AC: 29/6/2021

Item No. : 6.12

UNIVERSITY OF MUMBAI

Bachelor of Engineering

in

Information Technology

Third Year with Effect from AY 2021-22

(REV- 2019 'C' Scheme) from Academic Year 2019 – 20

Under

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

AC: 29/6/2021
Item No. 6.12

UNIVERSITY OF MUMBAI

Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	**Third Year Bachelor of Information Technology**
2	Eligibility for Admission	**After Passing Second Year Engineering as per the Ordinance 0.6243**
3	Passing Marks	**40%**
4	Ordinances / Regulations (if any)	**Ordinance 0.6243**
5	No. of Years / Semesters	**8 semesters**
6	Level	**Under Graduation**
7	Pattern	**Semester**
8	Status	**Revised**
9	To be implemented from Academic Year	**With effect from Academic Year: 2021-2022**

Date : 29/6/2021

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
University of Mumbai

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 Science and Technology (in particular Engineering)of University of Mumbai has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty 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. 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. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 13 weeks and remaining 2 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum more focused on providing information and knowledge across various domains of the said program, which led to heavily loading of students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of curriculum proposed in the present revision is in line with AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2020-21. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

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Incorporation and Implementation of Online Contents from NPTEL/ Swayam Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time in particular Revised syllabus of 'C ' scheme wherever possible additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In an earlier revision of curriculum in the year 2012 and 2016 in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents more appropriately as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HoD's/ Faculties of all the institute are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses, on successful completion they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

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Preface By Board of Studies Team

It is our honor and a privilege to present the Rev-2019 'C' scheme syllabus of Bachelor of Engineering in Information Technology (effective from year 2019-20) 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 considered as stakeholders will design of the syllabus of Information Technology. As per Industries views 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 first time we are giving skill-based labs and Mini-project to students from third semester onwards which will help students to work on latest IT technologies. 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.

We would like to thank senior faculties of IT department of all colleges affiliated to University of Mumbai for significant contribution in framing the syllabus. Also on behalf of all faculties we thank all the industry experts for their valuable feedback and suggestions. We sincerely hope that the revised syllabus will help all graduate engineers to face the future challenges in the field of information and technology

Program Specific 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 and security domain.
3. Ability to work in multidisciplinary projects and make it IT enabled.
4. Ability to adapt latest trends and technologies like **A**nalytics, **B**lockchain, **C**loud, **D**ata science.

Board of Studies in Information Technology - Team
Dr. Deven Shah (Chairman)
Dr. Lata Ragha (Member)
Dr. Vaishali D. Khairnar (Member)
Dr. Sharvari Govilkar (Member)
Dr. Sunil B. Wankhade (Member)
Dr. Anil Kale (Member)
Dr. Vaibhav Narwade (Member)
Dr. GV Choudhary (Member)

Ad-hoc Board Information Technology
University of Mumbai

Program Structure for Third Year Information Technology

Semester V & VI

UNIVERSITY OF MUMBAI

(With Effect from 2021-2022)

Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	**Pract.**	**Theory**	**Pract.**	**Total**
ITC501	Internet Programming	3	--	3	--	3
ITC502	Computer Network Security	3	--	3		3
ITC503	Entrepreneurship and E-business	3	--	3	--	3
ITC504	Software Engineering	3	--	3	--	3
ITDO501X	**Department Optional Course – 1**	**3**	**--**	**3**	**--**	**3**
ITL501	IP Lab	--	2	--	1	1
ITL502	Security Lab	--	2	--	1	1
ITL503	DevOPs Lab	--	2	--	1	1
ITL504	Advance DevOPs Lab	-	2	--	1	1
ITL505	Professional Communication & Ethics-II (PCE-II)	--	2*+2	--	2	2
ITM501	Mini Project – 2 A Web Based Business Model	--	4[$]	--	2	2
Total		**15**	**16**	**15**	**08**	**23**

Course Code	Course Name	Examination Scheme							
		Theory					**Term Work**	**Prac /oral**	**Total**
		Internal Assessment			**End Sem Exam**	**Exam. Duration (in Hrs)**			
		Test1	**Test2**	**Avg**					
ITC501	Internet Programming	20	20	20	80	3	--	--	100
ITC502	Computer Network Security	20	20	20	80	3	--	--	100
ITC503	Entrepreneurship and E-business	20	20	20	80	3	--	--	100
ITC504	Software Engineering	20	20	20	80	3	--	--	100
ITDO501X	**Department Optional Course – 1**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**
ITL501	IP Lab	--	--	--	--	--	25	25	50
ITL502	Security Lab	--	--	--	--	--	25	25	50
ITL503	DevOPs Lab	--	--	--	--	--	25	25	50

ITL504	Advance DevOPs Lab	--	--	--	--	--	25	25	50
ITL505	Professional Communication & Ethics-II (PCE-II)	--	--	--	--	--	50	--	50
ITM501	Mini Project – 2 A Web Based Business Model	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	**--**	**175**	**125**	**800**

* Theory class to be conducted for full class

$ indicates work load of Learner (Not Faculty), for Mini-Project. Students can form groups with minimum 2(Two) and not more than 4(Four). Faculty Load: 1hour per week per four groups.

ITDO501X	**Department Optional Course – 1**
ITDO5011	Microcontroller Embedded Programming
ITDO5012	Advance Data Management Technologies
ITDO5013	Computer Graphics & Multimedia System
ITDO5014	Advanced Data structure and Analysis

Program Structure for Third Year Information Technology

Semester V & VI

UNIVERSITY OF MUMBAI

(With Effect from 2021-2022)

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract. Tut.	Theory	Pract.	Total
ITC601	Data Mining & Business Intelligence	3	--	3	--	3
ITC602	Web X.0	3	--	3		3
ITC603	Wireless Technology	3	--	3	--	3
ITC604	AI and DS – 1	3	--	3	--	3
ITDO601X	**Department Optional Course – 2**	**3**	**--**	**3**	**--**	**3**
ITL601	BI Lab	--	2	--	1	1
ITL602	Web Lab	--	2	--	1	1
ITL603	Sensor Lab	--	2	--	1	1
ITL604	MAD & PWA Lab	--	2	--	1	1
ITL605	DS using Python Skill based Lab	--	2	--	1	1
ITM601	Mini Project – 2 B Based on ML	--	4[$]	--	2	2
Total		**15**	**14**	**15**	**07**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg					
ITC601	Data Mining & Business Intelligence	20	20	20	80	3	--	--	100
ITC602	Web X.0	20	20	20	80	3	--	--	100
ITC603	Wireless Technology	20	20	20	80	3	--	--	100
ITC604	AI and DS – 1	20	20	20	80	3	--	--	100
ITDO601X	**Department Optional Course – 2**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**
ITL601	BI Lab	--	--	--	--	--	25	25	50
ITL602	Web Lab	--	--	--	--	--	25	25	50
ITL603	Sensor Lab	--	--	--	--	--	25	25	50
ITL604	MAD & PWA Lab	--	--	--	--	--	25	25	50
ITL605	DS using Python Lab (SBL)	--	--	--	--	--	25	25	50

ITM601	Mini Project – 2 B Based on ML	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	**--**	**150**	**150**	**800**

$ indicates work load of Learner (Not Faculty), for Mini-Project. Students can form groups with minimum 2(Two) and not more than 4(Four). Faculty Load: 1hour per week per four groups.

ITDO601X	**Department Optional Course – 2**
ITDO6011	Software Architecture
ITDO6012	Image Processing
ITDO6013	Green IT
ITDO6014	Ethical Hacking and Forensic

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC501	Internet Programming	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test2	Avg.					
ITC501	Internet Programming	20	20	20	80	03	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To orient students to Web Programming fundamental.
2	To expose students to JavaScript to develop interactive web page development
3	To orient students to Basics of REACT along with installation
4	To expose students to Advanced concepts in REACT
5	To orient students to Fundamentals of node.js
6	To expose students to node.js applications using express framework.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Select protocols or technologies required for various web applications.	L1,L2,L3,L4
2	Apply JavaScript to add functionality to web pages.	L1, L2, L3
3	Design front end application using basic React.	L1,L2,L3,L4,L5,L6
4	Design front end applications using functional components of React.	L1,L2,L3,L4,L5,L6
5	Design back-end applications using Node.js.	L1,L2,L3,L4,L5,L6
6	Construct web based Node.js applications using Express.	L1,L2,L3,L4,L5,L6

Prerequisite: Knowledge of basic programming, network fundamentals and operating systems.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Introduction and basics of HTML, CSS	**02**	-
I	Web programming fundamentals	Working of web browser, HTTP protocol, HTTPS, DNS, TLS, XML introduction, Json introduction, DOM, URL, URI, REST API. **Self-learning Topics:** : Nginx server	**03**	CO1
II	Java script:	Introduction to ES6, Difference between ES5 and ES6. Variables, Condition, Loops, Functions, Events, Arrow functions, Setting CSS Styles using JavaScript, DOM manipulation, Classes and Inheritance. Iterators and Generators, Promise, Client-server communication, Fetch **Self-learning Topics:** Asynchronous JavaScript, JSON	**06**	CO2
III	React fundamentals	Installation, Installing libraries, Folder and file structure, Components, Component lifecycle, State and Props, React Router and Single page applications, UI design, Forms, Events, Animations, Best practices. **Self-learning Topics**: React vs Angular vs Vue	**07**	CO3
IV	Advanced React:	Functional components- Refs, Use effects, Hooks, Flow architecture, Model-View-Controller framework, Flux, Bundling the application. Web pack. **Self-learning Topics:** React Native	**07**	CO4
V	Node.js:	Environment setup, First app, Asynchronous programming, Callback concept, Event loops, REPL, Event emitter, Networking module, Buffers, Streams, File system, Web module. **Self-learning Topics:** Node.js with Mongodb.	**07**	CO5
VI	Express:	Introduction, Express router, REST API, Generator, Authentication, sessions, Integrating with React. **Self-learning Topics:** Commercial deployment.	**07**	CO6

Text Books:

1. Rediscovering JavaScript, Master ES6, ES7, and ES8, By Venkat Subramaniam · 2018
2. Learning React Functional Web Development with React and Redux, Alex Banks and Eve Porcello, O'Reilly
3. Learning Redux, Daniel Bugl, Packt Publication
4. Learning Node.js Development, Andrew Mead, Packt Publishing
5. RESTful Web API Design with Node.js 10, Valentin Bojinov, Packt Publication

References:

1. Web Development with Node and Express, Ethan Brown, O'Reilly

Online Resources:

2. https://reactjs.org/tutorial/tutorial.html
3. https://react-redux.js.org/introduction/quick-start
4. https://webpack.js.org/
5. https://www.youtube.com/watch?v=-27HAh8c0YU

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

- **Question paper format**

  - Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**

  - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

  - A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC502	Computer Network Security	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test2	Avg.					
ITC502	Computer Network Security	20	20	20	80	03	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	The basic concepts of computer and Network Security
2	Various cryptographic algorithms including secret key management and different authentication techniques.
3	Different types of malicious Software and its effect on the security.
4	Various secure communication standards including IPsec, SSL/TLS and email.
5	The Network management Security and Network Access Control techniques in Computer Security.
6	Different attacks on networks and infer the use of firewalls and security protocols.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Explain the fundamentals concepts of computer security and network security.	L1, L2
2	Identify the basic cryptographic techniques using classical and block encryption methods.	L1
3	Study and describe the system security malicious software.	L1, L2
4	Describe the Network layer security, Transport layer security and application layer security.	L1, L2
5	Explain the need of network management security and illustrate the need for NAC.	L1, L2
6	Identify the function of an IDS and firewall for the system security.	L1,L2, L3

Prerequisite: Basic concepts of Computer Networks & Network Design, Operating System

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic concepts of Computer Networks & Network Design, Operating System	**02**	--
I	Introduction to Network Security & cryptography	Computer security and Network Security(Definition), CIA, Services, Mechanisms and attacks, The OSI security architecture, Network security model. Classical Encryption techniques (mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher, transposition techniques: keyed and keyless transposition ciphers). Introduction to steganography. **Self-learning Topics:** Study some more classical encryption techniques and solve more problems on all techniques. Homomorphic encryption in cloud computing	**07**	CO1
II	Cryptography: Key management, distribution and user authentication	Block cipher modes of operation,Data Encryption Standard, Advanced Encryption Standard (AES). RC5 algorithm. Public key cryptography: RSA algorithm. Hashing Techniques: SHA256, SHA-512, HMAC and CMAC, Digital Signature Schemes – RSA, DSS. Remote user Authentication Protocols, Kerberos, Digital Certificate: X.509, PKI **Self-learning Topics:** Study working of elliptical curve digital signature and its benefits over RSA digital signature.	**09**	CO2
III	Malicious Software	SPAM, Trojan horse, Viruses, Worms, System Corruption, Attack Agents, Information Theft, Trapdoor, Keyloggers, Phishing, Backdoors, Rootkits, Denial of Service Attacks, Zombie **Self-learning Topics:** Study the recent malicious software's and their effects.	**04**	CO3
IV	IP Security, Transport level security and Email Security	IP level Security: Introduction to IPSec, IPSec Architecture, Protection Mechanism (AH and ESP), Transport level security: VPN. Need Web Security considerations, Secure Sockets Layer (SSL)Architecture, Transport Layer Security (TLS), HTTPS, Secure Shell (SSH) Protocol Stack. Email Security: Secure Email S/MIME Screen reader support enabled. **Self-learning Topics:** Study Gmail security and privacy from Gmail help	**07**	CO4
V	Network Management Security and Network Access Control	Network Management Security:SNMPv3, NAC:Principle elements of NAC,Principle NAC enforcement methods, How to implement NAC Solutions, Use cases for network access control **Self-learning Topics:** Explore any open source network management security tool	**06**	CO5

VI	System Security	IDS, Firewall Design Principles, Characteristics of Firewalls, Types of Firewalls **Self-learning Topics:** Study firewall rules table	**04**	CO6

Textbooks:

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

References:

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

Online References:

Sr. No.	Website Name
1.	https://swayam.gov.in/
2.	https://nptel.ac.in/
3.	https://www.coursera.org/

Assessment:
Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC503	Entrepreneurship and E-business	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test2	Avg.					
ITC503	Entrepreneurship and E-business	20	20	20	80	03	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Distinguish Entrepreneur and Entrepreneurship starting and feasibility study.
2	Realize the skills required to be an entrepreneur
3	Acquaint the students with challenges of starting new ventures
4	Identify the right sources of fund for starting a new business
5	Be familiarized with concept of E-business Models.
6	Understand various E-business Strategies.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the concept of entrepreneurship and its close relationship with enterprise and owner-management.	L1,L2
2	Understand the nature of business development in the context of existing organizations and of new business start-ups.	L1,L2
3	Comprehended important factors for starting a new venture and business development.	L1,L2,L3
4	Know issues and decisions involved in financing and resourcing a business start-up	L1,L2,L3,L4
5	Describe various E-business Models	L1,L2,L3,L4
6	Discuss various E-business Strategies.	L1,L2,L3,L4

Prerequisite: None

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	**None**	--	--
I	Introduction	Concept, meaning and definition of Entrepreneur and Entrepreneurship. Evolution of Entrepreneurship, Role of Entrepreneurship in economic Development; Managerial vs entrepreneurial approach; Classification and types of Entrepreneurs. Characteristics and qualities of successful Entrepreneurs; Women Entrepreneurs; Corporate & Social entrepreneurship. **Self-learning Topics:** Factors impacting emergence of entrepreneurship.	**04**	CO1
II	Entrepreneurship Development and Leadership	Entrepreneurial Motivation: motivating factors, Types of startups; Characteristics of entrepreneurial leadership, Components of Entrepreneurial Leadership; Factors influencing entrepreneurial development and motivation, Entrepreneurial Opportunities and challenges, Entrepreneurship process. Types of Enterprises and Ownership Structure: small scale, medium scale and large-scale enterprises: Meaning and definition (evolution), role of small enterprises in economic development; proprietorship, Policies governing SMEs, partnership, Ltd. companies and co-operatives: their formation, capital structure and source of finance. **Self-learning Topics:** study the white paper https://www.ncert.nic.in/ncerts/l/lebs213.pdf	**06**	CO2
III	New Venture Planning	Methods to Initiate Ventures; Acquisition-Advantages of acquiring an ongoing venture and examination of key issues; Developing a Marketing plan-customer analysis, sales analysis and competition analysis, Business Plan-benefits of drivers, perspectives in business plan preparation, elements of a business plan; Business plan failures. **Self-learning Topics:** Refer following URL to study various case studies https://www.entrepreneurindia.co/case-studies	**07**	CO3
IV	Financing & Managing Venture	Financing Stages; Sources of Finance; Venture Capital; Criteria for evaluating new-venture proposals & Capital-process. Management of venture: objectives and functions of management, scientific management, general and strategic management; introduction to human resource management: planning, job analysis, training, recruitment and selection **Self-learning Topics:** visit website	**06**	CO4

		https://www.startupindia.gov.in		
V	Overview of E – business	Concept of E-business, Business Success through adoption of technology, information management for business Initiatives, Performance improvement through e-business. Introduction to various collaborative partnerships, E-commerce: Sectors of e-commerce, B to C, B to B and C to C ecommerce, E-commerce success factors, clicks and Bricks in ecommerce, collaborative commerce. E-Marketplace, M-commerce, E-Government; Various E-business Models, Challenges of the E-Business Models, Globalization of E-business. **Self-learning Topics:** Social media applications for E-Business, Social media analytics.	**08**	CO5
VI	Strategic Initiatives for Technology	**Customer Relationship Management:** The evolution of CRM, functional areas of CRM, contemporary trends - SRM, PRM AND ERM, Future Trends of CRM **Enterprise Resource Planning**: Core and Extended ERP; components of ERP system; Benefits and Risks of ERP implementation **Supply Chain Management**: Meaning, definition, importance, and characteristics of SCM, Elements of SCM, Push & Pull supply chain model, Use of e-business to restructure supply chain, Supply chain management implementation **Procurement**: Meaning and advantages of e –procurement, Types& Drivers of e- procurement, Components of e-procurement systems, Implementation of e-procurement **Self-learning Topics:** SEM and SEO E-CRM	**08**	CO6

Textbooks:

1 Entrepreneurship; Robert Hisrich, Michael Peters; Tata McGraw Hill Publication
2 Entrepreneurship: New venture creation by David Holt, Prentice Hall of India Pvt. Ltd.
3 E- Business & E– Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education
4 E-commerce – A Managerial Perspective- P. T. Joseph, Prentice Hall India Publications. Content

References:

1 Entrepreneurship and Innovations in E-business An Integrative Perspective by Fang Zhao, Idea Group Publications.
2 Business Driven Technology –Haag/Baltzan/Philips –Tata McGraw Hill Publication
3 Digital Business and E-commerce Management by Dave Chaffey, David Edmundson-Bird, Tanya Hemphill, Pearson Education
4 E-Business 2.0 Roadmap for Success by Dr. Ravi Kalakota, Marcia Robinson, Pearson Education
5 Case Studies in International Entrepreneurship: Managing and Financing Ventures in the Global Economy. By Walter Kuemmerle, Walter Kuemmerle. McGraw-Hill/Irwin, 2004.

ISBN: 0072977841.

Note: - It is advisable that faculty should discuss case studies in the classroom

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC504	Software Engineering	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITC504	Software Engineering	20	20	20	80	03	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To provide the knowledge of software engineering discipline.
2	To understand Requirements and analyze it
3	To do planning and apply scheduling
4	To apply analysis, and develop software solutions
5	To demonstrate and evaluate real time projects with respect to software engineering principles
6	Apply testing and assure quality in software solution.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand and use basic knowledge in software engineering.	L1, L2
2	Identify requirements, analyze and prepare models.	L1, L2, L3
3	Plan, schedule and track the progress of the projects.	L1, L2, L3
4	Design & develop the software solutions for the growth of society	L1, L2, L3
5	To demonstrate and evaluate real time projects with respect to software engineering principles	L1, L2, L3, L4
6	Apply testing and assure quality in software solution	L1, L2, L3, L4

Prerequisite: Basic programming of knowledge.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	None	--	--
I	Introduction to Software Engineering	Nature of Software, Software Engineering, Software Process, Capability Maturity Model (CMM) Generic Process Model, Prescriptive Process Models: The Waterfall Model, V-model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, Agile process, Agility Principles, Extreme Programming (XP), Scrum, Kanban model **Self-learning Topics:** Personal and Team Process Models	**06**	CO1,CO2
II	Requirement Analysis	Software Requirements: Functional & non-functional – user-system requirement engineering process – feasibility studies – elicitation – validation & management – software prototyping – S/W documentation – Analysis and modelling Requirement Elicitation, Software requirement specification (SRS), **Self-learning Topics:** prioritizing requirements (Kano diagram) - real life application case study.	**07**	CO1,CO2
III	Software Estimation and Scheduling	Management Spectrum, 3Ps (people, product and process) Process and Project metrics Software Project Estimation: LOC, FP, Empirical Estimation Models - COCOMO II Model, Specialized Estimation Techniques, Object based estimation, use-case based estimation Project scheduling: Defining a Task Set for the Software Project, Timeline charts, Tracking the Schedule, Earned Value Analysis **Self-learning Topics:** Cost Estimation Tools and Techniques, Typical Problems with IT Cost Estimates.	**06**	CO3
IV	Design Engineering	Design Process & quality, Design Concepts, The design Model, Pattern-based Software Design. 4.2 Architectural Design :Design Decisions, Views, Patterns, Application Architectures, Modeling Component level Design: component, Designing class based components, conducting component-level design, User Interface Design: The golden rules, Interface Design	**07**	CO3, CO4

		steps & Analysis, Design Evaluation **Self-learning Topics:** Refinement, Aspects, Refactoring		
V	Software Risk, Configuration Management	Risk Identification, Risk Assessment, Risk Projection, RMMM Software Configuration management, SCM repositories, SCM process Software Quality Assurance Task and Plan, Metrics, Software Reliability, Formal Technical Review (FTR), Walkthrough **Self-learning Topics:**: Configuration management for WebApps	**07**	CO5
VI	Software Testing and Maintenance	Testing: Software Quality, Testing: Strategic Approach, Strategic Issues- Testing: Strategies for Conventional Software, Object oriented software, Web Apps- Validating Testing- System Testing- Art of Debugging. Maintenance : Software Maintenance-Software Supportability- Reengineering- Business Process Reengineering- Software Reengineering- Reverse Engineering- Restructuring- Forward Engineering **Self-learning Topics:** Test Strategies for WebApps	**06**	CO6

Text Books:

1 Roger S. Pressman, Software Engineering: A practitioner's approach, McGraw Hill
2 Rajib Mall, Fundamentals of Software Engineering, Prentice Hall India
3 PankajJalote, An integrated approach to Software Engineering, Springer/Narosa.
4 Ian Sommerville, Software Engineering, Addison-Wesley.

References:

1 https://nptel.ac.in/courses/106/101/106101061/
2 https://www.youtube.com/watch?v=wEr6mwquPLY
3 http://www.nptelvideos.com/video.php?id=911&c=9
4 https://onlinecourses.nptel.ac.in/noc19_cs70/unit?unit=25&lesson=66
5 https://onlinecourses.nptel.ac.in/noc19_cs70/unit?unit=25&lesson=67
6 https://onlinecourses.nptel.ac.in/noc19_cs70/unit?unit=25&lesson=65
7 https://onlinecourses.nptel.ac.in/noc19_cs70/unit?unit=25&lesson=64
8 https://onlinecourses.nptel.ac.in/noc19_cs70/unit?unit=25&lesson=63

Preferable: Case studies can be discussed on every unit as per requirement for better understanding, examples are given below.

Unit 1	An information system (mental health-care system), wilderness weather system.
Unit 2	Mental health care patient management system (MHC-PMS).
Unit 3	Software Tools for Estimation.

Unit 4	Risk management in Food delivery software.
Unit 5	Study design of Biometric Authentication software.
Unit 6	Selenium Testing with any online application.

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test.

- **Question paper format**

  - Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**

  - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

  - A total of **four questions** need to be answered.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL501	IP Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITL501	IP Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab aims:	
1	To orient students to HTML for making webpages
2	To expose students to CSS for formatting web pages
3	To expose students to developing responsive layout
4	To expose students to JavaScript to make web pages interactive
5	To orient students to React for developing front end applications
6	To orient students to Node.js for developing backend applications

Lab Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify and apply the appropriate HTML tags to develop a webpage.	L1, L2,L3,L4
2	Identify and apply the appropriate CSS tags to format data on webpage	L1, L2,L3,L4
3	Construct responsive websites using Bootstrap	L1, L2,L3,L4,L5,L6
4	Use JavaScript to develop interactive web pages.	L1, L2,L3,L4,L5,L6
5	Construct front end applications using React	L1, L2,L3,L4,L5,L6
6	Construct back end applications using Node.js/Express	L1, L2,L3,L4,L5,L6

Prerequisite: Knowledge of Java programming and object-oriented programming.

Hardware & Software Requirements:

Hardware Requirement: PC i3 processor and above	Software requirement: Google Chrome Browser (latest), Java 8 or above, NodeJS, React. Internet Connection

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	HTML5	Elements, Attributes, Head, Body, Hyperlink, Formatting, Images, Tables, List, Frames, Forms, Multimedia	**02**	LO1
II	CSS3	Syntax, Inclusion, Color, Background, Fonts, Tables, lists,CSS3 selectors, Pseudo classes, Pseudo elements	**02**	LO2
III	Bootstrap	Grid system, Forms, Button, Navbar, Breadcrumb, Jumbotron	**02**	LO3
IV	JavaScript	Variables, Operators, Conditions, Loops, Functions, Events, Classes and Objects, Error handling, Validations, Arrays, String, Date	**05**	LO4
V	React	Installation and Configuration. JSX, Components, Props, State, Forms, Events, Routers, Refs, Keys.	**08**	LO5
VI	Node.js	Installation and Configuration, Callbacks, Event loops, Creating express app.	**07**	LO6

Textbooks:

1. HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) 2Ed., DT Editorial Services
2. Learning React Functional Web Development with React and Redux, Alex Banks and Eve Porcello, O'Reilly
3. Learning Node.js Development, Andrew Mead, Packt Publishing

References:

1. https://www.tutorialspoint.com/
2. https://reactjs.org/tutorial/tutorial.html
3. https://nodejs.dev/learn
4. https://www.youtube.com/watch?v=-27HAh8c0YU

Term Work: Term Work shall consist of at least 12 to 15 practicals 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)

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

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL502	Security Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITL502	Security Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To apply the knowledge of symmetric cryptography to implement classical ciphers.
2	To analyze and implement public key encryption algorithms, hashing and digital signature algorithms.
3	To explore the different network reconnaissance tools to gather information about networks.
4	To explore the tools like sniffers, port scanners and other related tools for analyzing.
5	To Scan the network for vulnerabilities and simulate attacks.
6	To set up intrusion detection systems using open-source technologies and to explore email security.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Illustrate symmetric cryptography by implementing classical ciphers.	L1,L2
2	Demonstrate Key management, distribution and user authentication.	L1,L2
3	Explore the different network reconnaissance tools to gather information about networks	L1,L2, L3
4	Use tools like sniffers, port scanners and other related tools for analyzing packets in a network.	L1,L2,L3
5	Use open-source tools to scan the network for vulnerabilities and simulate attacks.	L1,L2,L3
6	Demonstrate the network security system using open source tools.	L1,L2

Prerequisite: Basic concepts of Computer Networks & Network Design, Operating System

Hardware & Software Requirements:

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

DETAILED SYLLABUS:

Sr. No.	Detailed Content	Hours	LO Mapping
I	Classical Encryption techniques (mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher)	**04**	LO1
II	1)Block cipher modes of operation using a)Data Encryption Standard b)Advanced Encryption Standard (AES). 2)Public key cryptography: RSA algorithm. 3)Hashing Techniques: HMAC using SHA 4)Digital Signature Schemes – RSA, DSS.	**06**	LO2
III	1) Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars. 2) Study of packet sniffer tools Wireshark, :- a. Observer performance in promiscuous as well as non-promiscuous mode. b. Show the packets can be traced based on different filters.	**04**	LO3
IV	1) Download and install nmap. 2) Use it with different options to scan open ports, perform OS fingerprinting, ping scan, tcp port scan, udp port scan, etc.	**04**	LO4
V	a) Keylogger attack using a keylogger tool. b) Simulate DOS attack using Hping or other tools c) Use the NESSUS/ISO Kali Linux tool to scan the network for vulnerabilities.	**04**	LO5
VI	1) Set up IPSec under Linux. 2) Set up Snort and study the logs. 3) Explore the GPG tool to implement email security	**04**	LO6

Text Books

1 Build your own Security Lab, Michael Gregg, Wiley India.
2 CCNA Security, Study Guide, TIm Boyles, Sybex.
3 Hands-On Information Security Lab Manual, 4th edition, Andrew Green, Michael Whitman,

Herbert Mattord.
4 The Network Security Test Lab: A Step-by-Step Guide Kindle Edition, Michael Gregg.

References:

1 Network Security Bible, Eric Cole, Wiley India.
2 Network Defense and Countermeasures, William (Chuck) Easttom.
3 Principles of Information Security + Hands-on Information Security Lab Manual, 4th Ed. , Michael E. Whitman , Herbert J. Mattord.
4 IITB virtual Lab: http://cse29-iiith.vlabs.ac.in/
5 https://www.dcode.fr/en

Sr.No	Experiment Title
1.	Breaking the Mono-alphabetic Substitution Cipher using Frequency analysis method.
2.	Design and Implement a product cipher using Substitution ciphers.
3.	Cryptanalysis or decoding Playfair, vigenere cipher.
4.	Encrypt long messages using various modes of operation using AES or DES.
5.	Cryptographic Hash Functions and Applications (HMAC): to understand the need, design and applications of collision resistant hash functions.
6.	Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA.
7.	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.
8.	Study of packet sniffer tools wireshark: - a. Observer performance in promiscuous as well as non-promiscuous mode. b. Show the packets can be traced based on different filters.
9.	Download, install nmap and use it with different options to scan open ports, perform OS fingerprinting, ping scan, tcp port scan, udp port scan, etc.
10.	Study of malicious software using different tools: a) Keylogger attack using a keylogger tool. b) Simulate DOS attack using Hping or other tools c) Use the NESSUS/ISO Kali Linux tool to scan the network for vulnerabilities.
11.	Study of Network security by a) Set up IPSec under Linux. b) Set up Snort and study the logs. c) Explore the GPG tool to implement email security

Term Work: Term Work shall consist of at least 12 to 15 practicals 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)

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

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL503	DevOPs Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITL503	DevOPs Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To understand DevOps practices which aims to simplify Software Development Life Cycle
2	To be aware of different Version Control tools like GIT, CVS or Mercurial
3	To Integrate and deploy tools like Jenkins and Maven, which is used to build, test and deploy applications in DevOps environment
4	To be familiarized with selenium tool, which is used for continuous testing of applications deployed.
5	To use Docker to Build, ship and manage applications using containerization
6	To understand the concept of Infrastructure as a code and install and configure Ansible tool.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	To understand the fundamentals of DevOps engineering and be fully proficient with DevOps terminologies, concepts, benefits, and deployment options to meet your business requirements	L1,L2
2	To obtain complete knowledge of the "version control system" to effectively track changes augmented with Git and GitHub	L1,L2
3	To understand the importance of Jenkins to Build and deploy Software Applications on server environment	L1,L2
4	Understand the importance of Selenium and Jenkins to test Software Applications	L1,L2

5	To understand concept of containerization and Analyze the Containerization of OS images and deployment of applications over Docker	L1,L2,L3
6	To Synthesize software configuration and provisioning using Ansible.	L1,L2,L3

Prerequisite: Operating System, Linux Administration, Java /Web Application Programming, and Software Engineering.

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel i3 core or above 2. 4 GB RAM or above 3. 500 GB HDD 4. Network interface card	1. Linux / Windows Operating system 2. VIRTUAL BOX/ VMWARE	1. Internet Connection for installing additional packages 2. GitHub account 3. Docker hub account

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Knowledge of Linux Operating system, installation and configuration of services and command line basics, Basics of Computer Networks and Software Development Life cycle.	**00**	LO1
I	Introduction to Devops	Understanding of the process to be followed during the development of an application, from the inception of an idea to its final deployment. Learn about the concept of DevOps and the practices and principles followed to implement it in any company's software development life cycle. Learn about the phases of Software Lifecycle. Get familiar with the concept of Minimum Viable Product (MVP) & Cross-functional Teams. Understand why DevOps evolved as a prominent culture in most of the modern-day startups to achieve agility in the software development process **Self-Learning Topics: Scrum, Kanban, Agile**	**04**	LO1
II	Version Control	In this module you will learn: • GIT Installation, Version Control, Working with remote repository • GIT Cheat sheet • Create and fork repositories in GitHub • Apply branching, merging and rebasing concepts. • Implement different Git workflow strategies in real-time scenarios • Understand Git operations in IDE **Self-Learning Topics: AWS Codecommit, Mercurial, Subversion, Bitbucket, CVS**	**04**	LO1 & LO2
III	Continuous Integration using Jenkins	In this module, you will know how to perform Continuous Integration using Jenkins by building and automating test cases using Maven / Gradle / Ant. • Introduction to Jenkins (With Architecture) • Introduction to Maven / Gradle / Ant.	**04**	LO1 & LO3

		• Jenkins Management Adding a slave node to Jenkins • Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to deploy an application over the tomcat server **Self-Learning Topics: Travis CI, Bamboo, GitLab, AWS CodePipeline**		
IV	Continuous Testing with Selenium	In this module, you will learn about selenium and how to automate your test cases for testing web elements. You will also get introduced to X-Path, TestNG and integrate Selenium with Jenkins and Maven. • Introduction to Selenium • Installing Selenium • Creating Test Cases in Selenium WebDriver • Run Selenium Tests in Jenkins Using Maven **Self-Learning Topics: Junit, Cucumber**	**04**	LO1 , LO3 & LO4
V	Continuous Deployment: Containerizatio n with Docker	In this module, you will be introduced to the core concepts and technology behind Docker. Learn in detail about container and various operations performed on it. • Introduction to Docker Architecture and Container Life Cycle • Understanding images and containers • Create and Implement docker images using Dockerfile. • Container Lifecycle and working with containers. • To Build, deploy and manage web or software application on Docker Engine. • Publishing image on Docker Hub. **Self-Learning Topics: Docker Compose, Docker Swarm.**	**05**	LO1 & LO5
VI	Continuous Deployment: Configuration Management with Puppet	In this module, you will learn to Build and operate a scalable automation system. • Puppet Architecture • Puppet Master Slave Communication • Puppet Blocks • Installation and Configuring Puppet Master and Agent on Linux machines • Use exported resources and forge modules to set up Puppet modules • Create efficient manifests to streamline your deployments **Self-Learning Topics: Ansible, Saltstack**	**05**	LO1 & LO6

Text books

1. DevOps Bootcamp, Sybgen Learning
2. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
3. Len Bass,Ingo Weber,Liming Zhu,"DevOps, A Software Architects Perspective", AddisonWesley-Pearson Publication.
4. John Ferguson Smart," Jenkins, The Definitive Guide", O'Reilly Publication.
5. Mastering Puppet 5: Optimize enterprise-grade environment performance with Puppet, by Ryan Russell-

Yates Packt Publishing (September 29, 2018)

References:

1. Sanjeev Sharma and Bernie Coyne," DevOps for Dummies", Wiley Publication
2. Httermann, Michael, "DevOps for Developers", Apress Publication.
3. Joakim Verona, "Practical DevOps", Pack publication
4. Puppet 5 Essentials - Third Edition: A fast-paced guide to automating your infrastructure by Martin Alfke Packt Publishing; 3rd Revised edition (September 13, 2017)

List of Experiments:

Sr.No	Experiment Title
1.	To understand DevOps: Principles, Practices, and DevOps Engineer Role and Responsibilities.
2.	To understand Version Control System / Source Code Management, install git and create a GitHub account.
3.	To Perform various GIT operations on local and Remote repositories using GIT Cheat-Sheet
4.	To understand Continuous Integration, install and configure Jenkins with Maven/Ant/Gradle to setup a build Job.
5.	To Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to Test and deploy an application over the tomcat server.
6.	To understand Jenkins Master-Slave Architecture and scale your Jenkins standalone implementation by implementing slave nodes.
7.	To Setup and Run Selenium Tests in Jenkins Using Maven.
8.	To understand Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.
9.	To learn Dockerfile instructions, build an image for a sample web application using Dockerfile.
10.	To install and Configure Pull based Software Configuration Management and provisioning tools using Puppet.
11.	To learn Software Configuration Management and provisioning using Puppet Blocks(Manifest, Modules, Classes, Function)
12	To provision a LAMP/MEAN Stack using Puppet Manifest.

Term Work: Term Work shall consist of at least 12 to 15 practicals based on the above list. Also Term work Journal must include at least 2 assignments, one of which must include a Case study on DevOps Implementation in real world and the other one can be based on the self-learning topics mentioned in syllabus.

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

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

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Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL504	Advance DevOps Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITL504	Advance DevOps Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To understand DevOps practices and cloud native environments to achieve continuous software delivery pipelines and automated operations that address the gap between IT resources and growing cloud complexity.
2	To Use Kubernetes services to structure N-tier applications.
3	To be familiarized with Infrastructure as code for provisioning, compliance, and management of any cloud infrastructure, and service.
4	To understand that security and speed in software development are not inversely-related objectives Internalizing the contribution of tools and automation in DevSecOps
5	To understand various troubleshooting techniques by monitoring your entire infrastructure and business processes
6	To understand how software and software-defined hardware are provisioned dynamically.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	To understand the fundamentals of Cloud Computing and be fully proficient with Cloud based DevOps solution deployment options to meet your business requirements	L1,L2
2	To deploy single and multiple container applications and manage application deployments with rollouts in Kubernetes	L1,L2,L3
3	To apply best practices for managing infrastructure as code environments and use terraform to define and deploy cloud	L1,L2,L3

	infrastructure.	
4	To identify and remediate application vulnerabilities earlier and help integrate security in the development process using SAST Techniques.	L1,L2,L3
5	To use Continuous Monitoring Tools to resolve any system errors (low memory, unreachable server etc.) before they have any negative impact on the business productivity	L1,L2,L3
6	To engineer a composition of nano services using AWS Lambda and Step Functions with the Serverless Framework	L1,L2,L3

Prerequisite: Operating System, Linux Administration, Java /Web Application Programming, Software Engineering, Cloud Computing and DevOps Ecosystem.

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel i3 core or above 2. 4 GB RAM or above 3. 500 GB HDD 4. Network interface card	1. Linux / Windows Operating system 2. VIRTUAL BOX/ VMWARE	1. Internet Connection for installing additional packages 2. GitHub account 3. AWS free tier account

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Knowledge of Linux Operating system, installation and configuration of services and command line basics, Basics of Computer Networks, Software Development Life cycle, Cloud Computing and DevOps Ecosystem.	**02**	--
I	Introduction to Devops on Cloud	Learn about various cloud services and service providers, also get the brief idea of how to implement DevOps over Cloud Platforms. • Introduction to high availability architecture and auto-scaling • Set up the DevOps infrastructure on the cloud • Work and set up IDE on Cloud9 • Deploy projects on AWS using Code Build, CodeDeploy, and CodePipeline **Self-Learning Topics:** AWS Codestar	**04**	LO1
II	Container Orchestration using Kubernetes	In this module, you will learn how Kubernetes automates many of the manual processes involved in deploying, managing, and scaling containerized applications. Install and configure Kubernetes Spin Up a Kubernetes Cluster Check the Nodes of Your Kubernetes Cluster	**04**	LO1, LO2

		Installing kubectl to manage cluster and deploy Your First Kubernetes Application **Self-Learning Topics:** • Using Services and Ingresses to Expose Deployments • Perform logging, monitoring, services, and volumes in Kubernetes.		
III	Infrastructure Automation with Terraform	In this module you will learn, Infrastructure as code for provisioning, compliance, and management of any cloud infrastructure, and service. • Introduction to Infrastructure as Code with Terraform • Install, Build, change and Destroy Infrastructure using Terraform. **Self-Learning Topics:** Terraform • Create Resource Dependencies • Provision Infrastructure • Define Input Variables, Query Data with output and store remote state	**04**	LO1, LO3
IV	DevSecOps: Static Application Security Testing (SAST)	In this module, you will learn to identify and remediate application vulnerabilities earlier and help integrate security in the development process using tools like SonarQube / Gitlab / • Perform static analysis on application source code and binaries. • Spot potential vulnerabilities before deployment • Analysis of java / web-based project • Jenkins SonarQube / Gitlab Integration **Self-Learning Topics:** Snyk, OWASP ZAP, Analysis Core Plugin	**04**	LO1, LO4
V	DevSecOps: Continuous Monitoring	In this module, you will learn to detect, report, respond to the attacks and issues which occur within the infrastructure. • Introduction to Continuous Monitoring • Introduction to Nagios • Installing Nagios • Nagios Plugins (NRPE) and Objects Nagios Commands and Notification • Monitoring of different servers using Nagios	**04**	LO1, LO5

		Self-Learning Topics: Splunk, Snort, Tenable		
VI	NoOps: Serverless Computing	In this module, you will learn serverless computing platform like AWS Lambda, which allows you to build your code and deploy it without ever needing to configure or manage underlying servers. • AWS Lambda - Overview and Environment Setup • Building and Configuring the Lambda function (NODEJS/PYTHON/JAVA) • Creating & Deploying using AWS Console/CLI • Creating & Deploying using Serverless Framework **Self-Learning Topics:** AWS Lambda • Create a REST API with the Serverless Framework	**04**	LO1, LO6

Textbooks:

1. AWS Certified SysOps Administrator Official Study Guide: Associate Exam by Stephen Cole (Author), Gareth Digby (Author), Chris Fitch (Author), Steve Friedberg (Author), Shaun Qual
2. AWS Certified Solutions Architect Official Study Guide: Associate Exam by Joe Baron
3. Terraform: Up & Running - Writing Infrastructure as Code, Second Edition by Yevgeniy Brikman , O'Reilly
4. Kubernetes: Up and Running - Dive into the Future of Infrastructure, Second Editionby Brendan Burns,O'Reilly
5. Going Serverless with AWS Lambda: Leveraging the latest services from the AWS cloud by Ajay Pherwani , Shroff/X-Team;
6. Learning Nagios, Packt Publishing.

References:

1. Learning Aws - Second Edition: Design, build, and deploy responsive applications using AWS by Amit Shah Aurobindo Sarkar
2. Mastering Aws Lambda by Yohan Wadia Udita Gupta

List of Experiments:

Sr. No	Experiment Title
1	To understand the benefits of Cloud Infrastructure and Setup AWS Cloud9 IDE, Launch AWS Cloud9 IDE and Perform Collaboration Demonstration.
2	To Build Your Application using AWS CodeBuild and Deploy on S3 / SEBS using AWS CodePipeline, deploy Sample Application on EC2 instance using AWS CodeDeploy.
3	To understand the Kubernetes Cluster Architecture, install and Spin Up a Kubernetes Cluster on Linux Machines/Cloud Platforms.
4	To install Kubectl and execute Kubectl commands to manage the Kubernetes cluster and deploy Your First Kubernetes Application.

5	To understand terraform lifecycle, core concepts/terminologies and install it on a Linux Machine.
6	To Build, change, and destroy AWS / GCP /Microsoft Azure/ DigitalOcean infrastructure Using Terraform.
7	To understand Static Analysis SAST process and learn to integrate Jenkins SAST to SonarQube/GitLab.
8	Create a Jenkins CICD Pipeline with SonarQube / GitLab Integration to perform a static analysis of the code to detect bugs, code smells, and security vulnerabilities on a sample Web / Java / Python application.
9	To Understand Continuous monitoring and Installation and configuration of Nagios Core, Nagios Plugins and NRPE (Nagios Remote Plugin Executor) on Linux Machine.
10	To perform Port, Service monitoring, Windows/Linux server monitoring using Nagios.
11	To understand AWS Lambda, its workflow, various functions and create your first Lambda functions using Python / Java / Nodejs.
12	To create a Lambda function which will log "An Image has been added" once you add an object to a specific bucket in S3.

Term Work: Term Work shall consist of at least 12 to 15 practicals based on the above list. Also Term work Journal must include at least 2 assignments based on the self-learning topics mentioned in syllabus.

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

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

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theory	**Pract.**	**Tut.**	**Theory**	**Pract.**	**Tut.**	**Total**
ITL505	Professional Communication & Ethics-II (PCE-II)	--	2*+ 2 Hours (Batch-wise)	--	--	02	--	02

***Theory class to be conducted for full class.**

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract	Oral	Internal Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		Test 1	Test 2	Avg.							
ITL505	Professional Communication & Ethics-II (PCE-II)	--	--	--	--	--	25	--	--	25	50

Course Code	**Course Name**	**Credits**
ITL505	Professional Communication & Ethics-II (PCE-II)	02
Course Rationale	This curriculum is designed to build up a professional and ethical approach, effective oral and written communication with enhanced soft skills. Through practical sessions, it augments student's interactive competence and confidence to respond appropriately and creatively to the implied challenges of the global Industrial and Corporate requirements. It further inculcates the social responsibility of engineers as technical citizens.	
Course Objectives	• To discern and develop an effective style of writing important technical/business documents. • To investigate possible resources and plan a successful job campaign. • To understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement. • To develop creative and impactful presentation skills. • To analyze personal traits, interests, values, aptitudes and skills. • To understand the importance of integrity and develop a personal code of ethics.	
Course Outcomes	**Learner will be able to…** • plan and prepare effective business/ technical documents which will in turn provide solid foundation for their future managerial roles. • strategize their personal and professional skills to build a professional image and meet the demands of the industry. • emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations. • deliver persuasive and professional presentations. • develop creative thinking and interpersonal skills required for effective professional communication. • apply codes of ethical conduct, personal integrity and norms of organizational behaviour.	

Module	Contents	Hours
1	**ADVANCED TECHNICAL WRITING :PROJECT/PROBLEM BASED LEARNING (PBL)** **1.1 Purpose and Classification of Reports:** **Classification on the basis of:** • Subject Matter (Technology, Accounting, Finance, Marketing, etc.) • Time Interval (Periodic, One-time, Special) • Function (Informational, Analytical, etc.) • Physical Factors (Memorandum, Letter, Short & Long) **1.2. Parts of a Long Formal Report:** • Prefatory Parts (Front Matter) • Report Proper (Main Body) • Appended Parts (Back Matter) **1.3. Language and Style of Reports** • Tense, Person & Voice of Reports • Numbering Style of Chapters, Sections, Figures, Tables and Equations • Referencing Styles in APA & MLA Format • Proofreading through Plagiarism Checkers **1.4. Definition, Purpose & Types of Proposals** • Solicited (in conformance with RFP) & Unsolicited Proposals • Types (Short and Long proposals) **1.5. Parts of a Proposal** • Elements • Scope and Limitations • Conclusion **1.6. Technical Paper Writing** • Parts of a Technical Paper (Abstract, Introduction, Research Methods, Findings and Analysis, Discussion, Limitations, Future Scope and References) • Language and Formatting • Referencing in IEEE Format	**06**
2	**EMPLOYMENT SKILLS** **2.1. Cover Letter & Resume** • Parts and Content of a Cover Letter • Difference between Bio-data, Resume & CV • Essential Parts of a Resume • Types of Resume (Chronological, Functional & Combination) **2.2 Statement of Purpose** • Importance of SOP • Tips for Writing an Effective SOP **2.3 Verbal Aptitude Test** • Modelled on CAT, GRE, GMAT exams **2.4. Group Discussions** • Purpose of a GD • Parameters of Evaluating a GD • Types of GDs (Normal, Case-based & Role Plays)	**06**

	• GD Etiquettes **2.5. Personal Interviews** • Planning and Preparation • Types of Questions • Types of Interviews (Structured, Stress, Behavioural, Problem Solving & Case-based) • Modes of Interviews: Face-to-face (One-to one and Panel) Telephonic, Virtual	
3	**BUSINESS MEETINGS** **1.1. Conducting Business Meetings** • Types of Meetings • Roles and Responsibilities of Chairperson, Secretary and Members • Meeting Etiquette **3.2. Documentation** • Notice • Agenda • Minutes	**02**
4	**TECHNICAL/ BUSINESS PRESENTATIONS** **1.1 Effective Presentation Strategies** • Defining Purpose • Analyzing Audience, Location and Event • Gathering, Selecting &Arranging Material • Structuring a Presentation • Making Effective Slides • Types of Presentations Aids • Closing a Presentation • Platform skills **1.2 Group Presentations** • Sharing Responsibility in a Team • Building the contents and visuals together • Transition Phases	**02**
5	**INTERPERSONAL SKILLS** **1.1. Interpersonal Skills** • Emotional Intelligence • Leadership & Motivation • Conflict Management & Negotiation • Time Management • Assertiveness • Decision Making **5.2 Start-up Skills** • Financial Literacy • Risk Assessment • Data Analysis (e.g. Consumer Behaviour, Market Trends, etc.)	**08**
6	**CORPORATE ETHICS** **6.1Intellectual Property Rights** • Copyrights • Trademarks • Patents • Industrial Designs	**02**

	• Geographical Indications • Integrated Circuits • Trade Secrets (Undisclosed Information) **6.2 Case Studies** • Cases related to Business/ Corporate Ethics	

List of assignments:

(In the form of Short Notes, Questionnaire/ MCQ Test, Role Play, Case Study, Quiz, etc.)

1. Cover Letter and Resume
2. Short Proposal
3. Meeting Documentation
4. Writing a Technical Paper/ Analyzing a Published Technical Paper
5. Writing a SOP
6. IPR
7. Interpersonal Skills
8. Aptitude test (Verbal Ability)

Note:

1. The Main Body of the project/book report should contain minimum 25 pages (excluding Front and Back matter).
2. The group size for the final report presentation should not be less than 5 students or exceed 7 students.
3. There will be an end–semester presentation based on the book report.

Assessment:

Term Work:

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

Assignment : 10 Marks

Attendance : 5 Marks

Presentation slides : 5 Marks

Book Report (hard copy) : 5 Marks

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

Internal oral:

Oral Examination will be based on a GD & the Project/Book Report presentation.

Group Discussion : 10 marks

Project Presentation : 10 Marks

Group Dynamics : 5 Marks

Books Recommended:

Textbooks and Reference books:

1. Arms, V. M. (2005). *Humanities for the engineering curriculum: With selected chapters from Olsen/Huckin: Technical writing and professional communication, second edition*. Boston, MA: McGraw-Hill.
2. Bovée, C. L., &Thill, J. V. (2021). *Business communication today*. Upper Saddle River, NJ: Pearson.
3. Butterfield, J. (2017). *Verbal communication: Soft skills for a digital workplace*. Boston, MA: Cengage Learning.
4. Masters, L. A., Wallace, H. R., & Harwood, L. (2011).*Personal development for life and work*. Mason: South-Western Cengage Learning.
5. Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). *Organizational behaviour*. Harlow, England:

Pearson.
6. Meenakshi Raman, Sangeeta Sharma (2004) Technical Communication, Principles and Practice. Oxford University Press
7. Archana Ram (2018) Place Mentor, Tests of Aptitude For Placement Readiness. Oxford University Press
Sanjay Kumar &PushpLata (2018). Communication Skills a workbook, New Delhi: Oxford University Press.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITM501	Mini Project – 2 A Web Based Business Model	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITM501	Mini Project – 2 A Web Based Business Model	--	--	--	--	25	25	50

Course Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcome: Learner will be able to…

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity;however, focus shall be on self-learning.

- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalisation of problem
    - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
    - Identification of need/problem
    - Proposed final solution
    - Procurement of components/systems
    - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
    - First shall be for finalisation of problem and proposed solution
    - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITDO5011	Microcontroller Embedded Programming	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITDO5011	Microcontroller Embedded Programming	20	20	20	80	3	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Conceptualize the architecture of embedded systems.
2	Study the basics of microcontroller 8051.
3	Elaborate on the concepts of microcontroller interfacing.
4	Understand the concepts of ARM architecture
5	Study the concepts of real-time operating system
6	Learn about various embedded platforms and their programming

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Introduce and discuss the embedded system concepts, architecture of embedded systems and understand the embedded development environments	L1, L2
2	Describe the architecture of 8051 microcontroller and write embedded programs for 8051Microcontroller	L2, L3
3	Illustrate the interfacing of peripherals with 8051 microcontroller and write programs	L2, L3
4	Understand and apply the concepts of ARM architecture	L2, L3
5	Explain and Demonstrate the open source RTOS	L3
6	**Select** the embedded platform and program it for real time application	L3, L4

Prerequisite: Computer Organization and Architecture, Operating System.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Revision of microcomputer system terminologies, High level, difference between microprocessor and microcontroller, basics of operating System.	**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. Introduction to Embedded System Integrated Development Environments (IDEs) with examples. **Self-learning Topics:** Comparison of CISC & RISC, Case studies of Real Time Embedded Systems.	**04**	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. Addressing modes, Instruction set 8051 developing tools, Programming based on Arithmetic & Logical Operations, I/O parallel and serial ports, Timers & Counters, and ISR. **Self-learning Topics:** Writing 8051 programming in Embedded C	**10**	CO2
III	Interfacing with 8051Microcontroller	Interfacing 8051 with peripherals: ADC, DAC, stepper motor. Interfacing 8051 with LED, LCD, keyboard, Temp sensor, etc. using assembly language. **Self-learning Topics:** Study of 8051 based GSM, Bluetooth and RS232 communication	**04**	CO3
IV	ARM 7 Architecture	Architectural inheritance, Detailed study of Programmer's model, ARM Development tools, Addressing modes, Instruction set: Data processing, Data Transfer, Control flow. Pipelining, Writing simple assembly language programs.	**07**	CO4

		Brief introduction to exceptions and interrupts handling. **Self-learning Topics:** Writing ARM programs in Embedded C and Python for sensor application		
V	Open source RTOS Real Time system concept with embedded OS	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 using pipes and mailboxes, performance matrix in scheduling models, interrupt management in RTOS environment, RTOS comparative study. ucos2 for real time embedded system demonstrate one case study: Case study of automobile RTOS issues in multitasking –selecting a Real Time Operating System **Self-learning Topics:** Inter-process-communication using semaphore, and Mutex, RTOS simple programming using ucos2	**07**	CO5
VI	Introduction to Embedded Platforms	Overview of various Embedded hardware Platforms: Architecture of Arduino, Basic Arduino programming using Arduino IDE and Arduino libraries for interfacing of LCD and sensors such as Temperature (DHT11), Pressure, Humidity. RaspberryPi (RPi-Functional Block diagram and its operation, GPIO pins, Features of RaspbianOS) Programming Arduino using python (pyserial or pyfirmata): blink.py Programming RaspberryPi GPIO using python: blink.py **Self-learning Topics:** Study of Arduino/ RaspberryPi using Thingspeak cloud platform and Blink app using Mobile.	**05**	CO6

Textbooks:

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 Hill

References:

1	Steve Furber, “ARM System on chip Architecture”, Pearson, edition second
2	Laya B. Das, “Embedded systems an integrated approach”, Pearson, Third impression, 2013
3	Embedded Systems, Architecture, program and Design by Rajkamal
4	Simon Monk,” Raspberry Pi Cookbook”, O’reilly
5	Massimo Banzi, “Getting Started with Arduino: The Open Source Electronics Prototyping Platform (Make)”, O'Reilly Media.
6	https://nptel.ac.in/courses/117/104/117104072/
7	https://www.coursera.org/learn/raspberry-pi-platform

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

- **Question paper format**

  - Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**

  - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

  - A total of **four questions** need to be answered.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITDO5012	Advance Data Management Technologies	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITDO5012	Advance Data Management Technologies	20	20	20	80	3	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To impart knowledge related to query processing and query optimization phases of a database management system.
2	To learn advanced techniques for data management and to overview emerging data models like Temporal, Mobile, and Spatial database.
3	To introduce advanced database models like distributed databases.
4	To create awareness of how enterprise can organize and analyze large amounts of data by creating a Data Warehouse.
5	To understand the process of data extraction, transformation and loading.
6	To understand the concept of Big data and NoSQL databases..

Course Outcomes:

Sr. No.	Course Outcomes:	Cognitive levels of attainment as per bloom's Taxonomy
1	Measure query costs and design alternate efficient paths for query execution.	L1,L2
2	Apply sophisticated access protocols to control access to the database.	L1,L2,L3
3	Implement Distributed databases.	L1,L2,L3

4	Organize strategic data in an enterprise and build a data Warehouse.	L1,L2,L3
5	Analyse data using OLAP operations so as to take strategic decisions.	L1,L2,L3,L4
6	Design modern applications using NoSQL databases**.** databases**.**	L1,L2,L3,L4

Prerequisite: Course on Database Management System

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Reviewing basic concepts of a Relational database, SQL concepts	**02**	----
I	Query Processing and Optimization	Overview: Introduction, Query processing in DBMS, Steps of Query Processing, Measures of Query Cost Selection Operation, Sorting, Join Operation, Evaluation of Expressions. Query Optimization Overview, Goals of Query Optimization, Approaches of Query Optimization, Transformations of Relational Expression, Estimating Statistics of Expression Results Choice of Evaluation Plans. **Self-learning Topics:** Solve problems on query optimization.	**06**	CO1
II	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, Remote Database access protocol. Overview of Advanced Database Models like Mobile databases, Temporal databases, Spatial databases. **Self-learning Topics**: Learn Data Security concepts like Authentication, Authorization and encryption.	**06**	CO2
III	Distributed Databases	Introduction: Distributed Data Processing, Distributed Database System: Architecture, Types, Design Issues. Data Fragmentation, Allocation in distributed databases. **Self-learning Topics**: Query Optimization in Distributed Databases	**04**	CO3
IV	Data Warehousing, Dimensional Modelling and OLAP	The Need for Data Warehousing; Data Warehouse Defined; Is data warehouse still relevant in the age of big data, Features of a Data Warehouse; Data Warehouse Architecture-Enterprise or centralized, federated and multi tired architectures; Data Warehouse and Data Marts; Data Warehousing Design Strategies, Data modeling-Dimensional 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. What is business intelligence, use of BI, Tools used in BI, Need for Online Analytical Processing; OLAP Operations	**09**	CO4

		in a cube: Roll-up, Drill-down, Slice, Dice, Pivot; OLAP Architectures: MOLAP, ROLAP, DOLAP and HOLAP. **Self-learning Topics:** Explore life cycle of data warehouse development		
V	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 **Self-learning Topics:** Find out various ETL tools for enterprise data management.	**05**	CO5
VI	Big data and NoSQL	Big data and NoSQL : Introduction, types and characteristics of big data, What is NoSQL, CAP theorem, BASE property, NoSQL data architecture patterns: Key-value stores, Graph stores, Column family stores, Document stores. **Self-learning Topics:** Google's Bigtable, Cassandra, MongoDB, Neo4j	**07**	CO6

Textbooks:

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.
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 Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling", 3rd Edition. Wiley India.
3 Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.
4 Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", Thomson Learning, 9th Edition.

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

- **Question paper format**

  - Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**

  - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

  - A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITDO5013	Computer Graphics & Multimedia System	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITDO5013	Computer Graphics & Multimedia System	20	20	20	80	3	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To equip student with the fundamental knowledge and basic technical competence in the field of Computer Graphics.
2	To emphasize on understanding of Computer Graphics Algorithms.
3	To prepare the student for advanced areas in the field of Computer Graphics.
4	To introduce student for professional avenues in the field of Computer Graphics
5	To introduce students about basic fundamentals and key aspects of Multimedia system.
6	To equip the students for various techniques of Multimedia.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe the basic concepts of Computer Graphics.	L1,L2
2	Demonstrate various algorithms for basic graphics primitives.	L1,L2
3	Apply 2-D geometric transformations on graphical objects. Use various Clipping algorithms on graphical objects	L1,L2,L3
4	Explore 3-D geometric transformations and curve representation techniques.	L1,L2,L3
5	Describe the basics of Multimedia System	L1,L2
6	Explore the Digital images audio & video and their related concepts.	L1,L2,L3

Prerequisite: Basic knowledge of mathematics.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	**Basic** knowledge of mathematics	--	---
I	Introduction	Definition and Representative uses of computer graphics, Overview of coordinate system, Definition of scan conversion, Raster scan & random scan displays, Architecture of raster graphicssystem with display processor, Architecture of random scan systems. **Self-learning Topics:-** study the working of some Raster scan display devices	**02**	CO1
II	Output Primitives	Scan conversions of point, line and circle: DDA algorithm and Brenham algorithm for line drawing, Midpoint algorithm for circle, Aliasing, Antialiasing techniques like Pre filtering and post filtering, super sampling, and pixel phasing. Filled Area Primitive: Scan line Polygon Fill algorithm, inside outside tests, Boundary Fill and Flood fill algorithm. **Self-learning Topics:-**Implementation of DDA and Bresenhams line algorithm for dotted line, dashed line, Dash-dot line etc.	**08**	CO2
III	Two Dimensional Transformations and Clipping	Basic 2D transformations:- Translation, Scaling, Rotation, Reflection. Matrix representation and Homogeneous Coordinates. Composite transformation. Viewing transformation pipeline and Window to Viewport coordinate transformation. Clipping operations: Point clipping, Line Clipping. Line clipping algorithms: Cohen- Sutherland, Liang-Barsky, Polygon Clipping Algorithms: Sutherland- Hodgeman, Weiler-Atherton. **Self-learning Topics:-**Implementation of 2D transformations like translation, rotation and scaling. Implementation of clipping algorithm.	**09**	CO3
IV	3D Transformation, curves and fractals	3D Transformations: Translation, Rotation, Scaling. Reflection , Composite transformations: Rotation about an arbitrary axis. Bezier Curve, B-Spline Curve.	**06**	CO4

		Fractal-Geometry: Fractal Dimension, Hilbert's curve, Koch Curve. **Self-learning Topics:-**Implementation of 3D transformations, Bezier curve , Koch curve.		
V	**Introduction to Multimedia**	Overview, Objects and Elements of Multimedia, Applications of Multimedia, Multimedia Systems Architecture – IMA, Workstation, Network, Types of Medium (Perception, Representation-..), Interaction Techniques **Self-learning Topics:-**Study the objects and elements of multimedia	**04**	CO5
VI	Digital Image, audio & video	Digital Image Representation (2D format, resolution) Types of Images (monochrome, gray, color), File formats: JPG. Compression Techniques: fundamentals (coding, inter pixel and psychovisual redundancies). Types – lossless and lossy Compression, Lossless Compression Algorithms– Shannon-Fano, Lossy Compression Algorithm – JPEG **Digital Audio** Basic Sound Concepts: computer representation of sound File Formats – WAV **Digital Video** Digitization of Video, types of video signals (component, composite and S- video). File Formats: MPEG Video **Self-learning Topics:-**Implementation of compression algorithms, Analysis of Digital audio and digital video file formats.	**10**	CO6

Text Books:

1 Hearn & Baker, "Computer Graphics C version", 2nd Edition, Pearson Publication

2 James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, "Computer Graphics Principles and Practice in C", 2nd Edition, Pearson Publication

3 Rajesh K. Maurya, "Computer Graphics", Wiley India Publication.

4 Multimedia System Design, Prabhat K. Andleigh& Kiran Thakrar, PHI

5 Fundamentals of Multimedia, Ze-Nian Li & Mark S. Drew, PHI.

References:

1 D. Rogers, "Procedural Elements for Computer Graphics", Tata McGraw-Hill Publications.
2 Samit Bhattacharya, "Computer Graphics", Oxford Publication
3 Multimedia Communication Systems: Techniques, Standards & Networks, K. R. Rao, Zoran S. Bojkovic & Dragorad A. Milovanovic, TMH.
4 Multimedia Systems, K. Buford, PHI.

Sr.No	Online Resources
1	https://nptel.ac.in/courses/106/106/106106090/
2	https://nptel.ac.in/courses/106/103/106103224/
3	https://nptel.ac.in/courses/106/102/106102065/
4	https://onlinecourses.swayam2.ac.in/nou21_cs04/preview
5	https://nptel.ac.in/courses/117/105/117105083/

Assessment:

Internal Assessment (IA)for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITDO5014	Advanced Data structure and Analysis	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITDO5014	Advanced Data structure and Analysis	20	20	20	80	3	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To learn mathematical background for analysis of algorithm
2	To learn various advanced data structures.
3	To understand the different design approaches of algorithm.
4	To learn dynamic programming methods.
5	To understand the concept of pattern matching
6	To learn advanced algorithms.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the different methods for analysis of algorithms.	L1,L2
2	Choose an appropriate advanced data structure to solve a specific problem.	L1,L2
3	Apply an appropriate algorithmic design approach for a given problem.	L1,L2,L3
4	Apply the dynamic programming technique to solve a given problem.	L1,L2,L3
5	Select an appropriate pattern matching algorithm for a given application.	L1,L2,L3
6	Understand the concepts of Optimization, Approximation and Parallel computing algorithms.	L1,L2

Prerequisite: Data structures and Analysis, Knowledge of Any Programming Language

DETAILED SYLLABUS:

Sr. No	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic of Data structures and analysis and programming language.	**02**	-
I	Introduction	Fundamentals of the analysis of algorithms: Time and Space complexity, Asymptotic analysis and notation, average and worst-case analysis, Recurrences: The substitution method, Recursive tree method, Masters method. **Self-learning Topics:** Analysis of Time and space complexity of iterative and recursive algorithms	**04**	CO1
II	Advanced Data Structures	B/B+ tree, Red-Black Trees, Heap operations, Implementation of priority queue using heap, Topological Sort. **Self-learning Topics:** Implementation of Red-Black Tree and Heaps.	**05**	CO2
III	Divide and Conquer AND Greedy algorithms	Introduction to Divide and conquer, Analysis of Binary Search, Merge sort and Quick sort, Finding minimum and maximum algorithm. Introduction to Greedy Algorithms: Knapsack Problem, Job sequencing using deadlines, Optimal storage on tape, Optimal Merge Pattern, Analysis of all these algorithms and problem solving. **Self-learning Topics:** Implementation of minimum and maximum algorithm, Knapsack problem, Job sequencing using deadlines.	**08**	CO3
IV	Dynamic algorithms	Introduction to Dynamic Algorithms, all pair shortest path, 0/1 knapsack, travelling salesman problem, Matrix Chain Multiplication, Optimal binary search tree, Analysis of All algorithms and problem solving. **Self-learning Topics:** Implementation of All pair shortest path, 0/1 Knapsack and OBST.	**06**	CO4
V	String Matching	Introduction, the naïve string matching algorithm, Rabin Karp algorithm, Boyer Moore algorithm, Knuth-Morris-Pratt algorithm, Longest Common Subsequence (LCS), Analysis of All algorithms and problem solving. **Self-learning Topics:** Implementation of Robin Karp algorithm, KMP algorithm and LCS.	**07**	CO5

VI	Advanced Algorithms and NP problems	**Optimization Algorithms:** Genetic algorithm(GA), **Approximation Algorithms:** Vertex-cover problem, **Parallel Computing Algorithms:** Fast Fourier Transform, **Introduction to NP-Hard and NP-Complete Problems** **Self-learning Topics:** Implementation of Genetic algorithm and Vertex-cover problem	**07**	CO6

Textbooks:

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.

References:

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.
4 Optimization Algorithms and Applications, By Rajesh Kumar Arora by Chapman and Hall

Online Resources

Sr.No	Website Links
1	https://nptel.ac.in/courses/106/106/106106131/
2	https://swayam.gov.in/nd1_noc19_cs47/preview
3	https://www.coursera.org/specializations/algorithms
4	https://www.mooc-list.com/tags/algorithms

Assessment:
Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marks Q.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered.

Program Structure for Third Year Information Technology

Semester V & VI

UNIVERSITY OF MUMBAI

(With Effect from 2021-2022)

Semester VI

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Pract. Tut.	Theory	Pract.	Total
ITC601	Data Mining & Business Intelligence	3	--	3	--	3
ITC602	Web X.0	3	--	3		3
ITC603	Wireless Technology	3	--	3	--	3
ITC604	AI and DS – 1	3	--	3	--	3
ITDO601X	**Department Optional Course – 2**	**3**	**--**	**3**	**--**	**3**
ITL601	BI Lab	--	2	--	1	1
ITL602	Web Lab	--	2	--	1	1
ITL603	Sensor Lab	--	2	--	1	1
ITL604	MAD & PWA Lab	--	2	--	1	1
ITL605	DS using Python Skill based Lab	--	2	--	1	1
ITM601	Mini Project – 2 B Based on ML	--	4[$]	--	2	2
Total		**15**	**14**	**15**	**07**	**22**

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac /oral	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test1	Test2	Avg					
ITC601	Data Mining & Business Intelligence	20	20	20	80	3	--	--	100
ITC602	Web X.0	20	20	20	80	3	--	--	100
ITC603	Wireless Technology	20	20	20	80	3	--	--	100
ITC604	AI and DS – 1	20	20	20	80	3	--	--	100
ITDO601X	**Department Optional Course – 2**	**20**	**20**	**20**	**80**	**3**	**--**	**--**	**100**
ITL601	BI Lab	--	--	--	--	--	25	25	50
ITL602	Web Lab	--	--	--	--	--	25	25	50
ITL603	Sensor Lab	--	--	--	--	--	25	25	50
ITL604	MAD & PWA Lab	--	--	--	--	--	25	25	50

ITL605	DS using Python Lab (SBL)	--	--	--	--	--	25	25	50
ITM601	Mini Project – 2 B Based on ML	--	--	--	--	--	25	25	50
Total		**--**	**--**	**100**	**400**	**--**	**150**	**150**	**800**

$ indicates work load of Learner (Not Faculty), for Mini-Project. Students can form groups with minimum 2(Two) and not more than 4(Four). Faculty Load: 1hour per week per four groups.

ITDO601X	**Department Optional Course – 2**
ITDO6011	Software Architecture
ITDO6012	Image Processing
ITDO6013	Green IT
ITDO6014	Ethical Hacking and Forensic

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC601	Data Mining & Business Intelligence	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITC601	Data Mining & Business Intelligence	20	20	20	80	3	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To introduce the concept of data warehouse 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 identifying opportunities to derive business value from data.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Demonstrate an understanding of the importance of data warehousing and data mining and the principles of business intelligence.	L1
2	Organize and prepare the data needed for data mining using pre preprocessing techniques.	L1,L2,L3
3	Perform exploratory analysis of the data to be used for mining.	L1,L2,L3,L4
4	Implement the appropriate data mining methods like classification, clustering or Frequent Pattern mining on large data sets.	L1,L2,L3,L4,L5
5	Define and apply metrics to measure the performance of various data mining	L1,L2,L3

	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.	L1,L2,L3

Prerequisite: Database Management System

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic Knowledge of databases	**01**	-
I	Data Warehouse (DWH) Fundamentals with Introduction to Data Mining	DWH characteristics, Dimensional modeling: Star, Snowflakes, OLAP operation, OLTP vs OLAP Data Mining as a step in KDD, Kind of patterns to be mined, Technologies used, Data Mining applications. **Self-learning Topics:** Data Marts, Major issues in Data Mining.	**04**	CO1
II	Data Exploration and Data Preprocessing	Types of Attributes, Statistical Description of Data, Measuring Data Similarity and Dissimilarity. Why Preprocessing? Data Cleaning, Data Integration, Data Reduction: Attribute Subset Selection, Histograms, Clustering, Sampling, Data Cube aggregation, Data transformation and Data Discretization: Normalization, Binning, Histogram Analysis **Self-learning Topics** Data Visualization, Concept hierarchy generation	**06**	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, Accuracy and Error measures, Precision, Recall, Holdout, Random Sampling, Cross Validation, Bootstrap, Introduction of Ensemble methods, Bagging, Boosting, AdaBoost and Random forest. **Self-learning Topics:** Multiple linear regression, logistic regression, Random forest, nearest neighbour classifier, SVM	**08**	CO4, CO5
IV	Clustering and Outlier Detection	Cluster Analysis: Basic Concepts; Partitioning Methods: K-Means, K Medoids; Hierarchical Methods: Agglomerative, Divisive, BIRCH; Density-Based Methods: DBSCAN. What are outliers? Types, Challenges; Outlier Detection Methods: Supervised, Semi Supervised,	**08**	CO4

		Unsupervised, Proximity based, Clustering Based. **Self-learning Topics** Hierarchical methods : Chameleon, Density based methods: OPTICS, Grid based methods: STING, CLIQUE		
V	Frequent Pattern Mining	**Basic Concepts**: Market Basket Analysis, Frequent Itemset, Closed Itemset, and Association Rules; Frequent Itemset. Mining Methods: The Apriori Algorithm: Finding Frequent Itemset Using Candidate Generation, Generating Association Rules from Frequent Itemset, Improving the Efficiency of Apriori, A pattern growth approach for mining Frequent Itemset, Mining Frequent Itemset using vertical data formats; Introduction to Advance Pattern Mining: Mining Multilevel Association Rules and Multidimensional Association Rules. **Self-learning Topics:** Association Mining to Correlation Analysis, lift, Introduction to Constraint-Based Association Mining	**08**	CO4, 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, Recommendation System **Self-learning Topics:** Clickstream Mining, Market Segmentation, Retail industry, Telecommunications industry, Banking & finance CRM, Epidemic prediction, Fake News Detection, Cyberbullying, Sentiment Analysis etc.	**04**	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. Paulraj Ponniah “Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals” Wiley Publications
4. Business Intelligence: Data Mining and Optimization for Decision Making by Carlo Vercellis, Wiley India Publications.
5. 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.
4. Data Mining https://onlinecourses.nptel.ac.in/noc21_cs06/preview

Assessment:

Internal Assessment (IA) for 20 marks:

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  - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

  - A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC602	Web X.0	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITC602	Web X.0	20	20	20	80	3	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand the digital evolution of web technology.
2	To learn Type Script and understand how to use it in web application.
3	To empower the use of AngularJS to create web applications that depend on the Model-View-Controller Architecture.
4	To gain expertise in a leading document-oriented NoSQL database, designed for speed, scalability, and developer agility using MongoDB.
5	To build web applications quickly and with less code using Flask framework.
6	To gain knowledge of Rich Internet Application Technologies.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the basic concepts related to web analytics and semantic web.	L1, L2
2	Understand how TypeScript can help you eliminate bugs in your code and enable you to scale your code.	L1, L2
3	Understand AngularJS framework and build dynamic, responsive single-page web applications.	L2, L3
4	Apply MongoDB for frontend and backend connectivity using REST API.	L1, L2, L3
5	Apply Flask web development framework to build web applications with less code.	L1, L2, L3

6	Develop Rich Internet Application using proper choice of Framework.	L1, L2, L3, L4

Prerequisite: Object Oriented Programming, Python Programming, HTML and CSS.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	HTML/HTML5 (Tags, Attributes and their properties), CSS/CSS3 (Types and Properties), Basics of Java Script, Python Programming	**02**	--
I	Introduction to WebX.0	**Evolution of WebX.0**; **Web Analytics 2.0**: Introduction to Web Analytics, Web Analytics 2.0, Clickstream Analysis, Strategy to choose your web analytics tool, Measuring the success of a website; **Web3.0 and Semantic Web**: Characteristics of Semantic Web, Components of Semantic Web, Semantic Web Stack, N-Triples and Turtle, Ontology, RDF and SPARQL **Self-learning Topics**: Semantic Web Vs AI, SPARQL Vs SQL.	**04**	CO1
II	Type Script	Overview, TypeScript Internal Architecture, TypeScript Environment Setup, TypeScript Types, variables and operators, Decision Making and loops, TypeScript Functions, TypeScript Classes and Objects, TypeScript Modules **Self-learning Topics**: Javascript Vs TypeScript	**06**	CO2
III	Introduction to AngularJS	Overview of AngularJS, Need of AngularJS in real web sites, AngularJS modules, AngularJS built-in directives, AngularJS custom directives, AngularJS expressions, Angular JS Data Binding, AngularJS filters, AngularJS controllers, AngularJS scope, AngularJS dependency injection, Angular JS Services, Form Validation, Routing using ng-Route, ng-Repeat, ng-style, ng-view, Built-in Helper Functions, Using Angular JS with Typescript **Self-learning Topics**: MVC model, DOM model, Javascript functions and Error Handling	**08**	CO3
IV	MongoDB and Building REST API using MongoDB	**MongoDB**: Understanding MongoDB, MongoDB Data Types, Administering User Accounts, Configuring Access Control, Adding the MongoDB Driver to Node.js, Connecting to MongoDB from Node.js, Accessing and Manipulating Databases, Manipulating MongoDB Documents from Node.js, Accessing MongoDB from Node.js, Using Mongoose for Structured Schema and Validation. **REST API**: Examining the rules of REST APIs, Evaluating API patterns, Handling typical CRUD functions (create, read, update, delete), Using Express and Mongoose to interact with MongoDB, Testing API endpoints **Self-learning Topics**: MongoDB vs SQL DB	**08**	CO4
V	Flask	Introduction, Flask Environment Setup, App Routing, URL Building, Flask HTTP Methods, Flask Request Object, Flask cookies, File Uploading in Flask	**06**	CO5

		Self-learning Topics: Flask Vs Django		
VI	Rich Internet Application	**AJAX:** Introduction and Working **Developing RIA using AJAX Techniques**: CSS, HTML, DOM, XML HTTP Request, JavaScript, PHP, AJAX as REST Client **Introduction to Open Source Frameworks and CMS for RIA**: Django, Drupal, Joomla **Self-learning Topics**: Applications of AJAX in Blogs, Wikis and RSS Feeds	**05**	CO6

Text Books:

1. Boris Cherny, "Programming TypeScript- Making Your Javascript Application Scale", O'Reilly Media Inc.
2. Adam Bretz and Colin J. Ihrig, "Full Stack JavaScript Development with MEAN", SitePoint Pty. Ltd.
3. Simon Holmes Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node", Manning Publications.
4. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", O'Reilly.
5. Dr. Deven Shah, "Advanced Internet Programming", StarEdu Solutions.

References:

1. Yakov Fain and Anton Moiseev, "TypeScript Quickly", Manning Publications.
2. Steve Fenton, "Pro TypeScript: Application - Scale Javascript Development", Apress
3. Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications", 2nd Edition, Addison-Wesley Professional

Online References:

Sr. No.	Website Links
1.	https://www.nptel.ac.in
2.	https://swayam.gov.in
3.	https://www.coursera.org
4.	https://udemy.com

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- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC603	Wireless Technology	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITC603	Wireless Technology	20	20	20	80	3	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Discuss the Fundamentals of Wireless Communication.
2	Comprehend the Fundamental Principles of Wide Area Wireless Networking Technologies and their Applications.
3	Explain Wireless Metropolitan and Local Area Networks.
4	Describe Wireless Personal Area Networks and Ad hoc Networks
5	Learn and Analyze Wireless Network Security Standards.
6	Study the Design Considerations for Wireless Networks.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe the basic concepts of Wireless Network and Wireless Generations.	L1,L2
2	Demonstrate and Evaluate the various Wide Area Wireless Technologies.	L1,L2,L3, L4, L5
3	Analyze the prevalent IEEE standards used for implementation of WLAN and WMAN Technologies	L1,L2,L3,L4
4	Appraise the importance of WPAN, WSN and Ad-hoc Networks.	L1,L2,L3,L4,L5
5	Analyze various Wireless Network Security Standards.	L1,L2,L3,L4
6	Review the design considerations for deploying the Wireless Network Infrastructure.	L1,L2

Prerequisite: Principle of Communication, Computer Network and Network Design, Computer Network Security.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Digital Modulation Techniques – ASK, FSK, BPSK, QPSK; Electromagnetic Spectrum; Multiplexing Techniques – FDM, TDM, OFDM; OSI and TCP/IP Model; Need for Security, Types of Security Threats and Attacks.	**02**	--
I	Fundamentals of Wireless Communication	Introduction to Wireless Communication - Advantages, Disadvantages and Applications; Multiple Access Techniques - FDMA, TDMA, CDMA, OFDMA; Spread Spectrum Techniques – DSSS, FHSS; Evolution of wireless generations – 1G to 5G (Based on technological differences and advancements); 5G – Key requirements and drivers of 5G systems, Use cases, Massive MIMO. **Self-learning Topics:** Modulation Techniques - QAM, MSK, GMSK	**07**	CO1
II	Wide Area Wireless Networks	Principle of Cellular Communication – Frequency Reuse concept, cluster size and system capacity, co-channel interference and signal quality; GSM – System Architecture, GSM Radio Subsystem, Frame Structure; GPRS and EDGE – System Architecture; UMTS – Network Architecture; CDMA 2000 – Network Architecture; LTE – Network Architecture; Overview of LoRa & LoRaWAN. **Self-learning Topics:-** IS-95	**09**	CO2
III	Wireless Metropolitan and Local Area Networks	IEEE 802.16 (WiMax) – Mesh mode, Physical and MAC layer; IEEE 802.11(Wi-Fi) – Architecture, Protocol Stack, Enhancements and Applications. **Self-learning Topics:-** WLL(Wireless Local Loop).	**06**	CO3
IV	Wireless Personal Area Networks and Ad hoc Networks	IEEE 802.15.1 (Bluetooth) – Piconet, Scatter net, Protocol Stack; IEEE 802.15.4 (ZigBee) – LR-WPAN Device Architecture, Protocol Stack; Wireless Sensor Network – Design Considerations, Issues and Challenges, WSN Architecture, Applications; Introduction of Ad hoc Networks – MANET and VANET – Characteristics, Applications, Advantages and Limitations; Over view of E-VANET(Electrical Vehicular AdHoc Networks). **Self-learning Topics**:- HR–WPAN (UWB)	**08**	CO4
V	Wireless Network Security	Security in GSM; UMTS Security; Bluetooth Security; WEP; WPA2. **Self-learning Topics :-** Study of Wireless Security Tools.	**04**	CO5

VI	Wireless Network Design Considerations	Cisco Unified Wireless Network; Designing Wireless Networks with Lightweight Access Points and Wireless LAN Controllers. **Self-learning Topics:-** Cisco Unified Wireless Network Mobility Services.	**03**	CO6

Text Books:

1. Wireless Communications, T.L. Singal, McGraw Hill Education.
2. Wireless Communications and Networking, Vijay Garg, Morgan Kaufmann Publishers.
3. Wireless Mobile Internet Security, 2nd Edition, Man Young Rhee, A John Wiley & Sons, Ltd., Publication.
4. 5G Outlook–Innovations and Applications,Ramjee Prasad,River Publishers Series in Communications.
5. Designing for Cisco Internetwork Solutions, 2nd Edition, CCDA, Diane Teare, Cisco Press.

Reference Books:

1. Cellular Communications: A Comprehensive and Practical Guide, Nishith Tripathi, Jeffery H Reed, Wiley.
2. Wireless Communications- Principles & Practice,Theodore S. Rappaport, Prentice Hall Series.
3. Wireless Communications and Networks", William Stallings, Pearson / Prentice Hall.
4. Adhoc & Sensor Networks Theory and Applications, Carlos de Morais Cordeiro,Dharma Prakash Agrawal, World Scientific,2nd Edition.
5. Wireless Networks, Nicopolitidia, M S Obaidat, GI Papadimitriou, Wiley India (Student Edition, 2010).

Online References:

Sr. No.	Website/Reference link
1.	www.swayam.gov.in
2.	www.coursera.org
3.	https://doi.org/10.1007/978-3-642-17878-8_63
4.	https://doi.org/10.1007/978-3-642-54525-2_44
5.	https://lora-alliance.org/resource_hub/what-is-lorawan/
6.	https://doi.org/10.1007/s42835-021-00687-8

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

- **Question paper format**

  - Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**

  - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

  - A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC604	AI and DS - 1	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITC604	AI and DS - 1	20	20	20	80	3	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To introduce the students' with different issues involved in trying to define and simulate intelligence.
2	To familiarize the students' with specific, well known Artificial Intelligence methods, algorithms and knowledge representation schemes.
3	To introduce students' different techniques which will help them build simple intelligent systems based on AI/IA concepts.
4	To introduce students to data science and problem solving with data science and statistics.
5	To enable students to choose appropriately from a wider range of exploratory and inferential methods for analyzing data, and interpret the results contextually.
6	To enable students to apply types of machine learning methods for real world problems.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents.	L1
2	Apply an appropriate problem-solving method and knowledge-representation scheme.	L1,L2,L3
3	Develop an ability to analyze and formalize the problem (as a state space, graph, etc.). They will be able to evaluate and select the appropriate search method.	L1,L2,L3,L4
4	Apply problem solving concepts with data science and will be able to tackle them from a statistical perspective.	L1,L2,L3

5	Choose and apply appropriately from a wider range of exploratory and inferential methods for analyzing data and will be able to evaluate and interpret the results contextually.	L1,L2,L3
6	Understand and apply types of machine learning methods for real world problems.	L1,L2, L3

Prerequisite:

1. Engineering Mathematics III (ITC301)
2. Data Structures and Analysis (ITC302)
3. Engineering Mathematics IV (ITC401)

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	**Nil**	--	--
I	Introduction to AI	**Introduction:** Introduction to AI, AI techniques, Problem Formulation. **Intelligent Agents:** Structure of Intelligent agents, Types of Agents, Agent Environments PEAS representation for an Agent. **Self-Learning Topics :** Identify application areas of AI	**04**	CO1
II	Search Techniques	Uninformed Search Techniques: Uniform cost search, Depth Limited Search, Iterative Deepening, Bidirectional search. Informed Search Methods: Heuristic functions, Best First Search, A*, Hill Climbing, Simulated Annealing. Constraint Satisfaction Problem Solving: Crypto-Arithmetic Problem, Water Jug, Graph Coloring. Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning. Comparing Different Techniques. **Self-Learning Topics :** IDA*, SMA*	**09**	CO2
III	Knowledge Representation using First Order Logic	**Knowledge and Reasoning:** A Knowledge Based Agent, WUMPUS WORLD Environment, Propositional Logic, First Order Predicate Logic, Forward and Backward Chaining, Resolution. Planning as an application of a knowledge based agent. Concepts of Partial Order planning, Hierarchical Planning and Conditional Planning. **Self-Learning Topics:** Representing real world problems as planning problems.	**06**	CO3
IV	Introduction to DS	Introduction and Evolution of Data Science, Data Science Vs. Business Analytics Vs. Big Data, Data Analytics, Lifecycle, Roles in Data Science Projects. **Self-Learning Topics :** Applications and Case Studies of Data Science in various Industries	**04**	CO4
V	Exploratory Data Analysis	Introduction to exploratory data analysis, Typical data formats. Types of EDA, Graphical/Non graphical Methods, Univariate/multivariate methods Correlation and covariance, Degree of freedom	**08**	CO5

		Statistical Methods for Evaluation including ANOVA. **Self-Learning Topics:** Implementation of graphical EDA methods.		
VI	Introduction to ML	Introduction to Machine Learning, Types of Machine Learning: Supervised **(**Logistic Regression, Decision Tree, Support Vector Machine) and Unsupervised (K Means Clustering, Hierarchical Clustering, Association Rules) Issues in Machine learning, Application of Machine Learning Steps in developing a Machine Learning Application. **Self-Learning Topics :** Real world case studies on machine learning	**08**	CO6

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson Education.
2. Elaine Rich, Kevin Knight, Shivshankar B Nair, Artificial Intelligence, McGraw Hill, 3rd Edition.
3. Howard J. Seltman, Experimental Design and Analysis, Carnegie Mellon University, 2012/1.
4. Ethem Alpaydın, "Introduction to Machine Learning", MIT Press

References:

1. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
2. George Lugar, AI-Structures and Strategies for Complex Problem Solving., 4/e, 2002, Pearson Education.
3. Data Science & Big Data Analytics, 1st Edition, 2015, EMC Education Services, Wiley. ISBN: 978-1118876138
4. Tom M.Mitchell "Machine Learning" McGraw Hill
5. Richard I. Levin, David S. Rubin "Statistics for Management" Pearson
6. Vivek Belhekar, "Statistics for Psychology using R" SAGE

Online References:

Sr. No.	Website/Reference link
1.	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs83/
2.	https://nptel.ac.in/courses/106/105/106105077/
3.	https://www.coursera.org/specializations/jhu-data-science
4.	https://www.coursera.org/learn/machine-learning
5.	https://www.udemy.com/course/statistics-for-data-science-and-business-analysis/

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

- **Question paper format**

  - Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**

- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL601	Business Intelligence Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITL601	Business Intelligence Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
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:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify sources of Data for mining and perform data exploration	L2
2	Organize and prepare the data needed for data mining algorithms in terms of attributes and class inputs, training, validating, and testing files	L2
3	Implement the appropriate data mining methods like classification, clustering or association mining on large data sets using open-source tools like WEKA	L3

4	Implement various data mining algorithms from scratch using languages like Python/ Java etc.	L3
5	Evaluate and compare performance of some available BI packages	L3, L4
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	L3, L4

Prerequisite: Object oriented Concept, Java programming language, Python.

Hardware & Software Requirements:

Hardware Requirements	**Software Requirements**
PC i3 processor and above	Open source data mining and BI tools like WEKA, Rapid Miner, Pentaho

DETAILED SYLLABUS:

Sr. No.	**Module**	**Detailed Content**	**Hours**	**LO Mapping**
0	Prerequisite	--	----	--
I	I	Tutorial on a) Design Star and Snowflake Schema	**02**	LO 1
II	II	Implement using tools or languages like JAVA/ python/R a) Data Exploration b) Data preprocessing	**04**	LO 2
III	III	Implement and evaluate using languages like JAVA/ python/R a) Classification Algorithms b) Clustering Algorithms c) Frequent Pattern Mining Algorithms	**06**	LO4
IV	IV	Perform and evaluate using any open-source tools a) Classification Algorithms b) Clustering Algorithms c) Frequent Pattern Mining Algorithms	**04**	LO3
V	V	Detailed case study of any one BI tool such as Pentaho, Tableau and QlikView	**04**	LO5
VI	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, Kaggle, KDD cup, Data Mining Cup, UCI Machine Learning Repository etc. c) Implement appropriate data mining algorithm d) Interpret and visualize the results	**06**	LO6

		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.
3. Paulraj Ponniah “Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals” Wiley Publications

References:

1. P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education
2. WEKA, RapidMiner Pentaho resources from the Web.
3. https://www.kaggle.com/learn/overview
4. Python for Data Science https://onlinecourses.nptel.ac.in/noc21_cs33/preview

Term Work: Term Work shall consist of at least 10 racticals based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Mini Project) + 5 Marks (Attendance)

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

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL602	Web Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITL602	Web Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	Open Source Tools for Web Analytics and Semantic Web.
2	Programming in TypeScript for designing Web Applications.
3	AngularJS Framework for Single Page Web Applications.
4	AJAX for Rich Internet Applications.
5	REST API and MongoDB for Frontend and Backend Connectivity.
6	Flask Framework for building web applications.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive Levels of Attainment as per Bloom's Taxanomy
On successful completion, of course, learner/student will be able to:		
1	Understand open source tools for web analytics and semantic web apps development and deployment.	L1, L2
2	Understand the basic concepts of TypeScript for designing web applications.	L1, L2, L3
3	Implement Single Page Applications using AngularJS Framework.	L1, L2, L3

4	Develop Rich Internet Applications using AJAX.	L1, L2, L3
5	Create REST Web services using MongoDB.	L1, L2, L3, L4
6	Design web applications using Flask.	L1, L2, L3, L4

Prerequisite: HTML/HTML5, CSS/CSS3, JavaScript, Python

Hardware & Software requirements:

Hardware Specifications	**Software Specifications**
PC with following Configuration 1. Intel Core i3/i5/i7 2. 4 GB RAM 3. 500 GB Hard disk	Angular IDE, Visual Studio Code, Notepad++, Python Editors, MySQL, XAMPP, MongoDB, JDK

DETAILED SYLLABUS:

Sr. No.	**Module**	**Detailed Content**	**Hours**	**LO Mapping**
I	Web Analytics & Semantic Web	Study **Any 1** tool in each 1. Study web analytics using open source tools like Matomo, Open Web Analytics, AWStats, Countly, Plausible. 2. Study Semantic Web Open Source Tools like Apache TinkerPop, RDFLib, Apache Jena, Protégé, Sesame.	**02**	LO1
II	TypeScript	Perform **Any 3** from the following 1. Small code snippets for programs like Hello World, Calculator using TypeScript. 2. Inheritance example using TypeScript 3. Access Modifiers example using TypeScript 4. Building a Simple Website with TypeScript	**04**	LO2
III	AngularJS	Perform **Any 2** from the following 1. Create a simple HTML "Hello World" Project using AngularJS Framework and apply ng-controller, ng-model and expressions. 2. Events and Validations in AngularJS. (Create functions and add events, adding HTML validators, using $valid property of Angular, etc.) 3. Create an application for like Students Record using AngularJS	**06**	LO3
IV	Rich Internet Application using AJAX	Perform **Any 3** from the following 1. Write a JavaScript program for a AJAX. 2. Write a program to use AJAX for user validation using and to show the result on the same page below the submit button.	**06**	LO4

		3. Design and develop small web application using AJAX, HTML and JSP.		
V	MongoDB and Building REST API using MongoDB	Perform **Any 1** from the following 1. Build a RESTful API using MongoDB. 2. Build a TypeScript REST API using MongoDB.	**04**	LO5
VI	Flask	Perform **Any 3** from the following 1. Design Feedback Form using Flask. 2. Design Weather App using Flask. 3. Design Portfolio Website using Flask. 4. Create a complete Machine learning web application using React and Flask.	**04**	LO6

Text Books:

1. John Hebeler, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, "Semantic Web Programming", Wiley Publishing, Inc, 1st Edition, 2009.
2. Boris Cherny, "Programming TypeScript- Making Your Javascript Application Scale", O'Reilly Media Inc., 2019 Edition.
3. Adam Bretz and Colin J. Ihrig, "Full Stack JavaScript Development with MEAN", SitePoint Pty. Ltd., 2015 Edition.
4. Simon Holmes Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node", Manning Publications, 2019 Edition.
5. Dr. Deven Shah, "Advanced Internet Programming", StarEdu Solutions, 2019 Edition.
6. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", O'Reilly, 2018 Edition.

References:

1. John Davies, Rudi Studer and Paul Warren, "Semantic Web Technologies Trends and Research in Ontology-based Systems", Wiley, 2006 Edition.
2. Yakov Fain and Anton Moiseev, "TypeScript Quickly", Manning Publications, 2020 Edition.
3. Steve Fenton, "Pro TypeScript: Application - Scale Javascript Development", Apress, 2014 Edition.
4. Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications", 2nd Edition, Addison-Wesley Professional, 2018 Edition.

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	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL603	Sensor Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITL603	Sensor Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	Learn various communication technologies, Microcontroller boards and sensors.
2	Design the problem solution as per the requirement analysis done using sensors and technologies.
3	Study the basic concepts of programming/sensors/ emulators.
4	Design and implement the mini project intended solution for project based earning.
5	Build, test and report the mini project successfully.
6	Improve the team building, communication and management skills of the students.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive Levels of Attainment as per Bloom's Taxanomy
On successful completion, of course, learner/student will be able to:		
1	Differentiate between various wireless communication technologies based on the range of communication, cost, propagation delay, power and throughput.	L1,L2

2	Conduct a literature survey of sensors used in real world wireless applications.	L1,L2
3	Demonstrate the simulation of WSN using the Network Simulators (Contiki/ Tinker CAD/ Cup carbon etc).	L1,L2,L3
4	Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing	L1,L2,L3
5	Report and present the findings of the study conducted in the preferred domain.	L1,L2,L3
6	Demonstrate the ability to work in teams and manage the conduct of the research study.	L1,L2,L3

Prerequisite: Computer Networks, Microprocessor Lab.

Hardware & Software requirements:

Hardware Specifications:	**Software Specifications:**
1.Laptop/ PC with minimum 2GB RAM and 500 GB Hard disk drive. 2. Sensors –DHT11/22, PIR, MQ2/MQ3, HC-SR04, Moisture sensor , Arduino Uno/Mega board, RPi Board 3. Wireless Radio Modules- Zigbee RF module, Bluetooth Module (HC-05), Mobile Phone with Bluetooth antenna 4. Others-Breadboard, wires, power supplies, USB cables, buzzers, LEDs, LCDs.	1. Windows or Linux Desktop OS Arduino IDE 2.XCTU configuration and test utility software 3. CupCarbon IOT simulator 4. Tinkercad Simulation Software 5. Contiki/Cooja 6. Internet connection

Guidelines

A. **Students should perform the following experiments:**

DETAILED SYLLABUS:

Sr. No.	**Module**	**Detailed Content**	**Hours**	**LO Mapping**
0	Prerequisite	Introduction to 8086, 8051 and Python programming	**02**	--
I	Review of Wireless Communication Technologies	Study of various wireless communication technologies like IEEE 802.15.1, IEEE 802.15.4 and IEEE 802.11. Mini Project: Allocation of the groups	**02**	LO1
II	Sensors and their Interfacing	Study of various types of sensors and display devices (eg. DHT-11/22, HC-SR04, MFRC 522, PIR Sensor) and demonstration of their interfacing using Arduino/ Raspberry pi. Mini Project: Topic selection	**02**	LO2
III	Wireless Communication tools	Installation and testing the simulation tools (eg. TinkerCad/Cupcarbon/ContikiCooja). Mini Project: Topic validation and finalizing software and Hardware requirement.	**02**	LO3
IV	Implementation of Wireless Technologies	Study of interfacing of Arduino/ Raspberry pi with Wireless Technologies (eg. HC-05, XBee S2C by	**02**	LO4

		Digi, ESP controller). Mini Project: Hardware procurement		
V	Remote Access	Study of interface using Mobile/Web to publish or remotely access the data on the Internet. Mini Project: Study of remote access technologies with respect to the selected project.	**02**	LO4
VI	Mini Project	Implementation of the Mini Project: 1. Design, configure, testing the Mini Project. 2. Report submission as per the guidelines.	**14**	LO4,LO5 ,LO6

B. Mini project

1. Students should carry out hardware based mini-project in a group of three/four students with a subject In charge/ mini project mentor associated with each group.
2. The group should meet with the concerned faculty during laboratory hours and the progress of work discussed must be documented.
3. Each group should perform a detailed literature survey and formulate a problem statement.
4. Each group will identify the hardware and software requirement for their defined mini project problem statement.
5. Design, configure and test their own circuit board.
5. Interface using Mobile/Web to publish or remotely access the data on the Internet.
6. A detailed report is to be prepared as per guidelines.
7. Each group may present their work in various project competitions and paper presentations

C. Documentation of the Mini Project

The Mini Project Report can be made on following lines:
1. Abstract
2. Contents
3. List of figures and tables
4. Chapter-1 (Introduction, Literature survey, Problem definition, Objectives, Proposed Solution, Wireless Technology used)
5. Chapter-2 (System design/Block diagram, Flow chart, Circuit/Interfacing diagram, Hardware and Software requirements, cost estimation)
6. Chapter-3 (Implementation snapshots/figures with explanation, code, future directions)
7. Chapter-4 (Conclusion)
8. References

Text Books:

1. Fundamentals of Sensor Network Programming: Applications and Technology, S. Sitharama Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley Publications.
2. ContikiCooja User Guide.
3. Building Wireless Sensor Networks, Robert Faludi, O'Reilly Publications.

Reference Books:

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

2. A comparative review of wireless sensor network mote technologies, IEEE paper 2009.

3. Wireless Sensor Networks-Technology, Protocols and Applications, KazemSohraby, Daniel Minoli and TaiebZnati, Wiley Publications.

4. Adhoc& Sensor Networks Theory and Applications, Carlos de MoraisCordeiro,Dharma Prakash Agrawal, World Scientific,2nd Edition.

Online References:

Sr. No.	Website/Reference link
1.	https://www.digi.com/resources/documentation/digidocs/90001526/tasks/t_download_and_install_xctu.htm
2.	https://www.arduino.cc/en/software
3.	http://cupcarbon.com/

Term Work:

Term Work shall consist of Mini Project on above guidelines/syllabus. Also Term work must include at least 2 assignments and mini project report.

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	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL604	MAD & PWA Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITL604	MAD & PWA Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	Learn the basics of the Flutter framework.
2	Develop the App UI by incorporating widgets, layouts, gestures and animation
3	Create a production ready Flutter App by including files and firebase backend service.
4	Learn the Essential technologies, and Concepts of PWAs to get started as quickly and efficiently as possible
5	Develop responsive web applications by combining AJAX development techniques with the jQuery JavaScript library.
6	Understand how service workers operate and also learn to Test and Deploy PWA.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On Completion of the course the learner/student should be able to:		
1	Understand cross platform mobile application development using Flutter framework	**L1, L2**
2	Design and Develop interactive Flutter App by using widgets, layouts, gestures and animation	**L3**
3	Analyze and Build production ready Flutter App by incorporating backend services and deploying on Android / iOS	**L3, L4**
4	Understand various PWA frameworks and their requirements	**L1, L2**
5	Design and Develop a responsive User Interface by applying PWA Design techniques	**L3**
6	Develop and Analyse PWA Features and deploy it over app hosting solutions	**L3, L4**

Prerequisite: HTML/HTML5, CSS3, Javascript

Hardware & Software Requirements:

Hardware Requirement:	**Software requirement:**
PC i3 processor and above	**JDK 8 and above, Android studio, Flutter SDK, AngularJs, React, Vue, PWA Builder, Google Chrome Browser, Github account.** **Internet Connection**

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping

I	Basics of Flutter Programming	Introduction of Flutter, Understanding Widget Lifecycle Events,Dart Basics, Widget Tree and Element Tree, Basics of Flutter installation, Flutter Hello World App.	**02**	LO1
II	Developing Flutter UI:Widgets, Layouts, Gestures, Animation	**USING COMMON WIDGETS:** SafeArea, Appbar, Column, Row, Container, Buttons, Text , Richtext,Form ,Images and Icon. **BUILDING LAYOUTS** : high level view of layouts, Creating the layout, Types of layout widgets **APPLYING GESTURES**: Setting Up GestureDetector, Implementing the Draggable and Dragtarget Widgets,Using the GestureDetector for Moving and Scaling **ADDING ANIMATION TO AN APP** :Using Animated Container,Using Animated CrossFade,Using Animated Opacity,Using Animation Controller, Using Staggered Animation **CREATING AN APP'S NAVIGATION:** Using the Navigator,Using the Named Navigator Route,Using the Bottom NavigationBar,Using the TabBar and TabBarView	**06**	LO2
III	Creating Production Ready Apps	**Working with files** : Including libraries in your Flutter app, Including a file with your app, Reading/Writing to files, Using JSON. **Using Firebase with Flutte**r: Adding the Firebase and Firestore Backend,Configuring the Firebase Project,Adding a Cloud Firestore Database and Implementing Security **Testing and Deploying of Flutter Application:** Widget testing, Deploying Flutter Apps on Android / iOS	**04**	LO3
IV	Introduction to Progressive Web App	**Introduction to Progressive Web App** ● Why Progressive Web App ● Characteristics of PWA ● PWAs and Hybrid Apps vs. Mobile Apps ● PWA Requirements: HTTPS, Service Workers, and Web App Manifest ● PWA framework tools ● Use cases	**02**	LO4

V	Creating Responsive UI	**Creating Responsive UI using JQuery Mobile / Material UI / Angular UI / React UI** ● Understanding the concept of responsive web design ● Comparing responsive, fluid, and adaptive web ● keys to great Progressive Web App UX ● Responsive Design – The Technicalities ● Flexible grid-based layout ● Flexible images and video ● Smart use of CSS splitting the website behavior (media queries)	06	LO5
VI	Web App Manifest & Service Workers	**Web App Manifest:** Understand the basic format and workings of the Web App Manifest file. ● Using an App Manifest to Make your App Installable ● Understanding App Manifest Properties ● Simulating the Web App on an Emulator ● Installing the Web App - Prerequisites ● Understanding manifest.json **Service Workers:** Making PWAs work offline with Service workers ● Introduction to Service Workers ● Service Workers Lifecycle (Registration, Installation and Activation) ● Implement Service Workers Features (Events) ● Handling cached content ● Enabling offline functionality ● Serving push notifications ● Loading cached content for new users ● Background synchronization ● Using IndexedDB in the Service Worker ● Geo-fencing **Deploy a PWA to GitHub Pages as a free SSL enabled static app hosting solution.** ● Initialising the PWA as a Git repo ● Testing with Lighthouse ● Deploying via GitHub Pages	06	LO6

Text Books:

1. Beginning Flutter a Hands-on Guide to App Development, Marco L. Napoli, Wiley, 2020.
2. Beginning App Development with Flutter: Create Cross-Platform Mobile Apps, By Rap Payne, 201**9**
3. Progressive Web Application Development by Example: Develop fast, reliable, and engaging user experiences for the web, Packt Publishing Limited ,2018
4. Building Progressive Web Apps,O'Reilly 2017

5. Progressive Web Apps with Angular: Create Responsive, Fast and Reliable PWAs Using Angular, Apress; 1st ed. edition (28 May 2019)

References:

1. Flutter in Action by Eric Windmill, MANING, 2019
2. Google Flutter Mobile Development Quick Start Guide.Packt,2019
3. Learning Progressive Web Apps: Building Modern Web Apps Using Service Workers ,Addison-Wesley Professional, 2020

Online References:

Sr. No.	Website/Reference link
1.	https://flutter.dev/docs/reference/tutorials
2.	**https://www.tutorialspoint.com/flutter/index.htm**
3.	**https://www.javatpoint.com/flutter**
4.	https://www.tutorialspoint.com/jquery_mobile/jqm_panel_responsive.htm
5.	https://www.w3schools.com/css/css_rwd_intro.asp
6	https://developers.google.com/web/updates/2015/12/getting-started-pwa
7	https://www.w3schools.com/react/
8	https://angular.io/docs
9	https://flaviocopes.com/service-workers/
10	https://blog.logrocket.com/how-to-build-a-progressive-web-app-pwa-with-node-js/

List of Experiments.

1. To install and configure Flutter Environment.
2. To design Flutter UI by including common widgets.
3. To create an interactive Form using form widget
4. To design a layout of Flutter App using layout widgets
5. To include icons, images, charts in Flutter app
6. To apply navigation, routing and gestures in Flutter App
7. To Connect Flutter UI with fireBase database
8. To test and deploy production ready Flutter App on Android platform
9. To create a responsive User Interface using jQuery Mobile/ Material UI/ Angular UI/ React UI for Ecommerce application.
10. To write meta data of your Ecommerce PWA in a Web app manifest file to enable “add to homescreen feature”.
11. To code and register a service worker, and complete the install and activation process for a new service worker for the E-commerce PWA.
12. To implement Service worker events like fetch, sync and push for E-commerce PWA.
13. To study and implement deployment of Ecommerce PWA to GitHub Pages.
14. To use google Lighthouse PWA Analysis Tool to test the PWA functioning.
15. To deploy an Ecommerce PWA using SSL enabled static hosting solution.

Assignment 1: MAD (Any one)

1. To Study basics of Dart language and design basic Flutter App
2. To include Files and JSON data in App
3. To build interactive App by including Flutter Gestures and Animations

Assignment 2: PWA (Any one)

1. To study the requirement for progressive web application for Ecommerce using the concept of service worker, Webapp Manifest and framework tools
2. To Design a wireframe for simple PWA for E-commerce website
3. Case study for successful real life implementation of PWA.

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 as mentioned in above syllabus.
Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)
Practical & Oral Exam: An Practical & Oral exam will be held based on the above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL605	DS using Python Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test1	Test 2	Avg.					
ITL605	DS using Python Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To know the fundamental concepts of data science and analytics
2	To learn data collection, preprocessing and visualization techniques for data science
3	To Understand and practice analytical methods for solving real life problems based on Statistical analysis
4	To learn various machine learning techniques to solve complex real-world problems
5	To learn streaming and batch data processing using Apache Spark
6	To map the elements of data science to perceive information

Lab Outcomes:

Sr. No.	Lab Outcomes	**Cognitive levels of attainment as per Bloom's Taxonomy**

On successful completion, of course, learner/student will be able to:		
1	Understand the concept of Data science process and associated terminologies to solve real-world problems	L1
2	Analyze the data using different statistical techniques and visualize the outcome using different types of plots.	L1, L2, L3, L4
3	Analyze and apply the supervised machine learning techniques like Classification, Regression or Support Vector Machine on data for building the models of data and solve the problems.	L1,L2, L3, L4
4	Apply the different unsupervised machine learning algorithms like Clustering, Decision Trees, Random Forests or Association to solve the problems.	L1, L2,L3
5	Design and Build an application that performs exploratory data analysis using Apache Spark	L1,L2,L3,L4,L5,L6
6	Design and develop a data science application that can have data acquisition, processing, visualization and statistical analysis methods with supported machine learning technique to solve the real-world problem	L1,L2,L3,L4,L5,L6

Prerequisite: Basics of Python programming and Database management system.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Introduction to Data Science and Data Processing using Pandas	i. Introduction, Benefits and uses of data science ii. Data Science tasks iii. Introduction to Pandas iv. Data preparation: Data cleansing, Data transformation, Combine/Merge /Join data, Data loading & preprocessing with pandas v. Data aggregation vi. Querying data in Pandas vii. Statistics with Pandas Data Frames viii. Working with categorical and text data ix. Data Indexing and Selection x. Handling Missing Data	**04**	LO1
II	Data Visualization and Statistics	i. Visualization with Matplotlib and Seaborn ii. Plotting Line Plots, Bar Plots, Histograms Density Plots, Paths, 3Dplot, Stream plot, Logarithmic plots, Pie chart, Scatter Plots and Image visualization using Matplotlib iii. Plotting scatter plot, box plot, Violin plot, swarm plot, Heatmap, Bar Plot using seaborn iv. Introduction to scikit-learn and SciPy v. Statistics using python: Linear algebra, Eigen value, Eigen Vector, Determinant, Singular Value Decomposition, Integration, Correlation, Central Tendency, Variability, Hypothesis testing, Anova, z-test, t-test and chi-square test.	**04**	LO2
III	Machine Learning	i. What is Machine Learning? ii. Applications of Machine Learning; iii. Introduction to Supervised Learning iv. Overview of Regression v. Support Vector Machine vi. Classification algorithms	**05**	LO3

IV	Unsupervised Learning	i. Introduction to Unsupervised Learning ii. Overview of Clustering iii. Decision Trees iv. Random Forests v. Association	**05**	LO4
V	Data analytics using Apache Spark	i. Introduction to Apache Spark ii. Architecture of Apache Spark iii. Modes and components iv. Basics of PySpark	**04**	LO5
VI	Case Studies	i. Understanding the different data science phases used in selected case study ii. Implementation of Machine learning algorithm for selected case study	**04**	LO1, LO6

Text Books:

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly publication
2. Frank Kane, "Hands-On Data Science and Python Machine Learning", packt publication
3. M.T. Savaliya, R.K. Maurya, G.M.Magar, "Programming with Python", 2nd Edition, Sybgen Learning.

References:

1. Armando Fandango, "Python Data Analysis", Second Edition, Packt publication.
2. Alberto Boschetti, Luca Massaron, "Python Data Science Essentials Second Edition", Packt Publishing
3. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", Manning Publications.

Online References:

Sr. No.	Website/Reference link
1.	https://www.w3schools.com/python/pandas/default.asp
2.	https://matplotlib.org/stable/gallery/index.html
3.	. https://seaborn.pydata.org/examples/index.html
4.	. https://docs.scipy.org/doc/scipy/reference/linalg.html#module-scipy.linalg
5.	https://scikit-learn.org/stable/auto_examples/index.html
6	https://www.tutorialspoint.com/scipy/scipy_integrate.htm\
7	https://machinelearningmastery.com/statistical-hypothesis-tests-in-python-cheat-sheet/
8	https://data-flair.training/blogs/data-science-project-ideas/

Suggested List of Experiments

For the following Experiments, use any available data set or download it from Kaggle/UCI or other repositories and use Python to solve each problem.

1. Data preparation using NumPy and Pandas
    a. Derive an index field and add it to the data set.
    b. Find out the missing values.
    c. Obtain a listing of all records that are outliers according to the any field. Print out a listing of the 10 largest values for that field.
    d. Do the following for the any field.
        i. Standardize the variable.
        ii. Identify how many outliers there are and identify the most extreme outlier.

2. Data Visualization / Exploratory Data Analysis for the selected data set using Matplotlib and Seaborn
    a. Create a bar graph, contingency table using any 2 variables.
    b. Create normalized histogram.
    c. Describe what this graphs and tables indicates?
3. Data Modeling
    a. Partition the data set, for example 75% of the records are included in the training data set and 25% are included in the test data set. Use a bar graph to confirm your proportions.
    b. Identify the total number of records in the training data set.
    c. Validate your partition by performing a two-sample Z-test.
4. Implementation of Statistical Hypothesis Test using Scipy and Sci-kit learn [Any one]

1. Normality Tests
    1. Shapiro-Wilk Test
    2. D'Agostino's K^2 Test
    3. Anderson-Darling Test
2. Correlation Tests
    1. Pearson's Correlation Coefficient
    2. Spearman's Rank Correlation
    3. Kendall's Rank Correlation
    4. Chi-Squared Test
3. Stationary Tests
    1. Augmented Dickey-Fuller
    2. Kwiatkowski-Phillips-Schmidt-Shin
4. Parametric Statistical Hypothesis Tests
    1. Student's t-test
    2. Paired Student's t-test
    3. Analysis of Variance Test (ANOVA)
    4. Repeated Measures ANOVA Test
5. Nonparametric Statistical Hypothesis Tests
    1. Mann-Whitney U Test
    2. Wilcoxon Signed-Rank Test
    3. Kruskal-Wallis H Test
    4. Friedman Test

5. Regression Analysis
    a. Perform Logistic Regression to find out relation between variables.
    b. Apply regression Model techniques to predict the data on above dataset

6. Classification modelling
    a. Choose classifier for classification problem.
    b. Evaluate the performance of classifier.
7. Clustering
    a. Clustering algorithms for unsupervised classification.
    b. Plot the cluster data.
8. Using any machine learning techniques using available data set to develop a recommendation system.

9. Exploratory data analysis using Apache Spark and Pandas
10. Batch and Streamed Data Analysis using Spark
11. Implementation of Mini project based on following case study using Data science and Machine learning [Any one]

List of Case Studies		
Fake News Detection	Road Lane Line Detection	Sentiment Analysis
Detecting Parkinson's Disease	Brain Tumor Detection with Data Science	Leaf Disease Detection
Speech Emotion Recognition	Gender Detection and Age prediction	Diabetic Retinopathy
Uber Data Analysis	Driver Drowsiness detection	Chatbot Project
Credit Card Fraud Detection	Movie/ Web Show Recommendation System	Customer Segmentation
Cancer Classification	Traffic Signs Recognition	Exploratory Data Analysis for Housing price prediction
Coronavirus visualizations	Visualizing climate change	Predictive policing
Uber's pickup analysis	Earth Surface Temperature Visualization	Web traffic forecasting using time series
Pokemon Data Exploration	Impact of Climate Change on Global Food Supply	Used Car Price Estimator
Skin Cancer Image Detection	World University Rankings	and so on ….

Assignments:

1) Recent trends in Data science
2) Comparative analysis between Batch and Streamed data processing tools like Map-reduce, Apache spark, Apache Flink, Apache Samza, Apache Kafka and Apache Storm.

Term Work:

- Term work shall consist of at least 10 experiments and a case study.
- Journal must include 2 assignments.
- The final certification and acceptance of term work indicates that performance in laboratory work is satisfactory and minimum passing marks may be given in term work.
- The distribution of marks for term work shall be as follows:
- Laboratory work (Experiments) …… (15) Marks.
- Mini project (Implementation) …… . (05) Marks.
- Attendance……. (05) Marks

TOTAL:…….(25) Marks.

Oral examination will be based on Laboratory work, mini project and above syllabus.

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITM601	Mini Project – 2 B Web Based on ML	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		Test1	Test 2	Avg.				
ITM601	Mini Project – 2 B Based on ML	--	--	--	--	25	25	50

Course Objectives

5. To acquaint with the process of identifying the needs and converting it into the problem.
6. To familiarize the process of solving the problem in a group.
7. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
8. To inculcate the process of self-learning and research.

Course Outcome: Learner will be able to…

10. Identify problems based on societal /research needs.
11. Apply Knowledge and skill to solve societal problems in a group.
12. Develop interpersonal skills to work as member of a group or leader.
13. Draw the proper inferences from available results through theoretical/ experimental/simulations.
14. Analyse the impact of solutions in societal and environmental context for sustainable development.
15. Use standard norms of engineering practices
16. Excel in written and oral communication.
17. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
18. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity;however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalisation of problem
    - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
  - Identification of need/problem
  - Proposed final solution
  - Procurement of components/systems
  - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalisation of problem and proposed solution
  - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

14. Quality of survey/ need identification
15. Clarity of Problem definition based on need.
16. Innovativeness in solutions
17. Feasibility of proposed problem solutions and selection of best solution
18. Cost effectiveness
19. Societal impact
20. Innovativeness
21. Cost effectiveness and Societal impact
22. Full functioning of working model as per stated requirements
23. Effective use of skill sets
24. Effective use of standard engineering norms
25. Contribution of an individual's as member or leader
26. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

9. Quality of problem and Clarity
10. Innovativeness in solutions
11. Cost effectiveness and Societal impact
12. Full functioning of working model as per stated requirements
13. Effective use of skill sets
14. Effective use of standard engineering norms
15. Contribution of an individual's as member or leader
16. Clarity in written and oral communication

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITDO6011	Software Architecture	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test 1	Test 2	Avg. of 2 Tests					
ITDO6011	Software Architecture	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand the importance of architecture in building effective, efficient, competitive software products.
2	To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation
3	To learn the design principles and to apply for large scale systems including distributed, network and heterogeneous systems
4	To understand principal design decisions governing the system.
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:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy

On successful completion, of course, learner/student will be able to:		
1	Understand the need of software architecture for sustainable dynamic systems.	L1
2	Have a sound knowledge on design principles and to apply for large scale systems.	L2
3	Apply functional and non-functional requirements	L1,L2,L3
4	Design architectures for distributed, network and heterogeneous systems	L1,L2,L3
5	Have good knowledge on service oriented and model driven architectures and the aspect-oriented architecture.	L1,L2, L3
6	Have a working knowledge to develop appropriate architectures through various case studies.	L1,L2, L3

Prerequisite: Software Engineering, Any Programming Language

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Software Engineering Concepts, Knowledge of Any programming Language	**02**	CO1
I	Basic Concepts and Architectures Design	Terminology, Models, Processes, Stakeholders, Design Process, Architectural Conceptions, Styles and architectural Patterns, Architectural conceptions in absences of experience, connectors, 4+1 view model of Architecture **Self Learning Topics** : Technical Paper "What_is_included_in_software_architectur"	**07**	CO1
II	Architectural Modeling and Analysis	Modeling Concepts, Ambiguity, Accuracy and Precisions, Complex Modeling, Evaluating Modeling Techniques, Specific Modeling Techniques, Analysis Goals, Scope of Analysis, Formality of Architectural Models, Types of Analysis, Level of Automation, System Stakeholders, Analysis Techniques **Self Learning Topics:** Technical Paper "Specification of Requirements and Software Architecture for the Customisation of Enterprise Software"	**09**	CO1, CO2
III	Implementation, Deployment and Mobility	Implementation Concepts, Existing Frameworks, Overview of Deployment and Mobility Challenges, Software Architecture and Deployment, Software Architecture and Mobility **Self Learning Topics:** Technical Paper"Application of Distributed System in Neuroscience: A Case Study of BCI Framework"	**06**	CO1, CO2
IV	Applied Architectures and Styles	Distributed and Network Architectures, Architectures for Network Based Applications, Decentralized Architectures, Service oriented Architectures and Web Services. **Self Learning Topics:**Technical Paper "Analysing the Behaviour of Distributed Software Architectures: a Case Study"	**06**	CO1, CO2, CO3

V	Designing for Non-Functional Properties	Efficiency, Complexity, Scalability and Heterogeneity, Adaptability, Dependability **Self Learning Topics:** Technical Paper "Threat-Modeling-in-Agile-Software-Development"	**04**	CO1,CO2, CO4, CO6
VI	Domain-Specific Software Engineering	Domain-Specific Software Engineering, Domain- Specific Architecture, Software Architects Roles **Self Learning Topics**: Research Paper "A Case Study of the Variability Consequences of the CQRS"	**05**	CO1,CO2, CO3

Text Books:

1. Software Architecture, Foundations, Theory, and Practise, Richard Taylor, Nenad Medvidovic, Eric M Dashofy, Wiley Student Edition.
2. The Art of Software Architecture: Design Methods and Techniques, Stephen T.Albin, Wiley India Private Limited.
3. Software Architecture in Practice by Len Bass, Paul Clements, Rick Kazman, Pearson

References:

1. DevOps A Software Architect's Perspective, Len Bass, Ingo Weber, Liming Zhu, Addison Wesley
2. Essentials of Software Architecture, Ion Gorton, Second Edition, Springer-verlag, 2011

Online Resources:

1. ArchStudio Software
2. https://www.coursera.org/learn/software-architecture
3. https://www.coursera.org/specializations/software-design-architecture
4. https://resources.sei.cmu.edu/library/asset-view.cfm?assetid=509483
5. http://infolab.stanford.edu/~backrub/google.html
6. https://web.njit.edu/~alexg/courses/cs345/OLD/F15/solutions/f3345f15.pdf

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

- **Question paper format**

  - Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**

  - **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

  - A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITDO6012	Image Processing	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg.					
ITDO6012	Image Processing	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Define image and its formation and debate about the roles of image processing in today's world and also introduce students to the major research domains in the field of image processing.
2	Describe point, mask and histogram processing units of image enhancements that can be applied on a given image for improving the quality of digital image required for an application.
3	Explain the forward and reverse discrete image transforms and discuss the selection of the image transform used for enhancement, compression, or representation and description.
4	Make students understand the impacts and effects of image compression techniques over a given bandwidth to learn how effectively storage and retrieval can be achieved using lossy and lossless compression methods.
5	Describe and demonstrate the proper procedure for segmenting images, and demonstrate how the image object can be described using image representation techniques.
6	Illustrate how to shape and reshape a given object in an image using morphological techniques over binary and gray scale images.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Define image and explain formation of image and recall its types and calculate image parameters by reading images using a programming language.	L1
2	Apply and differentiate point, mask and histogram processing techniques suitable for enhancing images required for an application.	L1,L2,L3
3	List and calculate discrete image transform coefficients and use it for enhancement, compression and representation.	L1,L2, L3
4	Compute compression ratio and fidelity criteria to evaluate and compare method efficiency and classify compression techniques into lossless and lossy methods.	L1,L2,L3, L4
5	Apply the segmentation techniques to highlight and select the region of interest and determine and describe using chain code, shape number and moments for representing objects in an image.	L1,L2,L3
6	Choose structuring elements and apply morphological operations to find a suitable shape for an object in the image.	L1,L2,L3

Prerequisite: Digital Signal Processing.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Digital Signal Processing, Matrix Multiplication.	**01**	
I	Introduction to Image Processing	**Image Fundamentals:** Image Definition, Steps and Components of Image Processing, Image Sensing and Acquisition, Image Sampling and Quantization. **Relationship Between Pixels:** Adjacency, Connectivity and Distance. **Self-Learning Topics:** Different Image File Formats and Types of noise in image.	**04**	CO1
II	Image Enhancement	**Point Processing Techniques**: Image Negative, Bit Plane Slicing, Gray Level Slicing, Contrast Stretching, Clipping, Thresholding, Dynamic Range Compression. **Mask Processing Techniques:** Filtering in Spatial Domain, Average Filter, Weighted Average Filter, Order Statistic Filter: Min, Max, Median Filter. **Histogram Processing:** Histogram Equalization and Specification. **Self-Learning Topics:** Application of Image Enhancement in Spatial Domain.	**08**	CO2
III	Image Transforms	**Discrete Fourier Transform:** Transform Pair, Transform Matrix, Properties, Filtering in Frequency Domain. **Other Discrete Transforms:** Discrete Cosine Transform, Discrete Hadamard Transform, Discrete Walsh, Transform, Discrete Haar Transform.	**07**	CO3

		Self-Learning Topics: Application of Transforms in Steganography and CBIR.		
IV	Image Compression	Entropy, Redundancy and Types, Compression Ratio, Compression Methods. **Lossless Compression:** Run-Length Encoding, Huffman Coding, Arithmetic Coding, LZW Coding, Lossless Predictive coding. **Lossy Compression**: Fidelity Criterion, Improved Gray scale Quantization**,** Symbol-Based Coding, Bit-Plane Coding, Vector Quantization. **Self-Learning Topics:** DPCM, Block Transform Coding, JPEG compression.	**07**	CO4
V	Image Segmentation and Representation	**Image Segmentation:** Point, Line and Edge Detections Methods, Hough Transform, Graph Theoretic Method, Region Based Segmentation. **Image Representation:** Chain Codes, Shape Number, Polygon Approximation, Statistical Moments. **Self-Learning Topics:** Fourier Descriptors, Otsu Thresholding, Application in Number Plate Recognition.	**07**	CO5
VI	Morphological Image Processing	**Basic Morphological Methods:** Erosion, Dilation, Opening, Closing, Hit-or-Miss Transformation. **Advanced Morphological Methods:** Skeletonization, Thinning, Thickening, Pruning, Boundary Extraction. **Self-Learning Topics:** Gray Scale Morphology: Erosion and Dilation.	**05**	CO6

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Addison - Wesley Publishing Company, 3e, 2007.
2. William K. Pratt, "Digital Image Processing", John Wiley, 4e, 2007.
3. S. Jayaraman, S. Esakkirajan and T. Veerakumar, "Digital Image Processing", MGH Publication, 2016.

References:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing using MATLAB," Pearson Education.
2. J. G. Proakis and D. G. Manolakis, "Digital Signal processing Principles, Algorithms and Applications," PHI Publications, 3e.
3. Anil K. Jain, "Fundamentals of Digital Image Processing," PHI, 1995.
4. Milan Sonka, "Digital Image Processing and Computer Vision," Thomson publication, Second Edition.2007.
5. Kenneth R. Castleman, "Digital Image Processing," PHI, 1996.
6. S. Sridhar, "Digital Image Processing," Oxford University Press, 2e, 2016.

Assessment:
Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **four questions** need to be answered

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITDO6013	Green IT	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg.					
ITDO6013	Green IT	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
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:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		

1	Describe awareness among stakeholders and promote green agenda and green initiatives in their working environments leading to green movement	L1
2	Identify IT Infrastructure Management and Green Data Centre Metrics for software development	L1,L2
3	Recognize Objectives of Green Network Protocols for Data communication.	L1,L2
4	Use Green IT Strategies and metrics for ICT development.	L1,L2,L3
5	Illustrate various green IT services and its roles.	L1,L2
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.	L1,L2,L3

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 **Hardware:** Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose **Software:** Introduction, Energy-Saving Software Techniques **Self learning Topics:** Evaluating and Measuring Software Impact to Platform Power	7	CO 1
II	Software development and data centers	Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, Green Data Centre Metrics **Self-learning Topics:** Sustainable Software: A Case Study, Data Centre Management Strategies: A Case Study	7	CO 1 CO 2
III	Data storage and communication	Storage Media Power Characteristics, Energy Management Techniques for Hard Disks Objectives of Green Network Protocols, Green Network Protocols and Standards **Self learning Topics:** System-Level Energy Management	6	CO 1 CO 3
IV	Information systems, green it strategy and metrics	Approaching Green IT Strategies, Business Drivers of Green IT Strategy Multilevel Sustainable Information,	6	CO 1 CO 4

		Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Measuring the Maturity of Sustainable ICT: A Capability Maturity Framework for SICT, Defining the Scope and Goal, Capability Maturity Levels **Self learning Topics:** Business Dimensions for Green IT Transformation		
V	Green IT services and roles	Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware **Self learning Topics:** Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise	6	CO 1 CO 4 CO 5
VI	Managing and regulating green IT	Strategizing Green Initiatives, Implementation of Green IT, Communication and Social Media The Regulatory Environment and IT Manufacturers, Nonregulatory Government Initiatives, Industry Associations and Standards Bodies, Green Building Standards, Social Movements and Greenpeace. **Self learning Topics:** Information Assurance, Green Data Centers, Case Study: Managing Green IT	5	CO 1 CO 5 CO 6

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:

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Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITDO6014	Ethical Hacking and Forensics	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		Test1	Test 2	Avg.					
ITDO6014	Ethical Hacking and Forensics	20	20	20	80	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand the concept of cybercrime and principles behind ethical hacking.
2	To explore the fundamentals of digital forensics, digital evidence and incident response.
3	To learn the tools and techniques required for computer forensics.
4	To understand the network attacks and tools and techniques required to perform network forensics.
5	To learn how to investigate attacks on mobile platforms.
6	To generate a forensics report after investigation.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Define the concept of ethical hacking.	L1
2	Recognize the need of digital forensics and define the concept of digital evidence and incident response.	L1,L2
3	Apply the knowledge of computer forensics using different tools and techniques.	L1,L2,L3
4	Detect the network attacks and analyze the evidence.	L1, L2,L3,L4
5	Apply the knowledge of computer forensics using different tools and techniques.	L1,L2,L3
6	List the method to generate legal evidence and supporting investigation reports	L1,L2

Prerequisite: Computer Networks, Computer Network Security

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Computer Networks, Computer Network Security	**01**	--
I	**Cybercrime and Ethical Hacking**	Introduction to Cybercrime, Types of Cybercrime, Classification of Cybercriminals, Role of computer in Cybercrime, Prevention of Cybercrime. Ethical Hacking, Goals of Ethical Hacking, Phases of Ethical Hacking, Difference between Hackers, Crackers and Phreakers, Rules of Ethical Hacking. **Self Learning Topics**: exploring various online hacking tools for Reconnaissance and scanning Phase.	**06**	CO1
II	**Digital Forensics Fundamentals**	Introduction to Digital Forensics, Need and Objectives of Digital Forensics, Types of Digital Forensics, Process of Digital Forensics, Benefits of Digital Forensics, Chain of Custody, Anti Forensics. Digital Evidence and its Types, Rules of Digital Evidences. Incident Response, Methodology of Incident Response, Roles of CSIRT in handling incident. **Self Learning Topics:** Pre Incident preparation and Incident Response process	**06**	CO2
III	**Computer Forensics**	Introduction to Computer Forensics, Evidence collection (Disk, Memory, Registry, Logs etc), Evidence Acquisition, Analysis and Examination(Window, Linux, Email, Web, Malware) , Challenges in Computer Forensics, Tools used in Computer Forensics.	**08**	CO3

		Self Learning Topics: Open source tool for Data collection & analysis in windows or Unix		
IV	**Network Forensics**	Introduction, Evidence Collection and Acquisition (Wired and Wireless), Analysis of network evidences(IDS, Router,), Challenges in network forensics, Tools used in network forensics. **Self Learning Topics:** IDS types and role of IDS in attack prevention	**08**	CO4
V	**Mobile Forensics**	Introduction, Evidence Collection and Acquisition, Analysis of Evidences, Challenges in mobile forensics, Tools used in mobile forensics **Self Learning Topics**: Tools / Techniques used in mobile forensics	**06**	CO5
VI	**Report Generation**	Goals of Report, Layout of an Investigative Report, Guidelines for Writing a Report, sample for writing a forensic report. **Self Learning Topics**: For an incident write a forensic report.	**04**	CO6

Text Books:

1. John Sammons, "The Basics of Digital Forensics: The Premier for Getting Started in Digital Forensics", 2nd Edition, Syngress, 2015.
2. Nilakshi Jain, Dhananjay Kalbande, "Digital Forensic: The fascinating world of Digital Evidences" Wiley India Pvt Ltd 2017.
3. Jason Luttgens, Matthew Pepe, Kevin Mandia, "Incident Response and computer forensics",3rd Edition Tata McGraw Hill, 2014.

References:

1. Sangita Chaudhuri, Madhumita Chatterjee, "Digital Forensics", Staredu, 2019.
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.

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