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Maharashtra State Board Of Technical Education, Mumbai

Learning and Assessment Scheme for Post S.S.C Diploma Courses

Programme Name	**: Diploma In Information Technology**		
Programme Code	**: IF**	**With Effect From Academic Year**	**: 2023-24**
Duration Of Programme	**: 6 Semester**	**Duration**	**: 16 WEEKS**
Semester	**: Sixth** **NCrF Entry Level : 4.0**	**Scheme**	**: K**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme												
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL				Based on Self Learning		Total Marks
																	Practical						
						CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
													Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
(All Compulsory)																								
1	MANAGEMENT	MAN	AEC	315301	1	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125
2	EMERGING TRENDS IN COMPUTER ENGINEERING AND INFORMATION TECHNOLOGY	ETI	DSC	316313	-	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125
3	WIRELESS AND MOBILE NETWORK	WMN	DSC	316325	-	3	-	4	1	8	4	3	30	70	100	40	25	10	-	-	25	10	150
4	CLIENT SIDE SCRIPTING	CSS	AEC	316005	-	2	-	4	-	6	3	-	-	-	-	-	25	10	25@	10	-	-	50
5	MOBILE APPLICATION DEVELOPMENT	MAD	DSC	316006	-	2	-	4	2	8	4	-	-	-	-	-	25	10	25#	10	25	10	75
6	CAPSTONE PROJECT	CPE	INP	316004	-	-	-	2	2	4	2	-	-	-	-	-	50	20	50#	20	50	20	150
Elective 2 (Any - One)																								
7	DIGITAL FORENSIC AND HACKING TECHNIQUES	DFH	DSE	316315	-	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175
	MACHINE LEARNING	MAL	DSE	316316	-	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175
	DATA WAREHOUSING WITH MINING TECHNIQUES	DWM	DSE	316321	-	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175
Total					**1**	**16**		**16**	**8**		**20**		**120**	**280**	**400**		**150**		**125**		**175**		**850**

Sr No	Course Title	Abbrevation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme										
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week		Paper Duration (hrs.)	Theory				Based on LL & TL				Based on Self Learning		Total Marks
																	Practical						
						CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
													Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	

Abbreviations : CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment,SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends : @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :
1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.
Course Category : Discipline Specific Course Core (DSC) , Discipline Specific Elective (DSE) , Value Education Course (VEC) , Intern./Apprenti./Project./Community (INP) , AbilityEnhancement Course (AEC) , Skill Enhancement Course (SEC) , GenericElective (GE)

Programme Name/s	**: Architecture Assistantship/ Architecture and Interior Design/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Software Technology/ Computer Science & Engineering/ Bamboo Technology/ Fashion & Clothing Technology/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Food Technology/ Computer Hardware & Maintenance/ Instrumentation & Control/ Instrumentation & Control Engineering/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Laboratory Technology/ Manufacturing Technology/ Medical Electronics/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg.**
Programme Code	**: AA/ AD/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DBT/ DC/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ IC/ ICE/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MRT/ MU/ PG/ PN/ PO/ SC/ SE/ TC/ TE**
Semester	**: Fifth / Sixth**
Course Title	**: MANAGEMENT**
Course Code	**: 315301**

I. RATIONALE

Effective management is the cornerstone of success for both organizations and individuals. It empowers diploma engineers/ professionals to accomplish their tasks with finesse and efficiency through strategic planning and thoughtful execution, projects can optimize finances, enhance safety measures, facilitate sound decision-making, foster team collaboration and cultivate a harmonious work environment. The diploma engineers require leadership and management skills with technical knowledge of the core field to carry out various tasks smoothly. This course aims to instill fundamental management techniques, empowering diploma engineers/ professionals to enhance their effectiveness in the workplace.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Apply the relevant managerial skills for achieving optimal results at workplace.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Use relevant management skills to handle work situation
- CO2 - Apply appropriate techniques of product, operations and project management
- CO3 - Use comprehensive tools of recent management practices
- CO4 - Plan suitable marketing strategy for a product / service
- CO5 - Utilize supply chain and human resource management techniques for effective management

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

MANAGEMENT **Course Code : 315301**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
315301	MANAGEMENT	MAN	AEC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125

Total IKS Hrs for Sem. : 1 Hrs

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Justify the importance of management thoughts in Indian knowledge system. TLO 1.2 Describe the importance of management in day to day life. TLO 1.3 Explain Henry Fayol’s principles of management. TLO 1.4 Describe the role of each level of management in its management hierarchy. TLO 1.5 Practice the self management skills for a given situation TLO 1.6 Apply the required managerial skills for a given situation	**Unit - I Introduction to Management** 1.1 Evolution of management thoughts from ancient/medieval to modern times in India (IKS) 1.2 Management: meaning, importance, characteristics, functions & challenges. 1.3 Introduction to scientific management- Taylor's & Fayol's principles of management 1.4 Levels & functions of management at supervisory level. 1.5 Self management skills: Self awareness, self discipline, self motivation, goal setting, time management, decision making, stress management, work life balance and multitasking 1.6 Overview of Managerial Skills: negotiation skills, team management, conflict resolution, feedback, leadership	Presentations Case Study Interactive session Quiz competition Mixed Picture Puzzle

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Identify the appropriate creativity technique for new product development TLO 2.2 Describe the new product development process for a product / service TLO 2.3 Comprehend the importance of various strategic steps Product Management TLO 2.4 Elaborate Agile product management TLO 2.5 Explain the significance of the Project Management TLO 2.6 Describe the various tools of project management	**Unit - II Product, Operations and Project Management** 2.1 Creativity and innovation management: creativity techniques - brainstorming, checklist, reverse brainstorming, morphological analysis, six thinking hats. 2.2 New product development, change management 2.3 Product Management -meaning, strategic steps for sustainable design of a product 2.4 Agile product management- concept, benefits, principles and manifesto 2.5 Project Management: importance, areas within project management,4Ps and phases 2.6 Tools of Project Management: PERT and CPM, GANTT & Chart Overview of Estimate and Budget	Presentations Case Study Video Demonstrations Presentations Role Play
3	TLO 3.1 Understand the importance of quality management tools TLO 3.2 Explain the importance of various techniques for optimization and waste minimization TLO 3.3 State the importance of ISO quality standards TLO 3.4 Describe ERP TLO 3.5 State the importance of ISO TLO 3.6 Recognize the importance of customer satisfaction as a competitive advantage	**Unit - III Management Practices** 3.1 Quality circle, kaizen, Six Sigma, TQM 3.2 5S, Kanban card system, TPM, Lean Manufacturing: Meaning, Steps and Importance 3.3 Quality Standards and ISO: Meaning, ISO 9001:2016, ISO 14000, OSHA 2020 3.4 The overview of ERP along with example 3.5 Service quality and customer/client satisfaction, servicescape	Presentation Case study Interactive session Quiz Video Demonstration Lecture Using Chalk-Board
4	TLO 4.1 Explain the importance of marketing techniques TLO 4.2 Explain the importance of needs, wants and desires in marketing TLO 4.3 Interpret the traditional and digital marketing techniques TLO 4.4 Plan different aspects of an event management	**Unit - IV Marketing Management** 4.1 Marketing management: meaning, significance, Seven P's of Marketing 4.2 Needs, wants and demands in marketing. Customer relationship management 4.3 Types of marketing: traditional and digital marketing 4.4 Event management: types, different aspects of event management, crisis management	Case Study Interactive session based video Role Play Flipped Classroom Presentations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 State the importance of supply chain and logistics management TLO 5.2 Explain the components of supply chain and logistics Management TLO 5.3 Describe the role of information technology in supply chain & logistics management TLO 5.4 State the significance of Human Resource Management TLO 5.5 Analyze the various methods of recruitment, selection and training for an organization TLO 5.6 List the qualities of a successful supervisor	**Unit - V Supply Chain & Human Resource Management** 5.1 The overview of Supply Chain and logistics Management 5.2 Components of Supply Chain and logistics Management 5.3 Role of information technology in supply chain & logistics management 5.4 Overview of Human Resource Management-Meaning,significance,scope and principles 5.5 Recruitment, selection and training of human resources. Chalk Circle 5.6 Qualities of a successful supervisor /team leader and types of leadership	Presentations Video Demonstrations Case Study Collaborative learning Video Demonstrations Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment / Article

- Make a one page note based on a book of management you read.
- Write a short article on inventory management exploring online learning resources.
- Prepare a report on ISO standards applicable to your field. a. IATF 16949-2016 / SLA-TS 16949-2016, - Automotive Industry b. ISO 22000 — Food safety management c. ISO 50001 — Energy management d. ISO/IEC 27001 - Cyber Security e. ISO/DIS 4931-1 - Buildings and civil engineering works
- Prepare a 4 quadrant matrix of time management for managing the tasks.
- Prepare a report on any one software used for Supply Chain and Logistics Management.
- Prepare a GANTT Chart for project management related to your field.

Note Taking

- Watch a Tedx Talk Video on managerial skills and take notes in the form of keywords.

Case Study

- Prepare a case study and discuss the same on following topics a.Self Management Skills b.Six Thinking Hats c.Kaizen d.Quality Circle e.Safety Measures in different organizations related to your field
- Study the recruitment and selection process of any organization related to your field.
- Prepare a case study on management lessons based on life of Chhatrapati Shivaji Maharaj
- Conduct outbound training on managerial skills. Make a video and upload on social media.

Quizes

- Participate in online quizzes related to areas of management .

Assignment

- Workshops to be conducted for students on following topics a. creativity techniques b. time management c. stress management d. negotiation and conflict e. goal setting f. meditation new product development

Micro project

- Write case study on application of Artificial Intelligence in Management Decision-Making

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED : NOT APPLICABLE

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Management	CO1	13	8	6	4	18
2	II	Product, Operations and Project Management	CO2	8	2	4	6	12
3	III	Management Practices	CO3	8	4	4	6	14
4	IV	Marketing Management	CO4	8	2	4	6	12
5	V	Supply Chain & Human Resource Management	CO5	8	4	4	6	14
Grand Total				**45**	**20**	**22**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- MCQ Based Class Test, Self Learning Activities / Assignment

Summative Assessment (Assessment of Learning)

- Summative Assessment (Assessment of Learning) MCQ based

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	1	1	1	-	-	2	3			
CO2	1	3	3	-	1	3	3			
CO3	1	3	1	-	1	1	3			
CO4	1	2	2	-	1	2	3			
CO5	1	1	2	-	1	2	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	A. K. Gupta	Engineering Management	S. Chand, ISBN: 81-219-2812-5, 2007, 2nd Edition
2	O. P. Khanna	Industrial Engineering &management	Dhanpat Rai Publication, ISBN: 978-8189928353, 2018
3	Harold Koontz and Heinz Weinrich	Essentials of Management	Tata McGraw Hill Education ISBN: 9789353168148, 2020, 12th edition
4	E. H. McGrath	Basic Managerial Skills for All	PHI ISBN: 978-8120343146, 2011, 9th Edition
5	Andrew DuBrin	Management Concepts and Cases	Cengage Learning, ISBN: 978-8131510537, 2009, 9th edition
6	K. Dennis Chambers	How Toyota Changed the World	Jaico Books ISBN: 978-81-8495-052-6, 2009
7	Jason D. O'Grandy	How Apple changed the Wolrd	Jaico Publishing House ISBN: 978-81-8495-052-0, 2009
8	Subhash Sharma	Indian Management	New Age International Private Limited ; ISBN-978-9389802412, 2020, 1st edition
9	Chitale, Dubey	Organizational Behaviour Text and Cases	PHI LEARNING PVT. LTD., ISBN: 978-9389347067, 2019, 2nd Edition

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.debonogroup.com/services/core-programs/six-thinking-hats/	Six Thinking Hats
2	https://hbr.org/1981/09/managing-human-resources	HR Management
3	https://theproductmanager.com/topics/agile-product-management/	Agile Product Management
4	https://www.cdlogistics.ca/freight-news/the-5-components-of-supply-chain-management	Supply Chain Management
5	https://www.infosectrain.com/blog/understanding-the-concepts-of-gantt-chart-and-critical-path-methodology-cpm	PERT, CPM, GANTT Chart
6	https://www.simplilearn.com/best-management-tools-article	Management Tools
7	https://www.psychometrica.in/free-online-psychometric-tests.html	Psychometric Tests

Sr.No	Link / Portal	Description
8	https://www.investopedia.com/terms/e/erp.asp	ERP
9	https://asq.org/quality-resources/quality-management-system	QMS
10	https://testlify.com/test-library/creative-thinking/	Psychometric Tests
11	https://www.mindtools.com/	Management Skills
12	https://www.investopedia.com/terms/d/digital-marketing.asp	Digital Marketing

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s	**: Automobile Engineering./ Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Software Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical and Electronics Engineering/ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Manufacturing Technology/ Production Engineering/ Computer Science/ Electronics & Computer Engg./**
Programme Code	**: AE/ AI/ AN/ AO/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ HA/ IE/ IF/ IH/ LE/ ME/ MK/ MRT/ PG/ SE/ TE**
Semester	**: Sixth**
Course Title	**: CAPSTONE PROJECT**
Course Code	**: 316004**

I. RATIONALE

Capstone projects in engineering study are considered important as it allow students to integrate and apply the knowledge and skills acquired throughout their academic program and effectively demonstrating their learning of programme by tackling a real-world problem, ultimately keeping them well prepared for the job market. The capstone project is usually the final assignment and plays a vital role in preparing students for the world of work to its practical applications and ability to help hone students' professional knowledge and skills. Normally, capstone projects are developed in collaboration with industries or businesses, providing students with valuable insights. Capstone projects has been considered as an integral part of diploma curriculum. It helps learners to perform and demonstrate skills gained due to early courses of Diploma study independent. Therefore, this is considered as a course of final year/semester study.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Apply professional skills for solving , executing and demonstrating solutions to real-world problems

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Elaborate the identified field problem from the perspective of project work at institute.
- CO2 - Conduct feasibility & viability analysis (using data collection, experiments, Simulation , Coding) to validate required resources, cost, support of the project work.
- CO3 - Apply the acquired knowledge and skills in providing solutions to the real field/industrial problems.
- CO4 - Present Project and its output/ findings / achievements alongwith its exhibits.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316004	CAPSTONE PROJECT	CPE	INP	-	-	2	2	4	2	-	-	-	-	-	50	20	50#	20	50	20	150

V. General guidelines for PROJECT WORK

- The Project- problems must be related to the programme or may be interdisciplinary, based on the industry expected outcomes.
- The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work they would like to execute.
- Project titles are to be finalized in co-ordination/consultation with the Faculty mentor. However, faculty may form a team of students as per specific roles- Literature survey/data collection, data Analysts, model/prototype developers, testers, Project managers using IoTs ITES and software /application development. Study type project is NOT advisable.
- Project must be assigned to a group of 3-4 students under the guidance of identified faculty mentor.
- Students are required to prepare a prototype/working model/software of the Project and simultaneously prepare a report.
- Students shall Submit One Hard copy and one Soft copy each of Project Report and soft-copy of the project code or the working model.
- Students must maintain a project execution diary having the progress steps and details. The concerned faculty should check the diary on a weekly basis and accordingly interact with students based on the progress shown and keep proper record with feedback if any.
- Project shall address National Thrust area such as Environment, Digitization, Automation, sustainability and similar domains.
- Student shall try to use the national and international standards wherever possible (processes / materials / equipments etc ..)
- For Software projects (particularly Computer and allied programmes), The project groups are advised to submit the progress report on a weekly basis on GitHub with date, activity completed, milestone achieved, Git Commit Id/Version No. The faculty remarks also shall be added .

VI. Project facilitation guidelines:

Once the Project statement has been finalized and allotted to the students, the Faculty Mentor role is very important as guide, motivator, catalyser to promote learning and sustain the interest of the students. At the same time the Faculty Mentor is not expected to guide the students on each step, otherwise it will curb the creativity of the students-group. The Faculty Mentor has to work as a mentor. Following should be kept in mind while facilitating the project at the institute:

1.Project orientation cum -briefing: the project should be relevant to the curriculum of the programme. The project shall be cost effective taking safety aspects, ethical issues, environmental issues and confidentiality as per expectation of industry(if any) into consideration, The work may be industry Sponsored.

2.Information search and data collection: the information and data should be realistic and relevant to the problem /project. Hypothetical data is not to be taken into consideration.

3.Implementation and Monitoring: The project must have important steps /milestones to achieve as per the time frame/action plan prepared by students and faculty. The monitoring mechanism such as daily/weekly dairy (**Format given below)** must be clearly explained and delineated for the students.

VII.Criteria of Assessment /Evaluation of Project work

A. Formative Assessment (FA) criteria

The **Formative Assessment** (FA) of the students for 50 marks is to be done based on following criteria.

Appropriate RUBRICS may be used for assessment

Rubrics for Assessment of the team

Sr.No.	Criteria	Marks
1	Project Selection & Problem definition	05
2	Literature survey and data collection/ Gathering	05
3	Design / concept of project/ Working - Execution of Project	10
4	Stage wise progress as per Action plan/milestone	05
5	Quality Report Writing	05

Rubrics for Individual Assessment

Sr.No.	Criteria	Marks
1	Contribution as a team member	05
2	Depth of Knowledge	10
3	Presentation	05

B. Summative Assessment Criteria

- The summative assessment for 50 marks is to be done and based on following criteria. This assessment shall be done by the faculty mentor and External examiner.

Sr.No.	Criteria	Marks
1	Capstone Project Completion as per plan	10
2	Project related Requirement Analysis & Designing	10
3	Developing a Solution with proper justifications, Teamwork	10
4	Project Report Writing	10
5	Project Presentation	10

(**NOTE :** Team based and Individual performance based summative assessment may include Innovativeness , Technology used , user friendliness , cost effectiveness , society benefits etc..)

SUGGESTED RUBRIC FOR SUMMATIVE ASSESSMENT OF CAPSTONE PROJECT

PROJECT ASSESSMENT				
Project Title:				
Project Assessment Rubric				
Performance	**Excellent**	**Good**	**Fair**	**Poor**
Criteria	**9-10 marks.**	**6-8 marks.**	**4-5 marks.**	**0-3 marks**

	Excellent	Good	Fair	Poor
Capstone Project Completion	**The project is completed as per tasks described in synopsis.**	**The project is completed but require minor modifications.**	**The project is completed but require several modifications.**	**The project is not completed as per tasks described in synopsis.**
Project related Requirement Analysis & Designing	**9-10 marks.**	**6-8 marks.**	**4-5 marks.**	**0-3 marks**
	Effectively contributed in requirement analysis and designing.	**Partially Contributed in requirement analysis and designing.**	**Attempted to contribute in requirement analysis and designing**	**No contribution in requirement analysis and designing.**
Developing a Solution with proper justifications , Teamwork	**9-10 marks.**	**6-8 marks.**	**4-5 marks.**	**0-3 marks**
	Developed the critical solution modules with Innovation, optimized design and worked very well with the team.	**Developed some solutions with higher complexity and worked well with the team.**	**Attempted to develop few solutions and worked with the team.**	**No contribution in developing a solution and in the team.**
Project Report Writing	**9-10 marks.**	**6-8 marks.**	**4-5 marks.**	**0-3 marks**
	Worked very well to submit an excellent project report .	**Worked well to submit the project report with covering all the aspects of a standard report.**	**Tried to submit the project report but standard of report was not satisfactory.**	**No contribution in project report writing.**
Project Presentation	**9-10 marks.**	**6-8 marks.**	**4-5 marks.**	**0-3 marks**
	Presented the project work flawlessly.	**Presented the project work very nice.**	**Presented the project work not so well.**	**Presentation skill is not up to the mark.**
Project Group Members				
ROLL NUMBER/Enrollment Number				
NAME				
Comments (if any)				

NOTE : " These are suggestive rubrics Faculty mentor and external examiner may frame different rubrics as per Programme need and assigned Project work "

C. Self Learning Assessment

Self Learning Assessment **Max Marks -50**

Sr.No.	Criteria	Max Marks	Marks Obtained
1	Project Selection & Problem definition	10	
2	Literature survey and data collection/ Gathering	05	

3	Design / concept of project/ Working - Execution of Project	15	
4	Stage wise progress as per Action plan/milestone/ psychomotor motor skills acquired	10	
5	Quality Report Writing	10	

VIII. CO-PO Mapping

CO-PO mapping will vary project wise and shall be prepared by concerned faculty for the given project

IX. Typographical instructions/guidelines for Project report writing

Following is the suggestive format for preparing the Project report. Actual report may differ slightly depending upon the nature of industry. The training report may contain the following.

a. The PROJECT report shall be computer typed (English- British) and printed on A4 size paper.
b. Text Font -Times New Roman (TNR), Size-12 point
c. Subsection heading TNR- 12 point bold normal
d. Section heading TNR- 12 capital bold
e. Chapter Name/ Topic Name – TNR- 14 Capital
f. All text should be justified. (Settings in the Paragraph)
g. The report must be typed on one side only with double space with a margin 3.5 cm on the left, 2.5 cm on the top, and 1.25 cm on the right and at bottom.
h. The training report must be hardbound/ Spiralbound with cover page in black colour. The name of the candidate, diploma (department), year of submission, name of the institute shall be printed on the cover [Refer sample sheet (outer cover)]
i. The training report, the title page [Refer sample sheet (inner cover)] should be given first then the Certificate followed by the acknowledgment and then contents with page numbers.

X. Project Report

On completion of the project work, every student will submit a project report which should contain the following:
1. Cover Page (as per annexure 1)
2. Title page (as per annexure 2)
3. Certificate by the Guide (as per annexure 3)
4. Acknowledgment (The candidate may thank all those who helped in the execution of the project.)
5. Abstract (It should be in one page and include the purpose of the study; the methodology used.)
6. Table of Contents (as per general guidelines): Detailed description of the project (This should be split in various chapters/sections with each chapter/section describing a project activity in totality).

Chapter–1 Introduction (background of the Industry or User based Problem/Task)
Chapter–2 Literature Survey (to finalize and define the Problem Statement)
Chapter–3 Scope of the project
Chapter–4 Methodology/Approach, if any
Chapter-5 Details of designs, working and processes
Chapter-6 Results and Applications

7. Conclusion
8. References (The listing of references should be typed 2 spaces below the heading “REFERENCES” in alphabetical order in single spacing left – justified. It should be numbered consecutively (in square [ ] brackets, throughout the text and should be collected together in the reference list at the end of the report. The references should be numbered in the order they are used in the text. The name of the author/authors should be immediately followed by the year and other details). Typical examples of the references are given below:

NOTE:
1.Project report must contain only a relevant and short mention – technology or platform or tools used. It

must be more focussed on project work and its implementation

2.Students can add/remove/edit chapter names as per the discussion with their guide

Formats

Project Report

"Project Title----------"

as a partial fulfilment of requirement of the

THIRD YEAR DIPLOMA IN

Submitted by

1)Name Of Student Enrollment Number

2)Name Of Student Enrollment Number

3)Name Of Student Enrollment Number

4)Name Of Student Enrollment Number

Are the bonafide on

FOR THE ACADEMIC YEAR

20-----20---

(H.O.D)

(Principal)

(Internal Guide) **(External Examiner)**

Department Name

(If NBA Accredited mention that)

Institute Name

(An Affiliated Institute of Maharashtra State Board of Technical Education)

Table of Contents

	Title Page	i
	Certificate of the Guide	ii
	Acknowledgement	iii
	Index	iv
	Abstract	v
	List of Figures	vi
	List of Tables (optional)	vii

INDEX

Sr.No.	**Chapter**	**Page No.**
1.	Chapter–1 Introduction (background of the Project Problem)	**1**
2.	Chapter–2 Literature Survey (to finalize and define the Problem Statement)	**5**
3.	Chapter–3 Scope of the project	
4	Chapter–4 Methodology/Approach, if any	
5	Chapter-5 Details of designs, working and processes	
6.	Chapter-6 Results and Applications	
7.	REFERENCES	

Note:

***Students can add/remove/edit chapter names as per the discussion with their guide**

Annexure

PROJECT DIARY (Weekly/Daily)

Name of the Student : _____

Name of Guide (Faculty) : _____

Enrollment Number : _____ Semester: _____Project batch Number : _____

WEEK : _____

Date	Activity carried out (Details)	Achievement of mile stone/step as per plan	Remark of Faculty
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			
Saturday			

Dated Signature of Faculty **Dated Signature of HOD**

MSBTE LOGO INST LOGO

Certificate

This is to certify that

Mr./Ms. *bearing examination seat No.* *has*

Satisfactorily completed his/her ***PROJECT*** *entitled*

Along with his/her batchmates in partial fulfillm ent for the

Diploma Course in

< PROGRAMME NAME>

Of the ***Maharashtra State Board of Technical Education*** *at our Polytechnic during the Academic Year20 -20 .*

The Project is completed by a group consisting of Persons under the guidance of the Faculty Guide

Faculty Name and Signature (Internal)	**Faculty Name and Signature (External if applicable)**	**HOD Name and Signature with Department Stamp**
Date and Time		

CLIENT SIDE SCRIPTING **Course Code : 316005**

Programme Name/s	**: Computer Technology/ Computer Engineering/ Computer Software Technology/ Computer Science & Engineering/ Information Technology/ Computer Science & Information Technology/ Computer Science**
Programme Code	**: CM/ CO/ CST/ CW/ IF/ IH/ SE**
Semester	**: Sixth**
Course Title	**: CLIENT SIDE SCRIPTING**
Course Code	**: 316005**

I. RATIONALE

Client-side scripting plays a fundamental role in modern web development by enhancing user interactions and improving the overall experience of websites and applications. Web developers utilize it extensively to accomplish tasks like creating dynamic webpages, reacting to events, making interactive forms, verifying information entered by visitors, managing the browser, and more. Using these characteristics, this course assists students in creating highly dynamic web pages.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified outcomes through various teaching learning experiences :
Develop web application using JavaScript (ES6+) and React Framework.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Develop web page using client side scripting technology.
- CO2 - Design dynamic web pages using JavaScript (ES6+)
- CO3 - Implement the built-in functions and objects in JavaScript (ES6+)
- CO4 - Develop web application using React.
- CO5 - Apply event handling in React Framework.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316005	CLIENT SIDE SCRIPTING	CSS	AEC	2	-	4	-	6	3	-	-	-	-	-	25	10	25@	10	-	-	50

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain purpose of scripting language. TLO 1.2 Differentiate between static and dynamic web pages. TLO 1.3 Describe the evolution of scripting technologies. TLO 1.4 Illustrate the AJAX architecture. TLO 1.5 Create JSON objects for accessing data in JavaScript program. TLO 1.6 Explain feature of Django and Flask framework.	**Unit - I Fundamental of Client Side Scripting** 1.1 Introduction to the Scripting: Basic web architecture, Role of the client and server, Static vs. dynamic web pages 1.2 History of Scripting Technologies: HTML as a foundation, Early use of inline scripting, Limitations of static HTML, JavaScript 1.3 Introduction to AJAX : AJAX Architecture, Actions 1.4 Basics of JSON: Objects, Scheme 1.5 Webpage with Python: Django and Flask framework	Lecture Using Chalk-Board Presentations Hands-on
2	TLO 2.1 Describe the MVC Architecture. TLO 2.2 State structure of the given JavaScript (ES6+) web page. TLO 2.3 Describe the function of different controls to be used in web form. TLO 2.4 Implement the filters and directives in given page. TLO 2.5 Write JavaScript (ES6+) program to handle the web page events.	**Unit - II JavaScript (ES6+) Basics** 2.1 Introduction to JavaScript (ES6+), : JavaScript (ES6+) Extends HTML, Expressions, MVC Architecture, Application in JavaScript (ES6+) , Variables Scope 2.2 JavaScript (ES6+) Forms: FORM tag, Form fields: Single line text field, password field, multiple line text area, radio buttons, and check boxes. Pull down menus: SELECT and OPTION tags. Buttons: submit, reset and generalized buttons, Form Validation 2.3 JavaScript (ES6+) Data Binding :Two-way Binding and ng-model directive 2.4 Filters: Built-In Filters, Custom Filter, Chaining Multiple Filters 2.5 JavaScript (ES6+) Events: ng-mousedown, ng-mouseup, ng-click	Lecture Using Chalk-Board Presentations Hands-on

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Identify the table attributes to organize data in web page. TLO 3.2 Write CSS code for applying type of formatting in web page. TLO 3.3 Describe the use of controllers and its method. TLO 3.4 Write JavaScript (ES6+) program using filters. TLO 3.5 Write JavaScript (ES6+) program to show use of external files in controller.	**Unit - III Working with JavaScript (ES6+)** 3.1 JavaScript (ES6+) Tables: Display Data in a Table, Adding style to the Table data, orderBy Filter, uppercase Filter, Table Index, using $even and $odd 3.2 JavaScript (ES6+) Controllers: Initializing the Model with Controllers, Role of a Controller, Controllers & Modules, Controller Business Logic, Presentation Logic and Formatting Data 3.3 Attaching Properties and functions to scope 3.4 Nested Controllers, Using Filters in Controllers 3.5 Controllers in External Files	Lecture Using Chalk-Board Presentations Hands-on
4	TLO 4.1 State the features of React. TLO 4.2 Describe the life cycle of React. TLO 4.3 Explain the use of different components in a form. TLO 4.4 Implement the state of React Hooks.	**Unit - IV Introduction of React Framework** 4.1 Introduction to React Framework, features, architecture & Form 4.2 Components: Functional components, Class components, Passing and using props 4.3 Lifecycle – Mounting, Updating and Unmounting 4.4 React Hooks – useState,useEffect, useContext	Lecture Using Chalk-Board Presentations Hands-on
5	TLO 5.1 Write JavaScript to design a form to accept input values using React. TLO 5.2 Write event driven program for the given problem using React. TLO 5.3 Explain the use of list and keys in web pages. TLO 5.4 Write CSS for React application.	**Unit - V Working with React Framework** 5.1 Event handling, Binding event handlers, Arrow functions vs. regular functions 5.2 Working with Forms - Adding components, Handling form, Submitting Forms, Form validation 5.3 Lists and Keys - Rendering Lists, List with Key, Using map() to render lists of elements 5.4 Cascading Style Sheets- Different types of Style Sheets, Styling Libraries, Popular CSS frameworks (e.g., Bootstrap, Material-UI)	Lecture Using Chalk-Board Presentations Hands-on

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Create web page using structure tags to display sample message.	1	* Write a program to display " Hello World " using: • Console.log() • document.write( ) • alert ()	2	CO1
LLO 2.1 Create Python script to display sample message.	2	Write a program to display "Welcome " using Python script	2	CO1
LLO 3.1 Write programs a JSON Object with properties and access the object using JSON.	3	Create objects for the given problem with JSON	4	CO1

CLIENT SIDE SCRIPTING **Course Code : 316005**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Install JavaScript (ES6+) software application.	4	1. Setup JavaScript (ES6+) development environment using: • Installation of Node.js and npm • Installation of JavaScript (ES6+) 2. Write a program to display "Good Morning " Message on web page	2	CO2
LLO 5.1 Use forms controls.	5	* Write JavaScript (ES6+) program to design form using various controls and apply validations on input	4	CO2
LLO 6.1 Implement data binding in JavaScript (ES6+)	6	* Write a program to display data model view and display data for given problem	2	CO2
LLO 7.1 Implement data binding synchronization between the model and the view.	7	Write a program to display two - way data binding	2	CO2
LLO 8.1 Use filters in JavaScript (ES6+)	8	*Write a program to implement different filters in JavaScript (ES6+)	2	CO2
LLO 9.1 Implement various keys and mouse events.	9	* Write a program to implement different events in JavaScript (ES6+)	2	CO2
LLO 10.1 Create a web page to implement table.	10	Write a program displaying data in a table	2	CO3
LLO 11.1 Implement table operation using filters.	11	* Write a program to implement CSS to table data-odd and even rows	2	CO3
LLO 12.1 Develop JavaScript (ES6+) applications using controllers.	12	* Write programs for implementation of different methods of JavaScript (ES6+) Controllers	2	CO3
LLO 13.1 Use concept of controllers external files.	13	* Write programs to demonstrate use of controllers in external files	4	CO3
LLO 14.1 Execute after writing program to handle data using React form.	14	* Write a program to handle data using React form	2	CO4
LLO 15.1 Execute after writing program passing function argument into React component.	15	Write a program to pass function argument into React component	2	CO4
LLO 16.1 Implement the concept of React life cycle.	16	*Write a program to pass function argument into React program and implemnt the life cycle of React	2	CO4
LLO 17.1 Implement states of React Hooks.	17	* Write a program to implement states of React Hooks	4	CO4
LLO 18.1 Use React components to design real time form.	18	Write a program to design real time form using react components	4	CO5
LLO 19.1 Apply validations for React form.	19	Write a program to apply validations for React form	4	CO5
LLO 20.1 Use concept of List using React.	20	* Write a program to manipulate List using key and without key in React	2	CO5
LLO 21.1 Create a page to use map function in React.	21	Write a program to render a list using map function in React	2	CO5

CLIENT SIDE SCRIPTING **Course Code : 316005**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 22.1 Implement different approaches for styling a React web page.	22	* Write a program to apply following approaches of css to a React web page • Inline styling • CSS stylesheets • CSS Modules	2	CO5
LLO 23.1 Carry out a microproject on the given problem statement.	23	* The microproject has to be web based real time application suggested by teacher such as : • Develop a web "Chat Application" having Chat window with send and recive the text,image etc. • Develop a web "Music Player application" where user can get the Album with signer and play the music.	4	CO2 CO3 CO4 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer system with all necessary peripherals and internet connectivity Node.js and npm JavaScript (ES6+) OR Visual Studio Code IDE	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamental of Client Side Scripting	CO1	5	0	0	0	0
2	II	JavaScript (ES6+) Basics	CO2	6	0	0	0	0
3	III	Working with JavaScript (ES6+)	CO3	6	0	0	0	0
4	IV	Introduction of React Framework	CO4	6	0	0	0	0
5	V	Working with React Framework	CO5	7	0	0	0	0
Grand Total				**30**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Continous assessment based on process and product related performance indicators.Each practical will be assessed considering-

-60% weightage to process
-40% weightage to product

Summative Assessment (Assessment of Learning)

- End Semester Examination (Lab. performance),Viva-voce

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	1	-	1	1	-	-	1			
CO2	2	2	2	2	1	-	1			
CO3	2	2	3	3	2	-	1			
CO4	2	2	2	3	2	-	1			
CO5	2	2	3	3	2	-	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Thomas A. Powell	HTML & CSS: The Complete Reference	McGraw Hill Education; 5th edition (1 July 2017), ISBN-13 : 978-0070701946
2	Valeri Karpov, Diego Netto	Professional AngularJS (WROX)	Wiley (1 January 2015), ISBN-13 : 978-8126556434
3	Brad Green, Shyam Seshadri	AngularJS: Less Code, More Fun, And Enhanced Productivity With Structured Web Apps (Greyscale Indian Edition)	Shroff/O'Reilly; First Edition (1 January 2013), ISBN-13 : 978-9351101260
4	Mayur Patil	React.js For Beginners	Notion Press (11 January 2023), ISBN-13 : 979-8889355106
5	Alex Banks	Learning React: Modern Patterns for Developing React Apps	Shroff/O'Reilly; Second edition (16 July 2020), ISBN-13 : 978-9385889158

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.tutorialspoint.com/angular/index.htm	Designing web page using AngularJS. (All contents)
2	https://www.w3schools.com/angular/	AngularJS Tutorial for beginners
3	https://www.w3schools.com/REACT/DEFAULT.ASP	React Tutorial for beginners
4	https://www.tutorialspoint.com/reactjs/index.htm	Designing web page using React.(All contents)
5	https://javascript.info/	The Modern JavaScript Tutorial

CLIENT SIDE SCRIPTING **Course Code : 316005**

Sr.No	Link / Portal	Description
6	https://www.javascripttutorial.net/react-tutorial/	Providing React,AngularJS and Javascript contents.
7	https://www.youtube.com/watch?v=NSWzs-Jt65w	Angular JS for Beginners

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Software Technology/ Computer Science & Engineering/ Data Sciences/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science/**
Programme Code	**: AI/ AN/ BD/ CM/ CO/ CST/ CW/ DS/ HA/ IF/ IH/ SE**
Semester	**: Sixth**
Course Title	**: MOBILE APPLICATION DEVELOPMENT**
Course Code	**: 316006**

I. RATIONALE

Android OS is one of the fastest growing environments which are widely used by smartphones, smart T.V, tablets and other equipments. Mobile Application Development course helps to design and covers the concepts which are required to understand and develop Android based applications.After completing this course students will be able to design, build and publish real-time Android applications.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following Industry Identified Outcomes through various teaching learning experiences:
• Build real-time Android applications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Interpret the features of android operating system.
- CO2 - Use after configuring Android development environment.
- CO3 - Develop android applications using UI components and layouts.
- CO4 - Create database driven Android applications.
- CO5 - Develop advanced Android applications that requires relevant permissions for security.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme												
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316006	MOBILE APPLICATION DEVELOPMENT	MAD	DSC	2	-	4	2	8	4	-	-	-	-	-	25	10	25#	10	25	10	75

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Differentiate between Android and other operating systems. TLO 1.2 Enlist Android OS features. TLO 1.3 Explain android architecture. TLO 1.4 Identify IDEs for Android Application development. TLO 1.5 Explain React Native Framework	**Unit - I Basics of Android OS** 1.1 Introduction to Android Operating System 1.2 Need and features of Android 1.3 Android Architecture Framework 1.4 Introduction to Android Application Development IDE (Android Studio, Eclipse, Visual Studio with Xamarin etc.) 1.5 Introduction to React Native Framework: Need and features of React Native, Cross-platform mobile application development concepts React Native Development Environment, Visual Studio Code, Node.js, Android Emulator/Physical Device Setup React Native vs Native Android Development, Advantages, limitations, and use cases	Lecture Using Chalk-Board Hands-on
2	TLO 2.1 Explain JDK and SDK for developing Mobile application. TLO 2.2 Explain different Android tools. TLO 2.3 Distinguish between DVM and JVM. TLO 2.4 Explain various Android terminologies. TLO 2.5 Explain relevant analogy of Android directory structure.	**Unit - II Introduction to Android Environment** 2.1 Use of Java JDK and introduction to Android SDK 2.2 Different Android tools like Android Development Tools (ADT), Android Virtual Devices (AVD) and emulators 2.3 Dalvik Virtual Machine (DVM) , difference between DVM and JVM 2.4 Terminologies in Android : Android Run Time (ART), Over the Air (OTA), Firmware Over The Air (FOTA), Global Positioning System (GPS) , Google Cloud Messaging (GCM) 2.5 Android directory structure	Hands-on Demonstration

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Describe to develop user interface for the given Android application. TLO 3.2 List steps to implement different layouts. TLO 3.3 Explain the process of developing Android application using given Android views. TLO 3.4 Write the steps to design Splash screen.	**Unit - III Design UI in Android** 3.1 GUI components like : Text View, Edit Text, Button, types of buttons like image button , toggle button, Checkbox, Radiobutton, Radiobutton Group, Progress bar, Scrollbars, List, Custom Toast Alert message etc. 3.2 Introduction to Layouts and types of Layouts : Constraint layout, Linear Layout, Frame Layout, Relative Layout etc. 3.3 Introduction to views and its types : List view, Grid view, Image view, Scroll view 3.4 Basics of splash screen , adding styles to splash screen	Demonstration Hands-on
4	TLO 4.1 Explain the use of given components for Android application development. TLO 4.2 Explain the use of different life cycle methods to develop Android Application. TLO 4.3 Write the steps to establish database connectivity to fire queries for performing the given database management operations.	**Unit - IV Android Components and Database Connectivity** 4.1 Major components in Android : Intent, Activity, Services, Broadcast Receiver 4.2 Life cycle of Android components like Activity, Broadcast Receiver, Services etc. 4.3 SQLite/Firebase database, necessity of SQLite/Firebase, creation and connection of the database, extracting data from the databases	Lecture Using Chalk-Board Presentations
5	TLO 5.1 Write the stpes to implement various advanced android concepts to develop an application. TLO 5.2 Explain the process to apply security services in android application development. TLO 5.3 Write steps to publish the given android application.	**Unit - V Android Application Deployment** 5.1 Advanced Concepts : Fragments,Location based services, SMS telephony, Audio capture, Camera, Bluetooth etc. 5.2 Security Concepts : Android security model, declaring and using permissions, using custom permission 5.3 Application Deployment : Process for creating and deploying Android applications on Google Play store, become a publisher	Presentations Lecture Using Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Install any Android IDE . LLO 1.2 Install and configure the React Native development environment. Create a basic mobile application to understand the structure and workflow of a React Native project.	1	* a. Install Android IDE and create Android virtual device b. Install and Configure React Native Development Environment	2	CO1
LLO 2.1 Use IDE to wirte and exceute Java program for Android application.	2	Develop a program to display “Hello World” on screen	2	CO2
LLO 3.1 Change the attributes in the directory structure.	3	*Explore the directory structure in Android IDE	2	CO2
LLO 4.1 Develop a program to implement Auto complete Text View and Edit Text.	4	* Develop android application using View Text and Edit Text.	2	CO3

MOBILE APPLICATION DEVELOPMENT **Course Code : 316006**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 5.1 Use different types of buttons in Android application.	5	*Develop a program to implement Button, Image Button and Toggle Button	2	CO3
LLO 6.1 Write a program to demonstrate the use of Checkbox and Radiobutton.	6	*Develop a program to design Checkbox and Radiobutton.	2	CO3
LLO 7.1 Implement progress Bar in android application.	7	Develop a program to implement Progress Bar	2	CO3
LLO 8.1 Create a login form using various UI components.	8	*Develop a program to create a login form using the above UI controls	2	CO3
LLO 9.1 Build android application using Linear and Constraint Layouts.	9	* Write program to implement Linear layout and Constraint layout to create any registration form with Custom Toast Alert	2	CO3
LLO 10.1 Develop android application using Frame, Table and Relative Layout.	10	Develop a program to implement Frame layout, Table layout and Relative layout for any e-commerce application	2	CO3
LLO 11.1 Create Android application to implement different types of views.	11	*Develop a program to implement Grid View, Image View, Scroll View, List View for any management system like library management/hotel management	2	CO3
LLO 12.1 Create an application to implement grid layout.	12	Develop a simple calculator which uses grid layout and GUI concepts	2	CO3
LLO 13.1 Write program to develop relevant GUI for given application.	13	* Develop a splash screen in android	2	CO3
LLO 14.1 Design a convertor application.	14	*Design and develop any convertor application like temperature convertor /currency convertor/ volume convertor	2	CO3
LLO 15.1 Implement a timer application.	15	Design and develop a simple countdown timer	2	CO3
LLO 16.1 Construct a date picker in application.	16	*Develop a program to implement Date Picker in application	2	CO3
LLO 17.1 Construct a time picker in application.	17	Develop a program to implement Time Picker in application	2	CO3
LLO 18.1 Create android activities.	18	Develop a program to create two simple activities for Login application	2	CO3
LLO 19.1 Implement intents in android application development.	19	*Develop a program to implement new Activity using explicit intent and implicit intent to open any other website	2	CO4
LLO 20.1 Implement android services to develop android applications.	20	*Develop a program to implement services like bluetooth/wifi	2	CO4
LLO 21.1 Implement the concept of broadcast receiver to develop and android application.	21	*Develop a program to implement a broadcast receiver to switch between different modes like Airplane mode/Silent Mode/Loud Mode	2	CO4
LLO 22.1 Implement the database operations with android front end.	22	*Develop a registration application to insert and retrieve the data from the database	2	CO4
LLO 23.1 Create an Android application for user authentication .	23	Develop an authentication application which uses database concepts	2	CO4
LLO 24.1 Develop an application which uses database.	24	Develop a MyContacts application which uses database concepts	2	CO4
LLO 25.1 Create Android application that uses camera with permissions.	25	Develop a program to use camera	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 26.1 Create application to Send and Receive SMS.	26	* Write a program for SMS application	2	CO5
LLO 27.1 Implement an email application.	27	*Develop a program to send and receive email	2	CO5
LLO 28.1 Develop GPS application.	28	Write a program that uses location services and checks for permissions	2	CO5
LLO 29.1 Build an Navigation drawer application.	29	*Write a program that creates Navigation drawer using fragment concepts	2	CO5
LLO 30.1 Build an torch application.	30	Write a program to create a simple flashlight app and check for permissions	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- The micro project has to be industry based, internet based ,laboratory based or field based as suggested by teacher.

a) Simple chatting application - A real-time chat application is a software application that enables users to exchange messages and communicate with each other in real-time.
b) Class time-table application - It helps to keep track of your classes but also allows you to add events to your weekly schedule.

Other

- Complete course of Android App Development on NPTEL

• Complete course of Android Development Courses on Spoken Tutorial

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Any compatible open source Android IDE (like - Android Studio, Eclipse,Visual Studio with Xamarin with SQLite / Firebase database compatibility)	All
2	Computer System (Computer system with i3 and above processors which is available in the laboratory with minimum 8GB RAM)	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basics of Android OS	CO1	2	0	0	0	0
2	II	Introduction to Android Environment	CO2	2	0	0	0	0
3	III	Design UI in Android	CO3	6	0	0	0	0
4	IV	Android Components and Database Connectivity	CO4	10	0	0	0	0
5	V	Android Application Deployment	CO5	10	0	0	0	0
Grand Total				**30**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Continuous Assessment based on Process and Product related Performance Indicators. Each Practical will be assessed considering:

60% weightage is to Process.
40% weightage is to Product.

Summative Assessment (Assessment of Learning)

- Laboratory Performance, Viva Voce

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	-	-	1	-	-	-			
CO2	2	1	-	3	-	-	1			
CO3	3	2	3	2	1	2	2			
CO4	2	2	2	2	1	3	1			
CO5	2	3	3	2	1	3	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Dixit, Prasanna Kumar	Android	Vikas Publication, New Delhi 2014, ISBN : 9789325977884
2	Maclean David , Komatineni Satya, Allen Grant	Pro Android 5	Apress Publications, 2015, ISBN :978-1-4302-4680-0

Sr.No	Author	Title	Publisher with ISBN Number
3	Hortan, John	Android Programming for Beginners	Packet Publications, 2015, ISBN : 978-1-78588-326-2
4	Pradeep Kothari	Android Application Development	Kogent Learning Solutions ISBN : 9789351194095

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.udemy.com/topic/android-development	Introduction to Android Operating system
2	https://onlinecourses.swayam2.ac.in/nou21_ge41/preview	Introduction to Android IDE tools.
3	https://www.geeksforgeeks.org/android-tutorial/	Basics of GUI components, layouts and views in android.
4	https://www.tutorialspoint.com/android/index.htm	Advanced components of android like intents, services, broadcast recevier and activities.
5	https://developer.android.com/training/data-storage/sqlite	Steps to insert and reteive data from the Databases.
6	https://developer.android.com/guide/topics/permissions/overview	Setting permissions in Android.
7	https://firebase.google.com/docs/database/android/start	Connectivity with Firebase database

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

EMERGING TRENDS IN COMPUTER ENGINEERING AND INFORMATION TECHNOLOGY

Course Code : 316313

Programme Name/s	**: Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Software Technology/ Computer Science & Engineering/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science**
Programme Code	**: BD/ CM/ CO/ CST/ CW/ HA/ IF/ IH/ SE**
Semester	**: Sixth**
Course Title	**: EMERGING TRENDS IN COMPUTER ENGINEERING AND INFORMATION TECHNOLOGY**
Course Code	**: 316313**

I. RATIONALE

Emerging trends in Computer Engineering and Information Technology are driven by the need for efficiency, security and automation. Technologies like AI, cloud computing, IoT, and blockchain enhance productivity and connectivity. Digital forensics is essential for investigating cybercrimes, while green computing promotes sustainability. This course creates awareness in students regarding emerging trends in the area of Computer Engineering and Information Technology.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain following Industry Identified Outcome through various Teaching Learning experiences : Create awareness of latest trends in Computer Engineering and Information Technology.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Elaborate the role of Artificial Intelligence ,Machine Learning and Deep Learning in various domains.
- CO2 - Compare the architecture of IoT in Local environment vs Cloud Environment.
- CO3 - Explain the functioning of Blockchain Technology in various applications considering different challenges.
- CO4 - Explain characteristics of different Immersive Technologies.
- CO5 - Identify the appropriate Model of Digital Forensic Investigation for given situation.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316313	EMERGING TRENDS IN COMPUTER ENGINEERING AND INFORMATION TECHNOLOGY	ETI	DSC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the concept of Al. TLO 1.2 List applications of Al. TLO 1.3 Define Machine Learning. TLO 1.4 Describe characteristics of different types of Machine learning. TLO 1.5 Describe the concept of Deep learning. TLO 1.6 Describe importance of Neural Network. TLO 1.7 Differentiate the concepts of AI, ML ad DL. TLO 1.8 Explain the function of different key components of Generative AI. TLO 1.9 Describe the role of AI & ML to improve the effectiveness of security mechanisms.	**Unit - I Introduction of AI and ML** 1.1 Introduction of AI :Concept ,Scope of Al, Types of AI, Applications of AI 1.2 Machine Learning: Concept, Types: Supervised, Unsupervised, Reinforcement, Applications of Machine Learning, Concept of Deep Learning, Applications of Deep Learning ,Concept of Neural Network, Difference between AI, ML and DL 1.3 Generative AI: Concept ,Transformers: Key components of Transformers: Self-attention mechanism, Multi-head attention, Positional encoding, Feed forward Neural Network, Layer Normalization, Encoder Decoder Structure, Types of Generative AI: Text Generation, Image Generation, Music and Audio Generation, Video Generation ,Applications of Generative AI 1.4 AI & ML in Digital security :Types of attacks : AI Powered cyber attack, Adversarial AI attacks, Evasion AI Attack, AI poisoning attack, AI powered attacks protection measures: Turn on Multi-Factor Authentication, Use Super Strong Password, Update Everything, Secure your Network, Use your mobile Device Securely	Presentations Case Study Lecture Using Chalk-Board Video Demonstrations

EMERGING TRENDS IN COMPUTER ENGINEERING AND INFORMATION TECHNOLOGY

Course Code : 316313

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Describe the concept of IoT. TLO 2.2 Write features and applications of IoT. TLO 2.3 List the advantages and Limitations of IoT. TLO 2.4 Explain the architecture of IoT in local environment. TLO 2.5 Describe the function of Sensors and actuators used in IoT. TLO 2.6 Explain NGN Architecture. TLO 2.7 Explain the architecture of cloud based IoT.	**Unit - II Internet of Things** 2.1 Introduction of Internet of Things (loT): Definition, Characteristics of loT, Features and Application of loT, Advantages and limitations of IoT 2.2 Design of loT: Physical design of IoT, Logical design of loT, Architecture of Internet of Things (IoT) 2.3 Sensors and actuators used in IoT 2.4 5G Network in IOT communication: 5-G characteristics and application areas, Next Generation Network: Architecture, Features, Functional block diagram, Network components: Media Gateway, Media Gateway Controller and Application Server 2.5 IoT and Cloud Computing: Architecture of Cloud based IoT	Presentations Lecture Using Chalk-Board Flipped Classroom
3	TLO 3.1 Explain the key features of Blockchain Technology. TLO 3.2 Describe Blockchain Architecture. TLO 3.3 Differentiate different types of Blockchain. TLO 3.4 List the Blockchain Applications. TLO 3.5 State the role of Smart Contracts & Cryptocurrencies. TLO 3.6 State the different challenges in Blockchain Technology.	**Unit - III Blockchain Technology** 3.1 Basics of Blockchain Technology-Definition, Key Features of Blockchain (Decentralization, Transparency, Immutability),Traditional vs Blockchain System 3.2 Blockchain Architecture 3.3 Types of Blockchain- Public Blockchain, Private Blockchain, Consortium Blockchain and Hybrid Blockchain 3.4 Blockchain Applications- Finance, Healthcare, Supply chain and Gaming 3.5 Role of Blockchain in Smart Contracts & Cryptocurrencies - Definition, Key Features of Smart Contracts, Popular Cryptocurrencies 3.6 Challenges in Blockchain Technology	Collaborative learning Presentations Case Study Flipped Classroom Video Demonstrations
4	TLO 4.1 Describe Key features of different immersive technologies. TLO 4.2 List applications of Immersive Technology. TLO 4.3 State the importance of Green Computing. TLO 4.4 Describe the concept of Quantum Computing.	**Unit - IV Immersive Technology and Sustainable Computing** 4.1 Introduction to Immersive Technology and types of immersive technologies- Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR), Extended Reality (XR), Haptic Technology 4.2 Applications of Immersive Technology 4.3 Green Computing- Definition and its importance, Energy efficient hardware and data centers. E-waste management and recycling 4.4 Quantum Computing- Introduction, Applications	Video Demonstrations Presentations Flipped Classroom Hands-on

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Write the goal of digital forensics and investigation. TLO 5.2 Describe the characteristics of different Digital Forensic Investigation models. TLO 5.3 Explain the features of different types of hacking. TLO 5.4 Describe various types of IT Acts and policies.	**Unit - V Digital Forensics and Ethical Hacking** 5.1 Introduction to digital forensics 5.2 Rules of digital forensics, The Process of Digital forensics investigation and Evidence Handling 5.3 Models of Digital Forensic Investigation: DFRWS Investigative Model, Abstract Digital Forensics Model (ADFM) ,Integrated Digital Investigation Process (IDIP), End to End digital investigation process (EEDIP) , An extended model for cybercrime investigation, UML modeling of digital forensic process model (UMDFPM) 5.4 Ethical Hacking: Definition, Types of hackers 5.5 Types of Hacking- Network Hacking: AI powered phishing scams, Ransomware 2.0, IoT exploits , Deep fake Technology, Operating System Hacking- OS downgrade attack, Firmware level exploits, Application Hacking- Advanced Web Application Firewall(WAF) Bypass Technique, Zero day exploits 5.6 National Cyber Security Policy (NCSP), 2013 ,IT Act 2000, IT Act 2008(Amendment) and IT Act 2023(DPDP),Cyber Crime Prevention against Women and Children (CCPWC) Scheme (2018)	Case Study Presentations Video Demonstrations Collaborative learning Flipped Classroom

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Write assignment covering all COs given by Course Teacher

Micro project

- Prepare a report on given case for Healthcare Blockchain System.The healthcare industry faces numerous challenges, including data fragmentation, lack of interoperability, and security vulnerabilities. Blockchain technology has emerged as a potential solution to address these issues by providing a decentralized, secure, and transparent way to manage healthcare data. This case study explores the implementation of a blockchain-based healthcare system and its impact on data management, security, and patient outcomes.
- Prepare a report on given case for IoT Integration in Precision Agriculture.The goal is to enhance farm productivity, reduce input costs, and promote sustainable agricultural practices through the seamless integration of IoT technologies into precision agriculture systems.
- Prepare a report on given case for Use of Immersive Technologies in Training .Walmart’s Virtual Reality (VR) Training Program-Walmart implemented virtual reality (VR) technology to train employees across its stores in the United States. The goal was to improve employee preparedness for real-world scenarios, from managing Black Friday crowds to handling customer service issues.
- Prepare a report on given case for IoT Integration Strategy for Telecom in Competitive Landscape.The goal is to position telecom providers as strategic enablers in the IoT value chain, driving innovation, improving customer experiences, and enhancing operational efficiencies in a highly competitive market.
- Prepare a report on given case for an Application of Artificial Intelligence in Education field.The goal is to leverage AI technologies to enhance teaching effectiveness, improve student outcomes, streamline administrative processes, and foster a more inclusive and engaging learning environment.

- Prepare a report on given case for Digital Forensics Investigation on a Mobile Device- Case: Insider Data Theft via Mobile Phone -A financial services company suspected an employee of leaking sensitive client data. Digital forensic experts performed a mobile device analysis on the employee's company-issued smartphone, recovering deleted messages, call logs, and file transfers, which revealed the employee had shared confidential documents through encrypted messaging apps. The forensic report provided clear evidence of data exfiltration, which was used in court to support the company's case and led to disciplinary action and legal proceedings.
- Prepare a report on given case for Copyright Challenges for Generative Artificial Intelligence Systems.This case study seeks to explore the evolving landscape of copyright challenges in generative AI, highlighting key legal disputes, emerging regulatory responses, and potential strategies for ensuring ethical and legally compliant deployment of these transformative technologies.

Other

- Course on Artificial intelligence for beginners provided by Microsoft
- Crash Course on Machine Learning provided by Google
- Course on Blockchain and its applications on SWAYAM platform provided by NPTEL
- Courses provided by Infosys Springboard

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Not Applicable	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction of AI and ML	CO1	9	6	6	2	14
2	II	Internet of Things	CO2	10	6	6	4	16
3	III	Blockchain Technology	CO3	8	4	6	2	12
4	IV	Immersive Technology and Sustainable Computing	CO4	8	6	4	2	12
5	V	Digital Forensics and Ethical Hacking	CO4	10	6	6	4	16
Grand Total				**45**	**28**	**28**	**14**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests (MCQs) of 30 marks will be conducted and average of two unit tests will be considered.

Formative assessment of self learning of 25 marks should be assessed based on self learning activity such as Infosys Springboard Certification/Microprojects/Assignment(60% weightage to process and 40% to product)

Summative Assessment (Assessment of Learning)

- End Semester Online (MCQ type)Exam

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	2	1	-	-	1	1			
CO2	2	2	1	-	-	1	1			
CO3	2	2	1	-	-	1	1			
CO4	2	2	1	-	-	1	1			
CO5	2	2	1	-	-	1	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	R.B. Mishra	Artificial Intelligence	PHI ISBN:978-8-1203-3849-9
2	S Sridhar, M Vijayalakshmi	Machine Learning	Oxford University Press ISBN:978-0-1901-2727-5
3	Bikramaditya Singhal Gautam Dhameja Priyanshu Sekhar Panda	Beginning Blockchain-A Beginner's Guide to Building Blockchain Solutions	Apress, ISBN-13 (pbk): 978-1-4842-3443-3 ISBN-13 (electronic): 978-1-4842-3444-0
4	Tiana Laurence	Blockchain For Dummies	Wiley India ISBN: 9788126527755
5	Arshadeep Bahga, Vijay Madisetti	Internet Of Things-A Hands-on Approach	University Press ISBN: 978-8-17371-954-7
6	John Sammons	The Basics of Digital Forensic	Elsevier ISBN: 978-1-59749-661-2
7	Dr. Nilakashi Jain, Dr. Dhananjat R. Kalbande	Digital Forensic (2017 Edition)	Wiley Publishing Inc. ISBN: 978-81-265-6574-0
8	Kevin Beaver CISSP	Hacking for Dummies (5th Edition)	Wiley Publishing Inc. ISBN: 978-81-265-6554-2
9	Sagaya Aurelia	Immersive Technologies	CRC Press ISBN: 978-10-327-5114-6
10	Githa S. Heggde,Santosh Kumar Patra,Rasananda Panda	Immersive Technology and Experiences	Palgrave Macmillan ISBN: 978-981-99-8833-4

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.versatek.com/wp-content/uploads/2016/06/IoT-eBook-version5.pdf	eBook on Internet of Things
2	https://www.youtube.com/watch?v=iqjcNRJf-Nc	Immersive technology
3	https://www.tutorialspoint.com/internet_of_things/internet_of_things_tutorial.pdf	eBook on Internet of Things

EMERGING TRENDS IN COMPUTER ENGINEERING AND INFORMATION TECHNOLOGY

Course Code : 316313

Sr.No	Link / Portal	Description
4	https://microsoft.github.io/AI-For-Beginners/	Artificial intelligence for beginners course
5	https://developers.google.com/machine-learning/crash-course	Machine learning course
6	https://www.infosecinstitute.com/resources/digital-forensics/digital-forensics-models/#gref	Digital Forensics
7	https://www.researchgate.net/publication/300474145_Digital_Forensics/	Digital Forensics eBook
8	https://www.tutorialspoint.com/ethical_hacking/ethical_hacking_process.htm	Ethical Hacking
9	https://onlinecourses.nptel.ac.in/noc22_cs44/preview	Blockchain Technology course
10	https://www.youtube.com/watch?v=ScqopKqK6v0	Immersive technology
11	https://www.indiacode.nic.in/bitstream/123456789/13116/1/it_act_2000_updated.pdf	IT Act 2000
12	https://www.meity.gov.in/static/uploads/2024/06/2bf1f0e9f04e6fb4f8fef35e82c42aa5.pdf	IT Act 2023 (DPDP)
13	https://www.indiacode.nic.in/bitstream/123456789/15386/1/it_amendment_act2008.pdf	IT Act 2008 (Amendment)
14	https://www.infosys.com/about/springboard.html	Digital Learning and Reskilling
15	https://iterasec.com/blog/understanding-ai-attacks-and-their-types/	Types of AI attacks
16	https://www.cm-alliance.com/cybersecurity-blog/5-ways-to-avoid-ai-powered-hacking	AI powered attacks -protection measures

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s	**: Artificial Intelligence/ Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Software Technology/ Computer Science & Engineering/ Data Sciences/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science**
Programme Code	**: AI/ BD/ CM/ CO/ CST/ CW/ DS/ HA/ IF/ IH/ SE**
Semester	**: Sixth**
Course Title	**: DIGITAL FORENSIC AND HACKING TECHNIQUES**
Course Code	**: 316315**

I. RATIONALE

Digital forensics helps analyze and preserve digital evidence to investigate cybercrimes, using specialized tools and procedures. Digital forensic experts play a pivotal role in defending against and responding to cyber threats. Hacking teaches how to identify and fix system vulnerabilities before malicious hackers exploit them. Ethical hacking is a legal way to secure information systems. This course prepares students to safeguard systems from cyber threats and malicious users.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcomes through various teaching learning experiences:

- Apply Digital Forensic methodology to carry out investigations and penetration tests.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Explain digital forensics investigation process.
- CO2 - Apply various Digital Forensic Investigation Models.
- CO3 - Apply digital Evidence collecting and handling techniques.
- CO4 - Identify various types of cyber attacks.
- CO5 - Apply Tools and Techniques for Ethical Hacking.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											Total Marks
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316315	DIGITAL FORENSIC AND HACKING TECHNIQUES	DFH	DSE	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain rules of Digital Forensics. TLO 1.2 Describe the given type of Digital Forensics. TLO 1.3 Explain Digital Forensics process.	**Unit - I Digital Forensics** 1.1 Overview of Digital forensics, Rules of digital forensic, Digital forensics investigation and its goal 1.2 Introduction to Cyber Crime and attack 1.3 Types of Digital Forensics- Computer Forensics, Network Forensics, Cloud Forensics, Mobile Forensics and Database Forensics 1.4 Digital Forensics process 1.5 Areas of Applications of computer forensics- Public Sector, Private Sector	Lecture using Chalk-Board Flipped Classroom Demonstration
2	TLO 2.1 Describe the given model of digital forensic investigation. TLO 2.2 Explain General ethical norms for investigators.	**Unit - II Digital Forensic Investigation Models** 2.1 Models of Digital Forensic Investigation: DFRWS Investigative Model, Abstract Digital Forensics Model (ADFM), Integrated Digital Investigation Process (IDIP), End-to-End digital investigation process (EEDIP), An extended model for cybercrime investigation, UML modeling of digital forensic process model (UMDFPM) 2.2 Challenges in Digital Forensics: Encryption, Volume of Data, Anti-Forensics Techniques, Legal and Ethical Issues, Emerging Technologies 2.3 Legal and Ethical Considerations in Digital Forensics: General ethical norms for investigators, Unethical norms for investigation	Lecture Using Chalk-Board Flipped Classroom Demonstration

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Describe the given rule for digital evidence. TLO 3.2 Explain the given type of digital evidence. TLO 3.3 Describe the evidence handling procedure. TLO 3.4 Explain various challenges in evidence handling. TLO 3.5 Explain Hashing and hashing algorithms.	**Unit - III Digital Evidences** 3.1 Crime Scenes and Collecting Evidence-Removable Media, Cell Phones, Order of Volatility 3.2 Documenting the Scene-Photography, Notes 3.3 Chain of Custody-Marking Evidence 3.4 Cloning-Purpose of Cloning, The Cloning Process, Forensically Clean Media, Forensic Image Formats, Risks and Challenges 3.5 Live System versus Dead System-Live Acquisition Concerns, Advantage of Live Collection, Principles of Live Collection, Conducting and Documenting a Live Collection 3.6 Hashing-Types of Hashing Algorithms, Hashing Example, Uses of Hashing	Lecture Using Chalk-Board Flipped Classroom Demonstration
4	TLO 4.1 Explain ethical hacking principles. TLO 4.2 Explain the symptoms of the given type of attack on computer system. TLO 4.3 Explain the process of ethical hacking for the given situation.	**Unit - IV Basics of Hacking** 4.1 Ethical Hacking: How Hackers Beget Ethical Hackers, Defining hacker, Malicious users 4.2 Understanding the need to hack your own systems 4.3 Understanding the dangers your systems face: Nontechnical attacks, Network-infrastructure attacks, Operating-system attacks, Application and other specialized attacks 4.4 Obeying the Ethical hacking Principles: Working ethically, Respecting privacy, Not crashing your systems 4.5 Ethical hacking Process: Formulating plan, Selecting tools, Executing the plan, Evaluating results	Lecture Using Chalk-Board Flipped Classroom Demonstration
5	TLO 5.1 Define Ethical Hacking and Penetration Testing. TLO 5.2 Describe Phases of Ethical Hacking. TLO 5.3 Describe the characteristics of the given type of Network Infrastructure Vulnerability. TLO 5.4 Explain the given social engineering attack.	**Unit - V Hacking Techniques** 5.1 Overview of Ethical Hacking and Penetration Testing 5.2 Phases of Ethical Hacking: Reconnaissance, Scanning, Exploitation, Post-Exploitation 5.3 Network Hacking: Network Infrastructure Vulnerabilities, Scanning-Ports, Ping swiping, Scanning SNMP, Grabbing Banners, Analysing Network Data and Network Analyzer, MAC-daddy attack 5.4 Introduction to Social Engineering, Types of social engineering attacks- Phishing, Watering hole attacks, Physical social engineering	Lecture Using Chalk-Board Flipped Classroom Demonstration

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Monitor CPU and Memory Utilization.	1	* a. Monitor CPU Utilization and Memory Utilization for detecting unauthorized process activations. (Hint: More CPU utilization as compared to Memory is an indicator of anomaly) b. Create complete memory dump using windows c. Read Memory Dump Using Windows Driver toolkit	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Investigate the given Digital Forensic scenario and prepare report.	2	*Study the DFRWS Investigative Model and apply it in a simulated digital forensic investigation (Consider digital forensic scenario like a case involving a potential data breach or unauthorized access to a computer system). a. Investigate according to phases of model. b. Prepare report detailing the steps taken during the investigation.	2	CO2
LLO 3.1 Analyze the given real world case and prepare the report based on the ethical issues arose.	3	Analyze a real-world or hypothetical case where ethical issues arose in a digital forensics investigation Task to be performed by students: a. Select a real-world case of a digital forensics investigation where ethical issues played a significant role (e.g., the case of the FBI's investigation of the San Bernardino iPhone, The Ashley Madison Hack (2015)) b. Analyze the case based on following points: • Ethical issues involved in the investigation • Situation handling procedure followed by Investigator • Does the investigation based on professional ethical norms • Or what Ethical guidelines should be followed c. Prepare Report on ethical issues, their impact on the investigation and a conclusion on how the situation could have been managed ethically	2	CO2
LLO 4.1 Investigate data in a cloud environment focusing on issues like data privacy and security breaches.	4	*Investigate data in a cloud environment, focusing on issues like data privacy and security breaches a. Conduct a forensic analysis of cloud storage (e.g., Dropbox, Google Drive) for potential data breaches or misuse b. Retrieve access logs and analyze activities that suggest unauthorized access or tampering (Hint: Use Cloud storage APIs, AWS CloudTrail, Google Cloud Platform logs.)	2	CO2
LLO 5.1 Run given commands on Windows/Linux OS to collect live data.	5	Collect live data on Windows\Linux: a. Create a response toolkit on windows having utility cmd.exe, PsLoggedOn, netstat b. Establish TCP connection between forensic workstation and the target system using netcat c. Run trusted cmd.exe, identify logged users and remote access users, Record creation, access times and all the modifications made to the files	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Create Forensic Images with any Imager Tool.	6	Create Forensic Images with any Imager Tool like Exterro FTK Imager	2	CO3
LLO 7.1 Perform Hashing to verify the authenticity of digital evidence.	7	*Perform Hashing to verify the authenticity of digital evidence a. Create a file and generate a hash (MD5, SHA-256) using hashing tools b. Alter the file slightly and generate the hash again to observe how the hash changes (Use HashCalc, MD5 & SHA Checksum Utility, Python's hashlib or any such tool)	2	CO3
LLO 8.1 Recover deleted or corrupted files from a storage device.	8	Recover deleted or corrupted files from a storage device and perform file carving (e.g., photos, documents) using any data recovery tool	2	CO3
LLO 9.1 Read and Interpret Operating Systems logs on Windows file system.	9	*Read and Interpret Operating Systems logs on Windows file system Hint: Check whether the log gives information about file systems. Any such entry indicates some malicious activity	2	CO4
LLO 10.1 Configure Kali Linux.	10	Install Kali Linux Hint: Students can install Kali Linux on VMware Workstation/Virtual Box	2	CO4
LLO 11.1 Use nmap utility for scanning.	11	*Use nmap utility to perform following tasks: a. Install Nmap on Linux or Windows OS b. Detect which devices are live on your local network. Identify the services and their versions running on a particular host c. Detect the operating system of a target host d. Perform a port scan on a specific set of ports e. Perform an aggressive scan to gather as much information as possible about a target host f. Use Nmap's scripting engine to search for vulnerabilities in a target system	2	CO4
LLO 12.1 Establish DoS attack using TCP/ICMP flooding.	12	Establish DoS attack using TCP/ICMP flooding: a. Ping continuously a particular machine at a time from different machines and observe the machine behavior on Network b. Write shell script for continuously flooding a Machine with ping and observe the machine behavior on Network	2	CO4
LLO 13.1 Use Wireshark tool to analyze network traffic.	13	* Capture Network traffic using Wireshark tool a. Install Wireshark tool on Windows/Kali Linux b. Use Wireshark tool to capture network traffic and to understand three-way handshaking concept/Analyze the packet c. Examine HTTP, FTP, or other protocols for evidence of cybercrime	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 14.1 Use any information gathering tool to collect information of IP addresses, domain names and emails.	14	Collect information of IP addresses, domain names and emails using any information gathering tool like Recon-ng	2	CO5
LLO 15.1 Simulate phishing attacks using Social-Engineer Toolkit.	15	*Use Social-Engineer Toolkit (SET) tool for Simulating phishing attacks to test human vulnerabilities	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Activity

- Find Job opportunities in Government sector in Digital Forensics and Ethical Hacking. Prepare detailed report on any Job Role. (e.g. Forensic Computer Analyst, Digital Forensics Experts, Forensic Investigator, Security Auditor)
- Arrange Visit to cyber cell or Digital Forensic Laboratory. OR Organize Expert Lecture of Cyber Expert.

Assignment

- Simulate a penetration testing environment and identify vulnerabilities in a network. Write a detailed penetration testing report that outlines vulnerabilities found, how they were exploited, and recommended mitigation strategies.
- Capture and analyze network traffic to detect malicious activities. Write a report detailing the network traffic analysis and identify malicious behavior. Also write how network forensics can help identify cyber-attacks and the importance of packet analysis.

Note

- Teacher should give more such assignments covering all COs.

Micro project

- Study any Trojan attack. Identify the Trojan attack:
  i. State the way trojan got installed on particular Machine.
  ii. State the effects of the Trojan.
  iii. Elaborate/Mention/State protection/Blocking mechanism for this specific Trojan, example specification of any anti-threats platform which filters the Trojan.
- Study Credit card fraud as an identity threat. Identify:
  i. Use of digital media in carrying out fraud.
  ii. Vulnerability Exploited.
  iii. Effect of fraud.
  iv. Protection/Precaution to be taken against such frauds.
- Study any case of forgery /falsification crime case solved using digital forensics:
  i. Identify the model used for Digital Investigation.
  ii. Was investigation done ethically or unethically?
  iii. Where does digital evidence found for crime establishment?
  iv. State the punishment meted.
- Study any case of fake profiling. Identify
  i. The way digital forensics was used in detecting the fraud.
  ii. Where was digital evidence located?
  iii. Effects.

Other

- Students are encouraged to register themselves in various MOOCs such as NPTEL/Infosys Springboard/udemy/any other online platform to enhance their learning.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer with Kali Linux Operating system/ Kali Linux/any open source OS installed on Virtual Box/VMware workstation	4,5,6,7,8,10,11,13,14
2	Digital Forensic and Hacking Freeware tools mentioned in practicals.	6,7,8,9,11,13,14,15
3	Computer system with basic configuration	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Digital Forensics	CO1	8	6	4	2	12
2	II	Digital Forensic Investigation Models	CO2	8	4	6	2	12
3	III	Digital Evidences	CO3	9	6	8	2	16
4	IV	Basics of Hacking	CO4	10	4	8	2	14
5	V	Hacking Techniques	CO5	10	4	8	4	16
Grand Total				**45**	**24**	**34**	**12**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Laboratory Performance, Unit Tests, Midterm Exam, Term Work, Seminar/ Presentations.
- Continuous assessment based on process and product related performance indicators.
- Each practical will be assessed considering 60% weightage to process and 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End Semester Exam, Practical exam, viva voce.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	2	1	-	1	-	-			
CO2	2	2	2	-	2	1	1			
CO3	2	3	3	2	2	1	2			
CO4	2	3	2	2	2	2	2			
CO5	1	2	2	3	2	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Pachghare V. K.	Cryptography and Information Security	PHI Learning Pvt. Ltd, Delhi ISBN-978-93-89347-11-1 ISBN- 978-93-89347-10-4
2	John Sammons	The Basics of Digital Forensic	Elsevier, Netherlands ISBN 978-1-59749-661-2
3	Kevin Beaver CISSP	Hacking for Dummies	Wiley Publishing, New Delhi ISBN: 978-81-265-6554-2
4	Mark D. Spivey CISSP	Practical Hacking Techniques and Countermeasures	Auerbach Publication, Taylor and Francis Group ISBN-13: 978-0-8493-7057-1

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://resources.infosecinstitute.com/digital-forensics-models/#gref.	Introduction to Digital forensics models
2	https://docs.kali.org/introduction/download-official-kali-linux-images	Download Kali Linux and its installation steps
3	www.openwall.com/passwords/windows-pwdump	Hash Suite-auditing tool for Windows password hashes.
4	https://www.techtarget.com/searchsecurity/tutorial/How-to-use-Social-Engineer-Toolkit	How to use Social-Engineer Toolkit
5	https://www.youtube.com/watch?v=GZMUYqjAS6k	How to make a Forensic Image with FTK Imager
6	https://www.youtube.com/watch?v=qTaOZrDnMzQ	Wireshark Tutorial for Beginners

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s	**: Computer Technology/ Computer Engineering/ Computer Software Technology/ Computer Science & Engineering/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science/**
Programme Code	**: CM/ CO/ CST/ CW/ HA/ IF/ IH/ SE**
Semester	**: Sixth**
Course Title	**: MACHINE LEARNING**
Course Code	**: 316316**

I. RATIONALE

A machine learning concepts equip students with fundamental knowledge and practical skills. Machine learning algorithms are important for data analysis, AI and Data Science. It emphasizes real-world applications such as data analytics, predictive analytics and problem-solving, which are in high demand across industries like healthcare, finance and technology.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences: Apply machine learning effectively across various domains.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Explain the role of machine learning in AI and data science.
- CO2 - Implement data preprocessing.
- CO3 - Implement feature engineering techniques to prepare data for machine learning models.
- CO4 - Apply supervised learning models to train and evaluate.
- CO5 - Apply unsupervised learning models to train and evaluate.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316316	MACHINE LEARNING	MAL	DSE	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe machine learning concept. TLO 1.2 Compare Traditional vs ML based Programming. TLO 1.3 Distinguish Supervised , unsupervised and Reinforcement learning. TLO 1.4 Explain the Challenges for Machine learning. TLO 1.5 Explain the features of python libraries used for Machine Libraries.	**Unit - I Introduction to Machine Learning** 1.1 Basics of ML - Define Machine Learning, Traditional programming vs ML-based approaches, Role and application of ML in artificial intelligence and data science 1.2 Types of ML (Supervised, Unsupervised, Reinforcement Learning)-Supervised Learning: Definition, working principle, examples (classification, regression), Unsupervised Learning: Definition, working principle, examples, Clustering, dimensionality reduction techniques, Reinforcement Learning: Concept of agents, rewards, and policy learning, Comparison of different ML types with real-world applications 1.3 Applications of ML- Real-world use cases of ML in various domains such as healthcare, finance, e-commerce, etc, challenges in Machine Learning 1.4 Introduction to Python for ML-Basics of Python programming relevant to ML, Overview required libraries: NumPy, Pandas, Matplotlib, Scikit-learn, Writing and executing simple ML scripts in Python	Lecture Using Chalk-Board Presentations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Illustrate the process of cleaning the data. TLO 2.2 Explain the functioning of algorithm used for handling missing values. TLO 2.3 Select the appropriate dataset splitting technique.	**Unit - II Data Preprocessing** 2.1 Data Cleaning :Introduction to Data Cleaning, Identifying and Handling Noisy Data, Removing Duplicates and Inconsistencies, Standardizing and Normalizing Data, Handling Outliers 2.2 Handling Missing Values -Types of Missing Data, Identifying Missing Values, Techniques to Handle Missing Data, Removing Missing Data, Mean, Median, and Mode Imputation, Predictive Imputation (Regression, KNN), Using Algorithms that Support Missing Values 2.3 Splitting Dataset for Training and Testing -Importance of Dataset Splitting, Train-Test Split Ratio Selection, Cross-Validation Techniques, K-Fold Cross Validation, Leave-One-Out Cross Validation, Stratified Sampling vs Random Sampling	Lecture Using Chalk-Board Presentations Video Demonstrations
3	TLO 3.1 Explain different feature selection methods. TLO 3.2 Illustrate the different feature extraction methods.	**Unit - III Feature Selection** 3.1 Feature Scaling and Selection-Importance of Feature Scaling, Normalization vs Standardization, Feature Selection Methods, Filter Methods (Correlation, Chi-Square), Wrapper Methods (Forward, Backward Selection), Embedded Methods (Lasso, Decision Trees) 3.2 Feature Extraction Techniques - Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) 3.3 Mutual Information-Based Feature Selection, ANOVA (Analysis of Variance) for Feature Selection, Recursive Feature Elimination (RFE) with Cross-Validation (RFECV), Feature Importance from Tree-Based Models (Beyond Decision Trees), XGBoost, LightGBM, Random Forest provide built-in feature importance scores (Gini importance, SHAP values).	Lecture Using Chalk-Board Presentations Demonstration
4	TLO 4.1 Distinguish the working of Decision Tree, KNN and SVM classification algorithm. TLO 4.2 Explain the working of specified Regression algorithm. TLO 4.3 Explain the process of model performance evaluation.	**Unit - IV Supervised Learning** 4.1 Classification Algorithms: Decision Trees, KNN(K-Nearest Neighbors), SVM(Support Vector Machine) 4.2 Regression Algorithms: Linear Regression, Logistic Regression, Ridge Regression 4.3 Model Performance Evaluation: Confusion Matrix, Accuracy, Precision, Recall	Lecture Using Chalk-Board Presentations Demonstration

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Explain the concept of clustering in data analysis and its significance. TLO 5.2 Compare K-Means and Hierarchical Clustering and choose the appropriate technique based on the problem. TLO 5.3 Describe the importance of Dimensionality reduction. TLO 5.4 Illustrate the process of dimensionality reduction using PCA.	**Unit - V Unsupervised Learning** 5.1 Clustering Techniques:-Define Clustering, Importance of clustering in data analysis, Applications of Clustering 5.2 K-Means Clustering: Definition and working principle, Steps involved in the K-Means algorithm, Advantages of K-Means, Disadvantages of K-Means, Hierarchical Clustering: Definition and types, Steps in Hierarchical Clustering, Advantages of Hierarchical Clustering, Disadvantages of Hierarchical Clustering, Comparing K-Means and Hierarchical Clustering 5.3 Dimensionality Reduction: Importance of Dimensionality Reduction 5.4 PCA -Definition and fundamental principles of PCA, Eigenvectors and eigenvalues, Steps in PCA, Explained Variance, Choosing the Optimal Dimensionality, Advantages and Disadvantages of PCA, Applications of PCA	Lecture Using Chalk-Board Presentations Demonstration

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Install required platform to use Scikit-learn library.	1	*Installation of IDE with necessary libraries	2	CO1
LLO 2.1 Write a program for handling missing values. LLO 2.2 Normalize data to make models work. LLO 2.3 Standardize data to make models work. LLO 2.4 Transform categorical data int numerical form using encoding methods. LLO 2.5 Split the dataset into train and test.	2	*Implement program for Data Preprocessing Techniques	2	CO1 CO2
LLO 3.1 Write a program to read dataset and differentiate attributes in various category.	3	Implement program to read dataset (Text, CSV, JSON ,XML)	2	CO2
LLO 4.1 Write a program to implement the Decision Tree model. LLO 4.2 Write a program to implement the K-Nearest Neighbor model. LLO 4.3 Evaluate classification performance using accuracy, precision, recall, and F1-score .	4	Implement the classification algorithms on previously prepared dataset	4	CO2 CO3 CO4
LLO 5.1 Write a program to implement the Linear Regression by using the suitable dataset. LLO 5.2 Write a program to implement the logistic regression by using the suitable dataset. LLO 5.3 Write a program to implement the Ridge Regression by using the suitable dataset. LLO 5.4 Evaluate model performance using metrics.	5	*Implement the regression model by using the suitable dataset	4	CO2 CO4

MACHINE LEARNING **Course Code : 316316**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Write a program to use clustering algorithms to find patterns in data. LLO 6.2 Visualize the results using Matplotlib / Seaborn.	6	*Implement program to use clustering algorithms to find patterns in data	2	CO3 CO4
LLO 7.1 Write a program to identify the most important features that contribute to the model accuracy.	7	Implement program to identify the most important features that contribute to the model accuracy	2	CO2 CO3
LLO 8.1 Write a program to use k-Nearest Neighbors (KNN) model for Classification on give dataset. LLO 8.2 Experiment with different values of K and measure model performance.	8	Implement program to use k-Nearest Neighbors (KNN) model for Classification on given dataset	2	CO4
LLO 9.1 Write a program to Train an SVM model on dataset.	9	*Implement program to train an SVM model on given dataset	2	CO4
LLO 10.1 Write a program to use logistic regression model to classify binary outcomes.	10	Implement program to use logistic regression model to classify binary outcomes	2	CO3
LLO 11.1 Write a program to use PCA technique to reduce the number of features while retaining important information.	11	*Implement program to use PCA technique to reduce the number of features while retaining important information	2	CO4
LLO 12.1 Write a program to use any machine learning model on given dataset. LLO 12.2 Preprocess, analyze, and build models to get the meaningful insights.	12	*Implement program to use machine learning model on given dataset	2	CO4 CO5
LLO 13.1 Write a program to use Pandas, Matplotlib to analyze data of previously created model . LLO 13.2 Plot histograms, box plots, scatter plots, and correlation heatmaps to understand relationships between variables.	13	Implement program to use Pandas, Matplotlib to analyze data of previously created model	2	CO4 CO5
LLO 14.1 Write a program to use any machine learning model on given dataset. LLO 14.2 Predict results based on various features using a regression model.	14	Implement program to use machine learning model on Boston Housing Dataset (available in Scikit-learn)	2	CO4 CO5
LLO 15.1 Write a program to make groups based on their features using K-Means Clustering.	15	Implement a program to segment customers into different groups based on their purchasing behavior features using K-Means Clustering	4	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- The micro project should be based on one of the following area as suggested by the teacher: Industry application/Internet-based/workshop-based/laboratory-based/field-based.

1.Develop a model for Waiter's Tip Prediction using Machine Learning algorithm , predict what amount of tip a person will give based on his/her visit to the restaurant using some features related to the same.

2.Implement a machine learning model which can predict the stock amount for the different products which are sold in different stores.
3.Implement a model for Stock Price Prediction is the task of forecasting future stock prices based on historical data and various market indicators.
4.Implement model to Predict Employee Attrition: Analyze HR datasets to determine factors affecting employee retention.
5.Implement model to perform Human Scream Detection and Analysis for Controlling Crime Rate using Machine Learning.

Assignment

- Solve assignment covering all COs given by teacher.

Other Courses

- Students are encouraged to register themselves in various Swayam/MOOC's/Infosys Springboard courses to enhance their learning. Various courses available on machine learning courses with certificates for Free such as Generative AI / AI Python for beginners/ Google AI for Anyone / Linear regression/ AWS Deep Learning Containers / CS229: Machine Learning By Stanford/ Great Learning Academy.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Computer system with a minimum 8GB RAM, Python/Jupyter Notebook/ Google Colab Free/unpaid Account/ Anaconda	All
2	Other Useful Tools: VS Code / PyCharm – Alternative Python development environments. Git & GitHub – For version control and project collaboration. Kaggle – Free datasets and cloud computing for ML experiments.	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Machine Learning	CO1	6	2	6	4	12
2	II	Data Preprocessing	CO2	10	4	8	4	16
3	III	Feature Selection	CO3	9	2	4	4	10
4	IV	Supervised Learning	CO4	10	4	8	4	16
5	V	Unsupervised Learning	CO5	10	4	8	4	16
Grand Total				**45**	**16**	**34**	**20**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Continuous assessment based on process and product related performance indicators. Each practical will be assessed considering 60% weightage to process 40% weightage to product. A continuous assessment-based term work.

Summative Assessment (Assessment of Learning)

- End Semester Examination, Lab Performance, Viva-voce.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	2	3	1	1	3			
CO2	3	2	2	3	1	1	3			
CO3	3	2	2	3	1	1	3			
CO4	3	3	3	3	1	3	3			
CO5	3	3	3	3	1	3	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Yuxi Liu	Python machine learning by examples	Packt publication ISBN:978-178355-311-2
2	Saikat Dutt,Subramanian ChandramouliAmit Kumar Das	Machine Learning	Person ISBN 978-93-530-6669-7,eISBN: 978-93-895-8813-2
3	Tom M Mitchell	Machine Learning	McGraw Hill, First edition ISBN: 13: 978-0070428072
4	Aurélien Géron	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems	O'Reilly Media ISBN-10 1492032646
5	Sebastian Raschka, Vahid Mirjalili	Python Machine Learning	Packt Publishing ISBN: 978-1800567703

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://machinelearningmastery.com/how-machine-learning-algorithms-work/	ML with Python

MACHINE LEARNING **Course Code : 316316**

Sr.No	Link / Portal	Description
2	https://www.geeksforgeeks.org/machine-learning/	ML Introduction
3	https://www.w3schools.com/python/python_ml_getting_started.asp	ML Python Basics
4	https://www.coursera.org/learn/machine-learning-with-python	ML with Python
5	https://www.kdnuggets.com/5-free-courses-to-master-machine-learning	Free ML Courses
6	https://developers.google.com/machine-learning/crash-course	Google ML Crash Course - Google ML Guide
7	https://www.youtube.com/@machinelearning-sudeshnasa3607	ML Tutorials Video(NPTEL)
8	https://www.youtube.com/watch?v=ukzFI9rgwfU	ML Overview
9	https://ekumbh.aicte-india.org/allbook.php	Python Programming
10	https://arxiv.org/abs/2006.10092	Housing Market Prediction Problem using Different Machine Learning Algorithms: A Case Study

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

DATA WAREHOUSING WITH MINING TECHNIQUES **Course Code : 316321**

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Cloud Computing and Big Data/ Data Sciences/ Information Technology/ Computer Science & Information Technology**
Programme Code	**: AI/ AN/ BD/ DS/ IF/ IH**
Semester	**: Sixth**
Course Title	**: DATA WAREHOUSING WITH MINING TECHNIQUES**
Course Code	**: 316321**

I. RATIONALE

Data warehousing provides the structure and storage needed to handle large datasets, while data mining enables the extraction of useful knowledge from those datasets. Together, they empower businesses to make smarter, data-driven decisions, optimize operations, and gain a deeper understanding of their customers and markets. This course aims to equip students with the practical skills to leverage data warehousing and mining techniques.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply mining tools to extract information from data warehouse.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Explain the architecture, models, and processes involved in data warehousing and its distinction from operational databases.
- CO2 - Apply OLAP operations for data analysis by designing multidimensional data models.
- CO3 - Apply data mining algorithms to discover frequent item-sets and association rules.
- CO4 - Apply various classification algorithms on a data set.
- CO5 - Apply various clustering algorithms on a data set.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316321	DATA WAREHOUSING WITH MINING TECHNIQUES	DWM	DSE	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe the need of Data warehousing. TLO 1.2 Differentiate between Operational Database Systems and Data Warehouses. TLO 1.3 Differentiate the working of different data warehouse models. TLO 1.4 Differentiate the concept of data pond, data lake and data ocean.	**Unit - I Basics of Data Warehousing** 1.1 Introduction to Data Warehouse 1.2 Need of Data Warehousing 1.3 Differences between Operational Database Systems and Data Warehouses 1.4 A Multi-Tiered Architecture of Data Warehouse 1.5 Data Warehouse Models: Enterprise Warehouse, Data Mart, And virtual Warehouse 1.6 Extraction, Transformation and Loading (ETL) 1.7 Metadata Repository 1.8 Concept of data pond, data lake, data ocean	Case Study Presentations Lecture Using Chalk-Board
2	TLO 2.1 Extract data from multidimensional data models. TLO 2.2 Design schemas for multidimensional data model. TLO 2.3 Illustrate the relationship of dimensions and measures. TLO 2.4 Perform OLAP operations.	**Unit - II Data Warehouse Modelling – Data Cube and Online Analytical Processing (OLAP)** 2.1 Data Cube: A Multidimensional Data Model 2.2 Stars, Snowflakes, and Fact Constellations: Schemas for Multidimensional Data Models 2.3 Dimensions: The Role of Concept Hierarchies 2.4 Measures: Categorization and Computation 2.5 OLAP Operations - Roll-up, Drill-down, Slice and Dice	Presentations Lecture Using Chalk-Board

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Describe Frequent Item sets, Closed Item sets, and Association Rules in market basket analysis. TLO 3.2 Explain Apriori algorithm. TLO 3.3 Explain the technique of Mining Frequent Item sets Using Vertical Data Format. TLO 3.4 Describe the concept of Mining Closed and Max Patterns.	**Unit - III Basics of Data Mining** 3.1 Market Basket Analysis 3.2 Frequent Item sets, Closed Item sets, and Association Rules 3.3 Apriori Algorithm: Finding Frequent Item sets by Confined Candidate Generation 3.4 Mining Frequent Item sets Using Vertical Data Format 3.5 Mining Closed and Max Patterns	Video Demonstrations Case Study Presentations Lecture Using Chalk-Board
4	TLO 4.1 Elaborate classification by learning. TLO 4.2 Explain Attribute Selection Measures for tree induction. TLO 4.3 Explain Bayes Classification Method. TLO 4.4 Apply Rule-Based Classification using IF-THEN for given data.	**Unit - IV Classification Techniques** 4.1 Introduction to Classification 4.2 Decision Tree -Decision Tree Induction, Attribute Selection Measures, Tree Pruning 4.3 Bayes Classification Methods - Bayes' Theorem, Naïve Bayesian Classification 4.4 Rule-Based Classification -Using IF-THEN Rules for Classification	Video Demonstrations Presentations Lecture Using Chalk-Board Hands-on Case Study
5	TLO 5.1 Describe features and applications of cluster analysis. TLO 5.2 Explain the given Partitioning Method for cluster analysis. TLO 5.3 Differentiate between Agglomerative and Divisive Hierarchical Clustering.	**Unit - V Cluster Analysis** 5.1 Introduction to Clustering 5.2 Cluster Analysis – Features and Applications of cluster analysis 5.3 Partitioning Methods - k-Means, k-Medoids 5.4 Hierarchical Methods- Agglomerative versus Divisive Hierarchical Clustering	Video Demonstrations Presentations Lecture Using Chalk-Board

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Install software for data mining.	1	Install Python along with scikit-learn, pandas, matplotlib, and DBMS	2	CO1
LLO 2.1 Implement ETL process.	2	*Implementing Extraction, Transformation and Loading process of Data Warehouse	2	CO1
LLO 3.1 Perform data mining operations such as Access specific data points, slice the cube, and aggregate multidimensional data.	3	*Write a program in python to access specific data points, slice the cube, and aggregate data of a dataset along different dimensions	2	CO2
LLO 4.1 Create star schema using SQL.	4	*Create star schema of 5 tables (one fact table and 4 dimension tables)	2	CO2
LLO 5.1 Create snowflake schema.	5	*Create snowflake schema using fact table, dimension tables and sub-dimension table	2	CO2
LLO 6.1 Create fact constellation schema.	6	Create fact constellation schema of 5 tables of student database	2	CO2
LLO 7.1 Implement Slice, Dice operations of OLAP.	7	Write a program in python to perform Slice, Dice operations of OLAP	2	CO2
LLO 8.1 Implement Drill-down, Roll-up operations of OLAP.	8	*Write a program in python to perform Drill-down, Roll-up operations of OLAP	2	CO2
LLO 9.1 Implement the Apriori Algorithm to solve given problem.	9	*Write a program in python to apply the Apriori Algorithm for Market Basket Analysis	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 10.1 Implement Naïve Bayesian classification algorithm.	10	*Write a program in python to apply Naïve Bayesian Classification algorithm for given STUDENT/CUSTOMER data set	2	CO4
LLO 11.1 Implement K-means algorithm.	11	*Write a program in python to apply K-means algorithm for STUDENT/CUSTOMER dataset	2	CO5
LLO 12.1 Implement K- Medoids algorithm.	12	Write a program in python to apply K- Medoids algorithm for STUDENT/CUSTOMER dataset	2	CO5
LLO 13.1 Implement Naïve Bayesian Classification to Image data set.	13	Write a program in python to apply Naïve Bayesian Classification to classify images (Use any dataset from Kaggle)	2	CO4
LLO 14.1 Implement K-medoid Clustering to Image data set.	14	Write a program in python to apply K-medoid Clustering to classify images (Use any dataset from Kaggle)	2	CO5
LLO 15.1 Implement K-means Clustering to Image data set.	15	Write a program in python to apply K-means Clustering to classify images (Use any dataset from Kaggle)	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Micro project

- Perform various operations of data warehousing and data mining for any data set from kaggle.com using jupyter notebook.
- Implement Partitioning Methods like K-Means clustering or k-Medoids using C/CPP/JAVA to group similar data points.
- Perform data mining operations on image data set.

Assignment

- Set up a data warehouse for a BI dashboard (using Tableau, Power BI, etc.).
- Perform various operation using ETL process such as extract data from various data sources, integrate that data, clean that data and transform data from one DB to another DB.
- Extract data from a data warehouse and apply data mining techniques (e.g., classification or clustering) to derive insights.

Other

- Complete course -"Hands On Machine Learning For Data Mining" from Infosys Springboard.
- Complete course -"Introduction to Data Mining" from Infosys Springboard.
- Complete course -"Data Mining with Python: Implementing classification and regression"from Infosys Springboard.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	PC-i3 or above with minimum 4GB RAM PYTHON 3 with scikit-learn, pandas, matplotlib Oracle/MySQL/SQL Server MS-Excel,WEKA	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Basics of Data Warehousing	CO1	12	4	10	4	18
2	II	Data Warehouse Modelling – Data Cube and Online Analytical Processing (OLAP)	CO2	10	4	8	4	16
3	III	Basics of Data Mining	CO3	8	2	8	4	14
4	IV	Classification Techniques	CO4	8	2	6	4	12
5	V	Cluster Analysis	CO5	7	0	4	6	10
Grand Total				**45**	**12**	**36**	**22**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Continuous assessment based on process and product related performance indicators.
- Each practical will be assessed considering 60% weightage to process, 40% weightage to product.
- A continuous assessment based term work.

Summative Assessment (Assessment of Learning)

- End semester examination, Lab performance, Viva voce

XI. SUGGESTED COS - POS MATRIX FORM

DATA WAREHOUSING WITH MINING TECHNIQUES **Course Code : 316321**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2									
CO2	2	3	3	2						
CO3	3	3	2	3	1					
CO4		2	2	3		2	1			
CO5		2	2	3		2	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Jiawei Han, Micheline Kamber, Jian Pei	Data Mining Concepts and Techniques	Morgan Kaufmann Publishers, ISBN 978-0-12-381479-1
2	Alex Berson, Stephen Smith	Data Warehousing, Data Mining and OLAP	McGraw Hill, ISBN-13 - 978-0070587410
3	Parteek Bhatia	Data Mining and Data Warehousing: Principles and Practical Techniques	Cambridge University Press, ISBN-13 978-1108727747
4	Avi Silberschatz, Henry F. Korth, S. Sudarshan	Database System Concepts (Seventh Edition)	McGraw-Hill ISBN 9780078022159

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.analyticsvidhya.com/blog/category/data-mining/	Data Mining blog
2	https://nptel.ac.in/courses/106105174	NPTEL Data Warehousing & Mining Video lectures
3	https://www.oracle.com/database/technologies/datawarehouse	Use for Data warehousing
4	https://www.oreilly.com/library/view/what-is-a/9781492088899/ch01.html	Data pond, Data lake, Data ocean

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

WIRELESS AND MOBILE NETWORK **Course Code : 316325**

Programme Name/s : **Information Technology**
Programme Code : **IF**
Semester : **Sixth**
Course Title : **WIRELESS AND MOBILE NETWORK**
Course Code : **316325**

I. RATIONALE

The rapid growth of wireless and mobile technologies has transformed the telecommunications industry, enabling seamless connectivity, mobility, and convenience. This course provides students with a deep understanding of the technologies and principles behind wireless communication, which is now a crucial part of modern life, enabling ubiquitous connectivity through devices like smartphones and tablets. Studets will able to analyse wireless protocols and their performance using tools and realisic simulation.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry/employer expected outcome throughvarious teaching learning experiences:Maintain mobile and wireless communication system.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify various terminologies used in GSM network systems.
- CO2 - Establish wireless network with the given technology.
- CO3 - Differentiate between various generations of mobile network .
- CO4 - Expalin 5G network system architecture.
- CO5 - Establish wireless sensor networks for the given application.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316325	WIRELESS AND MOBILE NETWORK	WMN	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	-	-	25	10	150

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Describe functions of given component in GSM network architecture. TLO 1.2 Classify the given GSM logical channel. TLO 1.3 Implement call processing in GSM. TLO 1.4 Explain the significance of given type of area in cellular network.	**Unit - I Introduction to GSM** 1.1 Global System for Mobile communication (GSM) architecture, GSM frequency spectrum, GSM radio aspects, GSM Supplementary services, GSM channel types 1.2 Call processing in GSM :Registration/location update, mobile terminated call and mobile originate call 1.3 Mobility management: Location update procedure: Inter LA movement, Inter MSC movement, Inter VLR movement 1.4 Concept of roaming 1.5 Types of area: Location area, Routing area, Tracking area 1.6 Network signaling: GSM protocol model	Lecture Using Chalk-Board Presentations Flipped Classroom Demonstration
2	TLO 2.1 Describe function of given components of GPRS architecture. TLO 2.2 Describe features of given IEEE protocol standard for wireless communication network. TLO 2.3 Explain architecture of given protocol standard. TLO 2.4 Compare performance of given wireless technologies based on given criteria.	**Unit - II GPRS and Mobile Data communication** 2.1 General packet radio services (GPRS) architecture, GPRS services 2.2 GPRS network nodes, mobility management and routing in GPRS 2.3 RFID (Radio Frequency Identification): Architecture, classification of RFID tags, applications, advantages and disadvantages 2.4 Wi-Fi : Classification, architecture, applications in business and healthcare domain 2.5 Wi-Max: Need of WMAN and applications in smart cities and public safety domain, Advantages and disadvantages	Lecture Using Chalk-Board Presentations Flipped Classroom Demonstration
3	TLO 3.1 Describe the specification of IMT-2000 global standard. TLO 3.2 Explain features of given next generation standard. TLO 3.3 Describe the function of the given section of UMTS network architecture. TLO 3.4 Compare features of two given next generation mobile communication.	**Unit - III Wireless application protocols and 3G mobile services** 3.1 Mobile internet standard, Wireless application protocol (WAP):Model, WAP Protocol stack 3.2 Wireless markup languages (WML) 3.3 International mobile telecommunications 2000 (IMT-2000) : Features and services 3.4 Wideband Code Division Multiple Access (W-CDMA) and CDMA 2000: Specifications and features 3.5 UMTS (Universal Mobile Telecommunication System) technology: Features, architecture, applications and advantages 3.6 Introduction to 4G technology : Architecture and Features of 4G ,Features of VoLTE, 4.5G	Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Describe 5G network architecture. TLO 4.2 List features of IMT 2020 standards. TLO 4.3 Sketch 5G radio spectrum. TLO 4.4 Implemet 5G network slicing.	**Unit - IV Introduction to 5G Technology** 4.1 Introduction to 5G: 5G network architecture, 5G enable technologies 4.2 IMT 2020 standard: Specifications and features 4.3 5G Radio spectrum: low band, medium band, millimeter wave (Ultrahigh) band, 5G service providers 4.4 5G network slicing: Architecture, Advantages of Network Slicing for IoT Ecosystem	Lecture Using Chalk-Board Presentations Video Demonstrations Flipped Classroom
5	TLO 5.1 Describe operational principle of Mobile IP. TLO 5.2 Implement line coding techniques. TLO 5.3 Implement shift keying and modulation techniques. TLO 5.4 Explain architecture of wireless sensor networks.	**Unit - V Wireless Network Technologies** 5.1 Mobile IP: Operational Principle, Home agent ,Foreign Agent 5.2 Line coding techniques: Unipolar NRZ, Bipolar RZ and Manchester NRZ 5.3 Binary amplitude shift keying, Binary phase shift keying, Binary frequency shift keying, PCM (Pulse code modulation), DM(Delta Modulation) 5.4 MANETs (Mobile Adhoc Networks): Topologies, features, applications, architecture 5.5 WSN (Wireless Sensor Networks): Different types of architecture, characteristics, applications	Lecture Using Chalk-Board Presentations Flipped Classroom Demonstration

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify different sections and components of mobile phone such as ringer section, dialer section, receiver section and transmitter section, camera, microphone, speaker, Dash light.	1	* Identify different sections of mobile phone	2	CO1
LLO 2.1 Analyze process of call connection and call release of cellular mobile system.	2	* Perform process of call connection and call release of cellular mobile system(Using any simulation tool)	2	CO1
LLO 3.1 Determine hardware information of the mobile using relevant software.	3	* Detect the hardware details of mobile handset. (Using any relevant mobile application)	2	CO1
LLO 4.1 Determine system information of the mobile using relevant software.	4	* Detect operating system and its version(Windows, Blackberry and mac OS) using any relevant mobile application.	2	CO1
LLO 5.1 Build a Personal Area Network of mobile devices.	5	Establish Personal Area Network for two or more devices.	2	CO2
LLO 6.1 Implement Bluetooth protocol services.	6	Transfer an image, audio and video file using Bluetooth protocol with varying distance between two or more devices	2	CO2
LLO 7.1 Create hotspot connection of any two devices.	7	* Make Hotspot connection on Wifi on any 2 devices	2	CO2
LLO 8.1 Configure Wi-Fi settings in mobile devices.	8	* Configure Wi-Fi setting in mobile devices using mobile tethering to connect two devices such as mobile phone to laptop	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 9.1 Installation of eSim on mobile handset. LLO 9.2 Authenticate eSIM(virtual SIM)on mobile handset.	9	* Install and authenticate eSIM(virtual SIM)on mobile handset	2	CO3
LLO 10.1 Identify different parts of smartphones.	10	* Identify Dual sim interface section, Touchscreen display section, battery charging circuit, power management unit of 4G or 5G smartphone and test working	2	CO3
LLO 11.1 Determine location of nearby tower. LLO 11.2 Determine internet connection strength.	11	Using appropriate mobile app locate and find Internet signal strength of mobile tower	2	CO3
LLO 12.1 Identify network topology and check availability of network.	12	Check network availability and network topology using any open share website	2	CO4
LLO 13.1 Configure manual and auto selection network.	13	* Implement manual and auto selection of network using mobile handset	2	CO4
LLO 14.1 Establish wireless connectivity using access points.	14	* Create seamless wireless connectivity using multiple access points	2	CO4
LLO 15.1 Develop a mobile application for wireless technology.	15	* Develop a mobile application for wireless technology using any wizards such as available on www.appypie.com or any other website	2	CO4
LLO 16.1 Implement radio frequency connectivity.	16	Apply RFID technology for real life applications using RFID kit	2	CO2
LLO 17.1 Simulate line coding technique Unipolar NRZ.	17	* Implement line coding technique Unipolar NRZ using MATLAB and Simulink	2	CO5
LLO 18.1 Simulate line coding technique Bipolar RZ.	18	* Implement line coding technique Bipolar RZ using MATLAB and Simulink	2	CO5
LLO 19.1 Simulate line coding technique Manchester NRZ.	19	* Implement line coding technique Manchester NRZ using MATLAB and Simulink	2	CO5
LLO 20.1 Implement amplitude shift keying using any relevant software.	20	* Simulate binary amplitude shift keying using MATLAB and Simulink	2	CO5
LLO 21.1 Implement amplitude shift keying using any relevant software.	21	Simulate binary phase shift keying using MATLAB and Simulink	2	CO5
LLO 22.1 Implement frequency shift keying using any relevant software.	22	Simulate frequency shift keying using MATLAB and Simulink	2	CO5
LLO 23.1 Simulate pulse code modulation using using any relevant software.	23	* Implement pulse code modulation using MATLAB and Simulink	2	CO5
LLO 24.1 Simulate delta modulation using any relevant software.	24	Implement delta modulation using MATLAB and Simulink	2	CO5
LLO 25.1 Simulate WSN using any relevant software.	25	* Implement WSN node to determine position on node and blink LED using cubcarbon simulator and senscript	2	CO5
LLO 26.1 Analyze performance of Wi-Fi Network.	26	* Analyse a Wi-Fi network using related software (Like NetSpot or Wi-Fi analyzers)	2	CO5
LLO 27.1 Create a Basic MANET.	27	Use network simulators such as NS3 or OMNeT++ to create a basic MANET	2	CO5
LLO 28.1 Configure mobile IP addressing on a local network.	28	Setup mobile IP addressing on a local network using Cisco Packet Tracer or any other software	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Case Study

- LTE Network Optimization in Rural India Objective: Explore how LTE (Long Term Evolution) networks are being optimized to provide reliable and affordable mobile data services in rural areas of India
- Wi-Fi 6 in high density venues (Stadiums and Airports) Objective: Examine the implementation of Wi-Fi 6 (802.11ax) technology in high-density venues such as sports stadiums or airports.
- LTE Network Optimization in Rural India Objective: Explore how LTE (Long Term Evolution) networks are being optimized to provide reliable and affordable mobile data services in rural areas of India
- Googles Project Loon-providing internet access via balloons Objective: Investigate Google's Project Loon, which aims to provide internet access to remote and underserved areas through high-altitude balloons

Micro project

- Comparative Study of 4G vs. 5G Network Performance
- Indoor Positioning System for Smartphones Using Wireless Networks
- Improving Mobile Network Connectivity in Remote Areas
- Development of a Mobile App for Real-time Traffic Monitoring Using Wireless Networks
- Prepare report on : Exploring the Transition from 5G to 5.5G - Technological Advancements and Future Prospects
- Prepare report on: 5.5G and Beyond- A Vision for the Future of Telecommunication Networks

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Wireshark Software	12
2	RFID Kit	16
3	MATLAB/Simulink (student version) Tool	2,17,24
4	Octave or Scilab(Free alternative to MATLAB)	2,17,24
5	Cupcarbon Software	25
6	NetSpot Software	26
7	NS3 Network simulator or OMNeT++ (with OMNet 6.1 IDE for windows) Network simulator	27

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
8	Cisco Packet Tracer	28
9	Device Info HW-Mobile application	3
10	D-Link Wi-Fi Access Points	7,8,14
11	Mobile devices (Handsets)-Bluetooth and Wi-Fi enabled	All
12	Computer System-Bluetooth and Wi-Fi enabled	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to GSM	CO1	8	4	6	2	12
2	II	GPRS and Mobile Data communication	CO2	8	4	6	6	16
3	III	Wireless application protocols and 3G mobile services	CO3	8	4	4	4	12
4	IV	Introduction to 5G Technology	CO4	9	4	6	4	14
5	V	Wireless Network Technologies	CO5	12	6	6	4	16
Grand Total				**45**	**22**	**28**	**20**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Continuous assessment based on process and product related performance indicators.
- Each practical will be assessed considering 60% weightage to process, 40% weightage to product.
- A continuous assessment based term work.

Summative Assessment (Assessment of Learning)

- End Semester Examination

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	-	1	2	1	2			
CO2	3	-	3	2	3	1	2			
CO3	3	-	-	2	2	1	3			
CO4	3	-	2	3	3	3	3			
CO5	3	2	2	3	2	3	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

WIRELESS AND MOBILE NETWORK **Course Code : 316325**

Sr.No	Author	Title	Publisher with ISBN Number
1	Theodore S. Rappaport	Wireless Communications Principles & Practice	Pearson Education India : 2nd edition (1January 2010), ISBN : 978-8131731864
2	Lin YI-Bang, Clamtac Emrich	Wireless and Mobile Network Architecture	John Wiley & Sons, New Delhi, 2001 ISBN 978-81-265-1560-8
3	William C.Y. Lee	Mobile Cellular Telecommunications	McGraw Hill Education (India) Private Limited. ISBN : 978-0070635999
4	T.L.Singal	Wireless Communications	McGraw Hill Education (1 July 2017)(India) Private Limited,ISBN : 978-0070681781

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.ericsson.com/en/reports-and-papers/white-papers/advanced-antenna-systems-for-5g-networks	5G-networks
2	https://mobilepacketcore.com/lte-4g-network-architecture/	LTE 4G architecture
3	https://www.linkedin.com/pulse/applications-5g-technology-ramya-chandran-swprc	Applications of 5G
4	https://www.spirent.com/products/automated-wireless-testing-wi-fi-5g	Wi-Fi Testing
5	https://mobilepacketcore.com/lte-4g-network-architecture/	4G architecture

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Cloud Computing and Big Data/ Computer Technology/ Computer Engineering/ Computer Software Technology/ Computer Science & Engineering/ Data Sciences/ Computer Hardware & Maintenance/ Information Technology/ Computer Science & Information Technology/ Computer Science/**
Programme Code	**: AI/ AN/ BD/ CM/ CO/ CST/ CW/ DS/ HA/ IF/ IH/ SE**
Semester	**: Sixth**
Course Title	**: REST FUL WEB DESIGNING AND INTERNET DATA EXCHANGE**
Course Code	**: 316375**

I. RATIONALE

In the rapidly evolving web landscape, dynamic, platform-independent RESTful Web Services and efficient Internet Data Exchange have become essential for developing modern web-based applications. Knowledge of RESTful Web Services Development and Internet Data Exchange using Python is increasingly important for Computer Engineering diploma graduates. Technologies such as JSON, XML, Flask/FastAPI, Java with Spring Boot, Node.js, and MySQL are widely used in contemporary web development and provide a strong foundation for building scalable, dynamic, and platform-independent applications.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Develop platform independent web based applications using RESTful Web Services, Internet data exchange, JSON, database and modern web development framework.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Identify REST architecture, web services and HTTP methods.
- CO2 - Develop and test basic REST APIs.
- CO3 - Design REST resources using JSON and XML.
- CO4 - Use AJAX to consume and process REST APIs.
- CO5 - Describe API platform, data access and API management.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
316375	REST FUL WEB DESIGNING AND INTERNET DATA EXCHANGE	RWD	DSE	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Explain REST architecture and Web Services. TLO 1.2 Apply HTTP methods, URI and RESTful resources. TLO 1.3 Exchange data using JSON/XML and REST API clients.	**Unit - I Introduction to REST Fundamentals** 1.1 Programmable Web, Web Services and REST Architecture – Programmable Web, Web Services, client-server architecture, REST architecture, REST principles, REST constraints, REST vs SOAP, advantages and applications of REST 1.2 HTTP Methods, Request–Response Cycle, RESTful Resources and URI – HTTP, request and response messages, HTTP methods (GET, POST, PUT, PATCH, DELETE), status codes, headers, RESTful resources, URI, URL, path parameters and query parameters 1.3 Data Exchange, REST API Clients and HTTP Libraries – Data exchange concepts, JSON, XML, JSON/XML structure and parsing, REST API clients, Postman, cURL, HTTP libraries, Fetch API and consuming REST APIs	Demonstration Hands-on Lecture Using Chalk-Board
2	TLO 2.1 Develop and test basic REST APIs. TLO 2.2 Explain resource-oriented architecture and resources. TLO 2.3 Apply URI, addressability and statelessness.	**Unit - II RESTful Services** 2.1 REST API Request–Response Handling, Description and Testing – Basic REST API request/response handling, API endpoints, request body, response body, error handling, status codes, API description, OpenAPI/Swagger, API testing using Postman 2.2 Resource-Oriented Architecture and Resources – Resource-oriented architecture, resources, data sets and resource identification 2.3 URI, Addressability and Statelessness – URI, resource naming, addressability and stateless communication	Presentations Hands-on Demonstration Flipped Classroom

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Explain resource representations using JSON and XML. TLO 3.2 Describe links, connectedness and uniform interface in REST. TLO 3.3 Design read-only and read/write REST resources. TLO 3.4 Interpret HTTP responses and represent user accounts as resources.	**Unit - III RESTful Services and HTTP Methods Status Codes** 3.1 Resource Representations – Meaning of resource representation, JSON and XML formats, conversion of resources into representations, and selecting suitable representations for clients 3.2 Links, Connectedness and Uniform Interface – Hypermedia links, linking related resources, navigation between resources, connectedness, resource-based URLs, and standard HTTP methods such as GET, POST, PUT and DELETE 3.3 Resource Design and Read/Write Services – Identifying resources, designing resource URIs, defining resource attributes and relationships, designing read-only resources using GET, and read/write resources using POST, PUT and DELETE 3.4 HTTP Responses and User Accounts as Resources – HTTP status codes, response headers and body, success and error responses, handling client/server errors, and representing user accounts as REST resources	Hands-on Presentations Demonstration
4	TLO 4.1 Explain Ajax architecture and its benefits. TLO 4.2 Use Ajax as a REST client. TLO 4.3 Handle REST API responses using Ajax TLO 4.4 Process JSON data using Ajax.	**Unit - IV Applications as REST Clients** 4.1 AJAX and Ajax Architecture – Introduction, Ajax architecture, evolution from AJAX to Ajax, advantages and limitations 4.2 Ajax as a REST Client – REST integration, making REST requests and client-server communication 4.3 Handling REST Responses – Receiving, processing and handling REST API responses 4.4 JSON Data Exchange – JSON format, receiving and processing JSON data in Ajax applications	Presentations Demonstration Hands-on
5	TLO 5.1 Explain API platform architecture and its capabilities. TLO 5.2 Describe data handlers and Data Access Objects. TLO 5.3 Describe API management, life cycle, retirement and monetization.	**Unit - V API Platform, Data Handler and API Management** 5.1 API Platform Architecture – Need and role of an API platform, its capabilities, organization, architecture, and integration with enterprise technical architecture 5.2 Data Handler and Data Access – Data handler concepts, Data Access Object (DAO), data access operations, and separation of data access responsibilities 5.3 API Management and Life Cycle – API management, API life cycle, API retirement, API client interaction, and API monetization	Demonstration Presentations Hands-on Flipped Classroom

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Perform REST operations using HTTP methods and RESTful URIs.	1	*Create and test GET, POST, PUT and DELETE requests using Postman/cURL and observe URI, headers, request and response.	2	CO1
LLO 2.1 Create and parse JSON/XML data for REST API data exchange.	2	* Create, read and parse JSON and XML data containing student information.	2	CO1
LLO 3.1 Consume and display REST API data using Fetch API.	3	Consume a REST API using Fetch API and display the response data on a web page.	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Test REST API requests and responses using Postman and status codes.	4	*Create/test REST API endpoints using Postman, including request/response body, status codes and basic error handling.	2	CO2
LLO 5.1 Identify and design resources for a RESTful application.	5	* Design REST resources for a simple application such as Student Management System and identify datasets and resources.	2	CO2
LLO 6.1 Design addressable resources using appropriate URIs and stateless communication.	6	Design suitable URIs for REST resources and demonstrate stateless communication using HTTP requests.	2	CO2
LLO 7.1 Create and process REST resource representations using JSON/XML.	7	* Create student/customer resource data in JSON and XML, convert resources into representations, and display the data.	2	CO3
LLO 8.1 Implement read-only and read/write REST services using appropriate HTTP methods.	8	* Design RESTful URIs and implement GET, POST, PUT and DELETE operations for a simple application such as Student Management.	2	CO3
LLO 9.1 Demonstrate connected REST resources using links and resource-based URLs.	9	Create related resources such as Student–Course and use hyperlinks/URIs to navigate between them.	2	CO3
LLO 10.1 Send REST requests using AJAX for client-server communication.	10	* Create a simple AJAX application to send GET/POST requests to a REST API without reloading the web page.	2	CO4
LLO 11.1 Receive and process REST API responses using AJAX.	11	Receive REST API responses using AJAX and display the response data dynamically on a web page.	2	CO4
LLO 12.1 Parse and display JSON data received from a REST API.	12	Fetch JSON data from a REST API using AJAX, parse it, and display selected data in HTML.	2	CO4
LLO 13.1 Demonstrate the basic architecture and components of an API platform.	13	* Design a basic API platform architecture showing client, API, server, database and their interactions.	2	CO5
LLO 14.1 Implement database operations using the DAO pattern	14	Create a simple application using the Data Access Object (DAO) pattern to perform database operations such as insert, update, retrieve and delete.	2	CO5
LLO 15.1 Demonstrate basic API management and life-cycle operations.	15	Create and document a simple REST API and demonstrate API creation, testing, versioning and retirement using an API management/testing tool.	2	CO5
LLO 16.1 Identify the requirements of an AI-based RESTful API Assistant.	16	* Develop a RESTful API-based AI Assistant that accepts user queries and provides suitable responses.	2	CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

Assignment

- Solve assignment covering all COs given by course teacher.

Micro project

- Online Examination REST API: Develop a REST API for an online examination system. The API can provide questions, accept student answers and return examination results. JSON can be used for exchanging questions, answers and result data between the client and server.
- Library Book Management REST API: Create a REST API to manage library books. The system should maintain book ID, title, author, category and availability status. Students can implement APIs to *add books, search books, update availability and delete book records.
- Hospital Appointment REST API: Develop a RESTful web service for managing doctor appointments. The system can maintain patient name, doctor name, appointment date, time and status. APIs can be created to book, view, update and cancel appointments* using JSON data.
- Student Management REST API: Develop a REST API to manage student information such as student ID, name, branch, semester and marks. The API should provide operations to *add, view, update and delete* student records using HTTP methods such as GET, POST, PUT and DELETE.
- Online Restaurant Menu REST API: Develop a RESTful API for managing restaurant menu items. The API can store item name, category, price and availability. Users can retrieve menu details, add new items, update prices and remove unavailable items using REST API operations.

Other

- Complete any course of RESTFUL WEB DESIGNING AND INTERNET DATA EXCHANGE on Infosys Springboard/Spoken Tutorial/NPTEL 2. Develop APIs using RESTful architecture, HTTP methods, JSON/XML, and AJAX for data exchange.

Note :

- Above is just a suggestive list of microprojects and assignments; faculty must prepare their own bank of microprojects, assignments, and activities in a similar way.
- The faculty must allocate judicial mix of tasks, considering the weaknesses and / strengths of the student in acquiring the desired skills.
- If a microproject is assigned, it is expected to be completed as a group activity.
- SLA marks shall be awarded as per the continuous assessment record.
- For courses with no SLA component the list of suggestive microprojects / assignments/ activities are optional, faculty may encourage students to perform these tasks for enhanced learning experiences.
- If the course does not have associated SLA component, above suggestive listings is applicable to Tutorials and maybe considered for FA-PR evaluations.

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Hardware Requirements: Computer systems with minimum Intel Core i3/equivalent processor, 8 GB RAM, 256 GB SSD, standard peripherals and LAN/Internet connectivity. A local or dedicated application server may be configured as required.	All
2	Software Requirements: Windows 10/11 or Linux operating system; Visual Studio Code or equivalent code editor; Google Chrome or any modern web browser; Node.js with Express.js; SQLite or MySQL database; JavaScript, JSON and basic HTML support; and internet access. Git/GitHub or equivalent version control: Postman or cURL for API testing	All

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to REST Fundamentals	CO1	8	4	4	6	14
2	II	RESTful Services	CO2	8	4	4	4	12

REST FUL WEB DESIGNING AND INTERNET DATA EXCHANGE **Course Code : 316375**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
3	III	RESTful Services and HTTP Methods Status Codes	CO3	12	4	4	8	16
4	IV	Applications as REST Clients	CO4	8	4	4	6	14
5	V	API Platform, Data Handler and API Management	CO5	9	2	6	6	14
Grand Total				**45**	**18**	**22**	**30**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Continuous assessment based on process and product related performance indicators. Each practical will be assessed considering 1) 60% weightage is to process 2) 40% weightage to product

Summative Assessment (Assessment of Learning)

- End Semester Examination, Lab Performance, Viva-voce

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	1	1	-	2	1			
CO2	3	3	3	3	-	2	1			
CO3	3	3	3	3	-	2	1			
CO4	3	3	3	3	-	2	1			
CO5	3	2	2	3	-	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Leonard Richardson and Sam Ruby	RESTful Web Services	Publisher: O'Reilly Media, 2013 Print ISBN-13: 978-1-4493-5806-8
2	Mike Amundsen	RESTful Web API Patterns and Practices Cookbook	O'Reilly Media Indian edition ISBN: 9789355421845
3	Sanjay Patni	Pro RESTful APIs with Micronaut: Build Java-Based Microservices with REST, JSON, and XML	Publisher: Apress Latest Edition: 3rd Edition, 2025 ISBN: 979-8-8688-1243-9

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description

REST FUL WEB DESIGNING AND INTERNET DATA EXCHANGE **Course Code : 316375**

Sr.No	Link / Portal	Description
1	https://www.w3schools.com/nodejs/nodejs_rest_api.asp	Restful webservice Designing
2	https://www.geeksforgeeks.org/node-js/rest-api-introduction/	REST API Introduction
3	https://www.tutorialspoint.com/restful/index.htm	RESTful Web Services Tutorial

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students