

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.

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

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.

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

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 Analytics, Blockchain, Cloud, Data science.

Board of Studies in Information Technology - Team

Dr. Deven Shah (Chairman)
Dr. Lata Raghya (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 ^s	--	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			
ITDO601 X	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
ITDO601 X	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 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
-

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	<p>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.</p> <p>Self-learning Topics: Study some more classical encryption techniques and solve more problems on all techniques. Homomorphic encryption in cloud computing</p>	07	CO1
II	Cryptography: Key management, distribution and user authentication	<p>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</p> <p>Self-learning Topics: Study working of elliptical curve digital signature and its benefits over RSA digital signature.</p>	09	CO2
III	Malicious Software	<p>SPAM, Trojan horse, Viruses, Worms, System Corruption, Attack Agents, Information Theft, Trapdoor, Keyloggers, Phishing, Backdoors, Rootkits, Denial of Service Attacks, Zombie</p> <p>Self-learning Topics: Study the recent malicious software's and their effects.</p>	04	CO3
IV	IP Security, Transport level security and Email Security	<p>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.</p> <p>Self-learning Topics: Study Gmail security and privacy from Gmail help</p>	07	CO4
V	Network Management Security and Network Access Control	<p>Network Management Security:SNMPv3, NAC:Principle elements of NAC,Principle NAC enforcement methods, How to implement NAC Solutions, Use cases for network access control</p> <p>Self-learning Topics: Explore any open source network management security tool</p>	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 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

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	<p>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.</p> <p>Self-learning Topics: Factors impacting emergence of entrepreneurship.</p>	04	CO1
II	Entrepreneurship Development and Leadership	<p>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.</p> <p>Self-learning Topics: study the white paper https://www.ncert.nic.in/ncerts/l/lebs213.pdf</p>	06	CO2
III	New Venture Planning	<p>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.</p> <p>Self-learning Topics: Refer following URL to study various case studies https://www.entrepreneurindia.co/case-studies</p>	07	CO3
IV	Financing & Managing Venture	<p>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</p> <p>Self-learning Topics: visit website</p>	06	CO4

		https://www.startupindia.gov.in		
V	Overview of E – business	<p>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.</p> <p>Self-learning Topics: Social media applications for E-Business, Social media analytics.</p>	08	CO5
VI	Strategic Initiatives for Technology	<p>Customer Relationship Management: The evolution of CRM, functional areas of CRM, contemporary trends - SRM, PRM AND ERM, Future Trends of CRM</p> <p>Enterprise Resource Planning: Core and Extended ERP; components of ERP system; Benefits and Risks of ERP implementation</p> <p>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</p> <p>Procurement: Meaning and advantages of e –procurement, Types& Drivers of e- procurement, Components of e-procurement systems, Implementation of e-procurement</p> <p>Self-learning Topics: SEM and SEO E-CRM</p>	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.

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 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
-

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	<p>Nature of Software, Software Engineering, Software Process, Capability Maturity Model (CMM)</p> <p>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</p> <p>Self-learning Topics: Personal and Team Process Models</p>	06	CO1,CO2
II	Requirement Analysis	<p>Software Requirements: Functional & non-functional – user-system requirement engineering process – feasibility studies – elicitation – validation & management – software prototyping – S/W documentation – Analysis and modelling</p> <p>Requirement Elicitation, Software requirement specification (SRS),</p> <p>Self-learning Topics: prioritizing requirements (Kano diagram) - real life application case study.</p>	07	CO1,CO2
III	Software Estimation and Scheduling	<p>Management Spectrum, 3Ps (people, product and process)</p> <p>Process and Project metrics</p> <p>Software Project Estimation: LOC, FP, Empirical Estimation Models - COCOMO II Model, Specialized Estimation Techniques, Object based estimation, use-case based estimation</p> <p>Project scheduling: Defining a Task Set for the Software Project, Timeline charts, Tracking the Schedule, Earned Value Analysis</p> <p>Self-learning Topics: Cost Estimation Tools and Techniques, Typical Problems with IT Cost Estimates.</p>	06	CO3
IV	Design Engineering	<p>Design Process & quality, Design Concepts, The design Model, Pattern-based Software Design. 4.2 Architectural Design :Design Decisions, Views, Patterns, Application Architectures, Modeling</p> <p>Component level Design: component, Designing class based components, conducting component-level design,</p> <p>User Interface Design: The golden rules, Interface Design</p>	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 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.
-

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:

<p>Hardware Requirement:</p> <p>PC With following Configuration</p> <ol style="list-style-type: none"> 1. Intel Core i3/i5/i7 Processor 2. 4 GB RAM 3. 500 GB Harddisk 	<p>Software requirement:</p> <ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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: <ul style="list-style-type: none"> 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. <ul style="list-style-type: none"> Introduction to Jenkins (With Architecture) Introduction to Maven / Gradle / Ant. 	04	LO1 & LO3

		<ul style="list-style-type: none"> • 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 <p>Self-Learning Topics: Travis CI, Bamboo, GitLab, AWS CodePipeline</p>		
IV	Continuous Testing with Selenium	<p>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.</p> <ul style="list-style-type: none"> • Introduction to Selenium • Installing Selenium • Creating Test Cases in Selenium WebDriver • Run Selenium Tests in Jenkins Using Maven <p>Self-Learning Topics: Junit, Cucumber</p>	04	LO1 , LO3 & LO4
V	Continuous Deployment: Containerization with Docker	<p>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.</p> <ul style="list-style-type: none"> • 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. <p>Self-Learning Topics: Docker Compose, Docker Swarm.</p>	05	LO1 & LO5
VI	Continuous Deployment: Configuration Management with Puppet	<p>In this module, you will learn to Build and operate a scalable automation system.</p> <ul style="list-style-type: none"> • 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 <p>Self-Learning Topics: Ansible, Saltstack</p>	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-

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.

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. <ul style="list-style-type: none"> 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

		<p>Installing kubectl to manage cluster and deploy Your First Kubernetes Application</p> <p>Self-Learning Topics:</p> <ul style="list-style-type: none"> • Using Services and Ingresses to Expose Deployments • Perform logging, monitoring, services, and volumes in Kubernetes. 		
III	Infrastructure Automation with Terraform	<p>In this module you will learn, Infrastructure as code for provisioning, compliance, and management of any cloud infrastructure, and service.</p> <ul style="list-style-type: none"> • Introduction to Infrastructure as Code with Terraform • Install, Build, change and Destroy Infrastructure using Terraform. <p>Self-Learning Topics:</p> <p>Terraform</p> <ul style="list-style-type: none"> • 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)	<p>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 /</p> <ul style="list-style-type: none"> • Perform static analysis on application source code and binaries. • Spot potential vulnerabilities before deployment • Analysis of java / web-based project • Jenkins SonarQube / Gitlab Integration <p>Self-Learning Topics: Snyk, OWASP ZAP, Analysis Core Plugin</p>	04	LO1, LO4
V	DevSecOps: Continuous Monitoring	<p>In this module, you will learn to detect, report, respond to the attacks and issues which occur within the infrastructure.</p> <ul style="list-style-type: none"> • 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	<p>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.</p> <ul style="list-style-type: none"> • 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 <p>Self-Learning Topics: AWS Lambda</p> <ul style="list-style-type: none"> • 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 Edition by 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 Udit 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	<ul style="list-style-type: none"> 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... <ul style="list-style-type: none"> 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	<p>ADVANCED TECHNICAL WRITING :PROJECT/PROBLEM BASED LEARNING (PBL)</p> <p>1.1 Purpose and Classification of Reports: Classification on the basis of:</p> <ul style="list-style-type: none"> • Subject Matter (Technology, Accounting, Finance, Marketing, etc.) • Time Interval (Periodic, One-time, Special) • Function (Informational, Analytical, etc.) • Physical Factors (Memorandum, Letter, Short & Long) <p>1.2. Parts of a Long Formal Report:</p> <ul style="list-style-type: none"> • Prefatory Parts (Front Matter) • Report Proper (Main Body) • Appended Parts (Back Matter) <p>1.3. Language and Style of Reports</p> <ul style="list-style-type: none"> • Tense, Person & Voice of Reports • Numbering Style of Chapters, Sections, Figures, Tables and Equations • Referencing Styles in APA & MLA Format • Proofreading through Plagiarism Checkers <p>1.4. Definition, Purpose & Types of Proposals</p> <ul style="list-style-type: none"> • Solicited (in conformance with RFP) & Unsolicited Proposals • Types (Short and Long proposals) <p>1.5. Parts of a Proposal</p> <ul style="list-style-type: none"> • Elements • Scope and Limitations • Conclusion <p>1.6. Technical Paper Writing</p> <ul style="list-style-type: none"> • 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	<p>EMPLOYMENT SKILLS</p> <p>2.1. Cover Letter & Resume</p> <ul style="list-style-type: none"> • Parts and Content of a Cover Letter • Difference between Bio-data, Resume & CV • Essential Parts of a Resume • Types of Resume (Chronological, Functional & Combination) <p>2.2 Statement of Purpose</p> <ul style="list-style-type: none"> • Importance of SOP • Tips for Writing an Effective SOP <p>2.3 Verbal Aptitude Test</p> <ul style="list-style-type: none"> • Modelled on CAT, GRE, GMAT exams <p>2.4. Group Discussions</p> <ul style="list-style-type: none"> • Purpose of a GD • Parameters of Evaluating a GD • Types of GDs (Normal, Case-based & Role Plays) 	06

	<ul style="list-style-type: none"> • GD Etiquettes 2.5. Personal Interviews <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Types of Meetings • Roles and Responsibilities of Chairperson, Secretary and Members • Meeting Etiquette 3.2. Documentation <ul style="list-style-type: none"> • Notice • Agenda • Minutes 	02
4	TECHNICAL/ BUSINESS PRESENTATIONS 1.1 Effective Presentation Strategies <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Sharing Responsibility in a Team • Building the contents and visuals together • Transition Phases 	02
5	INTERPERSONAL SKILLS 1.1. Interpersonal Skills <ul style="list-style-type: none"> • Emotional Intelligence • Leadership & Motivation • Conflict Management & Negotiation • Time Management • Assertiveness • Decision Making 5.2 Start-up Skills <ul style="list-style-type: none"> • Financial Literacy • Risk Assessment • Data Analysis (e.g. Consumer Behaviour, Market Trends, etc.) 	08
6	CORPORATE ETHICS 6.1Intellectual Property Rights <ul style="list-style-type: none"> • Copyrights • Trademarks • Patents • Industrial Designs 	02

	<ul style="list-style-type: none"> • Geographical Indications • Integrated Circuits • Trade Secrets (Undisclosed Information) <p>6.2 Case Studies</p> <ul style="list-style-type: none"> • 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 shall 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	<p>Overview of Embedded System Architecture, Application areas, Categories of embedded systems, specialties of embedded systems. Recent trends in embedded systems.</p> <p>Brief introduction to embedded microcontroller cores CISC, RISC, ARM, DSP and SoC.</p> <p>Introduction to Embedded System Integrated Development Environments (IDEs) with examples.</p> <p>Self-learning Topics: Comparison of CISC & RISC, Case studies of Real Time Embedded Systems.</p>	04	CO1
II	The Microcontroller Architecture and Programming of 8051	<p>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.</p> <p>Self-learning Topics: Writing 8051 programming in Embedded C</p>	10	CO2
III	Interfacing with 8051 Microcontroller	<p>Interfacing 8051 with peripherals: ADC, DAC, stepper motor.</p> <p>Interfacing 8051 with LED, LCD, keyboard, Temp sensor, etc. using assembly language.</p> <p>Self-learning Topics: Study of 8051 based GSM, Bluetooth and RS232 communication</p>	04	CO3
IV	ARM 7 Architecture	<p>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.</p>	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 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.
-

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	<p>Overview: Introduction, Query processing in DBMS, Steps of Query Processing, Measures of Query Cost Selection Operation, Sorting, Join Operation, Evaluation of Expressions.</p> <p>Query Optimization Overview, Goals of Query Optimization, Approaches of Query Optimization, Transformations of Relational Expression, Estimating Statistics of Expression Results Choice of Evaluation Plans.</p> <p>Self-learning Topics: Solve problems on query optimization.</p>	06	CO1
II	Advanced Data Management Techniques	<p>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.</p> <p>Self-learning Topics: Learn Data Security concepts like Authentication, Authorization and encryption.</p>	06	CO2
III	Distributed Databases	<p>Introduction: Distributed Data Processing, Distributed Database System: Architecture, Types, Design Issues. Data Fragmentation, Allocation in distributed databases.</p> <p>Self-learning Topics: Query Optimization in Distributed Databases</p>	04	CO3
IV	Data Warehousing, Dimensional Modelling and OLAP	<p>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 tiered 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.</p> <p>What is business intelligence, use of BI, Tools used in BI, Need for Online Analytical Processing; OLAP Operations</p>	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, Sliberchatz, 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 3rd 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 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
-

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	<p>Definition and Representative uses of computer graphics, Overview of coordinate system, Definition of scan conversion, Raster scan & random scan displays, Architecture of raster graphics system with display processor, Architecture of random scan systems.</p> <p>Self-learning Topics:- study the working of some Raster scan display devices</p>	02	CO1
II	Output Primitives	<p>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.</p> <p>Self-learning Topics:-Implementation of DDA and Bresenham's line algorithm for dotted line, dashed line, Dash-dot line etc.</p>	08	CO2
III	Two Dimensional Transformations and Clipping	<p>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.</p> <p>Self-learning Topics:-Implementation of 2D transformations like translation, rotation and scaling. Implementation of clipping algorithm.</p>	09	CO3
IV	3D Transformation, curves and fractals	<p>3D Transformations: Translation, Rotation, Scaling, Reflection, Composite transformations: Rotation about an arbitrary axis. Bezier Curve, B-Spline Curve.</p>	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”, 2ndEdition, 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
<u>1</u>	https://nptel.ac.in/courses/106/106/106106090/
<u>2</u>	https://nptel.ac.in/courses/106/103/106103224/
<u>3</u>	https://nptel.ac.in/courses/106/102/106102065/
<u>4</u>	https://onlinecourses.swayam2.ac.in/nou21_cs04/preview
<u>5</u>	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 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
-

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	<p>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.</p> <p>Self-learning Topics: Analysis of Time and space complexity of iterative and recursive algorithms</p>	04	CO1
II	Advanced Data Structures	<p>B/B+ tree, Red-Black Trees, Heap operations, Implementation of priority queue using heap, Topological Sort.</p> <p>Self-learning Topics: Implementation of Red-Black Tree and Heaps.</p>	05	CO2
III	Divide and Conquer AND Greedy algorithms	<p>Introduction to Divide and conquer, Analysis of Binary Search, Merge sort and Quick sort, Finding minimum and maximum algorithm.</p> <p>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.</p> <p>Self-learning Topics: Implementation of minimum and maximum algorithm, Knapsack problem, Job sequencing using deadlines.</p>	08	CO3
IV	Dynamic algorithms	<p>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.</p> <p>Self-learning Topics: Implementation of All pair shortest path, 0/1 Knapsack and OBST.</p>	06	CO4
V	String Matching	<p>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.</p> <p>Self-learning Topics: Implementation of Robin Karp algorithm, KMP algorithm and LCS.</p>	07	CO5

VI	Advanced Algorithms and NP problems	<p>Optimization Algorithms: Genetic algorithm(GA),</p> <p>Approximation Algorithms: Vertex-cover problem,</p> <p>Parallel Computing Algorithms: Fast Fourier Transform,</p> <p>Introduction to NP-Hard and NP-Complete Problems</p> <p>Self-learning Topics: Implementation of Genetic algorithm and Vertex-cover problem</p>	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, Rajsekar, Universities Press.
- 4 C and Data structures, Deshpande, Kakde, Dreamtech Press.

References:

- 1 Data Structures and Algorithms in C++, Goodrich, 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
<u>1</u>	https://nptel.ac.in/courses/106/106/106106131/
2	https://swayam.gov.in/nd1_noc19_cs47/preview
<u>3</u>	https://www.coursera.org/specializations/algorithms
<u>4</u>	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.