Vivekanand Education Society's
Institute of Technology
(Affiliated to University of Mumbai, Approved by AICTE & Recognized by Govt. of Maharashtra)

Department of Information Technology

Academic Year 2023-24

Semester V, VI

Program Structure for Third Year Information Technology

Scheme for Autonomous Program

(With Effect from 2023-2024)

Semester V

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned			
		Theory	Practical	Theory	Practical	Tutorial	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
	Total	15	16	15	8		23

* Theory class ; $ indicates workload of Learner (Not Faculty), for Mini Project

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA					
ITC501	Internet Programming	20	20	60	2	-	-	100
ITC502	Computer Network Security	20	20	60	2	-	-	100
ITC503	Entrepreneurship and E-business	20	20	60	2	-	-	100
ITC504	Software Engineering	20	20	60	2	-	-	100
ITDO501X	**Department Optional Course – 1**	20	20	60	2	-	-	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)	-	-	-	-	25	25	50
ITM501	Mini Project – 2 A Web Based Business Model	--	--	--	--	25	25	50
	Total	100	100	300	-	150	150	800

Department Optional Courses:

1. Microcontroller Embedded Programming	2. Computer Graphics & Multimedia System
3. Advance Data Management Technologies	4. Advanced Data structure and Analysis

Course Code:	Course Title:	Credit
ITC501	Internet Programming	3
Prerequisite: Knowledge of basic programming, network fundamentals and operating systems.		
2) Course Objectives: The course aims:		
1	To orient students to Web Programming fundamentals.	
2	To expose students to JavaScript to develop	
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.	
3) Course Outcomes: On successful completion, of course, learner/student will be able to:		
1	Select protocols or technologies required for various web applications.	
2	Apply JavaScript to add functionality to web pages.	
3	Design front end application using basic React.	
4	Design front end applications using functional components of React.	
5	Design back-end applications using Node.js.	
6	Construct web based Node.js applications using Express.	

4) Syllabus

Module		Content	Hrs
Module 1	Web programming fundamentals	**Web Application Architecture**,Working of web browser, HTTP protocol,HTTPS, DNS, TLS, XML, JSON, DOM, URL, URI, REST API.	03
Module 2	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	06
Module 3	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,	06
Module 4	Advanced React:	Functional components- Refs, Use effects, Hooks, Flow architecture, Model-View-Controller framework, Flux, Bundling the application. Web pack.	07
Module 5	NodeJS	**Features of NodeJS, Modules,** Environment setup, First app, Asynchronous programming, Callback concept, Architecture: Event loops, REPL, Event emitter, Networking module, Buffers, Streams, File system, Web module**. Connecting NodeJS to Database**	08
Module 6	Express	Introduction to Express ,Installing Express,Creating First Express application,The application, request, and response objects, Configuring Routes, REST API,Generator, **Understanding Middleware**, Cookies, Session, Authentication. Integrating with React.	07

		Total	37

5) Textbooks:	
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 React Functional Web Development with React and Redux, Alex Banks and Eve Porcello, O'Reilly
4	RESTful Web API Design with Node.js 10, Valentin Bojinov, Packt Publication
6) Reference Books:	
1	Web Development with Node and Express, Ethan Brown, O'Reilly

7) Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40)

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

8) Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Project based Assignment	10 marks
3.	Participation in event/ workshop /talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
4.	Multiple Choice Questions (Quiz)	5 marks

***** Rubrics 1 compulsory, along with rubrics rubrics 2 or (rubrics 3 & 4) students can select.

***** For sr.no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9) Rubrics for slow learners:-

1.) Case study, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2. Project based Learning and evaluation / Extra assignment / Question paper solution (10 marks)

3) Multiple Choice Questions (Quiz) (5 marks)

4) Literature review of papers/journals (5 marks)
5) Library related work (5 marks)

10) Rubrics for Indirect Assessment :-

1. Mock Viva/Practical
2. Skill Enhancement Lecture
3. Extra Assignments / lab / lecture

11) End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will comprise a total of five questions
3	All question carry 20 marks
4	Any three questions out of five need to be solved.

Course Code: ITC502	**Course Title :Computer Network Security**	**Credit**
Currently same	(Subject name)	3

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

2)Course Objectives:

The course aims:

1	Explain the fundamentals concepts of computer security and network security.
2	Identify the basic cryptographic techniques using classical and block encryption methods.
3	Study and describe the system security malicious software.
4	Describe the Network layer security, Transport layer security and application layer security.
5	Explain the need of network management security and illustrate the need for NAC.
6	Identify the function of an IDS and firewall for the system security.

3)Course Outcomes:

On successful completion, of course, learner/student will be able to:

1	Explain the fundamentals concepts of computer security and network security.
2	Identify the basic cryptographic techniques using classical and block encryption methods.

3	Study and describe the system security malicious software.
4	Describe the Network layer security, Transport layer security and application layer security.
5	Explain the need of network management security and illustrate the need for NAC.
6	Identify the function of an IDS and firewall for the system security.

4) Syllabus

Module		**Content**	**Hrs**
Module 1	**Introduction to Network Security & cryptography**	Computer security and Network Security(Definition), CIA, Services, Mechanisms and attacks, The OSI security architecture, Network security model. Classical Encryption techniques (mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher, transposition techniques: keyed and keyless transposition ciphers). Introduction to steganography. **Self-learning Topics:** Study some more classical encryption techniques and solve more problems on all techniques. Homomorphic encryption in cloud computing	07

Module 2	**Cryptography: Key management, distribution and user authentication**	Block cipher modes of operation,Data Encryption Standard, Advanced Encryption Standard (AES). RC5 algorithm. Public key cryptography: RSA algorithm. Hashing Techniques: SHA256, SHA-512, HMAC and CMAC, Digital Signature Schemes – RSA, DSS. Remote user Authentication Protocols, Kerberos, Digital Certificate: X.509, PKI **Self-learning Topics:** Study working of elliptical curve digital signature and its benefits over RSA digital signature.	09
Module 3	**Malicious Software**	SPAM, Trojan horse, Viruses, Worms, System Corruption, Attack Agents, Information Theft, Trapdoor, Keyloggers, Phishing, Backdoors, Rootkits, Denial of Service Attacks, Zombie **Self-learning Topics:** Study the recent malicious software and their effects.	04
Module 4	**IP Security, Transport level security and Email Security**	IP level Security: Introduction to IPSec, IPSec Architecture, Protection Mechanism (AH and ESP), Transport level security: VPN. Need Web Security considerations, Secure Sockets Layer (SSL)Architecture, Transport Layer Security (TLS), HTTPS,	07

		Secure Shell (SSH) Protocol Stack. Email Security: Secure Email S/MIME Screen reader support enabled. **Self-learning Topics:** Study Gmail security and privacy from Gmail help	
Module 5	**Network Management Security and Network Access Control**	Network Management Security:SNMPv3, NAC:Principle elements of NAC,Principle NAC enforcement methods, How to implement NAC Solutions, Use cases for network access control **Self-learning Topics:** Explore any open source network management security tool	06
Module 6	**System Security**	IDS,Classification of Intrusion Detection Systems,Detection Method of IDS Deployment, Firewall Design Principles, Characteristics of Firewalls, Types of Firewalls,IDS vs Firewalls **Self-learning Topics:** Study firewall rules table	06
		Total	**39**

5) 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.
6) Reference Books:	
1	Applied Cryptography, Protocols, Algorithms and Source Code in C, Bruce Schneier, Wiley.
2	Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill.
3	www.rsa.com

7) Internal Assessment:

Assessment consists of one)Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

8) Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Mini Project / Extra Experiments/ Virtual Lab	10 marks
3.	GATE Based Assignment test/Tutorials etc	10 marks
4.	Multiple Choice Questions (Quiz)	5 marks

*****For sr.no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9)Rubrics for slow learners:-

1.) Case study, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2. Project based Learning and evaluation / Extra assignment / Question paper solution (10 marks)

3) Multiple Choice Questions (Quiz) (5marks)

4) Literature review of papers/journals (5 marks)

5) Library related work (5 marks)

10)Rubrics for Indirect Assessment :-

1. Mock Viva/Practical
2. Skill Enhancement Lecture
3. Extra Assignments/lab/lecture

11)End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will comprise a total of five questions
3	All question carry 20 marks
4	Any three questions out of five need to be solved.

Course Code:	Course Title	Credit
ITC503	Entrepreneurship and E-business	3
1)Prerequisite:		
2)Course Objectives:		
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	
3)Course Outcomes:		
1	Understand the concept of entrepreneurship and its close relationship with enterprise and owner-management.	
2	Understand the nature of business development in the context of existing organizations and of new business start-ups.	
3	Comprehended important factors for starting a new venture and business development	
4	Know issues and decisions involved in financing and resourcing a business start-up	
5	Describe various E-business Models	
6	Discuss various E-business Strategies	

Syllabus

Module	Content	Hrs
Module 1 Introduction	Concept, meaning and definition of Entrepreneur and Entrepreneurship. Evolution of Entrepreneurship, Role of Entrepreneurship in economic Development; Managerial vs entrepreneurial approach; Classification and types of Entrepreneurs. Characteristics and qualities of successful Entrepreneurs; Women Entrepreneurs; Corporate & Social entrepreneurship. Self-learning Topics: Factors impacting emergence of entrepreneurship	04
Module 2 Entrepreneurship Development and Leadership	Entrepreneurial Motivation: motivating factors, Types of startups; Characteristics of entrepreneurial leadership, Components of Entrepreneurial Leadership; Factors influencing entrepreneurial development and motivation, Entrepreneurial Opportunities and challenges, Entrepreneurship process. Types of Enterprises and Ownership Structure: small scale, medium scale and large-scale enterprises: Meaning and definition (evolution), role of small enterprises in economic development; proprietorship, Policies governing SMEs, partnership, Ltd. companies and co-operatives: their formation, capital structure and source of finance. *Self-learning Topics: study the white paper https://www.ncert.nic.in/ncerts/l/lebs213.pdf*	06
Module 3 New Venture Planning	Methods to Initiate Ventures; Acquisition-Advantages of acquiring an ongoing venture and examination of key issues; Developing a Marketing plan-customer analysis, sales analysis and competition analysis, Business Plan-benefits of drivers, perspectives in business plan preparation, elements of a business plan; Business plan failures. *Self-learning Topics: Refer following URL to study various case studies https://www.entrepreneurindia.co/case-studies*	**07**
Module 4 Financing & Managing Venture	Financing Stages; Sources of Finance; Venture Capital; Criteria for evaluating new-venture proposals & Capital-process. Management of venture: objectives and functions of management, scientific management, general and strategic management; introduction to human resource management: planning, job analysis, training, recruitment and selection *Self-learning Topics: visit website ttps://www.startupindia.gov.in*	06
Module 5 Overview of E – business	Concept of E-business, Business Success through adoption of technology, information management for business Initiatives, Performance improvement through e-business. Introduction to various collaborative partnerships, E-commerce: Sectors of ecommerce, B to C, B to B and C to C ecommerce, Ecommerce 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.	08

	Self-learning Topics: Social media applications for E-Business, Social media analytics.	
Module 6 Strategic Initiatives for Technology	Customer Relationship Management: The evolution of CRM, functional areas of CRM, contemporary trends - SRM, PRM AND ERM, Future Trends of CRM Enterprise Resource Planning: Core and Extended ERP; components of ERP system; Benefits and Risks of ERP implementation Supply Chain Management: Meaning, definition, importance, and characteristics of SCM, Elements of SCM, Push & Pull supply chain model, Use of e-business to restructure supply chain, Supply chain management implementation Procurement: Meaning and advantages of e –procurement, Types& Drivers of e- procurement, Components of eprocurement systems, Implementation of eprocurement *Self-learning Topics: SEM and SEO E-CRM*	08
	Total	**39**

5) 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
4	E-commerce – A Managerial Perspective- P. T. Joseph, Prentice Hall India Publications. Content
6) Reference Books:	
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 EdmundsonBird, 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

7) Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40)
Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

8) Continuous Assessment:-
Continuous Assessment is of 20 marks. The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.n	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	**Creating Proof of concept /case studies (preparing a proposal for the new proposed business)**	**10 marks**
5.	**Mini Project / Extra Experiments/ Virtual Lab (Development of e-commerce web portal for the proposed business discussed under case study)**	**10 marks**
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5. marks

*****For sr.no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9) Rubrics for the slow learners:-

1) **Case study**, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2) Project based Learning and evaluation / Extra assignment / Question paper solution (10 marks)

3) Multiple Choice Questions (Quiz) (5 marks)

4) Literature review of papers/journals (5 marks)

5) Library related work (5 marks)

10)Rubrics for Indirect Assessment :-

1. **Mock Viva**/Practical

2. Skill Enhancement Lecture

3. Extra Assignments/lab/lecture

11)End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will comprise a total of five questions
3	All question carry 20 marks
4	Any three questions out of five needs to be solved.

Course Code: ITC504	**Course Title :Software Engineering**	**Credit**
Currently same	(Subject name)	3
1)Prerequisite: Basic programming of knowledge.		
2)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	
3)Course Outcomes: On successful completion, of course, learner/student will be able to:		
1	Understand and use basic knowledge in software engineering	
2	Identify requirements, analyze and prepare models	
3	Plan, schedule and track the progress of the projects.	

4	Design & develop the software solutions for the growth of society
5	To demonstrate and evaluate real time projects with respect to software engineering principles
6	Apply testing and assure quality in software solution

4) syllabus

Module		**Content**	**Hrs**
Module 1	**Introduction to Software Engineering**	Nature of Software, Software Engineering, Software Process, Capability Maturity Model (CMM) Generic Process Model, Prescriptive Process Models: The Waterfall Model, V-model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, Agile process, Agility Principles, Extreme Programming (XP), Scrum, Kanban model Self-learning Topics: Personal and Team Process Models	07
Module 2	**Requirement Analysis**	Software Requirements: Functional & non-functional – user-system requirement engineering process – feasibility studies – elicitation – validation & management – software prototyping – S/W documentation – Analysis and modelling Requirement Elicitation, Software requirement specification (SRS), Self-learning Topics: prioritizing requirements (Kano diagram) - real life application case study	09
Module 3	**Software Estimation**	Management Spectrum, 3Ps (people, product and process) Process and Project metrics	04

	and Scheduling	Software Project Estimation: LOC, FP, Empirical Estimation Models - COCOMO II Model, Specialized Estimation Techniques, Object based estimation, use-case based estimation Project scheduling: Defining a Task Set for the Software Project, Timeline charts, Tracking the Schedule, Earned Value Analysis Self-learning Topics: Cost Estimation Tools and Techniques, Typical Problems with IT Cost Estimates.	
Module 4	**Design Engineering**	Design Process & quality, Design Concepts, The design Model, Pattern-based Software Design. 4.2 Architectural Design :Design Decisions, Views, Patterns, Application Architectures, Modeling Component level Design: component, Designing class based components, conducting component-level design, User Interface Design: The golden rules, Interface Design steps & Analysis, Design Evaluation Self-learning Topics: Refinement, Aspects, Refactoring	07
Module 5	**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	06
Module 6	**Software Testing and Maintenance**	Testing: Software Quality, Testing: Strategic Approach, Strategic Issues- Testing: Strategies for Conventional Software, Object oriented software, Web AppsValidating Testing- System Testing- Art of Debugging. Maintenance : Software Maintenance-	06

		Software Supportability- Reengineering- Business Process Reengineering- Software Reengineering- Reverse Engineering- Restructuring- Forward Engineering Self-learning Topics: Test Strategies for WebApps	
		Total	**39**

5) Textbooks:	
1	1 Roger S. Pressman, Software Engineering: A practitioner's approach, McGraw Hill
2	2 Rajib Mall, Fundamentals of Software Engineering, Prentice Hall India
3	3 PankajJalote, An integrated approach to Software Engineering, Springer/Narosa.
4	4 Ian Sommerville, Software Engineering, Addison-Wesley. William Stallings, Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson Education, March 2013.
6) References	
1	https://www.youtube.com/watch?v=wEr6mwquPLY

7) Internal Assessment:

Assessment consists of one)Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

8) Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Case studies + Assignment	10 marks

*****For sr.no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9)Rubrics for slow learners:-

1.) Case study, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2. Project based Learning and evaluation / Extra assignment / Question paper solution (10 marks)

11)End Semester Theory Examination:	
1	Question paper will be of 60 marks

2	Question paper will comprise a total of five questions
3	All question carry 20 marks
4	Any three questions out of five need to be solved.

Course Code:	Course Title:	Credit
ITDO5012	Advance Data Management Technologies	3
Prerequisite: Basic concepts of a Relational database and SQL		
2) 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 databases.	
3	To introduce advanced database models like distributed databases.	
4	To create awareness of how enterprises 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.	
3) Course Outcomes: On successful completion, of course, the learner/student will be able to:		
1	Measure query costs and design alternate efficient paths for query execution..	
2	Apply sophisticated access protocols to control access to the database	
3	Implement Distributed databases.	
4	Organize strategic data in an enterprise and build a data Warehouse.	
5	Analyse data using OLAP operations so as to take strategic decisions	

6	Design modern applications using NoSQL databases. databases..

4) Syllabus

Module		Content	Hrs
Module 0	Prerequisite	Reviewing basic concepts of a Relational database, SQL concepts	02
Module 1	Query Processing and Optimization	Overview: Introduction, Query processing in DBMS, Steps of Query Processing, Measures of Query Cost Selection Operation, Sorting, Join Operation, Evaluation of Expressions. Query Optimization Overview, Goals of Query Optimization, Approaches of Query Optimization, Transformations of Relational Expression, Estimating Statistics of Expression.	06
Module 2	Advanced Data Management Techniques	Advanced Database Access protocols: Discretionary Access Control Based on Granting and Revoking Privileges. Mandatory Access Control and RoleBased Access Control, Remote Database access protocol. Overview of Advanced Database Models like Mobile databases, Temporal databases, Spatial databases.	06
Module 3	Distributed Databases	Introduction: Distributed Data Processing, Distributed Database System: Architecture, Types, Design Issues. Data Fragmentation, Allocation in distributed databases.**Transaction execution in Distributed Database:2 phase commit and 3 phase commit protocol**	05
Module 4	Data Warehousing, Dimensional Modelling and OLAP	The Need for Data Warehousing; Data Warehouse Defined; Is data warehouse still relevant in the age of big data, Features of a Data Warehouse; Data Warehouse Architecture-Enterprise or centralized, federated and multi tired architectures; Data Warehouse and Data Marts; Data	09

		Warehousing Design Strategies, Data modeling Dimensional Model; The Star Schema; How Does a Query Execute? The Snowflake Schema; Fact Tables and Dimension Tables; Factless Fact Table;, Updates To Dimension Tables, Primary Keys, Surrogate Keys & Foreign Keys. What is business intelligence, use of BI, Tools used in BI, Need for Online Analytical Processing; OLAP Operations in a cube: Roll-up, Drill-down, Slice, Dice, Pivot; OLAP Architectures: MOLAP, ROLAP, DOLAP and HOLAP.	
Module 5	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. **Trends in DataWarehouse:knowlege management, CRM, SCM**	05
Module 6	Big data and NoSQL	Big data and NoSQL : Introduction, types and characteristics of big data, **Big Data Challenges, Examples of Big Data in Real Life, Big Data Applications.** What is NoSQL, CAP theorem, BASE property, NoSQL data architecture patterns: Key-value stores, Graph stores, Column family stores, Document stores. **MongoDB.**	07
		Total	37

5) Textbooks:	
1	Korth, Slberchatz, Sudarshan, ”Database System Concepts”, 6th Edition, McGraw – Hill
2	Elmasri and Navathe, “Fundamentals of Database Systems”, 6th Edition, PEARSON Education.
3	Theraja Reema, “Data Warehousing”, Oxford University Press.
4	Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems” 3rd Edition - McGraw Hill
6) Reference Books:	
1	Paulraj Ponniah, “Data Warehousing: Fundamentals for IT Professionals”, Wiley India.
2	Peter Rob and Carlos Coronel, “Database Systems Design, Implementation and Management”, Thomson Learning, 9th Edition.
3	Ralph Kimball, Margy Ross, “The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling”, 3rd Edition. Wiley India

7) Internal Assessment:

Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40)

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

8) Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	GATE Based Assignment test/Tutorials etc	10 marks
3.	Participation in event/ workshop /talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	5 marks
4.	Multiple Choice Questions (Quiz)	5 marks

***** Rubrics 1 compulsory, along with rubrics 2 or (rubrics 3 & 4) students can select.

***** For sr.no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9) Rubrics for slow learners:-

1.) Case study, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2. Project-based Learning and evaluation / Extra assignment / Question paper solution (10 marks)

3) Multiple Choice Questions (Quiz) (5 marks)

4) Literature review of papers/journals (5 marks)

5) Library related work (5 marks)

10) Rubrics for Indirect Assessment :-

1. Mock Viva/Practical
2. Skill Enhancement Lecture
3. Extra Assignments / lab / lecture

11) End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will comprise a total of five questions
3	All questions carry 20 marks
4	Any three questions out of five need to be solved.

Course Code: TDO5014	**Course Title: Advance Data Structure and Analysis**	**Credit**
Currently same	(Subject name)	3
1) Prerequisite: Basics of Data structures and analysis and programming language, **Time and space complexity of algorithm**		
2) Course Objectives:		
1	To learn mathematical background for analysis of algorithm	
2	To learn various advanced data structures.	
3	To understand the different design approaches of algorithms.	
4	To learn dynamic programming methods.	
5	To understand the concept of pattern matching	
6	To learn advanced algorithms.	
3) Course Outcomes:		
1	Describe the different methods for analysis of algorithms.	
2	Choose an appropriate advanced data structure to solve a specific problem.	
3	Apply an appropriate algorithmic design approach for a given problem.	
4	Apply the dynamic programming technique to solve a given problem.	
5	Select an appropriate pattern matching algorithm for a given application.	
6	Describe the concepts of Optimization, Approximation and Geometric algorithms.	

4) syllabus

Module		Content	Hrs
0	Prerequisite	Basics of Data structures and analysis and programming language	2
1	Introduction	Fundamentals of the analysis of algorithms: Time and Space complexity, Asymptotic analysis and notation, average and worst-case analysis, Recurrences: The substitution method, Recursive tree method, Masters method. Self-learning Topics: Analysis of Time and space complexity of iterative and recursive algorithms	4
2	Advanced Data Structures	B/B+ tree, Red-Black Trees, Heap operations, Implementation of priority queue using heap, Topological Sort. Self-learning Topics: Implementation of Red-Black Tree and Heaps.	5
3	Divide and Conquer AND Greedy algorithms	Introduction to Divide and conquer, Analysis of Binary Search, Merge sort and Quick sort, Finding minimum and maximum algorithm. Introduction to Greedy Algorithms: Knapsack Problem, Job sequencing using deadlines, Optimal storage on tape, Optimal Merge Pattern, Analysis of all these algorithms and problem solving. Self-learning Topics: Implementation of minimum and maximum algorithm, Knapsack problem, Job sequencing using deadlines.	8
4	Dynamic algorithms	Introduction to Dynamic Algorithms, all pair shortest path, 0/1 knapsack, traveling salesman problem, Matrix Chain Multiplication, Optimal binary search tree, Analysis of All algorithms and problem solving. Self-learning Topics: Implementation of All pair shortest path, 0/1 Knapsack and OBST.	6

5	String Matching	Introduction, the naïve string matching algorithm, Rabin Karp algorithm, Boyer Moore algorithm, KnuthMorris-Pratt algorithm, Longest Common Subsequence (LCS), Analysis of All algorithms and problem solving. Self-learning Topics: Implementation of Robin Karp algorithm, KMP algorithm and LCS.	7
6	Advanced Algorithms and NP problems	Optimization Algorithms: Genetic algorithm(GA) Approximation Algorithms: Vertex-cover problem and **TSP**, **Geometric Algorithm: Closest Pair** Introduction to NP-Hard and NP-Complete Problems Self-learning Topics: Implementation of Genetic algorithm and Vertex-cover problem, **Randomized algorithms**	7
		Total	**39**

5) Textbooks:	
1	Introduction to Algorithms, Cormen, Leiserson, Rivest, Stein, PHI.
2	Algorithms: Design and Analysis, Harsh Bhasin, OXFORD
3	Fundamentals of Computer Algorithms, Horowitz, Sahani, Rajsekaran, Universities Press.
4	Data structures, Deshpande, Kakde, Dreamtech Press.
6) Reference Books:	
1	Data Structures and Algorithms in C++, Goodritch, Tamassia, Mount, WILEY.
2	Data Structures using C, Reema Thareja , OXFORD.
3	Data Structures and Algorithm Analysis in C, Mark A. Weiss, Pearson.
4	Optimization Algorithms and Applications, By Rajesh Kumar Arora by Chapman and Hall

7) Internal Assessment:

Assessment consists of one)Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

8) Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	GATE Based Assignment test/Tutorials etc	10 marks
3.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
4.	Multiple Choice Questions (Quiz)	5 marks

*****For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9)Rubrics for slow learners:-

1.) Case study, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2. Project based Learning and evaluation / Extra assignment / Question paper solution (10 marks)

3) Multiple Choice Questions (Quiz) (5marks)

4) Literature review of papers/journals (5 marks)

5) Library related work (5 marks)

10)Rubrics for Indirect Assessment :-

1. Mock Viva/Practical
2. Skill Enhancement Lecture
3. Extra Assignments/lab/lecture

11)End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will comprise a total of five questions
3	All question carry 20 marks
4	Any three questions out of five needs to be solved.

Lab Code	Lab Name	Credit
ITL501	**IP Lab**	**1**

1)Prerequisite:	
2) Lab Objectives: The course aims:	
1	To orient students to HTML for making webpages
2	To orient students to HTML for making webpages
3	To expose students to developing responsive layout
4	To expose students to developing responsive layout
5	To expose students to developing responsive layout
6	To orient students to Node.js for developing backend applications
3) Lab Outcomes: On successful completion, of course, learner/student will be able to:	
1	Identify and apply the appropriate HTML tags to develop a webpage.
2	Identify and apply the appropriate CSS tags to format data on webpage
3	Identify and apply the appropriate CSS tags to format data on webpage
4	Use JavaScript to develop interactive web pages.
5	Construct front end applications using React
6	Construct back end applications using Node.js/Express

4)Suggested Experiments: (minimum number of experiments to be completed can be specified)

Sr. No.	Name of the Experiment
1	Experiment to study basics of HTML5 and basic tags of HTML5.
2	Experiment to study Advanced tags of HTML5 .
3	Experiment to study basics of CSS.
4	Experiment to study advanced features supported by CSS3.
5	Experiment to study the basics of Java Script.
6	Experiment to study Advanced JavaScript concepts.
7	Experiment to study basics of Bootstrap.
8	Experiment to study the basics of React.
9	Experiment to study the Advanced React.
10	Experiment to study basics of Node JS.
11	Experiment to study basics of Express JS.

5) Useful Links:	
1	https://www.nptel.ac.in
2	https://www.tutorialspoint.com
3	https://nodejs.dev/learn
4	https://www.udemy.com/

6) Term Work:	
1	Term Work shall consist of at least 12 Practical's based on the above

	list. Also, Term work Journal must include at least 2 assignments: Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)
7) Continuous assessment exam	
1	Experiment submission on time
2	Explaination/concepts
3	Algorithm implementation
4	Analysis
5	Performance/Documentation

Lab Code	Lab Name	Credit
ITL502	Security Lab	**1**

1)Prerequisite: The Lab experiments aims:	
2)Lab Objectives:	
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.
3)Lab Outcomes: On successful completion, of course, learner/student will be able to:	
1	Illustrate symmetric cryptography by implementing classical ciphers.
2	Demonstrate Key management, distribution and user authentication.
3	Explore the different network reconnaissance tools to gather information about networks.
4	Use tools like sniffers, port scanners and other related tools for analyzing packets in a network.

5	Use open-source tools to scan the network for vulnerabilities and simulate attacks.
6	Demonstrate the network security system using open source tools.

4)Suggested Experiments: (minimum number of experiments to be completed can be specified)

Sr. No.	Name of the Experiment
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

5)Useful Links:	
1	IITB virtual Lab: http://cse29-iiith.vlabs.ac.in/
2	https://www.dcode.fr/en

6)Term Work:	
1	Term Work shall consist of at least 10 Practical 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)
7)Continuous assessment exam	
1.	Timely Submission of Experiments weekwise
2.	Explanation/concept:
3.	Algorithm/implementation:
4.	Analysis:

5.	Documentation/Performance:

Lab Code	Lab Name	Credit
ITL503	**DevOps**	**1**

1)Prerequisite: The Lab experiments aims:	
2)Lab Objectives:	
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 & configure Ansible/Puppet tool.
3)Lab Outcomes: 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
2	To obtain complete knowledge of the “version control system” to effectively track changes augmented with Git and GitHub
3	To understand the importance of Jenkins to Build and deploy Software Applications on server environment

4	Understand the importance of Selenium and Jenkins to test Software Applications
5	To understand concept of containerization and Analyze the Containerization of OS images and deployment of applications over Docker
6	To Synthesize software configuration and provisioning using Ansible/Puppet.

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	**04**	LO1

		Self-Learning Topics: Scrum, Kanban, Agile		
II	Version Control	In this module you will learn: • GIT Installation, Version Control, Working with remote repository • GIT Cheat sheet • Create and fork repositories in GitHub • Apply branching, merging and rebasing concepts. • Implement different Git workflow strategies in real-time scenarios • Understand Git operations in IDE **Self-Learning Topics: AWS Codecommit, Mercurial, Subversion, Bitbucket, CVS**	**04**	LO1 & LO2
III	Continuous Integration using Jenkins	In this module, you will know how to perform Continuous Integration using Jenkins by building and automating test cases using Maven / Gradle / Ant. • Introduction to Jenkins (With Architecture) • Introduction to Maven / Gradle / Ant. • Jenkins Management Adding a slave node to Jenkins • Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to deploy an application over the tomcat server **Self-Learning Topics: Travis CI, Bamboo, GitLab, AWS CodePipeline**	**04**	LO1 & LO3

IV	Continuous Testing with Selenium	In this module, you will learn about selenium and how to automate your test cases for testing web elements. You will also get introduced to X-Path, TestNG and integrate Selenium with Jenkins and Maven. • Introduction to Selenium • Installing Selenium • Creating Test Cases in Selenium WebDriver • Run Selenium Tests in Jenkins Using Maven **Self-Learning Topics: Junit, Cucumber**	**04**	LO1 , LO4
V	Continuous Deployment: Containerization with Docker	In this module, you will be introduced to the core concepts and technology behind Docker. Learn in detail about container and various operations performed on it. • Introduction to Docker Architecture and Container Life Cycle • Understanding images and containers • Create and Implement docker images using Dockerfile. • Container Lifecycle and working with containers. • To Build, deploy and manage web or software application on Docker Engine. • Publishing image on Docker Hub. **Self-Learning Topics: Docker Compose, Docker Swarm.**	**05**	LO1 & LO5

VI	Continuous Deployment: Configuration Management with Puppet	In this module, you will learn to Build and operate a scalable automation system. • Puppet/Ansible Architecture • Puppet/Ansible Master Slave Communication • Puppet/Ansible Blocks • Installation and Configuring Puppet/Ansible Master and Agent on Linux machines. **Self-Learning Topics:Saltstack**	**05**	LO1 & LO6

Text books

1. DevOps Bootcamp, Sybgen Learning
2. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
3. Len Bass, Ingo Weber, Liming Zhu, "DevOps, A Software Architects Perspective", Addison Wesley Pearson Publication.
4. John Ferguson Smart," Jenkins, The Definitive Guide", O'Reilly Publication.
5. "Mastering Puppet 5: Optimize enterprise-grade environment performance with Puppet", by Ryan Russell Yates Packt Publishing (September 29, 2018)

References:

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

Sr. No.	Name of the Experiment
1	Case study on real world: 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	Advanced git commands
5	To understand Continuous Integration, install and configure Jenkins with Maven/Ant/Gradle to setup a build Job.
6	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.
7	To understand Jenkins Master-Slave Architecture and scale your Jenkins standalone implementation by implementing slave nodes.
8	To Setup and Run Selenium Tests in Jenkins Using Maven.
9	To understand Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.
10	To learn Dockerfile instructions, build an image for a sample web application using Dockerfile.
11	Docker Compose – multi container tool
12	To install and Configure Pull based Software Configuration Management and provisioning tools using Puppet/Ansible.
13	To learn Software Configuration Management and provisioning using Puppet/Ansible Blocks(Manifest, Modules, Classes, Function)
14	To provision a LAMP/MEAN Stack using Puppet/Ansible Manifest.

5)Useful Links:

1. DevOps Bootcamp, Sybgen Learning
2. Len Bass, Ingo Weber, Liming Zhu, "DevOps, A Software Architects Perspective", Addison Wesley Pearson Publication.
3. https://devops.com/
4. http://git-scm.com/
5. https://github.com/
6. https://education.github.com/git-cheat-sheet-education.pdf
7. John Ferguson Smart," Jenkins, The Definitive Guide", O'Reilly Publication.
8. https://www.jenkins.io/
9. https://www.jenkins.io/doc/developer/publishing/continuous-integration/#ji-toolbar
10. https://www.jenkins.io/doc/book/security/
11. https://www.selenium.dev/
12. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
13. https://www.docker.com/
14. https://github.com/docker
15. https://docs.docker.com/compose/
16. https://docs.docker.com/samples/django/
17. https://docs.docker.com/engine/swarm/
18. "Mastering Puppet 5: Optimize enterprise-grade environment performance with Puppet", by Ryan Russell Yates Packt Publishing (September 29, 2018)
19. https://puppet.com/

6)Term Work:

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

7) Continuous assessment exam

1.	Timely Submission of Experiments weekwise
2.	Explanation/concept:
3.	Algorithm/implementation:
4.	Analysis:
5.	Documentation/Performance:

Lab Code	Lab Name	Credit
ITL504	**Adv. DevOps**	**1**

1)Prerequisite: The Lab experiments aims:	
2)Lab Objectives:	
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.
3)Lab Outcomes: 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 requirement

2	To deploy single and multiple container applications and manage application deployments with rollouts in Kubernetes
3	To apply best practices for managing infrastructure as code environments and use terraform to define and deploy cloud
4	To identify and remediate application vulnerabilities earlier and help integrate security in the development process using SAST Techniques.
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
6	To engineer a composition of nano services using AWS Lambda and Step Functions with the Serverless Framework

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Knowledge of Linux Operating system, installation and configuration of services and command line basics, Basics of Computer Networks, Software Development Life cycle, Cloud Computing and DevOps Ecosystem.	**02**	

I	Introduction to Devops on Cloud	Learn about various cloud services and service providers, also get the brief idea of how to implement DevOps over Cloud Platforms. Introduction to high availability architecture and auto-scaling Set up the DevOps infrastructure on the cloud Work and set up IDE on Cloud9 Deploy projects on AWS using Code Build, CodeDeploy, and CodePipeline Self-Learning Topics: AWS Codestar	**04**	LO1
II	Container Orchestration using Kubernetes	In this module, you will learn how Kubernetes automates many of the manual processes involved in deploying, managing, and scaling containerized applications. Install and configure Kubernetes Spin Up a Kubernetes Cluster Check the Nodes of Your Kubernetes Cluster Installing kubectl to manage cluster and deploy Your First Kubernetes Application Self-Learning Topics: Using Services and Ingresses to Expose Deployments Perform logging, monitoring, services, and volumes in Kubernetes.	04	LO1, LO2

III	Infrastructure Automation with Terraform	In this module you will learn, Infrastructure as code for provisioning, compliance, and management of any cloud infrastructure, and service. Introduction to Infrastructure as Code with Terraform Install, Build, change and Destroy Infrastructure using Terraform. Self-Learning Topics: Terraform Create Resource Dependencies Provision Infrastructure Define Input Variables, Query Data with output and store remote state	**04**	LO1,LO 3
IV	DevSecOps: Static Application Security Testing (SAST)	In this module, you will learn to identify and remediate application vulnerabilities earlier and help integrate security in the development process using tools like SonarQube / Gitlab / Perform static analysis on application source code and binaries. Spot potential vulnerabilities before deployment Analysis of java / web-based project Jenkins SonarQube / Gitlab Integration Self-Learning Topics: Snyk, OWASP	**04**	LO1,LO 4

		ZAP, Analysis Core Plugin		
V	DevSecOps: Continuous Monitoring	In this module, you will learn to detect, report, respond to the attacks and issues which occur within the infrastructure. Introduction to Continuous Monitoring Introduction to Nagios Installing Nagios Nagios Plugins (NRPE) and Objects Nagios Commands and Notification Monitoring of different servers using Nagios Self-Learning Topics: Splunk, Snort, Tenable	**04**	LO1,LO 6
VI	NoOps: Serverless Computing	In this module, you will learn serverless computing platform like AWS Lambda, which allows you to build your code and deploy it without ever needing to configure or manage underlying servers. AWS Lambda - Overview and Environment Setup Building and Configuring the Lambda function (NODEJS/PYTHON/JAVA) Creating & Deploying using AWS Console/CLI Creating & Deploying using Serverless Framework Self-Learning Topics: AWS Lambda Create a REST API with the Serverless	**04**	LO1,LO 6

		Framework		

Text books

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

References:

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

Sr. No.	Name of the Experiment
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.

5)Useful Links:

1. DevOps Bootcamp, Sybgen Learning
2. Len Bass, Ingo Weber, Liming Zhu, “DevOps, A Software Architects Perspective”, Addison Wesley Pearson Publication.
3. https://devops.com/
4. http://git-scm.com/
5. https://github.com/
6. https://education.github.com/git-cheat-sheet-education.pdf
7. John Ferguson Smart,” Jenkins, The Definitive Guide”, O'Reilly Publication.
8. https://www.jenkins.io/
9. https://www.jenkins.io/doc/developer/publishing/continuous-integration/#ji-toolbar
10. https://www.jenkins.io/doc/book/security/
11. https://www.selenium.dev/
12. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
13. https://www.docker.com/
14. https://github.com/docker
15. https://docs.docker.com/compose/
16. https://docs.docker.com/samples/django/
17. https://docs.docker.com/engine/swarm/
18. “Mastering Puppet 5: Optimize enterprise-grade environment performance with Puppet”, by Ryan Russell Yates Packt Publishing (September 29, 2018)
19. https://puppet.com/

6)Term Work:	
1	Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)
7) Continuous assessment exam	
1.	Timely Submission of Experiments weekwise
2.	Explanation/concept:
3.	Algorithm/implementation:
4.	Analysis:
5.	Documentation/Performance:

Course Code:	Course Title	Credit
ITL505	Professional Communication & Ethics-II (PCE-II)	02
1)Prerequisite:		
2)Course Objectives:		
1	To discern and develop an effective style of writing important technical/business documents	
2	To investigate possible resources and plan a successful job campaign.	
3	To understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.	
4	To develop creative and impactful presentation skills.	
5	To analyze personal traits, interests, values, aptitudes and skills.	
6	To understand the importance of integrity and develop a personal code of ethics.	
3)Course Outcomes:		
1	plan and prepare effective business/ technical documents which will in turn	
2	provide solid foundation for their future managerial roles.	
3	strategize their personal and professional skills to build a professional image and meet the demands of the industry.	

4	emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations.
5	develop creative thinking and interpersonal skills required for effective professional communication.
6	apply codes of ethical conduct, personal integrity and norms of organizational behaviour.

4) syllabus

Module		**Content**	**Hrs**
Module 1		**ADVANCED TECHNICAL WRITING :PROJECT/PROBLEM BASED LEARNING (PBL):** 1.1 Purpose and Classification of Reports: Classification on the basis of: Subject Matter (Technology, Accounting, Finance, Marketing, etc.) Time Interval (Periodic, One-time, Special) Function (Informational, Analytical, etc.) Physical Factors (Memorandum, Letter, Short & Long) 1.2. Parts of a Long Formal Report: Prefatory Parts (Front Matter) Report Proper (Main Body) Appended Parts (Back Matter) 1.3. Language and Style of Reports Tense, Person & Voice of Reports Numbering Style of Chapters, Sections, Figures, Tables and Equations Referencing Styles in APA & MLA Format Proofreading through Plagiarism Checkers 1.4. Definition, Purpose & Types of Proposals Solicited (in conformance with RFP) & Unsolicited	06

		Proposals Types (Short and Long proposals) 1.5. Parts of a Proposal Elements Scope and Limitations Conclusion 1.6. Technical Paper Writing Parts of a Technical Paper (Abstract, Introduction, Research Methods, Findings and Analysis, Discussion, Limitations, Future Scope and References) Language and Formatting Referencing in IEEE Format	
Module 2		EMPLOYMENT SKILLS 2.1. Cover Letter & Resume Parts and Content of a Cover Letter Difference between Bio-data, Resume & CV Essential Parts of a Resume Types of Resume (Chronological, Functional & Combination) 2.2 Statement of Purpose Importance of SOP Tips for Writing an Effective SOP 2.3 Verbal Aptitude Test Modelled on CAT, GRE, GMAT exams 2.4. Group Discussions Purpose of a GD Parameters of Evaluating a GD Types of GDs (Normal, Case-based & Role Plays) GD Etiquettes 2.5. Personal Interviews Planning and Preparation Types of Questions Types of Interviews (Structured, Stress, Behavioural, Problem Solving & Case-based) Modes of Interviews: Face-to-face (One-to one and Panel) Telephonic, Virtual	06

Module 3		**BUSINESS MEETINGS** 1.1. Conducting Business Meetings Types of Meetings Roles and Responsibilities of Chairperson, Secretary and Members Meeting Etiquette 3.2. Documentation Notice Agenda Minutes	02
Module 4		**TECHNICAL/ BUSINESS PRESENTATIONS** 1.1 Effective Presentation Strategies Defining Purpose Analyzing Audience, Location and Event Gathering, Selecting &Arranging Material Structuring a Presentation Making Effective Slides Types of Presentations Aids Closing a Presentation Platform skills 1.2 Group Presentations Sharing Responsibility in a Team Building the contents and visuals together Transition Phases	0 2
Module 5		**INTERPERSONAL SKILLS** 1.1. Interpersonal Skills Emotional Intelligence Leadership & Motivation Conflict Management & Negotiation Time Management Assertiveness Decision Making 5.2 Start-up Skills Financial Literacy Risk Assessment Data Analysis (e.g. Consumer Behaviour, Market Trends, etc.)	0 8
Module		**CORPORATE ETHICS**	0

6		6.1Intellectual Property Rights Copyrights Trademarks Patents Industrial Designs Geographical Indications Integrated Circuits Trade Secrets (Undisclosed Information) 6.2 Case Studies Cases related to Business/ Corporate Ethics	2
		Total	

	5) Textbooks & refrence boos
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: McGrawHill.
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	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. Press

7) Internal 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

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	Creating Proof of concept	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*****For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9)Rubrics for slow learners:-

1.) Case study, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2. Project based Learning and evaluation / Extra assignment / Question paper

solution (10 marks)

3) Multiple Choice Questions (Quiz) (5marks)

4) Literature review of papers/journals (5 marks)

5) Library related work (5 marks)

Course Code: ITM501	**Course Title :** **Mini Project – 2 A Web Based Business Model**	**Credit**
Currently same	**Mini Project – 1 A for Front end /backend Application using JAVA**	

1)Prerequisite:

2)Course Objectives:

The course aims:

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.

3)Course Outcomes:

On successful completion, of course, learner/student 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.

4) 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 nfaculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress,guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

5) 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

6) 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.

7) 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.

8) 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

Program Structure for Third Year Information Technology

Department Scheme for Autonomous Program

(With Effect

from 2023-2024)

Semester VI

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

# Indicates workload of Learner (Not Faculty)

Course Code	Course Name	Examination Scheme						
		Theory				Term Work	Pract & oral	Total
		Internal Assessment		End Sem Exam	Exam Duration (Hrs)			
		Mid Test (MT)	CA					
ITC601	Data Mining & Business Intelligence	20	20	40	60	3	--	--
ITC602	Web X.0	20	20	40	60	3	-	--
ITC603	Wireless Technology	20	20	40	60	3	-	--
ITC604	AI and DS – 1	20	20	40	60	3	-	--
ITDO601 X	**Department Optional Course – 2**	**20**	**20**	**40**	**60**	**3**	**-**	**--**
ITL601	BI Lab	--	--	--	--	--	25	25
ITL602	Web Lab	--	--	--	--	--	25	25
ITL603	Sensor Lab	--	--	--	--	--	25	25
ITL604	MAD & PWA Lab	--	--	--	--	--	25	25
ITL605	DS using Python Lab (SBL)	--	--	--	--	--	25	25
ITM601	Mini Project – 2 B Based on ML	--	--	--	--	--	25	25
	Total	100	100	200	300	150	150	800

Department Optional Courses:

Department Optional Course III (ELDO701)	Department Optional Course IV (ELDO702)
Software Architecture	Green IT
Image Processing	Ethical Hacking and Forensic

Course Code: ITC601	Course Title: Data Mining & Business Intelligence	Credit
Currently same	**Data Mining & Business Intelligence**	3

1) Prerequisite: Database Management System	
2) Course Objectives:	
1	To introduce the concept of data warehouse data Mining as an important tool for enterprise data management and as a cutting-edge technology for building competitive advantage.
2	To enable students to effectively identify sources of data and process it for data mining.
3	To make students well versed in all data mining algorithms, methods of evaluation.
4	To impart knowledge of tools used for data mining.
5	To provide knowledge on how to gather and analyze large sets of data to gain useful business understanding.
6	To impart skills that can enable students to approach business problems analytically identifying opportunities to derive business value from data.
3) Course Outcomes:	
1	Demonstrate an understanding of the importance of data warehousing and data mining and the principles of business intelligence.
2	Organize and prepare the data needed for data mining using pre preprocessing techniques.
3	Perform exploratory analysis of the data to be used for mining.
4	Implement the appropriate data mining methods like classification, clustering or Frequent Pattern mining on large data sets.
5	Define and apply metrics to measure the performance of various data mining algorithms.
6	Apply BI to solve practical problems: Analyze the problem domain, use the data collected in enterprise apply the appropriate data mining technique, interpret and visualize the results and provide decision support.

4) syllabus

Module		Content	Hrs
0	Prerequisite	Basic Knowledge of databases	1
I	Data Warehouse (DWH) Fundamentals with Introduction to Data Mining	DWH characteristics, Dimensional modeling: Star, Snowflakes, OLAP operation, OLTP vs OLAP Data Mining as a step in KDD, Kind of patterns to be mined, Technologies used, Data Mining applications. Self-learning Topics: Data Marts, Major issues in Data Mining.	4
II	Data Exploration and Data Preprocessing	Types of Attributes, Statistical Description of Data, Measuring Data Similarity and Dissimilarity. Why Preprocessing? Data Cleaning, Data Integration, Data Reduction: Attribute Subset Selection, Histograms, Clustering, Sampling, Data Cube aggregation, Data transformation and Data Discretization: Normalization, Binning, Histogram Analysis Self-learning Topics Data Visualization, Concept hierarchy generation	5
III	Classification	Basic Concepts; Classification methods: 1. Decision Tree Induction: Attribute Selection Measures, Tree pruning. 2. Bayesian Classification: Naïve Bayes Classifier. Prediction: Structure of regression models; Simple linear regression, Accuracy and Error measures, Precision, Recall, Holdout, Random Sampling, Cross Validation, Bootstrap, Introduction of Ensemble methods, Bagging, Boosting, AdaBoost and Random forest. Self-learning Topics: Multiple linear regression, logistic regression, Random forest, nearest neighbour classifier, SVM	8
IV	Clustering and Outlier Detection	Cluster Analysis: Basic Concepts; Partitioning Methods: K-Means, K Medoids; Hierarchical Methods: Agglomerative, Divisive, BIRCH; Density-Based Methods: DBSCAN. What are outliers? Types, Challenges; Outlier Detection Methods:	8

		Supervised, Semi Supervised, 08 CO4 Unsupervised, Proximity based, Clustering Based. Self-learning Topics Hierarchical methods : Chameleon, Density based methods: OPTICS, Grid based methods: STING, CLIQUE	
V	Frequent Pattern Mining	Basic Concepts: Market Basket Analysis, Frequent Itemset, Closed Itemset, and Association Rules; Frequent Itemset. Mining Methods: The Apriori Algorithm: Finding Frequent Itemset Using Candidate Generation, Generating Association Rules from Frequent Itemset, Improving the Efficiency of Apriori, A pattern growth approach for mining Frequent Itemset, Mining Frequent Itemset using vertical data formats; Introduction to Advance Pattern Mining: Mining Multilevel Association Rules and Multidimensional Association Rules. Self-learning Topics: Association Mining to Correlation Analysis, lift, Introduction to Constraint-Based Association Mining	8
VI	Business Intelligence	What is BI? Business intelligence architectures; Definition of decision support system; Development of a business intelligence system using Data Mining for business Applications like Fraud Detection, Recommendation System Self-learning Topics: Clickstream Mining, Market Segmentation, Retail industry, Telecommunications industry, Banking & finance CRM, Epidemic prediction, Fake News Detection, Cyberbullying, Sentiment Analysis etc.	5
		Total	**39**

5) Textbooks:	
1	Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.
2	P. N. Tan, M. Steinbach, Vipin Kumar, “Introduction to Data Mining”, Pearson Education.
3	Paulraj Ponniah “Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals” Wiley Publications
6) Reference Books:	
1	Michael Berry and Gordon Linoff “Data Mining Techniques”, 2nd Edition Wiley Publications.
2	Michael Berry and Gordon Linoff “Mastering Data Mining- Art & science of CRM”, Wiley Student Edition.
3	Vikram Pudi & Radha Krishna, “Data Mining”, Oxford Higher Education.
4	Data Mining https://onlinecourses.nptel.ac.in/noc21_cs06/preview

7) Internal Assessment:

Assessment consists of one)Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

8) Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	GATE Based Assignment test/Tutorials etc	10 marks
3.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
4.	Multiple Choice Questions (Quiz)	5 marks

*****For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9)Rubrics for slow learners:-

1.) Case study, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2. Project based Learning and evaluation / Extra assignment / Question paper solution (10 marks)

3) Multiple Choice Questions (Quiz) (5marks)

4) Literature review of papers/journals (5 marks)

5) Library related work (5 marks)

10)Rubrics for Indirect Assessment :-

1. Mock Viva/Practical
2. Skill Enhancement Lecture
3. Extra Assignments/lab/lecture

11)End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will comprise a total of five questions
3	All question carry 20 marks
4	Any three questions out of five needs to be solved.

Sample_Autonomous_Syllabus_Web X.0

Course Code: ITC302	**Course Title:**	**Credit**
ITC402	Web X.0	3
Prerequisite: **Object Oriented Programming, Python Programming, HTML and CSS**		
2) Course Objectives: The course aims:		
1	To understand the digital evolution of web technology.	
2	To learn Typescript and understand how to use it in web applications.	
3	To empower the use of AngularJS to create web applications that depend on the Model-View-Controller Architecture.	
4	To gain expertise in a leading document-oriented NoSQL database, designed for speed, scalability, and developer agility using MongoDB.	
5	To build web applications quickly and with less code using the Flask framework.	
6	To gain knowledge of Rich Internet Application Technologies.	
3) Course Outcomes: On successful completion, of course, learner/student will be able to:		
1	Understand the basic concepts related to web analytics and semantic web.	
2	Understand how TypeScript can help you eliminate bugs in your code and enable you to scale your code.	
3	Understand AngularJS framework and build dynamic, responsive single-page web applications.	
4	Apply MongoDB for frontend and backend connectivity using REST API. Apply Flask web development framework to build web applications with less code.	
5	Develop Rich Internet Application using proper choice of Framework.	

4) Syllabus

Module	Module Name	Content	Hrs
Module 1	Introduction to WebX.0	Evolution of WebX.0; Web Analytics 2.0: Introduction to Web Analytics, Web Analytics 2.0, Clickstream Analysis, Strategy to choose your web analytics tool, Measuring the success of a website; Web3.0 and Semantic Web: Characteristics of Semantic Web, Components of Semantic Web, Semantic Web Stack, N-Triples and Turtle, Ontology, RDF and SPARQL	**4**
Module 2	Typescript	Overview, TypeScript Internal Architecture, TypeScript Environment Setup, TypeScript Types, variables and operators, Decision Making and loops, TypeScript Functions, TypeScript Classes and Objects, TypeScript Modules	**6**
Module 3	Introduction to AngularJS	Overview of AngularJS, Need of AngularJS in real web sites, AngularJS modules, AngularJS built-in directives, AngularJS custom directives, AngularJS expressions, AngularJS Data Binding, AngularJS filters, AngularJS controllers, AngularJS scope, AngularJS dependency injection, AngularJS Services, Form Validation, Routing using ng-Route, ng-Repeat, ng-style, ng-view, Built-in Helper Functions, Using Angular JS with Typescript	8
Module 4	MongoDB and Building REST API using MongoDB	MongoDB: Understanding MongoDB, MongoDB Data Types, Administering User Accounts, Configuring Access Control, Adding the MongoDB Driver to Node.js, Connecting to MongoDB from Node.js, Accessing and Manipulating Databases, Manipulating MongoDB Documents from Node.js, Accessing MongoDB from Node.js, Using Mongoose for Structured Schema and Validation. REST API: Examining the rules of REST APIs, Evaluating API patterns, Handling typical CRUD functions (create, read, update, delete), Using Express and Mongoose to interact with MongoDB, Testing API endpoints	**8**
Module 5	**Flask**	Introduction, Flask Environment Setup, App Routing, URL Building, Flask HTTP Methods, Flask Request Object, Flask cookies, File Uploading in Flask	**6**
Module 6	Rich Internet Application	AJAX: Introduction and Working Developing RIA using AJAX Techniques: CSS, HTML, DOM, XML HTTP Request, JavaScript, PHP, AJAX as REST Client	**5**

		Introduction to Open Source Frameworks and CMS for RIA: Django, Drupal, Joomla	
		Total	37

5) Textbooks:

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

6) Reference Books:

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

7) Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40)
Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

8) Continuous Assessment:-
Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	***Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC**	10 marks
2.	GATE Based Assignment test/Tutorials etc	10 marks
3.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
4.	Multiple Choice Questions (Quiz)	5 marks

***** Rubrics 1 compulsory, along with rubrics rubrics 2 or (rubrics 3 & 4) students can select.
***** For sr.no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9) Rubrics for slow learners:-
1.) Case study, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)
2. Project based Learning and evaluation / Extra assignment / Question paper solution (10 marks)
3) Multiple Choice Questions (Quiz) (5 marks)
4) Literature review of papers/journals (5 marks)
5) Library related work (5 marks)

10) Rubrics for Indirect Assessment :-
1. Mock Viva/Practical
2. Skill Enhancement Lecture

11) End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will comprise a total of five questions
3	All question carry 20 marks
4	Any three questions out of five need to be solved.

Course Code: ITC603	**Course Title: Wireless Technology**	**Credit**
Currently same	**Wireless Technology**	3

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

2) Course Objectives:

1	Discuss the Fundamentals of Wireless Communication.
2	Comprehend the Fundamental Principles of Wide Area Wireless Networking Technologies and their Applications.
3	Explain Wireless Metropolitan and Local Area Networks.
4	Describe Wireless Personal Area Networks and Ad hoc Networks.
5	Learn and Analyze Wireless Network Security Standards.
6	Study the Design Considerations for Wireless Networks.

3) Course Outcomes:

1	Describe the basic concepts of Wireless Network and Wireless Generations.
2	Demonstrate and Evaluate the various Wide Area Wireless Technologies.
3	Analyze the prevalent IEEE standards used for implementation of WLAN and WMAN Technologies.
4	Appraise the importance of WPAN, WSN and Ad-hoc Networks.
5	Analyze various Wireless Network Security Standards.
6	Review the design considerations for deploying the Wireless Network Infrastructure.

4) syllabus

Module		Content	Hrs
0	Prerequisite	Digital Modulation Techniques – ASK, FSK, BPSK, QPSK; Electromagnetic Spectrum; Multiplexing Techniques – FDM, TDM, OFDM; OSI and TCP/IP Model; Need for Security, Types of Security Threats and Attacks.	2
I	Fundamentals of Wireless Communication	Introduction to Wireless Communication - Advantages, Disadvantages and Applications; Multiple Access Techniques - FDMA, TDMA, CDMA, OFDMA; Spread Spectrum Techniques – DSSS, FHSS; Evolution of wireless generations – 1G to 5G (Based on technological differences and advancements); 5G – Key requirements and drivers of 5G systems, Use cases, Massive MIMO. Self-learning Topics: Modulation Techniques - QAM, MSK, GMSK	7
II	Wide Area Wireless Networks	Principle of Cellular Communication – Frequency Reuse concept, cluster size and system capacity, cochannel interference and signal quality; GSM – System Architecture, GSM Radio Subsystem, Frame Structure; GPRS and EDGE – System Architecture; UMTS – Network Architecture; CDMA 2000 – Network Architecture; LTE – Network Architecture; Overview of LoRa & LoRaWAN. Self-learning Topics:- IS-95	9
III	Wireless Metropolitan and Local Area Networks	IEEE 802.16 (WiMax) – Mesh mode, Physical and MAC layer; IEEE 802.11(Wi-Fi) – Architecture, Protocol Stack, Enhancements and Applications. Self-learning Topics:- WLL(Wireless Local Loop). Self-learning Topics:- HR–WPAN (UWB)	6
IV	Wireless Personal Area Networks and Ad hoc Networks	IEEE 802.15.1 (Bluetooth) – Piconet, Scatter net, Protocol Stack; IEEE 802.15.4 (ZigBee) – LRWPAN Device Architecture, Protocol Stack; Wireless Sensor Network – Design Considerations, Issues and Challenges, WSN Architecture, Applications; Introduction of Ad hoc Networks – MANET and VANET – Characteristics, Applications, Advantages and Limitations; Over view of E-VANET(Electrical Vehicular AdHoc Networks). Self-learning Topics:- HR–WPAN (UWB)	4
V	Wireless Network Security	Security in GSM; UMTS Security; Bluetooth Security; WEP; WPA2. Self-learning Topics :- Study of Wireless Security Tools.	8
VI	Wireless Network	Cisco Unified Wireless Network; Designing Wireless Networks with Lightweight Access Points and Wireless	8

	Design Considerations	LAN Controllers. Self-learning Topics:- Cisco Unified Wireless Network Mobility Services	
		Total	**39**

5) Textbooks:	
1	Wireless Communications, T.L. Singal, McGraw Hill Education.
2	Wireless Communications and Networking, Vijay Garg, Morgan Kaufmann Publishers
3	Wireless Mobile Internet Security, 2nd Edition, Man Young Rhee, A John Wiley & Sons, Ltd., Publication.
6) Reference Books:	
1	Cellular Communications: A Comprehensive and Practical Guide, Nishith Tripathi, Jeffery H Reed, Wiley.
2	Wireless Communications- Principles & Practice,Theodore S. Rappaport, Prentice Hall Series
3	Wireless Communications and Networks", William Stallings, Pearson / Prentice Hall.
4	Adhoc & Sensor Networks Theory and Applications, Carlos de Morais Cordeiro,Dharma Prakash Agrawal, World Scientific,2nd Edition.

7) Internal Assessment:

Assessment consists of one)Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

8) Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	GATE Based Assignment test/Tutorials etc	10 marks
3.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
4.	Multiple Choice Questions (Quiz)	5 marks

*****For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9)Rubrics for slow learners:-

1.) Case study, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2. Project based Learning and evaluation / Extra assignment / Question paper solution (10 marks)

3) Multiple Choice Questions (Quiz) (5marks)

4) Literature review of papers/journals (5 marks)

5) Library related work (5 marks)

10)Rubrics for Indirect Assessment :-

1. Mock Viva/Practical
2. Skill Enhancement Lecture
3. Extra Assignments/lab/lecture

11)End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will comprise a total of five questions
3	All question carry 20 marks
4	Any three questions out of five needs to be solved.

Course Code:	Course Title	Credit
ITC604	AI and DS -I	3

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

2)Course Objectives: The course aims:

1	To model a decision making for a new problem in an uncertain domain
2	To demonstrate Cognitive skills of Artificial Intelligence.
3	To become familiar with the basics of Fuzzy Logic and Fuzzy Systems.
4	To become familiar with Deep Learning Concepts and Architectures.
5	To define and apply metrics to measure the performance of various learning algorithms.
6	To enable students to analyze data science methods for real world problems.

3)Course Outcomes: On successful completion, of course, learner/student will be able to:

1	Design models for reasoning with uncertainty as well as the use of unreliable information
2	Analyze the process of building a Cognitive application.
3	Design fuzzy controller system.
4	Apply learning concepts to develop real life applications.
5	Evaluate performance of learning algorithms.
6	Analyze current trends in Data Science.

4) Syllabus

Module		Content	Hrs

Module 1 Introduction to AI		Introduction: Introduction to AI, AI techniques, Problem Formulation. Intelligent Agents: Structure of Intelligent agents, Types of Agents, Agent Environments PEAS representation for an Agent. Self-Learning Topics : Identify application areas of AI, **Design PEAS model for real life applications**.	04
Module 2 Search Techniques		Uninformed Search Techniques: Uniform cost search, Depth Limited Search, Iterative Deepening, Bidirectional search. Informed Search Methods: Heuristic functions, Best First Search, A*, Hill Climbing, Simulated Annealing. Constraint Satisfaction Problem Solving: Crypto-Arithmetic Problem, Water Jug, Graph Coloring. Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning. Comparing Different Techniques. Self-Learning Topics : IDA*, SMA*	09
Module 3 Knowledge Representation using First Order Logic		Knowledge and Reasoning: A Knowledge Based Agent, WUMPUS WORLD Environment, Propositional Logic, First Order Predicate Logic, Forward and Backward Chaining, Resolution. Planning as an application of a knowledge based agent. Concepts of Partial Order planning, Hierarchical Planning and Conditional Planning. Self-Learning Topics: Representing real world problems as planning problems, **Knowledge reasoning in WUMPUS WORLD.**	**06**
Module 4 Introduction to DS		Introduction and Evolution of Data Science, Data Science Vs. Business Analytics Vs. Big Data, Data Analytics, Lifecycle, Roles in Data Science Projects. Self-Learning Topics : **Compare Data Science and Data Mining, Applications and Case Studies of Data Science in various Industries, Governance, Healthcare and E-commerce.**	04
Module 5 Exploratory Data Analysis		Introduction to exploratory data analysis, Typical data formats. Types of EDA, Graphical/Non graphical Methods, Univariate/multivariate methods Correlation and covariance, Degree of freedom Self-learning Topics: Statistical Methods for Evaluation including ANOVA. Self-Learning Topics: **Computation of ANOVA and Chi-Square Test in Machine learning application, Implementation** of graphical EDA methods.	08
Module 6 Introduction to ML		Introduction to Machine Learning, Types of Machine Learning: Supervised (Logistic Regression, Decision Tree, Support Vector	08

		Machine) and Unsupervised (K Means. K Medoid Clustering, Hierarchical Clustering, Association Rules) Issues in Machine learning, Application of Machine Learning Steps in developing a Machine Learning Application. Self-Learning Topics: Real world case studies on machine learning. **Performance evaluation of machine learning.**	
		Total	**39**

5) Textbooks:	
1	Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Pearson Education.
2	. Elaine Rich, Kevin Knight, Shivshankar B Nair, Artificial Intelligence, McGraw Hill, 3rd Edition.
3	Howard J. Seltman, Experimental Design and Analysis, Carnegie Mellon University, 2012/1.
4	Ethem Alpaydın, "Introduction to Machine Learning", MIT Press
6) Reference Books:	
1	Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Publication.
2	George Lugar, AI-Structures and Strategies for Complex Problem Solving., 4/e, 2002, Pearson Education.
3	Data Science & Big Data Analytics, 1st Edition, 2015, EMC Education Services, Wiley. ISBN: 978- 1118876138
4	Tom M.Mitchell "Machine Learning" McGraw Hill
5	Richard I. Levin, David S. Rubin "Statistics for Management" Pearson
6	Vivek Belhekar, "Statistics for Psychology using R" SAGE
7) Links	
1	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs83/
2	https://nptel.ac.in/courses/106/105/106105077/

3	https://www.coursera.org/specializations/jhu-data-science
4	https://www.coursera.org/learn/machine-learning
5	https://www.udemy.com/course/statistics-for-data-science-and-business-analysis

7) Internal Assessment:
Assessment consists of one Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40)
Mid Term test is to be conducted when approx. 50% syllabus is completed and the Duration of the midterm test shall be one hour.

8) Continuous Assessment:-
Continuous Assessment is of 20 marks**.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	***Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC**	10 marks
2.	**Creating Proof of concept /case studies/assignments**	10 marks
3.	**Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)**	5 marks
4.	**Multiple Choice Questions (Quiz**)	5 marks

***** Rubrics 1 compulsory, along with rubrics rubrics 2 or (rubrics 3 & 4) students can select.

***** For sr.no.1, the date of the certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9)Rubrics for slow learners:-

1.) *Case study*, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2. Project based Learning and evaluation / **Extra assignment** / Question paper solution (10 marks)

3) Multiple Choice Questions (Quiz) (5 marks)

4) Literature review of papers/journals (5 marks)

5) Library related work (5 marks)

10)Rubrics for Indirect Assessment :-

1. **Mock Viva**/Practical

2. Skill Enhancement Lecture

3. Extra Assignments/lab/lecture

11)End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will comprise a total of five questions
3	All question carry 20 marks
4	Any three questions out of five needs to be solved.

Course Code: ITDO6011	Course Title:Software Architecture	Credit
Currently same	**Software Architecture**	3
1) Prerequisite: Software Engineering, Any Programming Language		
2) Course Objectives:		
1	To understand the importance of architecture in building effective, efficient, competitive software products.	
2	To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation	
3	To learn the design principles and to apply for large scale systems including distributed, network and heterogeneous systems	
4	To understand principal design decisions governing the system.	
5	To understand different notations used for capturing design decisions.	
6	To understand different functional and non-functional properties of complex software systems	
3) Course Outcomes:		
1	Understand the need of software architecture for sustainable dynamic systems.	
2	Have a sound knowledge on design principles and to apply for large scale systems.	
3	Apply functional and non-functional requirements	
4	Design architectures for distributed, network and heterogeneous systems	
5	Have good knowledge on service oriented and model driven architectures and the aspect-oriented architecture.	
6	Have a working knowledge to develop appropriate architectures through various case studies	

4) syllabus

Module		Content	Hrs
0	Prerequisite	Software Engineering Concepts, Knowledge of Any programming Language	2
I	Basic Concepts and Architectures Design	Terminology, Models, Processes, Stakeholders, Design Process, Architectural Conceptions, Styles and architectural Patterns, Architectural conceptions in absences of experience, connectors, 4+1 view model of Architecture Self Learning Topics : Technical Paper "What_is_included_in_software_architectur"	7
II	Architectural Modeling and Analysis	Modeling Concepts, Ambiguity, Accuracy and Precisions, Complex Modeling, Evaluating Modeling Techniques, Specific Modeling Techniques, Analysis Goals, Scope of Analysis, Formality of Architectural Models, Types of Analysis, Level of Automation, System Stakeholders, Analysis Techniques Self Learning Topics: Technical Paper "Specification of Requirements and Software Architecture for the Customisation of Enterprise Software"	9
III	Implementation, Deployment and Mobility	Implementation Concepts, Existing Frameworks, Overview of Deployment and Mobility Challenges, Software Architecture and Deployment, Software Architecture and Mobility Self Learning Topics: Technical Paper"Application of Distributed System in Neuroscience: A Case Study of BCI Framework"	6
IV	Applied Architectures and Styles	Distributed and Network Architectures, Architectures for Network Based Applications, Decentralized Architectures, Service oriented Architectures and Web Services. Self Learning Topics:Technical Paper "Analysing the Behaviour of Distributed Software Architectures: a Case Study"	6
V	Designing for Non-Functional Properties	Efficiency, Complexity, Scalability and Heterogeneity, Adaptability, Dependability Self Learning Topics: Technical Paper "ThreatModeling-in-Agile-Software-Development"	4
VI	DomainSpecific Software Engineering	Domain-Specific Software Engineering, Domain- Specific Architecture, Software Architects Roles Self Learning Topics: Research Paper "A Case Study of the Variability Consequences of the CQRS"	5

		Total	**39**

5) Textbooks:	
1	Software Architecture, Foundations, Theory, and Practise, Richard Taylor, Nenad Medvidovic, Eric M Dashofy, Wiley Student Edition.
2	The Art of Software Architecture: Design Methods and Techniques, Stephen T.Albin, Wiley India Private Limited.
3	Software Architecture in Practice by Len Bass, Paul Clements, Rick Kazman, Pearson
6) Reference Books:	
1	DevOps A Software Architect's Perspective, Len Bass, Ingo Weber, Liming Zhu, Addison Wesley
2	Essentials of Software Architecture, Ion Gorton, Second Edition, Springer-verlag, 2011

7) Internal Assessment:

Assessment consists of one)Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

8) Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	GATE Based Assignment test/Tutorials etc	10 marks
3.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
4.	Multiple Choice Questions (Quiz)	5 marks

*****For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9)Rubrics for slow learners:-

1.) Case study, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2. Project based Learning and evaluation / Extra assignment / Question paper solution (10 marks)

3) Multiple Choice Questions (Quiz) (5marks)

4) Literature review of papers/journals (5 marks)

5) Library related work (5 marks)

10)Rubrics for Indirect Assessment :-

1. Mock Viva/Practical
2. Skill Enhancement Lecture
3. Extra Assignments/lab/lecture

11)End Semester Theory Examination:

1	Question paper will be of 60 marks
2	Question paper will comprise a total of five questions
3	All question carry 20 marks
4	Any three questions out of five needs to be solved.

Course Code:	Course Title	Credit
ITDO6013	Green IT	3
1)Prerequisite:		
2)Course Objectives: environmental Studies		
1	To understand what Green IT is and How it can help improve environmental Sustainability	
2	To understand the principles and practices of Green IT.	
3	To understand how Green IT is adopted or deployed in enterprises.	
4	To understand how data centres, cloud computing, storage systems, software and networks can be made greener.	
5	5 To measure the Maturity of Sustainable ICT world.	
6	To implement the concept of Green IT in Information Assurance in Communication and Social Media and all other commercial field.	
3)Course Outcomes:		
1	Describe awareness among stakeholders and promote green agenda and green initiatives in their working environments leading to green movement	
2	Identify IT Infrastructure Management and Green Data Centre Metrics for software Development	
3	Recognize Objectives of Green Network Protocols for Data communication.	
4	Use Green IT Strategies and metrics for ICT development.	
5	5 Illustrate various green IT services and its roles.	
6	Use new career opportunities available in IT profession, audits and others with	

	special skills such as energy efficiency, ethical IT assets disposal, carbon footprint estimation, reporting and development of green products, applications and services.

4) syllabus

Module		Content	Hrs
Module 1 Introduction		Environmental Impacts of IT, Holistic Approach to Greening IT, Green IT Standards and Eco-Labeling, Enterprise Green IT Strategy Hardware: Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose Software: Introduction, Energy-Saving Software Techniques Self learning Topics: Evaluating and Measuring Software Impact to Platform Power	9
Module 2 Software development and data centers		Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, Green Data Centre Metrics Self-learning Topics: Sustainable Software: A Case Study, Data Centre Management Strategies: A Case Study	07
Module 3 Data storage and communication		Storage Media Power Characteristics, Energy Management Techniques for Hard Disks Objectives of Green Network Protocols, Green Network Protocols and Standards Self learning Topics: System-Level Energy Management	06
Module 4 Information		Approaching Green IT Strategies, Business Drivers of Green IT Strategy	06

systems, green it strategy and metrics		Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Measuring the Maturity of Sustainable ICT: A Capability Maturity Framework for SICT, Defining the Scope and Goal, Capability Maturity Levels Self learning Topics: Business Dimensions for Green IT Transformation	
Module 5 Green IT services and roles		Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware Self learning Topics: Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise	06
Module 6 Managing and regulating green IT		Strategizing Green Initiatives, Implementation of Green IT, Communication and Social Media The Regulatory Environment and IT Manufacturers, Nonregulatory Government Initiatives, Industry Associations and Standards Bodies, Green Building Standards, Social Movements and Greenpeace. Self learning Topics: Information Assurance, Green Data Centers, Case Study: Managing Green IT	05
		Total	**39**

5) Textbooks:	
1	San Murugesan, G. R. Gangadharan, Harnessing Green IT, WILEY 1st Edition-2013
2	Mohammad Dastbaz Colin Pattinson Babak Akhgar, Green Information Technology A Sustainable Approach, Elsevier 2015
3	Reinhold, Carol Baroudi, and Jeffrey HillGreen IT for Dummies, Wiley 2009
6) Reference Books:	
1	Mark O'Neil, Green IT for Sustainable Business Practice: An ISEB Foundation Guide, BCS
2	Jae H. Kim, Myung J. Lee Green IT: Technologies and Applications, Springer, ISBN: 978-3-642-22178-1

7) Internal Assessment:

Assessment consists of one)Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

8) Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	Content beyond syllabus presentation	10 marks
4.	**Creating Proof of concept/assignments**	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*****For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9)Rubrics for slow learners:-

1.) **Case study,** Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2. Project based Learning and evaluation / Extra assignment / Question paper solution (10 marks)

3) Multiple Choice Questions (Quiz) (5marks)

4) Literature review of papers/journals (5 marks)

5) **Library related work** (5 marks)

10)Rubrics for Indirect Assessment :-

1. **Mock Viva**/Practical
2. Skill Enhancement Lecture
3. Extra Assignments/lab/lecture

11)End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will comprise a total of five questions
3	All question carry 20 marks
4	Any three questions out of five needs to be solved.

Course Code:	Course Title	Credit
ITDO6014	Ethical Hacking and Forensics	3
1)Prerequisite: Computer Networks, Computer Network Security		
2)Course Objectives:		
1	To understand the concept of cybercrime and principles behind ethical hacking.	
2	To explore the fundamentals of digital forensics, digital evidence and incident response.	
3	To learn the tools and techniques required for computer forensics.	
4	To understand the network attacks and tools and techniques required to perform network forensics.	
5	To learn how to investigate attacks on mobile platforms.	
6	To generate a forensics report after investigation.	
3)Course Outcomes:		
1	Define the concept of ethical hacking.	
2	Recognize the need of digital forensics and define the concept of digital	
3	Apply the knowledge of computer forensics using different tools and techniques.	
4	Detect the network attacks and analyze the evidence.	
5	Apply the knowledge of computer forensics using different tools and techniques.	
6	List the method to generate legal evidence and supporting investigation Reports	

4) syllabus

Module		Content	Hrs
Module 1 Cybercrime and Ethical Hacking		Introduction to Cybercrime, Types of Cybercrime, Classification of Cybercriminals, Role of computer in Cybercrime, Prevention of Cybercrime. Ethical Hacking, Goals of Ethical Hacking, Phases of Ethical Hacking, Difference between Hackers, Crackers and Phreakers, Rules of Ethical Hacking. Self Learning Topics: exploring various online hacking tools for Reconnaissance and scanning Phase	07
Module 2 Digital Forensics Fundamentals		Introduction to Digital Forensics, Need and Objectives of Digital Forensics, Types of Digital Forensics, Process of Digital Forensics, Benefits of Digital Forensics, Chain of Custody, Anti Forensics. Digital Evidence and its Types, Rules of Digital Evidences. Incident Response, Methodology of Incident Response, Roles of CSIRT in handling incident. Self Learning Topics: Pre Incident preparation and Incident Response process	06
Module 3 Computer forensics		Introduction to Computer Forensics, Evidence collection (Disk, Memory, Registry, Logs etc), Evidence Acquisition, Analysis and Examination(Window, Linux, Email, Web, Malware) , Challenges in Computer Forensics, Tools used in Computer Forensics. **real time case studies on current scenario** Self Learning Topics: Open source tool for Data collection & analysis in windows or Unix	08
Module 4 Network forensics		Introduction, Evidence Collection and Acquisition (Wired and Wireless), Analysis of network evidences(IDS, Router,), Challenges in network forensics, Tools used in network forensics. Self Learning Topics: IDS types and role of IDS in attack prevention	08
Module 5 Mobile		Introduction, Evidence Collection and Acquisition, Analysis of Evidences, Challenges in mobile forensics, Tools used in mobile forensics	06

Forensics		Self Learning Topics: Tools / Techniques used in mobile forensics	
Module 6 Report Generation		Goals of Report, Layout of an Investigative Report, Guidelines for Writing a Report, sample for writing a forensic report. Self Learning Topics: For an incident write a forensic report.	04
		Total	**39**

5) Textbooks:	
1	John Sammons, "The Basics of Digital Forensics: The Premier for Getting Started in Digital Forensics", 2nd Edition, Syngress, 2015.
2	Nilakshi Jain, Dhananjay Kalbande, "Digital Forensic: The fascinating world of Digital Evidences" Wiley India Pvt Ltd 2017.
3	Jason Luttgens, Matthew Pepe, Kevin Mandia, "Incident Response and computer forensics",3rd Edition Tata McGraw Hill, 2014.
6) Reference Books:	
1	Sangita Chaudhuri, Madhumita Chatterjee, "Digital Forensics", Staredu, 2019.
2	Bill Nelson,Amelia Phillips,Christopher Steuart, "Guide to Computer Forensics and Investigations" Cengage Learning, 2014.
3	Debra Littlejohn Shinder Michael Cross "Scene of the Cybercrime: Computer Forensics Handbook", 2nd Edition Syngress Publishing, Inc.2008

7) Internal Assessment:

Assessment consists of one)Mid Term Test of 20 marks and Continuous Assessment of 20 marks.(Total 40)

Mid Term test is to be conducted when approx. 50% syllabus is completed Duration of the midterm test shall be one hour.

8) Continuous Assessment:-

Continuous Assessment **is of 20 marks.** The rubrics for assessment will be considered on approval by the subject teachers. The rubrics can be any 2 or max 4 of the following:-

Sr.no	Rubrics	Marks
1.	*Certificate course for 4 weeks or more:- NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2.	Wins in the event/competition/hackathon	10 marks
3.	**Content beyond syllabus presentation**	10 marks
4.	**Creating Proof of concept /case studies/assignments**	10 marks
5.	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6.	GATE Based Assignment test/Tutorials etc	10 marks
7.	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject(in other institutes)	5 marks
8.	Multiple Choice Questions (Quiz)	5 marks

*****For sr.no.1, the date of certification exam should be within the term and in case a student is unable to complete the certification , the grading has to be done accordingly.

9)Rubrics for slow learners:-

1.) **Case study**, Presentation, group discussion, technical debate on recent trends in the said course (10 marks)

2. Project based Learning and evaluation / **Extra assignment** / Question paper solution (10 marks)

3) Multiple Choice Questions (Quiz) (5marks)
4) Literature review of papers/journals (5 marks)
5) Library-related work (5 marks)

10)Rubrics for Indirect Assessment :-

1. **Mock Viva**/Practical
2. Skill Enhancement Lecture
3. **Extra Assignments**/lab/lecture

11)End Semester Theory Examination:	
1	Question paper will be of 60 marks
2	Question paper will comprise a total of five questions
3	All question carry 20 marks
4	Any three questions out of five needs to be solved.

Sample Template for Lab Work

Lab Code	Lab Name	Credit
ITL601	Business Intelligence Lab	**1**

1)Prerequisite: The Lab experiments aims:	
2)Lab Objectives:	
1	To introduce the concept of data Mining as an important tool for enterprise data management and as a cutting-edge technology for building competitive advantage.
2	To enable students to effectively identify sources of data and process it for data mining.
3	To make students well versed in all data mining algorithms, methods, and tools.
4	To learn how to gather and analyze large sets of data to gain useful business understanding.
5	To impart skills that can enable students to approach business problems analytically by identifying opportunities to derive business value from data.
6	To identify and compare the performance of business.
Lab Outcomes:On successful completion, of course, learner/student will be able to:	
1	Identify sources of Data for mining and perform data exploration.
2	Organize and prepare the data needed for data mining algorithms in terms of attributes and class inputs, training, validating, and testing files.
3	Implement the appropriate data mining methods like classification, clustering or association mining on large data sets using open-source tools like WEKA.
4	Implement various data mining algorithms from scratch using languages like Python/ Java etc.
5	Evaluate and compare performance of some available BI packages.
6	Apply BI to solve practical problems: Analyze the problem domain, use

	the data collected in enterprise apply the appropriate data mining technique, interpret and visualize the results and provide decision support.

4)Suggested Experiments: (minimum number of experiments to be completed can be specified)	
Sr. No.	**Name of the Experiment**
1	Tutorial on a) Design Star and Snowflake Schema
2	Implement using tools or languages like JAVA/ python/R a) Data Exploration b) Data preprocessing
3	Implement and evaluate using languages like JAVA/ python/R a) Classification Algorithms b) Clustering Algorithms c) Frequent Pattern Mining Algorithms
4	Perform and evaluate using any open-source tools a) Classification Algorithms b) Clustering Algorithms c) Frequent Pattern Mining Algorithms
5	Detailed case study of any one BI tool such as Pentaho, Tableau and QlikView
6	Business Intelligence Mini Project: Each group assigned one new case study for this A BI report must be prepared outlining the following steps: a) Problem definition, identifying which data mining task is needed b) Identify and use a standard data mining dataset available for the problem. Some links for data mining datasets are: WEKA, Kaggle, KDD cup, Data Mining Cup, UCI Machine Learning Repository etc. c) Implement appropriate data mining algorithm d) Interpret and visualize the results e) Provide clearly the BI decision that is to be taken as a result of mining

5)Text books:	
1	Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3nd Edition.
2	G. Shmueli, N.R. Patel, P.C. Bruce, “Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner”, 1st Edition, Wiley India.
3	Paulraj Ponniah “Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals” Wiley Publications

6) Term Work:	
1	**Term Work shall consist of at least 10 Practical based on the above list, but not limited to. 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)**
7) Continuous assessment exam:	
1.	Timely Submission of Experiments weekwise
2.	Explanation/concept:
3.	Algorithm/implementation:
4.	Analysis
5.	Documentation/Performance:

Sample Template for Lab Work

Lab Code	Lab Name	Credit
		1

1)Prerequisite:	
2) Lab Objectives: The course aims:	
1	
2	
3	
4	
5	
6	
3) Lab Outcomes: On successful completion, of course, learner/student will be able to:	
1	
2	
3	
4	
5	

4)Suggested Experiments: (minimum number of experiments to be completed can be specified)

Sr. No.	**Name of the Experiment**
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	

5) Useful Links:	
1	
2	
3	
4	

6) Term Work:	
1	Term Work shall consist of at least 12 Practical's based on the above list. Also, Term work Journal must include at least 2 assignments. Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)
7) Continuous assessment exam	
1	Experiment submission on time
2	Web page design aspects considered in Web page development
3	Explanation/concepts
4	Documentation

Sample Template for Lab Work

Lab Code	Lab Name	Credit
ITL603	Sensor Lab	**1**

1)Prerequisite: The Lab experiments aims:	
2)Lab Objectives:	
1	Learn various communication technologies, Microcontroller boards and sensors.
2	Design the problem solution as per the requirement analysis done using sensors and technologies.
3	Study the basic concepts of programming/sensors/ emulators.
4	Design and implement the mini project intended solution for project based earning.
5	Build, test and report the mini project successfully.
6	Improve the team building, communication and management skills of the students.
Lab Outcomes:On successful completion, of course, learner/student will be able to:	
1	Differentiate between various wireless communication technologies based on the range of communication, cost, propagation delay, power and throughput.
2	Conduct a literature survey of sensors used in real world wireless applications.
3	Demonstrate the simulation of WSN using the Network Simulators (Contiki/ Tinker CAD/ Cup carbon etc).
4	Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing

5	Report and present the findings of the study conducted in the preferred domain
6	Demonstrate the ability to work in teams and manage the conduct of the research study. L1,L2,L3

4)Suggested Experiments: (minimum number of experiments to be completed can be specified)	
Sr. No.	**Name of the Experiment**
1	Introduction to 8086, 8051 and Python programming
2	Study of various wireless communication technologies like IEEE 802.15.1, IEEE 802.15.4 and IEEE 802.11. Mini Project: Allocation of the groups
3	Study of various types of sensors and display devices (eg. DHT-11/22, HC-SR04, MFRC 522, PIR Sensor) and demonstration of their interfacing using Arduino/ Raspberry pi. Mini Project: Topic selection
4	Installation and testing the simulation tools (eg. TinkerCad/Cupcarbon/ContikiCooja). Mini Project: Topic validation and finalizing software and Hardware requirement.
5	Study of interfacing of Arduino/ Raspberry pi with Wireless Technologies (eg. HC-05, XBee S2C by Digi, ESP controller). Mini Project: Hardware procurement
6	Implementation of the Mini Project: 1. Design, configure, testing the Mini Project. 2. Report submission as per the guidelines.

6) Term Work:	
1	**Term Work shall consist of at least 10 Practical based on the above list, but not limited to. 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)
7) Continuous assessment exam:	
1.	Timely Submission of Experiments weekwise
2.	Explanation/concept:
3.	Algorithm/implementation:
4.	Analysis
5.	Documentation/Performance:

Course Code:ITL604	Course Title: MAD & PWA Lab	Credit
Currently same	**MAD & PWA Lab**	01
1) Prerequisite: HTML/HTML5, CSS3, Javascrip		
2) Lab Objectives:		
1	Learn the basics of the Flutter framework.	
2	Develop the App UI by incorporating widgets, layouts, gestures and animation	
3	Create a production ready Flutter App by including files and firebase backend service	
4	Learn the Essential technologies, and Concepts of PWAs to get started as quickly and efficiently as possible	
5	Develop responsive web applications by combining AJAX development techniques with the jQuery JavaScript library.	
6	Understand how service workers operate and also learn to Test and Deploy PWA	
3) Lab Outcomes:		
1	Understand cross platform mobile application development using Flutter framework	
2	Understand cross platform mobile application development using Flutter framework	
3	Analyze and Build production ready Flutter App by incorporating backend services and deploying on Android / iOS	
4	Understand various PWA frameworks and their requirements	

5	Design and Develop a responsive User Interface by applying PWA Design techniques
6	Develop and Analyse PWA Features and deploy it over app hosting solutions

Sr. No.	**Module**	**Name of the Experiment**
1	Basics of Flutter Programming	Introduction of Flutter, Understanding Widget Lifecycle Events,Dart Basics, Widget Tree and Element Tree, Basics of Flutter installation, Flutter Hello World App.
2	Developing Flutter UI:Widgets, Layouts, Gestures, Animation	USING COMMON WIDGETS: SafeArea, Appbar, Column, Row, Container, Buttons, Text , Richtext,Form ,Images and Icon. BUILDING LAYOUTS : high level view of layouts, Creating the layout, Types of layout widgets APPLYING GESTURES: Setting Up GestureDetector, Implementing the Draggable and Dragtarget Widgets,Using the GestureDetector for Moving and Scaling ADDING ANIMATION TO AN APP :Using Animated Container,Using Animated

		CrossFade,Using Animated Opacity,Using Animation Controller, Using Staggered Animation CREATING AN APP'S NAVIGATION: Using the Navigator,Using the Named Navigator Route,Using the Bottom NavigationBar,Using the TabBar and TabBarView
3	Creating Production Ready Apps	Working with files : Including libraries in your Flutter app, Including a file with your app, Reading/Writing to files, Using JSON. Using Firebase with Flutter: Adding the Firebase and Firestore Backend,Configuring the Firebase Project,Adding a Cloud Firestore Database and Implementing Security Testing and Deploying of Flutter Application: Widget testing, Deploying Flutter Apps on Android / iOS
4	Introduction to Progressive Web App	Introduction to Progressive Web App ● Why Progressive Web App ● Characteristics of PWA ● PWAs and Hybrid Apps vs. Mobile Apps ● PWA Requirements: HTTPS, Service Workers, and Web App Manifest ● PWA framework tools ● Use cases
5	Creating Responsive UI	Creating Responsive UI using JQuery Mobile / Material UI / Angular UI / React UI ● Understanding the concept of responsive web design ● Comparing responsive, fluid,

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

5)Text books:	
1	Beginning Flutter a Hands-on Guide to App Development, Marco L. Napoli, Wiley, 2020
2	Beginning App Development with Flutter: Create Cross-Platform Mobile Apps, By Rap Payne, 2019
3	Progressive Web Application Development by Example: Develop fast, reliable, and engaging user experiences for the web, Packt Publishing Limited ,2018
4	Building Progressive Web Apps,O'Reilly 2017
5	Progressive Web Apps with Angular: Create Responsive, Fast and Reliable PWAs Using Angular, Apress; 1st ed. edition (28 May 2019)

6) Term Work:	
1	**Term Work shall consist of at least 10 Practical based on the above list, but not limited to. 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)**
7) Continuous assessment exam:	
1.	Timely Submission of Experiments weekwise
2.	Explanation/concept:
3.	Algorithm/implementation:
4.	Analysis
5.	Documentation/Performance:

Sample Template for Data Science Lab

Lab Code	Lab Name	Credit
ITL605	DS using Python Skill based Lab	**1**

1)Prerequisite: Artificial Intelligence and Data Science-I, Python Programming, Data Mining & Business Intelligence.	
2) Lab Objectives: The course aims:	
1	To know the fundamental concepts of data science and analytics.
2	To learn data collection, preprocessing and visualization techniques for data science.
3	To Understand and practice analytical methods for solving real life problems based on Statistical analysis.
4	To learn various machine learning techniques to solve complex real-world problems.
5	To learn streaming and batch data processing using Apache Spark
6	To map the elements of data science to perceive information
3) Lab Outcomes: On successful completion, of course, learner/student will be able to:	
1	Understand the concept of Data science process and associated terminologies to solve real-world problem.

2	Analyze the data using different statistical techniques and visualize the outcome using different types of plots.
3	Analyze and apply the supervised machine learning techniques like Classification, Regression or Support Vector Machine on data for building the models of data and solve the problems.
4	Apply the different unsupervised machine learning algorithms like Clustering, Decision Trees, Random Forests or Association to solve the problems.
5	Design and Build an application that performs exploratory data analysis using Apache Spark.
6	Design and develop a data science application that can have data acquisition, processing, visualization and statistical analysis methods with supported machine learning technique to solve the real-world problem.

4)Suggested Experiments: (minimum number of experiments to be completed can be specified)

Sr. No.	**Name of the Experiment**
1*	To implement Data preparation using NumPy and Pandas a. Derive an index field and add it to the data set. b. Find out the missing values. c. Obtain a listing of all records that are outliers according to the any field. Print out a listing of the 10 largest values for that field. Do the following for the any field. i. Standardize the variable. ii. Identify how many outliers there are and identify the most extreme outlier
2*	To implement Data Visualization / Exploratory Data Analysis for the selected data set using Matplotlib and Seaborn

	a. Create a bar graph, contingency table using any 2 variables. b. Create normalized histogram. Describe what this graphs and tables indicates
3*	To implement Data Modeling a. Partition the data set, for example 75% of the records are included in the training data set and 25% are included in the test data set. Use a bar graph to confirm your proportions. b. Identify the total number of records in the training data set. Validate your partition by performing a two-sample Z-test.
4	To implement Statistical Hypothesis Test using Scipy and Sci-kit learn. Correlation Tests 1. Pearson's Correlation Coefficient 2. Spearman's Rank Correlation 3. Kendall's Rank Correlation 4. Chi-Squared Test
5*	To implement Regression Analysis a. Perform Logistic Regression to find out relation between variables. Apply regression Model techniques to predict the data on above dataset
6*	To implement Classification modelling a. Choose classifier for classification problem. b. Evaluate the performance of classifier
7*	To implement Clustering a. Clustering algorithms for unsupervised classification. b. Plot the cluster data.

8*	To implement any machine learning techniques using available data set to develop a recommendation system
9*	To implement Exploratory data analysis using Apache Spark and Pandas
10*	To implement Batch and Streamed Data Analysis using Spark
11	Mini-Project

5) Useful Links:	
1	https://www.w3schools.com/python/pandas/default.asp
2	https://matplotlib.org/stable/gallery/index.htm
3	https://seaborn.pydata.org/examples/index.html
4	https://docs.scipy.org/doc/scipy/reference/linalg.html#module-scipy.linalg
5.	https://scikit-learn.org/stable/auto_examples/index.html
6	https://www.tutorialspoint.com/scipy/scipy_integrate.htm
7	https://machinelearningmastery.com/statistical-hypothesis-tests-in-python-cheatsheet/

8	https://data-flair.training/blogs/data-science-project-ideas/

6) Term Work:	
1	Term Work shall consist of at least 12 Practical based on the above list. **Also, Term work Journal must include at least 2 assignments.** Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Mini Project) +05 Marks (Attendance)
7) Continuous assessment exam	
1	Experiment submission on time
2	Explanation/Concepts
3	Algorithm implementation
4	Presentation/Analysis
5	Performance/Documentation

Course Code: ITM601	**Course Title :** **Mini Project – – 2 B Web Based on ML**	**Credit**
Currently same	**Mini Project – 1 A for Front end /backend Application using JAVA**	

1)Prerequisite:

2)Course Objectives:

The course aims:

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.

3)Course Outcomes:

On successful completion, of course, learner/student 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.

4) 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 nfaculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.

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

5) 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

6) 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.

7) 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.

8) 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