerging wireless technologies standards such as WLL, WLAN, WPAN, WMAN.
5. Explain the design considerations for deploying the wireless network infrastructure.
6. Differentiate and support the security measures, standards. Services and layer wise security considerations.

Prerequisite: Computer Networks.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Modulation and Demodulation Techniques, PSTN	02	
I	Fundamentals Wireless Communication	Fundamentals of Wireless Communication, Advantages, limitations and application, wireless media, Infrared Modulation Techniques, DSSS and FHSS, Frequency Spectrum: Radio and Infrared; Wireless generations: 1G: Cellular,2G: Mobile Radio,3G: UMTS- Security related Encryption Algorithm,4G	07	CO1
II	Evolution of Wireless Technologies	Multiple Access Technique: TDMA, FDMA, CSMA, CDMA Wireless Technologies: GSM, GPRS, EDGE,CDMA,LTE, UMTS	10	CO1 CO2
III	Types of Wireless Networks	Ad-hoc: MANET & VANET, Application, Advantage and limitations; Wireless Sensor Network: Application, advantages and limitations	09	CO1 CO3
IV	Emerging Wireless Technologies and standards	WLL , WLAN- 802.11 (Wi-Fi), WPAN- 802.15.1/3/4 (Bluetooth, Zigbee), WMAN-802.16a (Wi-max) , Wi-max and LTE /3GPP comparison, Mi-fi, Ly-fi,	10	CO1 CO2 CO4
V	Wireless Network Design Considerations	Wireless technology, Cisco Unified Wireless Network, Designing Wireless Networks with Lightweight Access Points and Wireless LAN Controllers	07	CO1 CO2 CO3 CO4 CO5
VI	Wireless Network Security	The need, attacks, security serviced, WEP, Mobile IP, VPN(PPTP, LLTP, IPSec), Network Layer Security, Transport Layer Security, Email Security: PGP, S/ MIME, Internet Firewalls for Trusted System	07	CO1 CO2 CO3 CO6

Text Books:

1. Cellular Communications: A Comprehensive and Pratical Guide, Nishith Tripathi, Jeffery H Reed, Wiley
2. Wireless Mobile Internet Security, 2nd Edition, Man, Young Rhee, Wiley- IEEE press
3. Designing for Cisco Internetwork Solutions (DESGN), 2nd Edition, CCDA, Diane Teare, cisco Press.

References:

1. Introduction to Digital mobile communication, 2nd Edition, Yoshihiko Akaiwa
2. "Wireless Communications and networks", William Stallings, Pearson / Prentice Hall
3. Wireless communication and networking, Vijay Garg

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:
- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITL601	Software Design Lab	--	02	--	--	1	--	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL601	Software Design Lab	--	--	--	--	25	--	25	50

Course Objectives: Students will try to:

1 Learn basic concepts of UML.
2 Master the vocabulary, rules, and idioms of the UML and learn how to model it effectively.
3 Understand how to apply the UML to solve a number of common modeling problems.
4 Model the systems, from concept to executable artifact, using object-oriented techniques.
5 Apply the knowledge of Software engineering and project management.
6 Understand the software development process using tool.

Course Outcomes: Students will be able to:

1. Sketch a Modeling with UML.
2. Deploy Structural Modeling.
3. Deploy Behavioral Modeling.
4. Deploy Architectural Modeling.
5. Examine estimation about schedule and cost for project development.
6. Select project development tool.

Prerequisite: Object oriented Concept, Java programming language.

Requirement:-

Hardware	Software
PC i3 or above.	IBM Rational Rose Modeler, Dia, StarUML (Any One) Orange Scrum, Xampp , GitHub

Guidelines

1. Students should take one case study as a mini project work which is to be conducted by a group of three students

2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.

3. The students must be able to identify Object oriented Technologies, Basic expression of Classes, Attributes and operations.

4. Students must develop a Conceptual Model of the UML for above case study.

5. Students should define Classes, Relationships, Class Diagrams, Advanced Classes and Relationship, Object Diagrams for above case study.

6. Students should define Use Cases, Use case Diagrams, Activity Diagrams, Interaction Diagrams, State Chart Diagrams for above case study.

7. Students should define Components, Deployment, Collaborations, Component Diagrams, Deployment Diagrams for above case study

8. Students should define SRS, WBS, Network Diagram, Gantt Chart, Cost Estimation Techniques

9. Demonstration it using Scrum Tool

10. Each group may present their work in various project competitions and paper presentations.

11. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. "The Unified Modeling Language User Guide" by Grady Booch, James Rumbaugh, Ivar Jacobson, Pearson Publication,ISBN 978-81-7758-372-4
2. Jack T. Marchewka, Information Technology Project Management, 4th edition, Wiley India, 2009.

References:

1. UML – Tutorial "www.tutorialspoints.com/uml/"
2. "An Introduction to Object-Oriented Analysis: Objects and UML in plain English" by Davis William Brown, Wiley, Second Edition
3. "Fundamentals of Object-Oriented Design in UML", Meilir Page-Jones, Pearson Education
4. UML in 24 Hours
5. UML Basics— an Introduction to the Unified Modeling Language – IBM "www.ibm.com › Learn › Rational"

Term Work:

Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Case Study) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Case Study and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITL602	Business Intelligence lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL602	Business Intelligence Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To introduce the concept of data Mining as an important tool for enterprise data management and as a cutting edge technology for building competitive advantage.
2. To enable students to effectively identify sources of data and process it for data mining
3. To make students well versed in all data mining algorithms, methods, and tools.
4. To learn how to gather and analyze large sets of data to gain useful business understanding.
5. To impart skills that can enable students to approach business problems analytically by identifying opportunities to derive business value from data.
6. To identify and compare the performance of business.

Lab Outcomes: Students should be able to:

1. Identify sources of Data for mining and perform data exploration
2. Organize and prepare the data needed for data mining algorithms in terms of attributes and class inputs, training, validating, and testing files.
3. Implement the appropriate data mining methods like classification, clustering or association mining on large data sets using open source tools like WEKA
4. Implement various data mining algorithms from scratch using languages like Python/ Java etc.
5. Evaluate and compare performance of some available BI packages
6. Apply BI to solve practical problems : Analyze the problem domain, use the data collected in enterprise apply the appropriate data mining technique, interpret and visualize the results and provide decision support.

Prerequisite: Object oriented Concept, Java programming language.

Requirement:-

Hardware	Software
PC i3 or above.	Open source data mining and BI tools like WEKA, Rapid Miner, Pentaho.

Detailed syllabus:

Module	Detailed Content	Hours	LO Mapping
1 & II	2 tutorials a) Solving exercises in Data Exploration b) Solving exercises in Data preprocessing	04	LO 1 LO 2
III	Using open source tools Implement a) Classifiers b) Clustering Algorithms c) Association Mining Algorithms	06	LO 3
IV	a) Implementation of any one classifier using languages like JAVA/ python/R b) Implementation of any one clustering algorithm using languages like JAVA/ python c) Implementation of any one association mining algorithm using languages like JAVA/ python	06	LO 4
V	Detailed case study of any one BI tool (open source tools like Pentaho can be used) (paper Assignment)	04	LO 5
VI	**Business Intelligence Mini Project**: Each group assigned one new case study for this; A BI report must be prepared outlining the following steps: a)Problem definition, Identifying which data mining task is needed b) Identify and use a standard data mining dataset available for the problem. Some links for data mining datasets are: WEKA site, UCI Machine Learning Repository, KDD site, KDD Cup etc. c) Implement the data mining algorithm of choice	06	LO 6

	d) Interpret and visualize the results e) Provide clearly the BI decision that is to be taken as a result of mining.		

Text Books:

1. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.
2. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", 1st Edition, Wiley India.

References:

1. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
2. WEKA, RapidMiner Pentaho resources from the Web.

Term Work:
Term Work shall consist of at least 10 to 12 practical's based on the below list. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITL603	Cloud Service Design Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Oral & Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITL603	Cloud Service Design Lab	--	--	--	--	25	--	25	50

Lab Objectives: **S**tudents to get familiar with:

1. Key concepts of virtualization & different types of Hypervisors used in virtualization along with implementation
2. Concept of On demand Application Delivery like SaaS using Ulteo
3. Open source cloud implementation and administration using Open Stack
4. Various Cloud services provided by Amazon Web Services
5. Programming on Platform as a Service cloud
6. Implementation of Storage as a service using Own Cloud.

Lab Outcomes: Students should be able to:

1. Define & implement Virtualization using different types of Hypervisors
2. Describe steps to perform on demand Application delivery using Ulteo .
3. Examine the installation and configuration of Open stack cloud
4. Analyze and understand the functioning of different components involved in Amazon web services cloud platform.
5. Describe the functioning of Platform as a Service
6. Design & Synthesize Storage as a service using own Cloud

Prerequisite Subjects: Computer Network, Operating System, Java Programming

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
a)Hardware Configuration for server 1.Intel or AMD Multi Core processors (like i3/i5/i7/Quad core/Octa core) with Intel VT-X or AMD-V support	**a) Software Requirements for Server** 1.Server OS for Physical Sever like CentOS /Fedora/Ubuntu/ Redhat Server 2.Pre-configured OpenSSH	1. Internet Connection for each PC with at least 2 MBPS bandwidth and LAN bandwidth of 1 GBPS.

2. 6 GB RAM 3. 500 GB Harddisk 4. Gigabit Ethernet (GbE) network interface card (NIC) **b)Hardware Configuration for Cloud Client** PC/Laptop/Smart phone/Thin Client or Any device which has built-in Wifi, Ethernet or data connection facility.	3.Xen Server DVD 4.Ulteo DVD **a) Software Requirements for Clients** 1. JDK 1.8 or higher & .NET Framework 4 2. Netbeans or Eclipse IDEs 3. OpenSSH client or putty 4.Vmware Workstation, 5.Oracle Virtualbox 6. Built-in web browser.	

Suggested List of Experiments

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Virtualization	1. Creating and running virtual machines on Hosted Hypervisors like KVM Type 1 ,Vmware Workstation,Oracle Virtualbox 2. Creating and running virtual machines on Bare-Metal Hypervisors Type 0 like Xen,Vmware ESXI or HyperV	06	LO1
II	On demand Application Delivery and Virtual Desktop infrastructure	Installation and Configuration of Ulteo to demonstrate on demand Application delivery over web browser to explore SaaS Environment.	04	LO2
III	Open source cloud implementation and administration	To demonstrate installation and Configuration of Open stack Private cloud.	04	LO3
IV	Amazon Web Services	Like auto scaling, elastic load balancing, virtual private computing & Networking. Security service provided by Amazon web services. Accessing AWS using	06	LO4

		web services API provided by Amazon.		
V	Platform as a Service	To Demonstrate Platform as a Service using Googleapp Engine/IBM BlueMix/tSuru	04	LO5
VI	Storage as a Service	Explore Storage as a service using own Cloud for remote file access using web interfaces. S3 storage and glacier storage and understand the storage LC management provided by AWS.	02	LO6

Text Books:

1. Barrie Sosinsky ,"Cloud Computing Bible",Wiley Publication.
2. Kailash Jayaswal, Jagannath Kallalurchi, Donald J. Houde, Dr.Deven Shah, "Cloud Computing Black Book", Dreamtech Press.
3. Joe Baron et.al ,"AWS certified solution Architect", Sybex publication.
4. Mastering Cloud Computing, Rajkumar Buyya, MGH publication

Reference Books:

1. Learn to Master Cloud Computing by Star EduSolutions
2. Kai Hwang,"Distributed and Cloud Computing",MK Publication
3. Thomas Erl,Robert Cope,Amin naserpour,"Cloud Computing Design Patterns",Pearson
   Publication.
4. Judith Hurwitz ,"Cloud Computing for Dummies" , Wiley Publication.

Web Resources:

   1. http://fosshelp.blogspot.in
   2. https://aws.amazon.com/
   3. https://docs.openstack.org/
   4. https://owncloud.org/
   5. https://appengine.google.com

Term Work:
Term Work shall consist of at least 10 to 12 practical's based on the below list. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL604	Sensor Network Lab	--	02	--	--	1	--	1

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test2	Avg. of twoTests					
ITL604	Sensor Network Lab	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To learn different types of sensors from Motes families.
2. To design the problem solution as per the requirement analysis done using Motes sensors.
3. To study the basic concepts of programming/sensors/ emulator like cooja etc.
4. To design and implement the mini project intended solution for project based learning.
5. To build and test the mini project successfully.
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Identify the requirements for the real world problems.
2. Conduct a survey of several available literatures in the preferred field of study.
3. Study and enhance software/ hardware skills.
4. Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing.
5. To report and present the findings of the study conducted in the preferred domain
6. Demonstrate an ability to work in teams and manage the conduct of the research study.

Guidelines

1. The mini project work is to be conducted by a group of three students

2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.

3. The students may do survey for different application using different types of sensors for their mini project.

4. Each group will identify the Hardware (Motes from different Motes families) & sensor configuration and software requirement for their mini project problem statement.

5. Design your own circuit board using multiple sensors etc.

6. Installation, configure and manage your sensors in such away so that they can communicate with each other.

7. Work with operating system, emulator like contiki cooja and do coding to for input devices on sensors.

8. Create and interface using Mobile/Web to publish or remotely access the data on Internet.

9. Each group along with the concerned faculty shall identify a potential problem statement, on which the study and implementation is to be conducted.

10. Each group may present their work in various project competitions and paper presentations.

11. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Text Books:

1. Fundamentals of Sensor Network Programming: Applications and Technology, By S. Sitharama Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley publication.
2. Contiki Cooja User Guide.

References:

1. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , Arshdeep Bahga
2. A comparative review of wireless sensor network mote technologies, IEEE paper 2009

Term Work:
Term Work shall consist of full Mini Project on above guidelines/syllabus. Also Term work Journal must include at least 2 assignments.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical / Oral	Tutorial	Total
ITM605	Mini-Project	--	04	--	--	2	--	2

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical & Oral	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test2	Avg. of two Tests					
ITM605	Mini-Project	--	--	--	--	25	--	25	50

Lab Objectives: Students will try:

1. To offer students a glimpse into real world problems and challenges that need IT based solutions
2. To enable students to create very precise specifications of the IT solution to be designed.
3. To introduce students to the vast array of literature available of the various research challenges in the field of IT
4. To create awareness among the students of the characteristics of several domain areas where IT can be effectively used.
5. To enable students to use all concepts of IT in creating a solution for a problem
6. To improve the team building, communication and management skills of the students.

Lab Outcomes: Student will be able to:

1. Discover potential research areas in the field of IT
2. Conduct a survey of several available literature in the preferred field of study
3. Compare and contrast the several existing solutions for research challenge
4. Demonstrate an ability to work in teams and manage the conduct of the research study.
5. Formulate and propose a plan for creating a solution for the research plan identified
6. To report and present the findings of the study conducted in the preferred domain

Guidelines

1. The project work is to be conducted by a group of three students

2. Each group will be associated with a project mentor/guide. The group should meet with the project mentor/guide periodically and record of the meetings and work discussed must be documented.

3. Department has to allocate half day for the project work in VI semester, 1 day in VII semester and 2 day in VIII semester every week.

4. To encourage project based learning in the curriculum students may identify their technical domain area in semester VI and can perform the Mini-project in the VI semester or students may do literature survey

5. Each group along with its guide/mentor shall identify a potential research area/problem domain, on which the study is to be conducted.

6. Each team will do a rigorous literature survey of the problem domain by reading and understanding at least 3-5 research papers from current good quality national/international journals/conferences. (Papers selected must be indexed by Scopus/IEEE/Springer/ACM etc.). The list of papers surveyed must be clearly documented.

7. The project assessment for term work will be done at least two times at department level by giving presentation to panel members which consist of at least three (3) members as Internal examiners (including the project guide/mentor) appointed by the Head of the department of respective Programme.

8. A report is to be prepared summarizing the findings of the literature survey. A comparative evaluation of the different techniques surveyed is also to be done.

9. Teams must analyze all the results obtained by comparing with other standard techniques.

10. Every team must publish their work in national / international conference/journals (if possible publish in Scopus indexed journals).

11. The team will finally propose a plan for project work to be continued in the final year.

12. Semester VII to carry out the project good quality project and all these project part

Evaluation

1. Each team has to give presentation/demo to the Internal Panel and External examiner.

2. Each team will prepare a report that will summarize the results of the literature survey and the project proposal. The list of papers surveyed must be clearly documented.

3. Each group will be jointly evaluated by a team of Internal and External Examiners approved by the University of Mumbai.

4. Oral exam will be conduct on the project done by the students.

Term Work:
Term Work shall consist of full Mini Project on above guidelines/syllabus.

Term Work Marks: 25 Marks (Total marks) = 20 Marks (Mini Project) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO6021	Advance Internet Programming	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6021	Advance Internet Programming	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To get familiar with the concept of Search Engine Basics.
2. To Understand Search Engine Optimization Techniques.
3. To Learn Web Service Essentials.
4. To gain knowledge of Rich Internet Application Technologies.
5. To be familiarized with Web Analytics 2.0
6. To explore Web 3.0 and Semantic web standards.

Course Outcomes: Students will be able to:

1. Determine SEO Objectives and Develop SEO plan prior to Site Development.
2. Explain Search Engine Optimization Techniques and Develop Keyword Generation.
3. Describe different Web Services Standards.
4. Develop Rich Internet Application using proper choice of Framework.
5. Apply multiple quantitative and qualitative methods for web analytics 2.0.
6. Explain Web 3.0 and Semantic web standards

Prerequisite: Basics of Internet Programming – HTML5, CSS3, XML.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Introduction to HTML 5 & CSS3 basics, XML basics	02	
I	Search Engine Basics	Search Engine Basics Algorithm based Ranking Systems – Determining Searcher Intent and Delivering Relevant, Fresh Content, Analyzing Ranking Factors, Using Advanced Search Techniques, Vertical Search Techniques, Country Specific search engines. Determining SEO Objective and Finding Your Site's Audience – Setting SEO Goals and Objective Developing SEO plans Prior to Site Development, SEO for Raw traffic ; E-commerce Sales; Mindshare/Branding; Direct Marketing; Reputation Management; Ideological Influence	09	CO1
II	Search Engine Optimization	Getting started SEO: Defining Your Site's Information Architecture, Auditing an Existing Site to identify SEO Problems, Identifying Current Server Statistic Software and Gaining Access – Determining Top competitors, Benchmarking Current Indexing Status, Current Rankings, Benchmarking Current Traffic Source and Volumes, Conduct SEO/Website SWOT analysis. Keyword Generation – Creating Pages – Website Structure- Creating Content-Creating Communities-building Links-Using Google Analytics-Social Media Optimization-Creating Pay-per-click Campaigns- Optimizing PPC Campaigns through Quality Score optimization - Tracking Results and Measuring Success.	09	CO1 CO2
III	Web Services	Web Services: Introduction to Web Services, XML, XSL, XSLT, WSDL, SOAP, UDDI, Transaction, Business Process Execution Language for web Services, WS-Security and web service security specification, WS-Reliable Messaging, WS-Policy, WS-Attachments. REST-ful web services, Resource Oriented Architecture, Comparison of REST, SOA, SOAP.	08	CO1 CO2 CO3
IV	Rich Internet Application	**Introduction to AJAX**, Blogs, Wikis, RSS feeds **Working with Java Script Object Notation (JSON)**, Implement JSON on server side,	08	CO4

		Implementing Security and Accessibility in AJAX Applications: Secure AJAX application, Accessible Rich Internet Applications **Developing RIA using AJAX Techniques:** CSS, HTML, DOM, XMLHTTPRequest, JavaScript, PHP, AJAX as REST Client **Introduction to Open Source Frameworks and CMS for RIA:** Django, Drupal, Joomla introduction and comparison.		
V	Web Analytics 2.0	Introduction to Web Analytics 2.0 1: State of the Analytics Union, State of the Industry, Rethinking Web Analytics: Meet Web Analytics 2.0, Optimal Strategy for Choosing Your Web Analytics Soul Mate. The Awesome World of Clickstream Analysis: Metrics. The Key to Glory: Measuring Success. Failing Faster: Unleashing the Power of Testing and Experimentation.	08	CO4 CO5
VI	Web 3.0 and Semantic Web	**Web 3.0 and Semantic Web**: Challenges, Components, Semantic Web Stack: RDF, RDF Schema (RDFS), Simple Knowledge Organization System (SKOS), SPARQL as RDF query language, N-Triples as a format for storing and transmitting data, Turtle (Terse RDF Triple Language), Web Ontology Language (OWL) a family of knowledge representation languages, Rule Interchange Format (RIF), a framework of web rule language dialects supporting rule interchange on the Web	08	CO4 CO5 CO6

Text Books:

1**.** The Art of SEO O'Reilly Publication
2. Web Services Essentials by Ethan Cerami O'Reilly Media
3. Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity, by Avinash Kaushik, ISBN: 978-0-470-52939-3, wiley publication.
4. "Semantic Web Technologies: Trends and Research in Ontology-based Systems", by John Davies, Rudi Studer, and Paul Warren John, Wiley & Son'
5. Advance Internet Technology by Dr. Deven Shah Dreamtech.

References:

1. RESTful Web Services, By Leonard Richardson, Sam Ruby, O'Reilly Media
2. Rich Internet Application AJAX and Beyond WROX press
3. Handbook of Semantic Web Technologies, by John Domingue, Dieter Fensel, Springer Reference
4. Tim O'Reilly, What is Web 2.0? : Design Patterns and Business Models for the Next Generation of Software, O'REILLY

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITDLO6022	Software Architecture	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6022	Software Architecture	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand importance of architecture in building effective, efficient, competitive software product.
2. To understand principal design decisions governing the system.
3. To understand role of architecture in software engineering
4. To understand designing application from architectural perspective
5. To understand different notations used for capturing design decisions.
6. To understand different functional and non-functional properties of complex software systems.

Course Outcomes Students will be able to:

1. Students will cite knowledge of various approaches to document a software system (Remembering)
2. Students will be able to describe functional and non-functional requirements (Understanding)
3. Students will be able to use proper architecture for software (Applying)
4. Students will be able to categorize different components used in the software system (Analyzing)
5. Students will be able to choose from different architectural styles (Evaluating)
6. Students will be able to improve quality of software by selecting proper architecture (Creating)

Prerequisite: Programming Language, UML

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Power of analogy: Architecture of the building, limitations of analogy, The reorientation of software engineering,	02	CO1
I	Introduction to Software Architecture and Software Product Life Cycle	Evolution of Software Development, Fundamentals of Software Engineering, Elements of Software Architecture. Management View, Software Engineering View, Engineering Design View, Architectural View,	07	CO1 CO2
II	Architectural Design Process and Introduction to Software Design	Understanding the problem, Identifying design elements and their relationship, Evaluating the Architecture, Transforming the Architecture, Problems in Software Architectural Design, Function form and Fabrication, The scope of Design, Psychology and Philosophy of Design, General Methodology of Design	09	CO1 CO2 CO3
III	Complexity, Modularity, Models and Knowledge Representation	Complexity, Modularity, What are Models, What are Models used for, What roles do Models Play, Modeling the Problem and Solution Domain, Views,	09	CO1 CO4
IV	Architecture Representation and Architectural Design Principles	Goals of Architecture Representation, Foundation of Architectural Representation, Architectural Description Language, Architectural Level of Design, Architecting with Design Operators, Functional Design Strategies.	09	CO4
V	Architectural Styles, Patterns and Meta models	Defining Architectural Patterns and Style, Common Architectural Styles, Understanding Metamodels, Applying Reference Models, Fundamental Metamodel for describing Software Component	08	CO4 CO5
VI	Architectural Description and Architectural	Standardizing Architectural Description, Creating an Architectural Description, Applying	08	CO1

Framework, Architecture Quality	Architectural Description, Software Architecture Framework, 4+1 View Model of Architecture, Reference Model for Open Distributed Processing, Importance of Assessing Software Quality, How to improve Quality. DevOps practice and Architecture.		CO6

Text Books:

1. The Art of Software Architecture: Design Methods and Techniques, Stephen T.Albin, Wiley India Private Limited.
2. Software Architecture, Foundations, Theory, and Practise, Richard Taylor, Nenad Medvidovic, Eric M Dashofy, Wiley Student Edition.

References:

1. Software Architecture in Practice by Len Bass, Paul Clements, Rick Kazman, Pearson.
2. DevOps A Software Architect's Perspective, Len Bass, Ingo Weber, Liming Zhu, Addison Wesley

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITDLO6023	Digital Forensics	04	--	-	04	--	-	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6023	Digital Forensics	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand underlying principles and many of the techniques associated with the digital forensic practices and cyber crime
2. To explore practical knowledge about ethical hacking Methodology.
3. To learn the importance of evidence handling and storage for various devices
4. To develop an excellent understanding of current cyber security issues (Computer Security Incident) and analyzed the ways that exploits in securities.
5. To investigate attacks, IDS .technical exploits and router attacks and "Trap and Trace" computer networks.
6. To apply digital forensic knowledge to use computer forensic tools and investigation report writing.

Course Outcomes: Student will able to:

1. Define the concept of ethical hacking and its associated applications in Information Communication Technology (ICT) world.
2. Underline the need of digital forensic and role of digital evidences .
3. Explain the methodology of incident response and various security issues in ICT world, and identify digital forensic tools for data collection .
4. Recognize the importance of digital forensic duplication and various tools for analysis to achieve adequate perspectives of digital forensic investigation in various applications /devices like Windows/Unix system.
5. Apply the knowledge of IDS to secure network and performing router and network analysis
6. List the method to generate legal evidence and supporting investigation reports and will also be able to use various digital forensic tools .

Prerequisite: Cryptography and Security, Computer Networks

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Cryptography and Security ,Computer Networks	2	
I	Introduction to Cyber Crime and Ethical Hacking	**Introduction of Cybercrime**: Types of cybercrime ,categories of cybercrime , Computers' roles in crimes, Prevention from Cyber crime, Hackers, Crackers, Phreakers **Ethical Hacking** :Difference between Hacking and Ethical hacking : Steps of Ethical Hacking, Exploring some tools for ethical hacking: reconnaisance tools, scanning tools	6	CO1
II	Introduction to Digital Forensics and Digital Evidences	**Digital Forensic** ,Rules for Digital Forensic The Need for Digital Forensics, Types of Digital Forensics, Ethics in Digital Forensics, **Digital Evidences** : Types and characteristics and challenges for Evidence Handling	6	CO2
III	Computer Security Incident Response Methodology	**Introduction to Computer Security Incident** Goals of Incident response, Incident Response Methodology, Formulating Response Strategy, **IR Process** – Initial Response, Investigation, Remediation, Tracking of Significant ,Investigative Information, Reporting **Pre Incident Preparation,** Incident Detection and Characterization. **Live Data Collection** : Live Data Collection on Microsoft Windows Systems: Live Data	11	CO3

		Collection on Unix-Based Systems		
IV	Forensic Duplication and Disk Analysis, and Investigation	**Forensic Duplication** Forensic Image Formats, Traditional Duplication, Live System Duplication, Forensic Duplication tools **Disk and File System Analysis:** Media Analysis Concepts, File System Abstraction Model The Sleuth Kit : Installing the Sleuth Kit , Sleuth Kit Tools Partitioning and Disk Layouts : Partition Identification and Recovery, Redundant Array of Inexpensive Disks Special Containers : Virtual Machine Disk Images , Forensic Containers Hashing, Carving : Foremost , Forensic Imaging : Deleted Data , File Slack , dd , dcfldd , dc3dd **Data Analysis** Analysis Methodology Investigating Windows systems , Investigating UNIX systems , Investigating Applications, Web Browsers, Email, Malware Handling: Static and Dynamic Analysis	11	CO4
V	Network Forensics	Technical Exploits and Password Cracking , Introduction to Intrusion Detection systems, Types of IDS Understanding Network intrusion and attacks , Analyzing Network Traffic, Collecting Network based evidence, Evidence Handling. Investigating Routers, Handling Router Table Manipulation Incidents, Using Routers as Response Tools	9	CO5
VI	Forensic Investigation	**Report** :Goals of Report, Layout of an		

	Report and Forensic Tools	Investigative Report, Guidelines for Writing a Report, sample for writing a forensic report . **Computer Forensic Tools** : need and types of computer forensic tools, task performed by computer forensic tools . Study of open source Tools like SFIT, Autopsy etc. to acquire, search, analyze and store digital evidence	7	CO6

Text Books:

1. Jason Luttgens, Matthew Pepe, Kevin Mandia, "Incident Response and computer forensics",3rd Edition Tata McGraw Hill, 2014.
2. Nilakshi Jain, Dhananjay Kalbande, "Digital Forensic : The fascinating world of Digital Evidences " Wiley India Pvt Ltd 2017.
3. Cory Altheide, Harlan Carvey "Digital forensics with open source tools "Syngress Publishing, Inc. 2011.
4. Chris McNab, Network Security Assessment, By O'Reily.

References:

1. Clint P Garrison "Digital Forensics for Network, Internet, and Cloud Computing A forensic evidence guide for moving targets and data , Syngress Publishing, Inc. 2010
2. Bill Nelson,Amelia Phillips,Christopher Steuart, "Guide to Computer Forensics and Investigations" . Cengage Learning, 2014
3. Debra Littlejohn Shinder Michael Cross "Scene of the Cybercrime: Computer Forensics Handbook", 2nd Edition Syngress Publishing, Inc.2008.
4. Marjie T. Britz, Computer Forensics and Cyber Crime, Pearson, Third Edition.

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITDLO6024	Multimedia Systems	04	--	---	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6024	Multimedia Systems	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To learn and understand technical aspect of Multimedia Systems.
2. To understand the standards available for different audio, video and text applications.
3. To Design and develop various Multimedia Systems applicable in real time.
4. To learn various multimedia authoring systems.
5. To understand various networking aspects used for multimedia applications.
6. To develop multimedia application and analyze the performance of the same.

Course Outcomes: Students will be able to:

1. Developed understanding of technical aspect of Multimedia Systems.
2. Understand various file formats for audio, video and text media.
3. Develop various Multimedia Systems applicable in real time.
4. Design interactive multimedia software.
5. Apply various networking protocols for multimedia applications.
6. To evaluate multimedia application for its optimum performance.

Prerequisite: Knowledge of computer graphics, computer networking and database systems.

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic of database, computer networks and computer graphics.	2	--
I	Multimedia Systems Design: An Introduction	Multimedia Elements. Multimedia Systems Architecture, Evolving Technologies for Multimedia Systems, Defining Objects For	9	CO1

		Multimedia Systems. Multimedia Data Interface Standards. The Need for Data Compression. Multimedia applications including digital libraries, system software , streaming videos and its applications.		
II	Compression and Decompression Data and File Format Standards	Types of Compression. Image Compression Schemes. Video Compression. Audio Compression. Rich-Text Format. TIFF File Format. Resource Interchange File Format (RIFF), MIDI File Format. JPEG DIB File Format for Still and Motion Images. JPEG Still Image. AVI video File Format. MPEG Standards.	10	CO1 CO2
III	Multimedia Application Design	Multimedia Application Classes. Types of Multimedia Systems. Virtual Reality Design. Components of Multimedia Systems. Multimedia database issues and solutions. Organizing Multimedia Databases.	8	CO1 CO2 CO3
IV	Multimedia Authoring, User Interface and	Multimedia Authoring Systems. Hypermedia Application Design Considerations. User Interface Design. Information Access. Object Display/Playback Issues	7	CO4
V	Distributed Multimedia Systems	Components of a Distributed Multimedia System. Distributed Client-Server Operation. Middleware in Distributed Workgroup Computing. Multiserver Network Topologies. Distributed Multimedia Databases. Managing Distributed Objects. Application Workflow Design Issues. Distributed Application Design Issues	8	CO4 CO5
VI	System Design: Methodology and Considerations.	Fundamental Design Issues. Determining Enterprise Requirements. Examining Current Architecture and Feasibility. Performance Analysis. Designing for Performance Multimedia System Design. System Extensibility. Multimedia Systems Design Example.	8	CO5 CO6

Text Books:

1. **Prabhat K. Andleigh, Kiran Thakrar** "Multimedia Systems Design" 1/e, Pearson , ISBN 978-93-325-4938-8
2. Fundamentals of Multimedia by Ze-Nian Li& Mark.S.Drew
3. Introduction to Multimedia Communication, Application, Middleware, Networking by K.R.Roa, Zoran S,Bojkovic & Dragorad A. Milovanovic.

References:

1. Organization of Multimedia Resources: Principles and Practice of Information Retrieval by Mary A. Burke
2. Multimedia Systems Design by Prabhat K.Andleigh/ Kiran Thakrar

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:
- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITDLO6025	Green IT	04	--	--	04	--	--	04

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral & Practical	Total
		Internal assessment			End Sem. Exam			
		Test1	Test2	Avg. of two Tests				
ITDLO6025	Green IT	20	20	20	80	--	--	100

Course Objectives: Students will try:

1. To understand what Green IT is and How it can help improve environmental Sustainability
2. To understand the principles and practices of Green IT.
3. To understand how Green IT is adopted or deployed in enterprises.
4. To understand how data centres, cloud computing, storage systems, software and networks can be made greener.
5. To measure the Maturity of Sustainable ICT world.
6. To implement the concept of Green IT in Information Assurance in Communication and Social Media and all other commercial field.

Course Outcomes: Students will be able to:

1. Describe awareness among stakeholders and promote green agenda and green initiatives in their working environments leading to green movement
2. Identify IT Infrastructure Management and Green Data Centre Metrics for software development
3. Recognize Objectives of Green Network Protocols for Data communication.
4. Use Green IT Strategies and metrics for ICT development.
5. Illustrate various green IT services and its roles.
6. Use new career opportunities available in IT profession, audits and others with special skills such as energy efficiency, ethical IT assets disposal, carbon footprint estimation, reporting and development of green products, applications and services.

Prerequisite: Environmental Studies

Detailed syllabus:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Environmental Studies	2	
I	Introduction	Environmental Impacts of IT, Holistic Approach to Greening IT, Green IT Standards and Eco-Labeling, Enterprise Green IT Strategy , Green IT: Burden or Opportunity? **Hardware:** Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose. **Software:** Introduction, Energy-Saving Software Techniques, Evaluating and Measuring Software Impact to Platform Power.	9	CO1
II	Software development and data centers	Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics, Sustainable Software Methodology, Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, IT Infrastructure Management, Green Data Centre Metrics	9	CO1 CO2
III	Data storage and communication	Storage Media Power Characteristics, Energy Management Techniques for Hard Disks, System-Level Energy Management, Objectives of Green Network Protocols, Green Network Protocols and Standards.	9	CO1 CO3
IV	Information systems, green it strategy and metrics	Approaching Green IT Strategies, Business Drivers of Green IT Strategy, Business Dimensions for Green IT Transformation, Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Organizational Level Information, Regional/City Level Information, Measuring the Maturity of Sustainable ICT.	8	CO1 CO4

V	Green it services and roles	Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework, Sustainable IT Roadmap, Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware, Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise.	9	CO1 CO4 CO5
VI	Managing and regulating green it	Strategizing Green Initiatives, Implementation of Green IT, Information Assurance, Communication and Social Media, The Regulatory Environment and IT Manufacturers, Nonregulatory Government Initiatives, Industry Associations and Standards Bodies, Green Building Standards, Green Data Centres, Social Movements and Greenpeace.	6	CO1 CO5 CO6

Text Books:

1. San Murugesan, G. R. Gangadharan, Harnessing Green IT,WILEY 1st Edition-2013
2. Mohammad Dastbaz Colin Pattinson Babak Akhgar, Green Information Technology A Sustainable Approach , Elsevier 2015
3. Reinhold, Carol Baroudi, and Jeffrey HillGreen IT for Dummies, Wiley 2009

References:

1. Mark O'Neil , Green IT for Sustainable Business Practice: An ISEB Foundation Guide, BCS
2.Jae H. Kim, Myung J. Lee Green IT: Technologies and Applications, Springer, ISBN: 978-3-642-22178-1
3. Elizabeth Rogers, Thomas M. Kostigen The Green Book: The Everyday Guide to Saving the Planet One Simple Step at a Time, Springer

Assessment:

Internal Assessment for 20 marks:
Consisting of **Two Compulsory Class Tests**
Approximately 40% to 50% of syllabus content must be covered in First test and remaining 40% to 50% of syllabus contents must be covered in second test.

End Semester Examination: Some guidelines for setting the question papers are as:

- Weightage of each module in end semester examination is expected to be/will be proportional to number of respective lecture hours mentioned in the syllabus.
- Question paper will comprise of total **six questions**, **each carrying 20 marks.**
- **Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**.
- **Remaining question will be mixed in nature** (for example if Q.2 has part (a) from module 3 then part (b) will be from any other module. (Randomly selected from all the modules.)
- Total **four questions** need to be solved.