Maharashtra State Board Of Technical Education, Mumbai

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

Programme Name : Diploma In Artificial Intelligence / Artificial Intelligence and Machine Learning / Data Sciences

Programme Code : AI / AN / DS | **With Effect From Academic Year** : 2023-24

Duration Of Programme : 6 Semester | **Duration** : 16 WEEKS

Semester : Fourth | **NCrF Entry Level : 3.5** | **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	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	314301	2	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125
2	JAVA PROGRAMMING	JPR	AEC	314317	-	4	-	4	2	10	5	3	30	70	100	40	25	10	50#	20	25	10	200
3	DATA COMMUNICATION AND COMPUTER NETWORK	DCN	DSC	314318	-	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175
4	MATHEMATICS FOR MACHINE LEARNING	MML	AEC	314320	-	4	-	2	-	6	3	3	30	70	100	40	25	10	25@	10	-	-	150
5	MICROPROCESSOR PROGRAMMING	MIC	DSC	314321	-	3	-	2	1	6	3	3	30	70	100	40	25	10	25@	10	25	10	175
6	UI/UX DESIGN	UID	SEC	314005	-	1	-	4	1	6	3	-	-	-	-	-	25	10	25@	10	25	10	75
Total					**2**	**18**		**16**	**6**		**20**		**150**	**350**	**500**		**125**		**150**		**125**		**900**

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/ Fashion & Clothing Technology/ Dress Designing & Garment Manufacturing/ 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/ Hotel Management & Catering Technology/ Instrumentation & Control/ 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/ Metallurgical Engineering/ Production Engineering/ Printing Technology/ Polymer Technology/ Surface Coating Technology/ Computer Science/ Textile Technology/ Electronics & Computer Engg./ Travel and Tourism/ Textile Manufactures**
Programme Code	**: AA/ AD/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CST/ CW/ DC/ DD/ DE/ DS/ EE/ EJ/ EK/ EP/ ET/ EX/ FC/ HA/ HM/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ ML/ MRT/ MU/ MY/ PG/ PN/ PO/ SC/ SE/ TC/ TE/ TR/ TX**
Semester	**: Fourth / Sixth**
Course Title	**: ENVIRONMENTAL EDUCATION AND SUSTAINABILITY**
Course Code	**: 314301**

I. RATIONALE

The survival of human beings is solely depending upon the nature. Thus, threats to the environment directly impact on existence and health of humans as well as other species. Depletion of natural resources and degradation of ecosystems is accelerated due to the growth in industrial development, population growth, and overall growth in production demand. To address these environmental issues, awareness and participation of individuals as well as society is necessary. Environmental education and sustainability provide an integrated, and interdisciplinary approach to study the environmental systems and sustainability approach to the diploma engineers.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Resolve the relevant environmental issue through sustainable solutions

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Identify the relevant Environmental issues in specified locality.
- CO2 - Provide the green solution to the relevant environmental problems.
- CO3 - Conduct SWOT analysis of biodiversity hotspot
- CO4 - Apply the relevant measures to mitigate the environmental pollution.
- CO5 - Implement the environmental policies under the relevant legal 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	
314301	ENVIRONMENTAL EDUCATION AND SUSTAINABILITY	EES	VEC	3	-	-	1	4	2	1.5	30	70*#	100	40	-	-	-	-	25	10	125

Total IKS Hrs for Sem. : 2 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.

ENVIRONMENTAL EDUCATION AND SUSTAINABILITY **Course Code : 314301**

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 the need of studying environment and its components. TLO 1.2 Investigate the impact of population growth and industrialization on the relevant environmental issues and suggest remedial solutions TLO 1.3 Explain the Concept of 5 R w.r.t. the given situation TLO 1.4 Elaborate the relevance of Sustainable Development Goals in managing the climate change TLO 1.5 Explain the concept of zero carbon-footprint with carbon credit	**Unit - I Environment and climate change** 1.1 Environment and its components, Types of Environments, Need of environmental studies 1.2 Environmental Issues- Climate change, Global warming, Acid rain, Ozone layer depletion, nuclear accidents. Effect of population growth and industrialization 1.3 Concept of 5R, Individuals' participation in i) 5R policy, ii) segregation of waste, and iii) creating manure from domestic waste 1.4 Impact of Climate change, Factors contributing to climate change, Concept of Sustainable development, Sustainable development Goals (SDGs), Action Plan on Climate Change in Indian perspectives 1.5 Zero Carbon footprint for sustainable development, (IKS-Enviornment conservation in vedic and pre-vedic India)	Lecture Using Chalk-Board Presentations
2	TLO 2.1 Justify the importance of natural resources in sustainable development TLO 2.2 Explain the need of optimum use of natural resources to maintain the sustainability TLO 2.3 Differentiate between renewable and non-renewable sources of energy TLO 2.4 Suggest the relevant type of energy source as a green solution to environmental issues	**Unit - II Sustainability and Renewable Resources** 2.1 Natural Resources: Types, importance, Causes and effects of depletion. (Forest Resources, Water Resources, Energy Resources, Land resources, Mineral resources), (IKS-Concepts of Panchmahabhuta) 2.2 Impact of overexploitation of natural resources on the environment, optimum use of natural resources 2.3 Energy forms (Renewable and non-renewable) such as Thermal energy, nuclear energy, Solar energy, Wind energy, Geothermal energy, Biomass energy, Hydropower energy, biofuel 2.4 Green Solutions in the form of New Energy Sources such as Hydrogen energy, Ocean energy & Tidal energy	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.
3	TLO 3.1 Explain the characteristics and functions of ecosystem TLO 3.2 Relate the importance of biodiversity and its loss in the environmental sustainability TLO 3.3 Describe biodiversity assessment initiatives in India TLO 3.4 Conduct the SWOT analysis of the biodiversity hot spot in India TLO 3.5 Explain the need of conservation of biodiversity in the given situation	**Unit - III Ecosystem and Biodiversity** 3.1 Ecosystem - Definition, Aspects of ecosystem, Division of ecosystem, General characteristics of ecosystem, Functions of ecosystem 3.2 Biodiversity - Definitions, Levels, Value, and loss of biodiversity 3.3 Biodiversity Assessment Initiatives in India 3.4 SWOT analysis of biodiversity hot spot in India 3.5 Conservations of biodiversity - objects, and laws for conservation of biodiversity	Lecture Using Chalk-Board Presentations Video Demonstrations
4	TLO 4.1 Classify the pollution based on the given criteria TLO 4.2 Justify the need of preserving soil as a resource along with the preservation techniques TLO 4.3 Maintain the quality of water in the given location using relevant preventive measures TLO 4.4 State the significance of controlling the air pollution to maintain its ambient quality norms TLO 4.5 Compare the noise level from different zones of city with justification TLO 4.6 Describe the roles and responsibilities of central and state pollution control board	**Unit - IV Environmental Pollution** 4.1 Definition of pollution, types- Natural & Artificial (Man- made) 4.2 Soil / Land Pollution – Need of preservation of soil resource, Causes and effects on environment and lives, preventive measures, Soil conservation 4.3 Water Pollution - sources of water pollution, effects on environment and lives, preventive measures, BIS water quality standards for domestic potable water, water conservation 4.4 Air pollution - Causes, effects, prevention, CPCB norms of ambient air quality in residential area 4.5 Noise pollution - Sources, effects, prevention, noise levels at various zones of the city 4.6 Pollution Control Boards at Central and State Government level: Norms, Roles and Responsibilities	Lecture Using Chalk-Board Presentations
5	TLO 5.1 Explain Constitutional provisions related to environmental protection TLO 5.2 Explain importance of public participation (PPP) in enacting the relevant laws TLO 5.3 Use the relevant green technologies to provide sustainable solutions of an environmental problem TLO 5.4 Explain the role of information technology in environment protection	**Unit - V Enviornmental legislation and sustainable practices** 5.1 Article (48-A) and (51-A (g)) of Indian Constitution regarding environment, Environmental protection and prevention acts 5.2 Public awareness about environment. Need of public awareness and individuals' participation. Role of NGOs 5.3 Green technologies like solar desalination, green architecture, vertical farming and hydroponics, electric vehicles, plant-based packaging 5.4 Role of information technology in environment protection and human health	Lecture Using Chalk-Board Presentations Video Demonstrations

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

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Suggest the steps to implement (or improve the implementation) of the 5R policy in your home/institute stating your contribution
Draft an article on India's Strategies to progress across the Sustainable Development Goals
Make a chart of Renewable and non-renewable energy sources mentioning the advantages and disadvantages of each source
Conduct the SWOT analysis of biodiversity hotspot in India
Prepare a mind-mapping for the zero carbon footprint process of your field
Prepare a chart showing sources of pollution (air/water/ soil), its effect on human beings, and remedial actions
Any other assignment on relevant topic related to the course suggested by the facilitator

UNICEF Certification(s)

- Students may complete the self-paced course launched by Youth Leadership for climate Exchange under UNICEF program on portal www.mahayouthnet.in . The course encompasses five Modules in the form of Units as given below: -

Unit 1: Living with climate change
Unit 2 : Water Management and Climate Action
Unit 3: Energy Management and Climate Action
Unit 4 : Waste Management and Climate Action
Unit 5 : Bio-cultural Diversity and Climate Action
If students complete all the five Units they are not required to undertake any other assignment /Microproject/activities specified in the course. These units will suffice to their evaluations under SLA component

Micro project

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Technical analysis of nearby commercial RO plant.
Comparative study of different filters used in Household water filtration unit
Evaluate any nearby biogas plant / vermicomposting plant or any such composting unit on the basis of sustainabilityand cost-benefit
IKS-Study and prepare a note on Vedic and Pre-Vedic techniques of environmental conversion
Visit a local polluted water source and make a report mentioning causes of pollution
Any other activity / relevant topic related to the course suggested by the facilitator

Activities

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Prepare a report on the working and functions of the PUC Center machines and its relavance in pollution control.
Prepare and analyse a case study on any polluted city of India
Prepare a note based on the field visit to the solid waste management department of the municipal corporation / local authority

Record the biodiversity of your institute/garden in your city mentioning types of vegetation and their numbers
Visit any functional hall/cultural hall /community hall to study the disposal techniques of kitchen waste and prepare a report suggesting sustainable waste management tool
Watch a video related to air pollution in India and present the summary
Any other assignment on relevant topic related to the course suggested by the facilitator

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	Nil	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	Environment and climate change	CO1	8	4	4	4	12
2	II	Sustainability and Renewable Resources	CO2	10	4	4	8	16
3	III	Ecosystem and Biodiversity	CO3	8	4	4	4	12
4	IV	Environmental Pollution	CO4	12	4	8	6	18
5	V	Enviornmental legislation and sustainable practices	CO5	7	4	4	4	12
Grand Total				**45**	**20**	**24**	**26**	**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 considered. Formative assessment of self learning of 25 marks should be assessed based on self learning activity such as UNICEF Certification(s)/Microproject/assignment/activities. (60 % weightage to process and 40 % to product)

Summative Assessment (Assessment of Learning)

- 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	-	1	-	-	3	2	3			
CO2	-	2	2	-	3	2	3			
CO3	-	-	-	-	3	1	2			
CO4	1	-	-	-	3	2	2			
CO5	1	-	2	-	3	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	Y. K. Singh	Environmental Science	New Age International Publishers, 2006, ISBN: 81-224-2330-2
2	Erach Bharucha	Environmental Studies	University Grants Commission, New Delhi
3	Rajagopalan R.	Environmental Studies: From Crisis to Cure.	Oxford University Press, USA, ISBN: 9780199459759, 0199459754
4	Shashi Chawla	A text book of Environmental Science	Tata Mc Graw-Hill New Delhi
5	Arvind Kumar	A Text Book of Enviornmental science	APH Publishing New Delhi (ISBN 978-8176485906)

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://sdgs.un.org/goals	United Nation’s website mentioning Sustainability goals
2	http://www.greenbeltmovement.org/news-and-events/blog	Green Belt Movement Blogs on various climatic changes and other issues
3	http://www.greenbeltmovement.org/what-we-do/tree-planting-fo r-watersheds	Green Belt Movement's work on tree plantation, soil conservation and watershed management techniques

Sr.No	Link / Portal	Description
4	https://www.youtube.com/@ierekcompany/videos	International Experts For Research Enrichment and Knowledge Exchange – IEREK's platform to exchange the knowledge in fields such as architecture, urban planning, sustainability
5	www.mahayouthnet.in	UNICEF Intiative for youth leadership for climate action
6	https://eepmoefcc.nic.in/index1.aspx?lsid=297&lev=2&lid=1180&langid=1	GOI Website for public awareness on enviornmetal issues
7	https://egyankosh.ac.in/handle/123456789/61136	IGNOU's Intiative for online study material on Enviornmental studies
8	https://egyankosh.ac.in/handle/123456789/50898	IGNOU's Intiative for online study material on sustainability
9	https://sustainabledevelopment.un.org/content/documents/11803Official-List-of-Proposed-SDG-Indicators.pdf	Final list of proposed Sustainable Development Goal indicators
10	https://sustainabledevelopment.un.org/memberstates/india	India’s Strategies to progress across the SDGs.
11	https://www.un.org/en/development/desa/financial-crisis/sustainable-development.html	Challenges to Sustainable Development
12	https://nptel.ac.in/courses/109105190	NPTEL course on sustainable development
13	https://onlinecourses.swayam2.ac.in/cec19_bt03/preview	Swayam Course on Enviornmetal studies (Natural Resources, Biodiversity and other topics)
14	https://onlinecourses.nptel.ac.in/noc23_hs155/preview	NPTEL course on enviornmental studies which encomopasses SDGs, Pollution, Cliamate issues, Energy, Policies and legal framework
15	https://www.cbd.int/development/meetings/egmbped/SWOT-analysis-en.pdf	SWOT analysis of Biodiversity
16	https://www.sanskrit.nic.in/SVimarsha/V2/c17.pdf	Central sanskrkit university publication on Vedic and pre vedic enviornmetal conservation

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/ Electronics & Computer Engg.**
Programme Code	**: AI/ AN/ BD/ CM/ CO/ CST/ CW/ DS/ HA/ IF/ IH/ SE/ TE**
Semester	**: Fourth**
Course Title	**: JAVA PROGRAMMING**
Course Code	**: 314317**

I. RATIONALE

Java is platform independent, open-source object-oriented programming language and used for web applications. Java has the broad industry support and is prerequisite with many allied technologies like Java Server Pages, Android Application Development. This course will enable students to develop applications using java.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Develop standalone and network-based applications using Java.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Develop java program using classes and objects.
- CO2 - Develop java program for implementing code reusability concept.
- CO3 - Develop program to implement multithreading and exception handling.
- CO4 - Develop java program for implementing event handling using window-based application components.
- CO5 - Implements network programming in java.
- CO6 - Develop java program for managing database.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
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															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
314317	JAVA PROGRAMMING	JPR	AEC	4	-	4	2	10	5	3	30	70	100	40	25	10	50#	20	25	10	200

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

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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 Write programs to create classes and objects for the given problem. TLO 1.2 Describe characteristics of the given java token. TLO 1.3 Write program to evaluate given expressions. TLO 1.4 Write programs using relevant control structure to solve the given problem. TLO 1.5 Develop programs using vectors and wrapper classes for the given problem. TLO 1.6 Use constructors for the given programming problem.	**Unit - I Basic Syntactical Constructs in Java** 1.1 Java features and the Java programming environment 1.2 Defining a class, creating object, accessing class members 1.3 Java tokens and data types, symbolic constant, scope of variable, typecasting, and different types of operators and expressions, decision making and looping statements 1.4 Arrays, strings, string buffer classes, vectors, wrapper classes 1.5 Constructors and methods, types of constructors, method and constructor overloading, nesting of methods, command line arguments, garbage collection, visibility control: public, private, protected, default, private protected	Chalk-Board Demonstration 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.
2	TLO 2.1 Apply identified type of inheritance for the given programming problem. TLO 2.2 Differentiate between overloading and overriding with the help of examples. TLO 2.3 Develop program using interface. TLO 2.4 Create user defined package for the given problem.	**Unit - II Inheritance, Interface and Packages** 2.1 Inheritance: concept of inheritance , types of Inheritance: single inheritance, multilevel inheritance, hierarchical inheritance, method overriding, final variables, final methods, use of super, abstract methods and classes 2.2 Interfaces: Define interface, implementing interface, accessing interface variables and methods, extending interfaces 2.3 Package: Define package, types of package, naming and creating package, accessing package, import statement, static import, adding class and interfaces to a package	Lecture Using Chalk-Board Presentations Hands-on Flipped Classroom
3	TLO 3.1 Distinguish the errors and exceptions with example. TLO 3.2 Develop program for handling the given exception. TLO 3.3 Create threads to run multiple processes in a program. TLO 3.4 Develop program using different thread life cycle methods.	**Unit - III Exception Handling and Multithreading** 3.1 Errors and Exception: Types of errors and exceptions, try and catch statement, throws and finally statement, built-in exceptions, throwing our own exception 3.2 Multithreaded programming : creating a thread: By extending to thread class and by implementing runnable Interface, Life cycle of thread: Thread methods, thread exceptions, thread priority and methods, synchronization	Lecture Using Chalk-Board Presentations Flipped Classroom Hands-on
4	TLO 4.1 Write steps to develop Graphical User Interface (GUI) using AWT components with frame for the given problem. TLO 4.2 Develop program using menu and dialog boxes for the given problem. TLO 4.3 Write steps to develop Graphical user interface (GUI) using advanced swing components for the given problem. TLO 4.4 Use delegation event model to develop event driven program for the given problem. TLO 4.5 Use relevant AWT/ Swing component(s) to handle the given event.	**Unit - IV Event handling using Abstract Window Toolkit (AWT) & Swings Components** 4.1 Component, container, window, frame, panel, use of AWT controls: labels, buttons, checkbox, checkbox group, textfield, textarea 4.2 Use of layout managers: flowLayout, borderLayout, gridLayout, gridBagLayout, menubars, menus, file dialog 4.3 Introduction to swing: Swing features, difference between AWT and Swing. 4.4 Swing components: Icons and Labels, TextField, ComboBox, Button, Checkbox, RadioButton 4.5 Advanced Swing Components: Tabbed Panes, Scroll Panes, Trees, Tables, Progress bar, tool tips 4.6 Introduction to Event Handling: The delegation Event Model: Event sources, Event listeners 4.7 Event classes: The action event class, the Item event class, the Key event class, the mouse event class, text event 4.8 Event listener interfaces: ActionListener , ItemListener , KeyListener , MouseListener , MouseMotion , TextListener	Lecture Using Chalk-Board Presentations Demonstration 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 Describe the concepts of sockets in java. TLO 5.2 Use networking classes to retrieve host details. TLO 5.3 Develop program for Client/Server communication through TCP/IP Server sockets for the given problem.	**Unit - V Basics of Network Programming** 5.1 Socket Overview: Client/Server , reserved Sockets , proxy servers , Internet Addressing 5.2 Java and the Net: The networking classes and interfaces, InetAddress : Factory Methods , Instance Methods 5.3 TCP/IP Client and Server Sockets, datagram sockets, datagram packets 5.4 The URL Class, URLConnection class	Lecture Using Chalk-Board Presentations Flipped Classroom Hands-on
6	TLO 6.1 Choose relevant database connectivity methods. TLO 6.2 Describe two tier and three tier architecture of JDBC. TLO 6.3 Choose relevant type of JDBC driver for the specified environment. TLO 6.4 Elaborate steps with example to establish connectivity with the specified database.	**Unit - VI Interacting with Database** 6.1 Introduction to JDBC, ODBC 6.2 JDBC architecture: Two tier and three tier models 6.3 Types of JDBC drivers, Class Class , DriverManager class, Connection interface, Statement interface, PreparedStatement interface, ResultSet Interface	Lecture Using Chalk-Board Presentations Flipped Classroom 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 Install any IDE software application.	1	* Setup Java Programming development environment using: • Command prompt.(Classpath and path setup) • Any IDE (Eclipse, Netbeans, VScode, Jcreator etc.).	2	CO1
LLO 2.1 Implement programs to evaluate different types of Expressions.	2	Write programs to evaluate different types of expressions.	2	CO1
LLO 3.1 Develop program to implement different control structures.	3	Write programs to demonstrate use of: • if statements (all forms of if statement • Switch – Case statement • Different types of Loops(for,while and do..while).	2	CO1
LLO 4.1 Develop program to implement different control structures.	4	*Write programs for implementation of different methods of: • String class. • StringBuffer class.	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 5.1 Implement array and vectors in Java.	5	* Write programs to demonstrate: • Use of Array. • Use of Vectors .	2	CO1
LLO 6.1 Convert primitive data types into object and vice-versa.	6	Write programs using Wrapper Class : • to convert primitive into object. • to convert object into primitive.	2	CO1
LLO 7.1 Initialize objects using constructors.	7	Develop a program for implementation of different types of constructors.	2	CO1
LLO 8.1 Implement concepts of inheritance for code reusability.	8	Develop program to implement: • Single inheritance. • Multilevel inheritance.	2	CO2
LLO 9.1 Implement multiple inheritance.	9	* Develop program for implementation of interface.	2	CO2
LLO 10.1 Implement packages in Java.	10	*Write programs to demonstrate use of : • Built in packages • User defined packages.	2	CO2
LLO 11.1 Identify the different types of errors using exception handling.	11	Write programs for implementation of try, catch and finally block.	2	CO3
LLO 12.1 Manage different types of user defined exceptions.	12	*Write programs for implementation of throw, throws clause.	2	CO3
LLO 13.1 Execute different processes simultaneously using multithreading.	13	*Write programs using multithreading.	2	CO3
LLO 14.1 Design GUI using different AWT components.	14	* Write program to design any type of form using AWT components.	2	CO4
LLO 15.1 Design GUI using different menu class.	15	Write program to create a menu bar with various menu items and sub menu items.	2	CO4
LLO 16.1 Design GUI using border layout manager.	16	Write program to demonstrate the use of border layout. The layout shows four buttons at four sides with captions “left”, “right”, “top” and “bottom” using Swing Components.	2	CO4
LLO 17.1 Design GUI using grid layout manager.	17	*Write program to design a calculator to demonstrate the use of grid layout using swing components.	2	CO4
LLO 18.1 Implement swing components in a frame.	18	Write program using swing to display a JComboBox in a JFrame .	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 19.1 Design tree and table using advanced swing components in a frame.	19	Write program to create JTree and JTable.	2	CO4
LLO 20.1 Implement various keys and mouse events.	20	* Write program to handle key events and mouse events.	2	CO4
LLO 21.1 Implement action event in java.	21	*Write program to implement action event in frame using swing components.	2	CO4
LLO 22.1 Implement text event in java.	22	Write program to handle text event on swing components.	2	CO4
LLO 23.1 Extract the hostname and IP address using InetAddress class.	23	Write program to retrieve hostname and IP address using InetAddress class.	2	CO5
LLO 24.1 Retrieve various components of URL using different methods of URL and URLConnection class.	24	*Write program to demonstrate various methods of: • URL class. • URLConnection.	2	CO5
LLO 25.1 Implement client-server TCP based communication.	25	*Write program that demonstrates connection oriented communication using socket.	2	CO5
LLO 26.1 Implement client-server UDP based communication.	26	Write program to demonstrate sending and receiving data through datagram.	2	CO5
LLO 27.1 Make database connectivity using appropriate JDBC driver.	27	*Write program to: • Create sample database. • Make connectivity with database.	2	CO6
LLO 28.1 Manage database using JDBC.	28	*Write program to implement following operations on database: • Insert record. • Update record. • Delete record.	2	CO6
LLO 29.1 Manage database using JDBC.	29	Write program to demonstrate the use of PreparedStatement.	2	CO6
LLO 30.1 Implement dynamic query.	30	*Write program to retrieve data from table using ResultSet interface.(Use various methods of navigation methods).	2	CO6

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)

Other

- Complete any course of Java Programming on Infosys Springboard/Spoken Tutorial/NPTEL
- Develop java code for given problem suggested by course teacher.

Micro project

- Develop mini-ATM machine system. It should accept account_no, account_holder_name, account_balance and perform operations such as withdrawal, Deposit and balance check.
- Develop Quiz Management System. Quiz should accept student credentials and contain 10 MCQ type questions. Determine the final result. Save the result in table along with student credentials.
- Energy Billing System: Expected to develop bill amount module based on usage of energy consumption.
- Develop Employee Management System. Insert employee details such as employee_name, emp_id,emp_salary etc.. into database and retrieve data from table.
- Any other micro project as suggested by course teacher.

Assignment

- Solve assignment covering all COs given by course teacher.

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	Databases like MySQL, Oracle, MS-Access or any other.	27,28,29,30
2	Computer System (Any computer system with basic configuration).	All
3	Computer with JDK1.8 or above, any IDE for Java Programming such as Eclipse, Jcreator, NetBeans,VScode .	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	Basic Syntactical Constructs in Java	CO1	8	4	4	4	12
2	II	Inheritance, Interface and Packages	CO2	10	2	4	6	12
3	III	Exception Handling and Multithreading	CO3	12	2	4	6	12

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
4	IV	Event handling using Abstract Window Toolkit (AWT) & Swings Components	CO4	14	4	4	8	16
5	V	Basics of Network Programming	CO5	8	2	4	4	10
6	VI	Interacting with Database	CO6	8	2	2	4	8
Grand Total				**60**	**16**	**22**	**32**	**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 on 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	2	2	1	2	--	1	1			
CO2	2	2	2	2	--	1	1			
CO3	2	2	2	2	--	1	1			
CO4	2	2	2	2	1	2	2			
CO5	2	2	3	2	1	2	2			
CO6	2	2	3	3	1	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	E Balaguruswamy	Programming with JAVA	Mcgraw Hill Education (India) Private Limited, New Delhi . ISBN-13: 978-93-5134-320-2
2	Schildt Herbert	Java Complete Reference	Mcgraw Hill Education, New Delhi . ISBN:9789339212094

Sr.No	Author	Title	Publisher with ISBN Number
3	Holzner, Steven et al	Java 8 Programming Black Book	Dreamtech Press, New Delhi. ISBN: 978-93-5119-758-4

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.javatpoint.com/java-tutorial	All content
2	https://www.w3schools.com/java/	All content
3	https://www.tutorialspoint.com/java/index.htm	All content
4	https://www.programiz.com/java-programming/online-compiler/	Online compiler for java
5	https://onecompiler.com/java	Online compiler for java
6	https://www.odbms.org/wp-content/uploads/2013/11/009.01-Arlow-JDBC-Tutorial-July-2005.pdf	Database Connectivity
7	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_29959473947367270000_shared/overview	All content
8	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013842009554911232973 0_shared/overview	All content
9	https://onlinecourses.nptel.ac.in/noc22_cs47/preview	All content

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	**: Fourth**
Course Title	**: DATA COMMUNICATION AND COMPUTER NETWORK**
Course Code	**: 314318**

I. RATIONALE

Data communication and computer networks are essential components of modern computing infrastructure, enabling seamless exchange of information and facilitating collaboration across various devices and locations. By considering various applications, students should be able to choose, classify, install, troubleshoot, and maintain various data communication networks. This course provides the important concepts and techniques related to networking and offer students to have valuable insights into technology behind network communication.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

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

• Manage Data Communication and Computer Network

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Analyze the functioning of Data Communication and Computer Network.
- CO2 - Select relevant Transmission Media and Switching Techniques as per need.
- CO3 - Analyze the Transmission Errors with respect to IEEE standards.
- CO4 - Configure different TCP/IP services.
- CO5 - Implement relevant Network Topology using Networking Devices.

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	
314318	DATA COMMUNICATION AND COMPUTER NETWORK	DCN	DSC	3	-	4	1	8	4	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 the role of the given component in the process of data communication. TLO 1.2 Compare the characteristics of analog and digital signals on the given parameter. TLO 1.3 Explain the process of data communication using the given mode. TLO 1.4 Classify computer networks on the specified parameter.	**Unit - I Fundamentals of Data Communication and Computer Network** 1.1 Process of data communication and its components: Transmitter, Receiver, Medium, Message, Protocol 1.2 Protocols, Standards, Standard organizations, Bandwidth, Data Transmission Rate, Baud Rate and Bits per second 1.3 Modes of Communication (Simplex, Half duplex, Full Duplex) 1.4 Analog Signal and Digital Signal, Analog and Digital Transmission: Analog To Digital, Digital To Analog Conversion 1.5 Fundamental Of Computer Network: Definition And Need Of Computer Network, Applications, Network Benefits 1.6 Classification Of Network: LAN, WAN,MAN	Lecture Using Chalk-Board, Presentations, Video Demonstrations

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 Explain with sketches the construction of a given type of cable. TLO 2.2 Explain with sketches the characteristics of the given type of unguided transmission media. TLO 2.3 Explain with sketches the working of the given Multiplexing technique. TLO 2.4 Describe with sketches the working principle of the given Switching technique. TLO 2.5 Compare different Switching techniques on the given parameter.	**Unit - II Transmission Media And Switching** 2.1 Communication Media: Guided Transmission Media Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable 2.2 Unguided Transmission Media: Radio Waves, Microwaves, Infrared, Satellite 2.3 Line-of-Sight Transmission, Point-to-Point, Broadcast 2.4 Multiplexing: Frequency-Division Multiplexing ,Time - Division Multiplexing 2.5 Switching: Circuit-switched network, Packet switched network	Lecture Using Chalk-Board, Presentations, Video Demonstrations
3	TLO 3.1 Explain working of the given error detection and correction method. TLO 3.2 Explain features of the given IEEE communication standard. TLO 3.3 Explain characteristics of the given layer in IEEE 802.11 architecture. TLO 3.4 Explain with sketches the process of creating a Bluetooth environment using the given architecture. TLO 3.5 Compare the specified generations of mobile telephone systems on the given parameter.	**Unit - III Error Detection and Correction** 3.1 Types of Errors, Forward Error Correction Versus Retransmission 3.2 Framing: Fixed Sized and Variable Sized Framing 3.3 Error Detection: Repetition codes, Parity bits, Checksums, CRC 3.4 Error Correction: Automatic Repeat Request (ARQ), Hamming Code 3.5 Wireless LAN IEEE 802.11 standard Architecture, Features of IEEE 802.11 versions: 802.11,802.11a,802.11b,802.11g,802.11n,802.11p 3.6 Bluetooth Architecture: Piconet, Scatternet 3.7 Mobile Generations: 3G, 4G and 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 Identify functions and features of the given layer of OSI Reference model. TLO 4.2 Compare the specified service on the given parameters. TLO 4.3 Classify IP Addresses on the basis of its class from the given set of addresses. TLO 4.4 Distinguish between IPv4 and IPv6 on the given parameters. TLO 4.5 Describe with sketches the procedure to configure the given TCP/IP service.	**Unit - IV Network Communication Models** 4.1 THE OSI MODEL: Layered Architecture, Encapsulation 4.2 Layers in OSI Model(Functions of each layer)-Physical Layer,Data-Link Layer,Network Layer,Transport Layer,Session Layer,Presentation Layer,Application Layer 4.3 TCP/IP Layers and their functions: Host To Network Layer,Internet Layer,Transport Layer,Application Layer 4.4 Protocols: Host To Network Layer-SLIP,PPP, Internet Layer-IP,ARP,RARP,ICMP, Transport Layer-TCP and UDP, Application Layer-FTP,HTTP,SMTP,TELNET,BOOTP,DHCP 4.5 Addressing: Physical Address, Logical Address, Port Address 4.6 IP Address-Concept, Notation, Address Space 4.7 IPv4 Addressing: Classful and Classless Addressing ,subnet mask,supernetting,subnetting 4.8 IPV6 Addressing scheme and basic structure	Lecture Using Chalk-Board, Presentations, Case Study, Flipped Classroom
5	TLO 5.1 Compare different computing models on the given parameter. TLO 5.2 Identify relevant network topology for the given situation. TLO 5.3 Compare different topologies on the given parameter. TLO 5.4 Select network connecting device for the given situation. TLO 5.5 Describe with sketches the procedure to configure the given networking device.	**Unit - V Network Topologies And Network Devices** 5.1 Network Computing Model: Peer To Peer, Client Server 5.2 Network Topologies: Introduction, Definition, Selection criteria, Types of Topology- Star ,Mesh, Tree, Hybrid 5.3 Network Connecting Devices: Switch, Router, Repeater, Bridge, Gateways and Modem	Lecture Using Chalk-Board, Video Demonstrations, 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 Implement Amplitude Shift Keying(ASK)	1	* Amplitude Shift Keying(ASK) using any simulator	2	CO1
LLO 2.1 Implement Frequency Shift Keying(FSK)	2	Frequency Shift Keying(FSK) using any simulator	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 3.1 Implement Phase Shift Keying(PSK)	3	Phase Shift Keying(PSK) using any open source simulation software	2	CO1
LLO 4.1 Create standard network straight cable by using cable tester.	4	*Create and Test standard straight network cable(Universal Colour Code) using crimping tool	2	CO2
LLO 5.1 Create standard Cross network cable by using cable tester.	5	Create and Test standard Cross network cable(Universal Colour Code) using crimping tool	2	CO2
LLO 6.1 Use basic programming skills to simulate communication systems. LLO 6.2 Debug and execute the program for Time Division Multiplexing(TDM).	6	* Generate a Time Division Multiplexing(TDM) signal using relevant simulation software	2	CO2
LLO 7.1 Transfer data using Bluetooth.	7	*Create a Hybrid Network Using Bluetooth	2	CO3
LLO 8.1 Identify different error detection methods. LLO 8.2 Detect errors using Checksum.	8	*Locate the error bit in the given data string by applying checksum error detection method	2	CO3
LLO 9.1 create WI-FI environment.	9	*Implement Wireless network	2	CO3
LLO 10.1 Draw block diagram for parity check. LLO 10.2 Implement parity check with examples.	10	Write a ‘C’ program for parity check error detection	2	CO3
LLO 11.1 Implement C Program for CRC	11	*Write a ‘C’ program for Cyclic Redundancy Check(CRC) error detection	2	CO3
LLO 12.1 Implement Hamming code in any suitable programming language.	12	*Write a ‘C’ program for error correction using Hamming code	2	CO3
LLO 13.1 Use IP address and appropriate subnet mask for given problem statement.	13	*Configure static IP address in operating system along with appropriate subnet mask for given problem	2	CO4
LLO 14.1 Implement IP addresses for intranet in Class A, Class B, Class C.	14	* Implement Classful Address in a given network node i)Identify range of IP Address in various classes ii)Justify the reason to choose various IP address classes for creating given network	2	CO4
LLO 15.1 Troubleshoot computer network using commands.	15	*Execute TCP/IP network commands:ipconfig,ping,tracert	2	CO4
LLO 16.1 Troubleshoot computer network using commands.	16	*Execute TCP/IP network commands: netstat, pathping, route	2	CO4
LLO 17.1 Use wireshark packet sniffer software.	17	*1) Install Wireshark and configure as packet sniffer- i)Capture IP,TELNET, FTP packets using Wireshark	2	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 18.1 Measure various types of Delay by using Wireshark.	18	Capture TCP and UDP packet using Wireshark	2	CO4
LLO 19.1 Filter ARP and ICMP packet Traffic using Wireshark.	19	Capture ARP and ICMP packet Traffic using Wireshark	2	CO4
LLO 20.1 Install server operating system	20	Install Operating System Linux/Windows/Any other Server	2	CO4
LLO 21.1 Create FTP Server	21	Use FTP protocol to transfer file from one system to another system	2	CO4
LLO 22.1 Implement IPv6 addressing scheme on a network.	22	Create IPv6 environment in a small network using simulator	2	CO4
LLO 23.1 Configure HTTP server on given operating system.	23	*Create HTTP server	2	CO5
LLO 24.1 Use star topology for a given situation.	24	*Create computers using Star topology with wired media	2	CO5
LLO 25.1 Use Network simulator CISCO packet tracer.	25	Create Tree topology using CISCO packet tracer software	2	CO5
LLO 26.1 Implement remote login feature.	26	Configure TELNET for remote login	2	CO5
LLO 27.1 Survey existing network infrastructure.	27	*Visit your computer laboratory- i)Identify the type of topology ii)Identify types of connecting devices with specifications iii)Identify types of cables with specifications iv)List the type of network applications commonly used in the laboratory iv)Draw the layout of installed network	4	CO5
LLO 28.1 Transfer a file from one computer to another. LLO 28.2 Print documents from remote system in a network.	28	Share folder and printer in a network	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 an assignment on any relevant topic given by the Teacher
- For a trading firm an organization with 10users, draw network architecture design of wireless LAN.
- Identify appropriate network topology and network connecting devices for following requirement. Draw network design for proposed network. An organization having its office in a building of 5 floor. Each floor it needs 20 machines. There is one File server. Each floor has 2 print servers to facilitate printer capacity using Tree topology.

Micro project

- Install and configure NIC and find MAC Address of Device
- Design a network using any topology and do fault identification
- Create a tool that monitors network bandwidth usage in real-time

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	Desktop Computer with basic configuration	All
2	Network Tool Kit: Crimping Tool for RJ-45 connector ,3in 1 modular crimping tool for RJ-45 UTP CAT-5/CAT-6 Networking Cable,LAN Cutter 8P/6pP/4P All-in-One or similar,Cable Tester/LAN Tester(Specification: Network Cable Tester for LAN RJ-45/CAT5/CAT6 UTP Wire Test Tool or similar)	All
3	Network Accessories: RJ45 connector, UTP cable, optical fibre cable, Coaxial cable, various connectors,1000Mbps NIC	All
4	UPS 6 KVA online	All
5	Ethernet Switch- 4/8/16/24/32	All
6	Router-256MB Memory storage capacity, compatible with Desktop and Laptop, Rack Mountable, Wireless Connectivity	All
7	Printer	All
8	Wireshark(https://www.wireshark.org/download.html)or any other Packet Analyzer Tool	All
9	Simulation Software: CISCO Packet Tracer, CORE Network Emulator or Similar	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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of Data Communication and Computer Network	CO1	10	4	8	4	16
2	II	Transmission Media And Switching	CO2	10	4	4	6	14
3	III	Error Detection and Correction	CO3	8	4	4	6	14
4	IV	Network Communication Models	CO4	12	4	6	8	18
5	V	Network Topologies And Network Devices	CO5	5	2	2	4	8
Grand Total				**45**	**18**	**24**	**28**	**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	1	-	2	1	-	-	1			
CO2	1	1	2	1	-	1	1			
CO3	1	2	1	1	-	-	1			
CO4	1	2	2	1	-	1	1			
CO5	-	2	2	1	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	Behrouz A. Forouzan	Data Communication and Networking	McGraw-Hill Higher Education ISBN-13 978-0-07-296775-3

Sr.No	Author	Title	Publisher with ISBN Number
2	Behrouz A. Forouzan:	TCP/IP Protocol Suit	McGraw Hill Education ISBN-13 978-0073376042
3	A.S. Tanenbaum	Computer Networks	PRENTICE HALL ISBN-10: 0-13-212695-8 ,ISBN-13:978-0-13-212695-3
4	Godbole Achyut	Data Communication and Networks	McGraw Hill Education ISBN-10 9780071077705,ISBN-13 978-0071077705
5	Comer Douglas E.	TCP/IP Principles, Protocols and Architectures	PEARSON ISBN 10: 0-13-608530-X ISBN 13: 978-0-13-608530-0

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.geeksforgeeks.org/data-communication-definition-components-types-channels/	Data Communication-Definition, Components,Types,Channels
2	https://www.tutorialspoint.com/data_communication_computer_network/index.htm	Data Communication and Computer Network
3	https://nptel.ac.in/courses/106105081	Computer Networks
4	https://nptel.ac.in/courses/106105183	Computer Networks and Internet Protocol
5	Introduction To Computer Networks | Studytonight	Introduction To Computer Networks

Note :

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

MATHEMATICS FOR MACHINE LEARNING **Course Code : 314320**

Programme Name/s : **Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Data Sciences**

Programme Code : **AI/ AN/ DS**

Semester : **Fourth**

Course Title : **MATHEMATICS FOR MACHINE LEARNING**

Course Code : **314320**

I. RATIONALE

Mathematics plays a crucial role in Artificial Intelligence(AI) and Machine Learning(ML). This course is included in curriculum as Mathematics which is foundation for Artificial Intelligence and Machine Learning. It provides the theoretical framework, algorithms and tools necessary for understanding, developing and deploying AI and ML system effectively. This course will enable students to implement mathematical concepts using Python programming which will enhance the knowledge and methodology to solve AI/ML based engineering problems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply mathematics to solve real-world problems using AI/ML concepts and principles to enhance decision-making, design and innovation with precision and efficiency.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Use partial differentiation concept to obtain optimal solution.
- CO2 - Implement matrix concept to solve real life problems.
- CO3 - Build programs to implement basic operations based on vectors and tensors.
- CO4 - Evaluate numerical differentiation and integration functions.
- CO5 - Apply the linear programming problem concept to obtain optimal solution.

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	
314320	MATHEMATICS FOR MACHINE LEARNING	MML	AEC	4	-	2	-	6	3	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 Calculate partial derivative of first order, second order and mixed order. TLO 1.2 Verify Euler's theorem for the homogeneous function. TLO 1.3 Calculate maximum and minimum value of the function. TLO 1.4 Find maximum and minimum value of the function subject to the given condition using Lagrange's undetermined multipliers.	**Unit - I Partial Differentiation** 1.1 Introduction to Derivative 1.2 Partial derivative (Two variables): Introduction, Partial derivative of first order, second order and mixed order 1.3 Homogeneous Function 1.4 Euler's theorem on homogeneous function (Two variables) 1.5 Maxima and minima of function (Two variables) 1.6 Lagrange's method of undetermined multipliers with one constraint (Two variables)	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.
2	TLO 2.1 Reduce the matrix to echelon form and normal form. TLO 2.2 Find the inverse of matrix by elementary transformation. TLO 2.3 Calculate the rank of matrix using determinant of order 2 and 3. TLO 2.4 Calculate the rank of matrix by reducing matrix to echelon form of order 2 and 3. TLO 2.5 Calculate the rank of matrix by reducing matrix to normal form of order 2 and 3. TLO 2.6 Check the consistency of non-homogenous system of linear equation using rank of matrix. TLO 2.7 Check the consistency of homogenous system of linear equation using rank of matrix. TLO 2.8 Find solution of non-homogeneous system of linear equations. TLO 2.9 Find solution of homogenous system of linear equations. TLO 2.10 Find eigen-values and eigen-vectors for the given matrix of order 2.	**Unit - II Matrices** 2.1 Review of types of matrices and algebra of matrices 2.2 Elementary row and column transformation of matrices 2.3 Conversion of matrix to echelon and normal form 2.4 Inverse of matrix using elementary transformation 2.5 Rank of matrix using determinant of order two & three, Rank of matrix by reducing matrix to echelon and normal form 2.6 Non-Homogeneous and Homogeneous system of linear equations 2.7 Consistency of system of linear equations using rank of matrices 2.8 Non-Homogeneous system of linear equation: Unique solution, Infinite number of solutions 2.9 Homogeneous system of linear equation: Unique or trivial solution, Infinite number of non-trivial solutions 2.10 Eigen values and Eigen-vector: Basic Definition, Characteristic Polynomial, Characteristic Equation, Eigen-value and Eigen-vector of a matrix of order 2	Lecture Using Chalk-Board 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.
3	TLO 3.1 Calculate the magnitude of given vector and unit vector perpendicular to given vector. TLO 3.2 Calculate direction ratio and direction cosines of a vector. TLO 3.3 Find scalar(dot) product of two vectors. TLO 3.4 Find angle between two vectors using scalar(dot) product. TLO 3.5 Find projection of one vector on another vector. TLO 3.6 Find vector(cross) product of two vectors. TLO 3.7 Find angle between two vectors using vector(cross) product. TLO 3.8 Find scalar triple product of the vectors. TLO 3.9 Define different types of tensors.	**Unit - III Vectors and Tensors** 3.1 Introduction, Definition of scalar and vector quantity, Representation of vector, Magnitude of vector, Component of vector, Direction ratio, Direction cosines 3.2 Types of vectors: Zero vector, Unit vector, Position vector, Equal vector, Negative vector. Parallel vector, Co-initial vector, Collinear vector 3.3 Algebra of vectors: Addition of vectors, Triangle law of vectors addition, Parallelogram law of vectors addition, Subtraction of vectors, Multiplication of vectors by scalar 3.4 Product of two vectors: Scalar (dot) product of two vectors, Projection of one vector on another vector, Angle between two vectors using scalar(dot) product, Properties of scalar(dot) product 3.5 Vector (cross)product of two vectors, Angle between two vectors using vector(cross) product, Properties of vector(cross) product 3.6 Scalar triple product of vectors 3.7 Tensor: Definition of tensors, Types of tensors, Rank of tensors, Algebra of tensors	Lecture Using Chalk-Board Demonstration Flipped Classroom
4	TLO 4.1 Find first order derivative using forward and backward interpolation. TLO 4.2 Evaluate numerical integration using Trapezoidal rule. TLO 4.3 Evaluate numerical integration using Simpson's one third rule. TLO 4.4 Evaluate numerical integration using Simpson's three eight rule.	**Unit - IV Numerical Differentiation and Integration** 4.1 Introduction to numerical differentiation and integration 4.2 Derivative using forward and backward interpolation 4.3 Numerical integration using Trapezoidal rule 4.4 Numerical integration using Simpson's one third rule 4.5 Numerical integration using Simpson's three eight rule	Lecture Using Chalk-Board Flipped Classroom Presentations
5	TLO 5.1 Formulate given problem in Linear Programming Problems. TLO 5.2 Find optimal solution of Linear Programming Problems using graphical (corner point) method. TLO 5.3 Find optimal solution of Linear Programming Problems using simplex method.	**Unit - V Linear Programming Problems** 5.1 Introduction, Basic terms in Linear Programming Problems 5.2 Mathematical formulation of Linear Programming Problems 5.3 Method of solving Linear Programming Problems (Two equations in two variables): Graphical (corner point) method, Simplex method	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 Find partial derivative of first order, second order and mixed order using Python programming.	1	Write a program to compute partial derivative.	2	CO1
LLO 2.1 Find maximum and minimum value of the function for two variables using Python programming.	2	* Write a program to find maximum and minimum value of the function for two variables.	2	CO1
LLO 3.1 Find maximum and minimum value of the function for three variables using Python programming.	3	Write a program to find maximum and minimum value of the function for three variables.	2	CO1
LLO 4.1 Calculate the rank of a matrix by elementary transformation using Python programming.	4	Write a program to find a) Elementary row and column transformations using Python loops. b) Rank of a matrix.	2	CO2
LLO 5.1 Calculate the inverse of a matrix by elementary transformation using Python programming.	5	* Write a program to find inverse of a matrix by elementary transformation.	2	CO2
LLO 6.1 Solve system of linear equations using Python programming.	6	* Write a program to solve system of linear equations.	2	CO2
LLO 7.1 Calculate eigen-values and eigen-vectors for the given matrix of order 2 using Python programming.	7	Write a program to calculate eigen values and eigen vector for given matrix of order 2.	2	CO2
LLO 8.1 Calculate eigen-values and eigen-vectors for the given matrix of order 3 using Python programming.	8	Write a program to calculate eigen values and eigen vector for given matrix of order 3.	2	CO2
LLO 9.1 Implement algebra of vectors using Python programming.	9	* Write a program to implement algebra of vectors like addition, subtraction and scalar multiplication.	2	CO3
LLO 10.1 Implement vectors operations using Python programming.	10	* Write a program to implement vectors operations like dot product, cross product and scalar triple product.	2	CO3
LLO 11.1 Implement basic algebraic operations on tensors using Python programming.	11	Write a program to implement basic algebraic operations on tensors like addition, subtraction.	2	CO3
LLO 12.1 Find numerical differentiation for the given data using Python programming.	12	* Write a program to evaluate numerical differentiation for the given data.	2	CO4
LLO 13.1 Find numerical integration using Trapezoidal rule for the given data using Python programming.	13	Write a program to evaluate numerical integration using Trapezoidal rule for the given data.	2	CO4
LLO 14.1 Find numerical integration using Simpson's one third rule for the given data using Python programming.	14	* Write a program to evaluate numerical integration using Simpson's one third rule for the given data.	2	CO4
LLO 15.1 Find optimal solution of linear programming problems by applying simplex method using Python programming.	15	* Write a program to implement simplex method for 2 equations in 2 variables.	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)

Assignment

- Collect five linear programming problems that can be solved graphically. Draw graph, identify the feasible region and determine the optimal solution.
- Collect data set of different types of functions such as polynomial, trigonometric, logarithmic, exponential function of two variables. Calculate the partial derivatives of first order, second order and mixed order for each function.
- Solve five examples to find addition, subtraction, scalar product and cross product of given vectors.
- Solve five examples to find the eigen values and eigen vector of matrix of order two and three.
- Solve five examples on numerical differentiation and integration.

Micro project

- Not Applicable

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 Modern Operating System, Intel Core i3/i5 Processor or equivalent, RAM minimum 4 GB onwards.	All
2	Python Interpreter/ IDE like Jupyter Notebook, PyCharm, Spyder etc.	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	Partial Differentiation	CO1	10	4	4	6	14
2	II	Matrices	CO2	18	2	6	12	20
3	III	Vectors and Tensors	CO3	14	2	4	8	14
4	IV	Numerical Differentiation and Integration	CO4	10	2	4	6	12
5	V	Linear Programming Problems	CO5	8	0	4	6	10
Grand Total				**60**	**10**	**22**	**38**	**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	2	1	1	-	1			
CO2	2	2	2	1	1	-	1			
CO3	2	2	2	1	1	-	2			
CO4	2	2	2	1	1	-	1			
CO5	2	3	3	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	H. K. Dass, Er. Rajnish Verma	Higher Engineering Mathematics	S. Chand Technical, ISBN: 9788121938907

Sr.No	Author	Title	Publisher with ISBN Number
2	A. C. Shrivastava, P. K. Shrivastava	Engineering Mathematics	PHI Learning, New Delhi, ISBN:9788120342934
3	Grewal B. S.	Higher Engineering Mathematics	Tata McGraw Hill Education, New Delhi, ISBN : 9789386173522
4	K.Nageswara Rao, Shaikh Akbar	Python Programming	Scitech Publication(India) Pvt. Ltd. ISBN:9789385983450
5	Mark Lutz	Learning Python	O'Reilly Publication ISBN-13: 9780672329784

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://atozmath.com/default.aspx	Online Learning Initiative for Mathematics Problems with Solutions
2	https://www.w3schools.com/ai/ai_mathematics.asp	Machine Learning Mathematics
3	https://www.geeksforgeeks.org/machine-learning-mathematics/	Machine Learning Mathematics
4	https://docs.python.org/3/tutorial/index.html	The Python Tutorial
5	https://onlinecourses.nptel.ac.in/noc21_ma38/preview	NPTEL Course
6	https://www.purplemath.com/index.htm	Foundational Mathematics to improve learning
7	https://mathworld.wolfram.com/	Extensive mathematical resource with detailed explanations
8	https://www.khanacademy.org/math	Mathematical concepts through video lectures

Note :

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

MICROPROCESSOR PROGRAMMING **Course Code : 314321**

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Computer Technology/ Computer Engineering/ Computer Software Technology/ Computer Science & Engineering/ Data Sciences/ Computer Hardware & Maintenance/ Computer Science**
Programme Code	**: AI/ AN/ CM/ CO/ CST/ CW/ DS/ HA/ SE**
Semester	**: Fourth**
Course Title	**: MICROPROCESSOR PROGRAMMING**
Course Code	**: 314321**

I. RATIONALE

The microprocessor is the most vital component of a computer system and is considered be its' brain and heart. This course will cover the basics of 8086 and its architecture along with instruction set, data types, assembly language programming with effective use of procedure and macro. This course will enable the students to inculcate assembly language programming concepts and methodology to solve problems related with microprocessor-based systems.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

This course aims to help the student to attain the following industry expected outcomes through various teaching-learning experiences:

*Develop assembly language programs using 8086.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Analyze the functional block diagram of 8086 microprocessor.
- CO2 - Use program development tools and assembler directives.
- CO3 - Use instructions in different addressing modes.
- CO4 - Develop an assembly language program for a given task using assembler.
- CO5 - Use procedures and macros to develop an assembly language program for a given problem.

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	
314321	MICROPROCESSOR PROGRAMMING	MIC	DSC	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 the function of the given pin of 8086. TLO 1.2 Explain function of Bus Interface Unit and Execution Unit in 8086 Microprocessor. TLO 1.3 State functions of the given Register of 8086 Microprocessor. TLO 1.4 Calculate the physical address for the given segmentation of 8086 Microprocessor.	**Unit - I 8086-16 Bit Microprocessor** 1.1 8086 Microprocessor: Salient features, pin descriptions 1.2 Architecture of 8086: Functional block diagram, register organization 1.3 Concept of pipelining 1.4 Memory segmentation, Physical memory addresses generation	Lecture using chalk-board Presentations Hands-on
2	TLO 2.1 Describe the given steps of program development and execution. TLO 2.2 Write steps to develop a code for the given problem using assembly language. TLO 2.3 Use relevant command of debugger to correct the specified programming error. TLO 2.4 Describe function of the given assembler directives with example.	**Unit - II The Art of Assembly Language Programming** 2.1 Program development steps: Problem definition, Algorithm, Flowchart, Initialization checklist, Choosing instructions, Converting algorithm into assembly language program 2.2 Assembly Language Programming Tools: • Editor • Assembler • Linker • Debugger 2.3 Assembler directives	Lecture using chalk-board Presentations Hands-on Collaborative learning

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 Determine the length of the given instruction. TLO 3.2 Describe the given addressing modes with examples. TLO 3.3 Explain the operation performed by the given instruction during its execution. TLO 3.4 Identify the addressing mode of the given instruction.	**Unit - III Instruction Set of 8086 Microprocessor** 3.1 Machine language instruction format 3.2 Addressing modes 3.3 Instruction set: • Arithmetic instructions • Logical Instructions • Data transfer instructions • Flag manipulation instructions • String operation instructions • Program control transfer or branching instructions • Process control instructions	Lecture using chalk-board Presentations Hands-on Collaborative learning
4	TLO 4.1 Use the given model of assembly language program for the given problem. TLO 4.2 Develop ALP for the given problem. TLO 4.3 Apply relevant control loops in the program for the given problem. TLO 4.4 Use string instruction to manipulate the elements of the given block of data.	**Unit - IV Assembly Language Programming** 4.1 Models of 8086 assembly language program 4.2 Programming using assembler: • Arithmetic operations on hexadecimal and BCD numbers • Sum of series • Smallest and largest numbers from array • Sorting numbers in ascending and descending order • Check whether given number is odd or even • Check whether given number is positive or negative • Block transfer • String operations - Length, Reverse, Compare, Concatenation, Copy • Count numbers of '1' and '0' in 16 bit number	Lecture using chalk-board Presentations Hands-on Collaborative learning
5	TLO 5.1 Apply the relevant 'parameter- passing' method in the given situation. TLO 5.2 Develop an assembly language program using the relevant procedure for the given problem. TLO 5.3 Develop an assembly language program using macros for the given problem. TLO 5.4 Compare procedures and macros on the basis of the given parameter.	**Unit - V Procedure and Macro** 5.1 Procedure: Defining and calling procedure - PROC, ENDP, FAR and NEAR Directives; CALL and RET instructions; Parameter passing methods, Assembly language programs using procedure 5.2 Macro: Defining macro, MACRO and ENDM Directives, Macro with parameters, Assembly language programs using macro	Lecture using chalk-board Presentations Hands-on Collaborative learning

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 the functions of various blocks in 8086 architecture. LLO 1.2 Identify the use of registers of 8086.	1	* Identification of various blocks in 8086 microprocessor architecture	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Identify the function of given assembly language tool. LLO 2.2 Use assembler directives in a given situation.	2	* Use assembly language programming (ALP) tools and directives	2	CO2
LLO 3.1 Use different addressing mode instructions in program. LLO 3.2 Write an assembly language program for addition and subtraction using different addressing mode instruction.	3	* ALP to perform addition and subtraction of two given numbers	2	CO3
LLO 4.1 Write an assembly language program for multiplication of two 16 bit unsigned numbers. LLO 4.2 Write an assembly language program for multiplication of two 16 bit signed numbers.	4	ALP for multiplication of two signed and unsigned numbers	2	CO3
LLO 5.1 Write an assembly language program for division of two unsigned numbers. LLO 5.2 Write an assembly language program for division of two signed numbers.	5	ALP to perform division of two unsigned and signed numbers	2	CO3
LLO 6.1 Use DAA and DAS instructions to perform arithmetic operations on BCD numbers. LLO 6.2 Write an ALP to perform arithmetic operations on BCD numbers.	6	ALP to add, subtract, multiply and divide two BCD numbers	2	CO3
LLO 7.1 Implement loop in assembly language program. LLO 7.2 Use string instruction to perform block transfer operation. LLO 7.3 Write an ALP to perform block transfer data without using string instruction. LLO 7.4 Write an ALP to perform block transfer data with using string instruction.	7	* ALP to perform block transfer operation	2	CO4
LLO 8.1 Implement loop in assembly language program to find sum of series. LLO 8.2 Write an assembly language program to find sum of series of n Hexadecimal numbers. LLO 8.3 Write an assembly language program to find sum of series of n BCD numbers.	8	ALP to find sum of series	2	CO4
LLO 9.1 Implement loop in assembly language program to find smallest and largest number from the array of n numbers. LLO 9.2 Use decision making branching instruction to find smallest or largest number. LLO 9.3 Write an assembly language program to find smallest number from the array of n numbers. LLO 9.4 Write an assembly language program to find largest number from the array of n numbers.	9	* ALP to find smallest and largest number from array of numbers	2	CO4

MICROPROCESSOR PROGRAMMING **Course Code : 314321**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 10.1 Apply iterative method to arrange numbers in array in ascending or descending order. LLO 10.2 Write an assembly language program to arrange numbers in array in ascending order. LLO 10.3 Write an assembly language program to arrange numbers in array in descending order.	10	ALP to arrange numbers in an array in ascending or descending order	2	CO4
LLO 11.1 Write an assembly language program to find length of string. LLO 11.2 Write an assembly language program to concatenate two strings.	11	* ALP to find the length of string and concatanate two strings	2	CO4
LLO 12.1 Write an assembly language program to copy string. LLO 12.2 Write an assembly language program to copy string in reverse order.	12	ALP for string operations such as string reverse and string copy	2	CO4
LLO 13.1 Write an assembly language program to compare two strings without string instruction. LLO 13.2 Write an assembly language program to compare two strings using string instruction.	13	ALP to compare two strings	2	CO4
LLO 14.1 Use div and rotate instructions to check the given number is odd or even. LLO 14.2 Write an assembly language program to count odd and even from the array of n numbers.	14	* ALP to check a given number is odd or even	2	CO4
LLO 15.1 Use rotate instructions to check the given number is positive or negative. LLO 15.2 Write an assembly language program to count positive and negative numbers in given array.	15	ALP to check a given number is positive or negative	2	CO4
LLO 16.1 Use rotate instructions to count '0' and '1' in the given number. LLO 16.2 Write an assembly language program to count number of' ‘0' and '1's in a given number.	16	ALP to count number of' ‘0' and '1's in a given number	2	CO4
LLO 17.1 Use CALL and RET instructions to call procedures using different parameter passing methods.. LLO 17.2 Use assembler directives: PROC and ENDP to write the procedure. LLO 17.3 Write an assembly language program using procedure to perform for addition, subtraction, multiplication and division. LLO 17.4 Write an assembly language program using procedure to solve equation such as Z = (A+B)*(C+D).	17	* ALP to perform arithmetic operations on given numbers using procedure	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 18.1 Use assembler directives MACRO and ENDM to write the macros using parameters. LLO 18.2 Write an assembly language program using macro to perform for addition, subtraction, multiplication and division. LLO 18.3 Write an assembly language program using macro to solve equation such as Z = (A+B)* (C+D).	18	ALP to perform arithmetic operations on given numbers using macro	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 laboratory-based developed in assembly language as suggested by teacher. Each microproject should encompass of two or more CO's which are in fact, an integration of laboratory experiments and LLO's. Some of the suggested microprojects are given below.

a. Conversion of number system-(Any one):
1. Convert hexadecimal number to equivalent BCD.
2. Convert BCD number to equivalent hexadecimal number

b. Array-(Any one):
1. Separate odd and even number from given array, store them in separate array and find the sum.
2. Separate odd and even number from given array, store them in separate array and find the smallest and largest among them.
3. Separate odd and even number from given array, store them in separate array and sort numbers in ascending and descending order.

c. Basic mathematical functions-(Any one):
1. Generate fibonacci series.
2. Calculate a factorial of given number.

d. String manipulation-(Any one):
1. Convert given lower case string to upper case string and vice-versa.
2. Check the given string for palindrome.
3. Search given character and its position in a string; i.e. find how many times character is present in a string and its position in a string.

Assignment

- Prepare a comparative survey report of 8086 microprocessor with i3, i5, i7, i9 or AMD Ryzen processor.

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:** Personal computer, (Processor i3 onwords preferable), RAM minimum 2GB Operating system: Windows-7 onwards	All
2	**Software:** a) Assembler: Borland Turbo (TASM) / Microsoft Assembler (MASM) b) Linker: Borland Turbo (TLINK) / Microsoft (LINK) c) Debugger: Borland Turbo (TD) / Microsoft debugger (CS or Debug) d) Editor: DOS-Edit / Notepad	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	8086-16 Bit Microprocessor	CO1	6	2	6	6	14
2	II	The Art of Assembly Language Programming	CO2	6	2	2	4	8
3	III	Instruction Set of 8086 Microprocessor	CO3	12	2	8	8	18
4	IV	Assembly Language Programming	CO4	15	0	4	16	20
5	V	Procedure and Macro	CO5	6	2	4	4	10
Grand Total				**45**	**8**	**24**	**38**	**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.

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	2	-	-	-	-	1	1			
CO2	2	1	1	2	-	1	1			
CO3	3	2	2	2	-	1	1			
CO4	3	3	3	2	-	1	1			
CO5	3	3	3	2	-	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	Douglas V. Hall	Microprocessor and Interfacing (Programming and Hardware)	McGraw Hill Education, New Delhi ISBN-13: 978-0070257429
2	Walter A. Triebel, Avtar Singh	The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware, and Applications	Pearson Publications, New Delhi ISBN-13: 978-0131228047
3	Sunil Mathur	Microprocessor 8086: Architecture, Programming and Interfacing	PHI, New Delhi ISBN-13: 978-8120340879
4	K. R. Venugopal and Raj Kumar	Microprocessor X86 Programming	BPB Publications, Delhi ISBN-13: 978-8170294580

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.tutorialspoint.com/microprocessor/microprocessor_8086_overview.htm	Architecture of 8086
2	https://www.geeksforgeeks.org/architecture-of-8086/	Architecture of 8086
3	https://www.javatpoint.com/8086-microprocessor	Pin description and Architecture of 8086

MICROPROCESSOR PROGRAMMING **Course Code : 314321**

Sr.No	Link / Portal	Description
4	https://electronicsdesk.com/assembler-directives.html	Assembler directives
5	https://www.geeksforgeeks.org/addressing-modes-8086-microprocessor/	Addressing modes of 8086
6	https://www.tutorialspoint.com/microprocessor/microprocessor_8086_addressing_modes.htm	Addressing modes of 8086
7	https://www.tutorialspoint.com/microprocessor/microprocessor_8086_instruction_sets.htm	Instruction set of 8086
8	https://www.javatpoint.com/instruction-set-of-8086	Instruction set of 8086
9	https://nptel.ac.in/courses/108103157	NPTEL Course on Microprocessors and Interfacing

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 Science**
Programme Code	**: AI/ AN/ BD/ CM/ CO/ CST/ CW/ DS/ SE**
Semester	**: Fourth**
Course Title	**: UI/UX DESIGN**
Course Code	**: 314005**

I. RATIONALE

In digital applications, the user communicates with the product via user interface. This course is designed to elicit fundamental principles and practical skills from stakeholders which are essential to design user friendly interfaces. The course will help students to apply design thinking concepts to create or re-create the prototype.

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:

Design user-centered applications, websites, interfaces.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Explain design thinking concept.
- CO2 - Interpret user requirements.
- CO3 - Select appropriate visual design for given problem.
- CO4 - Create interactions using design tool.
- CO5 - Create innovative design prototype for given applications.

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		
314005	UI/UX DESIGN	UID	SEC	1	-	4	1	6	3	-	-	-	-	-	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 Explain design thinking concepts. TLO 1.2 Define User Interface. TLO 1.3 Describe User experience.	**Unit - I Design Thinking Fundamentals** 1.1 Introduction to Design thinking – Concept, Purpose, 5 stages of design thinking – Empathize, Define, Ideate, Prototype, Test 1.2 Introduction to User Interface / User Experience (UI/UX) – Definition of Design with respect to digital media, User Interface, User experience, Difference between UI and UX. History of UX. Need of UI and UX	Chalk-Board Demonstration Presentations Flipped Classroom
2	TLO 2.1 Explain research methods for user requirements. TLO 2.2 Describe requirement analysis techniques. TLO 2.3 Identify user persona.	**Unit - II User Requirements and its Analysis** 2.1 Introduction to research and analysis tool (freeware) such as FigJam 2.2 User requirements – Definition, Types of user research - Qualitative research, Quantitative research. Tools to collect user requirements – personal observation, interviews, questionnaire, User/ Expert reviews 2.3 User requirement analysis - Understanding target audience and client requirements, Competitive analysis, Affinity mapping, Defining User Persona	Chalk-Board Case Study Demonstration Hands-on 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.
3	TLO 3.1 Demonstrate storyboarding for given problem. TLO 3.2 Demonstrate User journey mapping for given problem. TLO 3.3 Describe graphic design principles. TLO 3.4 Explain visual communication.	**Unit - III User Interface Design** 3.1 Storyboarding, User journey mapping 3.2 Gestalt principles of design - Aesthetics in UI design - Using Light, Color and Contrast Effectively in UI Design 3.3 Introduction to any freeware design tool such as Figma 3.4 Visual Communication Design - effective visual communication for graphical user interface	Chalk-Board Demonstration Hands-on Presentations
4	TLO 4.1 Explain User Experience design. TLO 4.2 Describe steps to create gamification techniques. TLO 4.3 Describe steps to create micro-animation. TLO 4.4 Write steps to create interactions using buttons, navigations etc. in any design tool.	**Unit - IV User Experience Design Tool** 4.1 Introduction to User Experience design 4.2 UX design open source tool such as - Figma features – Navigations, interactions, Buttons Creating library 4.3 Gamification, micro-animation 4.4 Creating visual identity of the project – design system, design theme	Chalk-Board Demonstration Hands-on Presentations
5	TLO 5.1 Create low fidelity prototyping of design on paper. TLO 5.2 Create medium fidelity prototype on paper. TLO 5.3 Write steps to create high fidelity prototype using design tool. TLO 5.4 Test the design prototype.	**Unit - V Prototyping and Testing** 5.1 Introduction to Wireframing - Purpose of wireframing, Types – low fidelity, medium fidelity, high fidelity 5.2 Basics of sketching, Creating low fidelity wireframes, medium fidelity and high fidelity in Figma 5.3 Basic considerations in wireframing – device, size, behavior, interaction 5.4 Elements used in wireframing – visual design, high fidelity elements 5.5 Prototyping and Testing	Chalk-Board Demonstration Hands-on Presentations

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 categories of website/ App such as government / e-commerce / tourism related etc. LLO 1.2 Compare different websites/ Apps under one category for design aesthetics. LLO 1.3 Use design tool to collect user requirements. LLO 1.4 Record observations using any design tool.	1	***Use Design tool for user requirement collection and analysis** • Visit minimum 5 websites/ Apps of the particular category. Identify problems in overall navigation, look and feel of websites, relevance of the information. Record all findings using Design tool	4	CO1 CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 2.1 Observe various interfaces used in kiosk based applications. LLO 2.2 Prepare affinity mapping of User Requirements using design tools.	2	**Use Design tool for user requirement collection and analysis of various interfaces such as kiosks** • Visit minimum 5 interfaces. Identify problems in overall navigation, look and feel of the interface, relevance of the information. Record all findings using Design tool	4	CO1 CO2
LLO 3.1 Use any Design tool to create a 'blank project'. LLO 3.2 Use frame, shape, text of design tool to create screen layout of given user interface.	3	***Recreate a given user interface using any open source design tool** (For example, to recreate the first screen of personal mobile phone etc.)	4	CO1 CO2 CO3
LLO 4.1 Use frames, images, and colors to design given screen. LLO 4.2 Explore various plug-ins/ extensions in the design tool. LLO 4.3 Use different plug-ins/extensions in design tool.	4	***Create grid system for the given screen using any design tool** (For example dashboard of particular application/ welcome screen of any blog portal etc.)	4	CO3 CO4 CO5
LLO 5.1 Use frames, components, auto-layouts to design given screen using Design tool. LLO 5.2 Create asset using design tool. LLO 5.3 Create library/repository of created assets in the design tool.	5	***Design given user interface using various components such as auto-layouts in the design tool** (For example, design sample login page/ design registration form etc.)	4	CO2 CO3 CO4 CO5
LLO 6.1 Use horizontal scrolling component in the design tool to create given page(s).	6	***Use horizontal scrolling to create pages for given website/ App** (For example, page(s) in social media Apps/ tourism related webpage(s))	4	CO4
LLO 7.1 Use vertical scrolling component in the design tool to create given page(s).	7	***Use vertical scrolling for a given website/ App** (For example, Retail website/App or food ordering Apps etc.)	4	CO4
LLO 8.1 Use frame, shape, text tools, components of the design tool to replicate the design of given web page(s). LLO 8.2 Use interactions, menus to replicate web page design.	8	**Recreate given website for UI design, color, images, interactions, menu**	4	CO3 CO4 CO5
LLO 9.1 Use various menus - bottom menu, slide menu to demonstrate navigations in the screen.	9	***Create navigations for the given website/ App** (For example, create navigation in App using bottom menu etc.)	4	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 10.1 Use components and navigations to design quiz like page in design tool.	10	**Design a quiz for given user interface** (For example, quiz for LMS / government web site / retail web sites etc.)	4	CO5
LLO 11.1 Observe gamification techniques used in existing user interfaces. LLO 11.2 Use files, templates to create gamification effect in given scenario using design tool.	11	**Create any two gamification effects for given user interface in given scenario** (For example, racing effect etc.)	4	CO3 CO4
LLO 12.1 Use files, templates to create gamification effect in given scenario using design tool.	12	**Create gamification for task completion in website such as LMS/ retail website/ banking website** (For example, popping up effect/ releasing balloons in the air etc. once a task is completed)	4	CO3 CO4 CO5
LLO 13.1 Observe micro-animations used in existing websites, Apps, interfaces. LLO 13.2 Use templates to create micro-animation for given user scenario.	13	**Create any five micro animations for the given user interface in given scenario** (For example, progress bar effect/ waitin for reply or responce effect/ status bar/ welcome page or opening page animatio etc.)	4	CO3 CO4
LLO 14.1 Use Interactions/ events to create Prototype in design tool.	14	***Create prototyping with different interactions – tab, click, hover, delay. for the given user interface**	4	CO4 CO5
LLO 15.1 Use plug-in/ extension to convert the created prototype into html page(s). LLO 15.2 Use browser to run the generated HTML page(s).	15	**Convert created prototype in HTML page(s)**	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 has to be Industry Application Based, Internet-based, Workshop-based, Laboratory-based or Field-based as suggested by Teacher:

1. Prepare a prototype for online blog:

a. Prepare a competitive analysis of similar website
b. Define user persona and prepare user journey mapping using any design tool
c. Construct prototype using - navigation, interaction, frames in design tool
d. Validate the prototype by checking navigation and conditions given

e. Convert the design prototype into HTML code

2. Reconstruct given user interface such as kiosk system:

a. Observe the given user interface

b. Identify improvement in the user interface in terms of - look and feel, navigation, interactions

c. Prepare affinity mapping using design tool

d. Reconstruct the given interface using various components in design tool

3. Prepare a prototype for food ordering App:

a. Prepare a competitive analysis of similar Apps

b. Define user persona and prepare user journey mapping using any design tool

c. Construct prototype using - navigation, interaction, frames in design tool

d. Validate the prototype by checking navigation and conditions given

4. Rebuild smart TV user interface layout

a. Visit existing interfaces of smart television

b. Record findings related to color scheme, theme, look and feel, location on display of existing interfaces

c. Record minimum 10 different user reviews regarding the smart television user interface (chose user from different backgrounds)

d. Record improvements in look, navigation, and interactions

e. Redefine user persona for existing interface

f. Rebuild the interface prototype using design tool

Assignment

-

1. Prepare a case-study report -

a. Identify any dedicated interface such as Automated deposit cum Withdrawal machine.

b. Perform a user requirement analysis through any research method (e.g. Interview/ Questionnaire etc.).

c. Define user persona for the same.

d. Prepare a low fidelity prototype for it.

2. Prepare user storyboard and user journey mapping for given user interface -

a. Identify user requirements .

b. Perform a user requirement through research methods (e.g. Interview/ Questionnaire etc.).

c. Define user persona for the same.

d. Prepare a user journey mapping for the same.

e. Prepare a storyboard for the user interface.

3. Prepare low, medium, and high fidelity prototype for given user interface -

a. Identify user interface.

b. Collect user requirements by any two methods (e.g. Personal observation/ expert review etc.)

c. Define user persona for the same.

d. Prepare a low fidelity prototype on paper for the same.

Other

- Following are some suggestive self-learning topics or any relevant topics suggested by the Teacher:

1. Prepare a feature-based detailed report of similar types of website/portal(such as Flight/ bus Reservation websites/ MIS / e-commerce web sites / educational institutions websites etc).

2. Prepare affinity mapping in any design tool (e.g. FigJam) for user requirements in given domain of the project.

3. Define user persona and perform requirements mapping using design tools in any of the following category – Ticket booking kiosk/ Online examination system / Quiz App.

4. Prepare user journey mapping for given scenario in the given project

5. Prepare low, medium, and high-fidelity prototypes for a given scenario using any design tool.

6. Prepare a library/repository of design components using any design tool like Figma.
7. Reconstruct any ticket booking website to address improvements in look and feel, ease of use within it.

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	Design tool - preferably open-source based tool such as Figma	All
2	Computer system with minimum specifications as - Processor - 2.9 GHz or equivalents or higher with 10th generation or onwards Operating System - 64 bit RAM - 8GB DDR3 or higher Internet Connectivity	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	Design Thinking Fundamentals	CO1	2	0	0	0	0
2	II	User Requirements and its Analysis	CO2	3	0	0	0	0
3	III	User Interface Design	CO3	4	0	0	0	0
4	IV	User Experience Design Tool	CO4	3	0	0	0	0
5	V	Prototyping and Testing	CO5	3	0	0	0	0
Grand Total				**15**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- 1. Continuous assessment based on process and product related performance indicators.

Each practical will be assessed considering:
60% weightage to process
40% weightage to product
2. 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	2	1	2	1	-	1	1			
CO2	3	2	2	2	-	-	2			
CO3	3	3	3	3	1	-	1			
CO4	2	3	3	3	2	1	1			
CO5	2	3	3	3	2	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	Jesse James Garrett	The Elements of User Experience: User-Centered Design for the Web and Beyond	New Riders Publishing, 201 West 103 Street, Indianapolis, IN 46290 800-545-5914 ISBN:978-0-321-68368-7
2	Falk Uebernickel, Li Jiang, Walter Brenner, Britta Pukall, Therese Naef	Design Thinking: The Handbook	World Scientific Publishing Co Pte Ltd, No.16, South West Boag Road T. Nagar, Chennai 600017, INDIA ISBN-10: 9811203504 ISBN-13: 978-9811203503
3	Fabio Staiano	Designing and Prototyping Interfaces with Figma	Packt Publishing Ltd, Grosvenor House, 11 St Paul's Square, Birmingham, B3 1RB ISBN-10: 180056418X ISBN-13: 978-1800564183
4	Kilian Langenfeld	Design Thinking for Beginners	Personal Growth Hackers ISBN-10: 3967160629 ISBN-13: 978-3967160628

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://aim.gov.in/pdf/Design_Thinking.pdf	Design thinking phases and learning resources

Sr.No	Link / Portal	Description
2	https://www.ideou.com/pages/design-thinking-resources	Design thinking resources
3	https://www.figma.com/resource-library/what-is-design-thinking/	Design thinking and its stages
4	https://www.figma.com/resource-library/what-is-ui-design/	Key elements of UI design
5	https://youtu.be/-wzNTPXVIyM?si=zET5z3GpIPl-cAry	User Experience and research methods
6	https://youtu.be/XT152i5asdQ?si=jPdLFFExnaZO8NRs	User Experience and research methods
7	https://usabilitypost.com/2008/08/14/using-light-color-and-contrast-effectively-in-ui-design/	Using Light, Color and Contrast Effectively in UI Design
8	http://web.cs.wpi.edu/~matt/courses/cs563/talks/smartin/int_design.html	Effective Visual Communication for Graphical User Interfaces
9	https://youtu.be/Y9ixRTTx5iU?si=vSCsbCr6gXD5eG-n	Visual Communication Design
10	https://youtu.be/K-DRTBMnzm8?si=DaUPM4iLW2CU3oSU	Low fidelity design
11	https://youtu.be/KCYLE78w074?si=xZsvSnO9qx7iVE2S	High fidelity design
12	www.figma.com	Figma - Design Tools - Figma and FigJam (Freeware)
13	https://www.figma.com/resource-library/design-basics/	Design basics using Figma (Freeware)
14	https://wireframe.cc/	Single-page, public wireframe without user account available in free version.
15	https://drive.google.com/file/d/1Od0G1mtlRHz5LkxgT3GPr7wDEIw7GV05/view	Design Thinking and user experience research (Notes by NPTEL)
16	https://www.mindmeister.com/	Collaborative mind mapping tool
17	https://miro.com/	UX tool
18	https://www.hotjar.com/	UIUX tool

Note :

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