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REINFORCEMENT LEARNING **Course Code : 316323**

Programme Name/s : **Artificial Intelligence and Machine Learning/ Data Sciences**
Programme Code : **AN/ DS**
Semester : **Sixth**
Course Title : **REINFORCEMENT LEARNING**
Course Code : **316323**

I. RATIONALE

Reinforcement learning enables machines to autonomously learn optimal actions through trial and error, making it vital for dynamic, real-world decision-making. It drives advancements in fields like robotics, gaming, and personalized systems. Students learn how agents make sequential decisions by interacting with environments to maximize cumulative rewards. They explore key concepts like Markov decision processes, Q-learning, policy gradients, and reinforcement learning techniques.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following Industry Identified Outcomes through various teaching learning experiences: Develop Reinforcement Learning (RL) algorithms in real-world AI applications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Explain fundamental concepts of Reinforcement Learning.
- CO2 - Apply Markov Decision Processes to solve RL Problems.
- CO3 - Apply the Bellman Equation and Dynamic Programming (DP) Methods to solve RL Problems.
- CO4 - Apply Monte Carlo (MC) Methods for solving RL Problems.
- CO5 - Select appropriate method between DP,MC,TD to solve RL problem.

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	
316323	REINFORCEMENT LEARNING	RFL	DSE	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175

Total IKS Hrs for Sem. : Hrs

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

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

Note :

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

REINFORCEMENT LEARNING **Course Code : 316323**

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Differentiate between Supervised, Unsupervised, and Reinforcement Learning. TLO 1.2 Explain Agent Environment Interface. TLO 1.3 Describe the Key Components of Reinforcement Learning. TLO 1.4 Explain various applications of Reinforcement Learning. TLO 1.5 Compare Model-based and Model-free learning. TLO 1.6 Explain Different Types of Environments in Reinforcement Learning.	**Unit - I Introduction to Reinforcement Learning** 1.1 Basics of Machine Learning: Supervised Learning, Unsupervised Learning & Reinforcement Learning 1.2 The Agent Environment Interface 1.3 Components of RL: Agent, Environment, State, Action, Reward 1.4 Applications of RL (e.g., robotics, gaming, recommendation systems) 1.5 Fundamental concepts of RL: Action space, Policy, Episode , Horizon, Return and discount factor, The value function 1.6 Model-based and Model-free learning 1.7 Different types of environments :Deterministic and stochastic environments, Discrete and continuous environments, Episodic and non-episodic environments, Single and multi-agent environments	Lecture Using Chalk-Board Presentations Video Demonstrations
2	TLO 2.1 Solve Multi-Armed Bandit Problem. TLO 2.2 Explain the trade-off between exploration and exploitation. TLO 2.3 Explain Markov Property. TLO 2.4 Explain the concept of a Markov Chain and its components. TLO 2.5 Explain Markov Reward and Markov decision processes. TLO 2.6 Solve Decision-Making Problems using Markov Decision Processes (MDPs). TLO 2.7 Solve state transition problems using epsilon-greedy algorithm.	**Unit - II Markov Decision Processes (MDPs)** 2.1 Multi-armed Bandit Problem 2.2 Exploration vs. Exploitation 2.3 epsilon-greedy algorithm 2.4 Markov property 2.5 Markov Chain 2.6 Markov Reward Processes (MRPs) 2.7 Markov Decision Processes (MDPs)	Lecture Using Chalk-Board Demonstration Presentations
3	TLO 3.1 Find the solution for Model based problem the Bellman Equation for the Value Function. TLO 3.2 Solve the Bellman Equation for the Q Function. TLO 3.3 Find the solution for Model based problem using Dynamic programming Value iteration. TLO 3.4 Solve Dynamic programming Value Policy Iteration.	**Unit - III The Bellman Equation and Dynamic Programming(DP)** 3.1 Bellman equation of the value function 3.2 Bellman equation of the Q function 3.3 Dynamic programming: Value iteration 3.4 Dynamic programming: Policy Iteration	Lecture Using Chalk-Board Presentations Video Demonstrations Presentations

REINFORCEMENT LEARNING **Course Code : 316323**

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 Explain the Monte Carlo Method. TLO 4.2 Find the solution for Modeless problem using the Monte Carlo Prediction. TLO 4.3 Solve Modeless problem using the Monte Carlo Control.	**Unit - IV Monte Carlo(MC) Methods** 4.1 Introduction to Monte Carlo Method 4.2 Monte Carlo Prediction: First-visit Monte Carlo 4.3 Monte Carlo Prediction: Every-visit Monte Carlo 4.4 Monte Carlo Control : On-Policy control 4.5 Monte Carlo Control : Off-Policy control	Lecture Using Chalk-Board Presentations Presentations Video Demonstrations Flipped Classroom
5	TLO 5.1 Solve the Temporal Difference (TD) Learning . TLO 5.2 Solve the Q-Learning algorithm. TLO 5.3 Solve SARSA algorithm. TLO 5.4 Differentiate between DP,MC,TD.	**Unit - V Temporal Difference (TD) Learning** 5.1 Introduction to Temporal Difference (TD) Learning 5.2 TD prediction algorithm 5.3 SARSA (State-Action-Reward-State-Action) 5.4 Q-Learning 5.5 Comparing the DP, MC, and TD methods	Presentations Lecture Using Chalk-Board Video Demonstrations 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 Set up RL environment.	1	*Setting Up Python and RL Libraries	2	CO1
LLO 2.1 Explore OpenAI Gym to be used for RL Problems.	2	*Exploring OpenAI Gym Environments : a) List available environments using Load b) Render a basic environment and observe working of the environment	4	CO1
LLO 3.1 Implement Markov Chain.	3	Simulating a Markov Chain in Python	2	CO2
LLO 4.1 Implement the Markov Property in a simple Gym environment.	4	*Implementing the Markov Property in OpenAI Gym	2	CO2
LLO 5.1 Implement Bellman Expectation Equation.	5	*Implementing Bellman Expectation Equation in OpenAI Gym	2	CO3
LLO 6.1 Implement Dynamic programming's value iteration.	6	Write a python program using OpenAI Gym to solve the Frozen Lake problem using Value Iteration	2	CO3
LLO 7.1 Implement Dynamic programming Policy Iteration.	7	*Implement Python program using OpenAI Gym to solve the Frozen Lake problem using Dynamic programming Policy Iteration	2	CO3
LLO 8.1 Implement First-visit MC prediction algorithm.	8	Implement Python program using OpenAI Gym to implement First-visit MC prediction	2	CO4
LLO 9.1 Implement Every-visit Monte Carlo prediction algorithm.	9	*Implement First-visit MC prediction using python and OpenAI Gym	2	CO4
LLO 10.1 Implement TD prediction algorithm.	10	Using TD prediction algorithm solve the problem of Predicting the value of states in the Frozen Lake environment	2	CO5
LLO 11.1 Implement SARSA algorithm.	11	Using SARSA algorithm solve the problem of Predicting the value of states in the Frozen Lake environment	4	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 12.1 Implement Q-Learning algorithm.	12	*Using Q-Learning algorithm solve the problem of Predicting the value of states in the Frozen Lake environment	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)

Other

- Complete any course related to the Reinforcement Learning on MOOCS such as NPTEL, Coursera, Infosys Springboard etc.

Assignment

- Solve assignments covering all COs given by the course teacher.
- Assignments on Monte Carlo simulations to assess the risk and uncertainty in investment projects.
- Derive the Bellman Equation for Value Function.
- Solve the Bellman Equation for a Simple MDP.

Micro project

- Mountain Car Problem: In this OpenAI Gym environment, an agent learns to drive a car up a hill.
- Utilize OpenAI Gym to create an environment where an agent learns to balance a pole on a moving cart. Implement algorithms like Q-learning or policy gradients to train the agent.
- Tic-Tac-Toe Game: Develop an RL agent that learns to play Tic-Tac-Toe, focusing on state representation and reward shaping.

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 - (Computer System which is available in lab with minimum 4GB RAM)	All
2	Python 3.7 or higher	All

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

REINFORCEMENT LEARNING **Course Code : 316323**

Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Reinforcement Learning	CO1	12	4	10	6	20
2	II	Markov Decision Processes (MDPs)	CO2	9	4	4	6	14
3	III	The Bellman Equation and Dynamic Programming(DP)	CO3	8	4	4	4	12
4	IV	Monte Carlo(MC) Methods	CO4	8	2	6	4	12
5	V	Temporal Difference (TD) Learning	CO5	8	2	6	4	12
Grand Total				**45**	**16**	**30**	**24**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests of 30 marks each conducted during the semester. Continuous assessment based on process and product related performance indicators. Each practical will be assessed considering 60% weightage to process, 40% weightage to product. A continuous assessment based term work.

Summative Assessment (Assessment of Learning)

- End semester examination, Lab performance, Viva voce.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3			1			1			
CO2	3	2	2	2	1		1			
CO3	2	2	2	3	1		1			
CO4	2	2	2	3	1	2	1			
CO5	2	2	2	3	1	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	Sudharsan Ravichandiran	Deep Reinforcement Learning with Python	Packt Publishing ISBN : 978-1-83921-068-6, Second Edition 2020
2	Richard S. Sutton and Andrew G. Barto	Reinforcement Learning: An Introduction Second edition	The MIT Press. ISBN: 978-0-26203-924-6
3	Phil Winder	Reinforcement Learning Industrial Applications of Intelligent Agents	O'Reilly Media, Inc. ISBN-978-1-09811-483-1, First edition 2020
4	Miguel Morales	Grokking Deep Reinforcement Learning	Manning Publisher ISBN: 978-161729545 4

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Sr.No	Author	Title	Publisher with ISBN Number
5	Keng, Wah Loon, Graesser, Laura	Foundations of Deep Reinforcement Learning: Theory and Practice in Python	Addison-Wesley Professional ISBN: 978-0135172384

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://neptune.ai/blog/best-reinforcement-learning-tutorials-examples-projects-and-courses	Best Reinforcement Learning Tutorials, Examples, Projects, and Courses
2	https://www.geeksforgeeks.org/what-is-reinforcement-learning/	Reinforcement Learning tutorials
3	https://www.youtube.com/playlist?list=PLz2x4RAIbeXkTJFEipkD_ds3z0qx8_5D7	Reinforcement Learning Tutorials - NPTEL
4	https://swayam.gov.in/search_courses?searchText=RL	SWAYAM
5	https://infyspringboard.onwingspan.com/web/en/login	Infosys Springboard
6	https://deeplizard.com/learn/video/nyjbcRQ-uQ8	Reinforcement Learning Series Introduction
7	https://gordicaleksa.medium.com/how-to-get-started-with-reinforcement-learning-rl-4922fafeaf8c	How to get started with Reinforcement Learning (RL)
8	https://www.youtube.com/playlist?list=PLzvYlJMoZ02Dxtwe-MmH4nOB5jYlMGBjr	Reinforcement Learning By the Book

Note :

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

MSBTE Approval Dt. 04/09/2025 **Semester - 6, K Scheme**

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

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

I. RATIONALE

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

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

Apply mining tools to extract information from data warehouse.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

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

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

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

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

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

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

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

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

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

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

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

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

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

Note : Out of above suggestive LLOs -

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

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

Micro project

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

Assignment

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

Other

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

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

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

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

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

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

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

Summative Assessment (Assessment of Learning)

- End semester examination, Lab performance, Viva voce

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

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

XIII . LEARNING WEBSITES & PORTALS

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

Note :

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

MSBTE Approval Dt. 04/09/2025 **Semester - 6, K Scheme**

18-11-2025 02:14:00 PM

ADVANCED ALGORITHM IN AI & ML **Course Code : 316320**

Programme Name/s : **Artificial Intelligence/ Artificial Intelligence and Machine Learning**
Programme Code : **AI/ AN**
Semester : **Sixth**
Course Title : **ADVANCED ALGORITHM IN AI & ML**
Course Code : **316320**

I. RATIONALE

Machine Learning is a sub-field of Computer Science that leverages algorithms to replicate the way humans learn. It employs statistical techniques to train models and generate predictions. Many state-of-the-art AI and ML models rely on advanced algorithms to function effectively. Advanced algorithms often provide optimized ways to train models or make predictions more efficiently. The demand for AI and ML experts is growing, with roles in research, data science, and machine learning requiring a strong grasp of advanced algorithms. Mastering these techniques can develop ability to solve problems and stay at the forefront of AI innovation.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following industry identified outcome through various teaching learning experiences:
Apply advanced AI-ML algorithms to solve real world problems.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Apply suitable Machine learning model for dataset feature extraction.
- CO2 - Implement Machine learning algorithms on given problem.
- CO3 - Implement Artificial Neural Networks analyzing associated parameters of Deep Learning.
- CO4 - Build a Convolutional Neural Network for given context.
- CO5 - Classify Sequential and Image Data using Deep Learning.

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	
316320	ADVANCED ALGORITHM IN AI & ML	AAM	DSE	3	-	2	1	6	3	3	30	70	100	40	25	10	25#	10	25	10	175

ADVANCED ALGORITHM IN AI & ML **Course Code : 316320**

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 Select a suitable model for the given data with justification. TLO 1.2 Explain the process of supervised learning on the given data. TLO 1.3 Explain the process of Feature extraction and Engineering. TLO 1.4 Compare Feature Engineering for the given type of data. TLO 1.5 Differentiate between Feature scaling & Feature selection.	**Unit - I ML Models and Features Engineering** 1.1 Introduction of ML models 1.2 Training a model for Supervised learning 1.3 Features : Understanding data, Feature extraction and Engineering 1.4 Feature engineering on : Numerical data, Categorical data & Text data 1.5 Feature scaling & Feature selection	Lecture Using Chalk-Board Presentations
2	TLO 2.1 Explain the working of Support Vector Machines. TLO 2.2 Explain the method of performance analysis of clustering for the given problem. TLO 2.3 Illustrate the process of Dimensionality Reduction. TLO 2.4 Explain Association Rule Learning. TLO 2.5 Differentiate between various Generative models.	**Unit - II Supervised and Unsupervised Learning Algorithms** 2.1 Supervised Learning : Support Vector Machines- Working, Types and Implementation of SVM 2.2 Unsupervised Learning : K-Mediod Algorithm- working and implementation 2.3 Dimensionality Reduction: Introduction, Subset Selection, Principal Component Analysis 2.4 Association Rule Learning–Apriori Algorithm, Eclat Algorithm 2.5 Generative Models - Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs)	Lecture Using Chalk-Board Presentations Demonstration

ADVANCED ALGORITHM IN AI & ML **Course Code : 316320**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Describe the concepts of ANN. TLO 3.2 Explain the functioning of Perceptron Learning Algorithm with example. TLO 3.3 Explain Gradient Descent rule. TLO 3.4 Calculate the output of the network for the given input pattern & given activation function.	**Unit - III Artificial Neural Networks** 3.1 Introduction of Artificial Neural Networks(ANN) 3.2 Perceptron : Basic Components, working, Types ,Training Rule 3.3 Gradient Descent Rule, Gradient, Types of Gradient Descent 3.4 Activation Functions: Sigmoid, ReLU, Hyperbolic tangent, Softmax etc.	Lecture Using Chalk-Board Presentations Flipped Classroom
4	TLO 4.1 Illustrate use of CNN in real-life applications. TLO 4.2 Explain the functions of different Layers in a CNN. TLO 4.3 Describe the characteristics of different types of Pooling. TLO 4.4 Analyse different open source CNN architectures.	**Unit - IV Convolutional Neural Networks** 4.1 Convolutional Neural Networks : Introduction, Architecture and Applications 4.2 Padding, Strided convolution, Convolution over volume, Pooling 4.3 Case studies: LeNet, AlexNet, VGGNet, ResNet, GoogleNet etc.	Lecture Using Chalk-Board Presentations Case Study
5	TLO 5.1 Describe the process of implementing Deep Learning for Sequential Data. TLO 5.2 Illustrate the process of implementing Deep Learning for Image Data. TLO 5.3 Explain working of GPT.	**Unit - V Deep Learning for Sequential data and Image data** 5.1 Sequential Data: Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM) networks, Gated Recurrent Units (GRUs) 5.2 Image Data : Pre-trained Neural Networks, Transfer Learning, Fine Tuning 5.3 Introduction to Transformers, Generative Pre-training Transformer(GPT)	Lecture Using Chalk-Board Presentations 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 Install required platform to use Python, PyTorch, Scikit-learn library.	1	* a. Installation of Tools and Libraries (Jupyter Notebook /Matplotlib/ Numpy / Pandas / PyTorch/ scikit-learn) b. Use of google colab (https://colab.research.google.com/)	2	CO1
LLO 2.1 Implement filter and wrapper method on dataset.	2	Apply filter and wrapper method on any standard datasets	2	CO1
LLO 3.1 Implement program for Data Preprocessing Techniques.	3	* Perform following operations :(Assume suitable data/dataset if needed). I. Write program to read dataset (Text,CSV,JSON,XML) II. Which of the attributes are numeric and which are categorical? III. Performing Data Cleaning, Handling Missing Data, Removing Null data IV. Rescaling Data v. Encoding Data V. Feature Selection	2	CO1
LLO 4.1 Implement SVM for classification using dataset.	4	* Write a program to implement SVM for classification using suitable dataset	2	CO2
LLO 5.1 Implement unsupervised machine learning algorithm.	5	Write a program to implement unsupervised machine learning algorithm (Clustering – K Medoid) in python on dataset to cluster data. (Assume suitable dataset)	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Implement Apriori Algorithm for Association Rule Learning.	6	* Write a program to implement Association Rule Learning (Apriori Algorithm) on any dataset	2	CO2
LLO 7.1 Implement Eclat Algorithm for Association Rule Learning.	7	Write a program to implement Association Rule Learning (Eclat Algorithm) on any dataset	2	CO2
LLO 8.1 Implement Perceptron algorithm for AND logic gate.	8	* Write a program to implement AND Logic Gate with 2-bit Binary Input using Perceptron algorithm	2	CO3
LLO 9.1 Implement Perceptron algorithm using dataset.	9	* Write a program to implement Perceptron Learning in Python using Iris flower dataset	2	CO3
LLO 10.1 Develop Gradient Descent in PyTorch.	10	Write a program to implement Gradient Descent in PyTorch	2	CO3
LLO 11.1 Implement Back propagation/feed forward neural network.	11	Write a program to implement /Simulate Back propagation/feed forward neural network	2	CO4
LLO 12.1 Apply given CNN architecture.	12	Build a small CNN model consisting of 5 convolution layers	2	CO4
LLO 13.1 Implement CIFAR 10- CNN.	13	* Write a program to implement CIFAR 10- CNN using PyTorch	2	CO4
LLO 14.1 Implement a basic LSTM model for forecasting future values based on past data.	14	Basic Time Series Forecasting with LSTM	2	CO5
LLO 15.1 Classify image data using pre trained model.	15	* Classification of images using imagenet dataset	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

- Train a GAN for Image Generation.
- Implement and Tune a Convolutional Neural Network (CNN) for Transfer Learning.
- Implement and Train a Transformer Model for Text Generation.
- Implement a Neural Network with Backpropagation and Vanishing Gradient Problem.
- Implement and Train a Transformer Model for Text Generation
- Build an AI Model for Time Series Forecasting.

Micro project

- Develop a micro project for credit card fraud detection using publically available datasets like Kaggle credit card fraud detection dataset to classify transactions as either fraudulent or non-fraudulent.
- Develop a micro project for image classification using support vector machine. Use labeled dataset of images like CIFAR-10 Dataset, MNIST Dataset etc. Discuss the limitations of SVM for image classification.
- Develop a micro project to implement machine learning model capable of predicting stock market trends (up/down) based on historical data and provide visualization of stock price movement.
- Develop a micro project for Predicting Diabetes. Use Pima Indians Diabetes Database available on kaggle. Provide visualizations of model evaluation, such as confusion matrix and ROC curve, for better interpretation.
- Develop a micro project for Face Recognition system which uses Dlib's deep learning model.

Other

- Complete the course on Infosys Springboard such as Variety of ML algorithms / Support vector algorithm in ML / Advanced setting in ML model etc .

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 (i5 preferable), RAM minimum 8 GB onwards	All
2	Operating system: Windows 10 onwards	All
3	Software: Editor: Python setup, PyTorch	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	ML Models and Features Engineering	CO1	6	4	2	4	10
2	II	Supervised and Unsupervised Learning Algorithms	CO2	12	4	4	10	18
3	III	Artificial Neural Networks	CO3	9	2	6	6	14
4	IV	Convolutional Neural Networks	CO4	9	4	4	6	14
5	V	Deep Learning for Sequential data and Image data	CO5	9	2	6	6	14
Grand Total				**45**	**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 term work.

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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	1	2	-	2			
CO2	2	2	2	2	2	2	3			
CO3	2	2	2	2	2	1	3			
CO4	2	2	2	2	2	1	3			
CO5	2	1	2	2	2	1	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	Andreas C. Müller & Sarah Guido	Introduction to Machine Learning with Python	O'Reilly Media, Inc ISBN-13: 978-9352134571
2	Tom M Mitchell	Machine Learning	McGraw Hill Education; First Edition ISBN-13: 978-1259096952
3	Rudolph Russell	Machine Learning Step-by-Step Guide To Implement Machine Learning Algorithms with Python	CreateSpace Independent ISBN-13: 978-1719528405
4	Dipanjan Sarkar, Raghav Bali, Tushar Sharma	Practical Machine Learning with Python A Problem-Solver's Guide to Building Real-World Intelligent Systems	Apress ISBN-13:978-1484232064
5	François Chollet	Deep Learning with Python	Manning Publications ISBN-13:978-1617294433
6	Rajiv Chopra	Deep Learning - A Practical Approach	Khanna Publishing House ISBN-13:978-9386173416
7	Ian Pointer	Programming PyTorch for Deep Learning	O'Reilly Media ISBN-13:978-1492045359
8	Josh Patterson, Adam Gibson	Deep Learning: A Practitioner's Approach	Shroff/O'Reilly ISBN-13:978-9352136049

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.python.org/downloads/	Python IDE download
2	https://www.pdfdrive.com/machine-learning-step-by-step-guide-to-implement-machine-learning-algorithms-with-python-d158324853.html	AI and ML E-Books

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Sr.No	Link / Portal	Description
3	https://www.geeksforgeeks.org/how-to-install-python-pycharm-on-windows/	Guidelines for Installation of python
4	https://www.pythoncentral.io/how-to-install-pytorch-using-pip-a-step-by-step-guide/	Installation of PyTorch on windows
5	https://www.geeksforgeeks.org/what-is-feature-engineering/	Feature Engineering
6	https://scikit-learn.org/stable/modules/svm.html	Support Vector Machine
7	https://towardsdatascience.com/an-introduction-to-deep-learning-for-sequential-data-ac966b9b9b67/	Deep learning for sequential data

Note :

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

CAPSTONE PROJECT **Course Code : 316004**

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

I. RATIONALE

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

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

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

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

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

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

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

CAPSTONE PROJECT **Course Code : 316004**

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

V. General guidelines for PROJECT WORK

- The Project- problems must be related to the programme or may be interdisciplinary, based on the industry expected outcomes.
- The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work they would like to execute.
- Project titles are to be finalized in co-ordination/consultation with the Faculty mentor. However, faculty may form a team of students as per specific roles- Literature survey/data collection, data Analysts, model/prototype developers, testers, Project managers using IoTs ITES and software /application development. Study type project is NOT advisable.
- Project must be assigned to a group of 3-4 students under the guidance of identified faculty mentor.
- Students are required to prepare a prototype/working model/software of the Project and simultaneously prepare a report.
- Students shall Submit One Hard copy and one Soft copy each of Project Report and soft-copy of the project code or the working model.
- Students must maintain a project execution diary having the progress steps and details. The concerned faculty should check the diary on a weekly basis and accordingly interact with students based on the progress shown and keep proper record with feedback if any.
- Project shall address National Thrust area such as Environment, Digitization, Automation, sustainability and similar domains.
- Student shall try to use the national and international standards wherever possible (processes / materials / equipments etc ..)

VI. Project facilitation guidelines:

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

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

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

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

VII.Criteria of Assessment /Evaluation of Project work

A. Formative Assessment (FA) criteria

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

Appropriate RUBRICS may be used for assessment

Rubrics for Assessment of the team

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

Rubrics for Individual Assessment

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

B. Summative Assessment Criteria

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

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

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

SUGGESTED RUBRIC FOR SUMMATIVE ASSESSMENT OF CAPSTONE PROJECT

PROJECT ASSESSMENT				
Project Title:				
Project Assessment Rubric				
Performance	**Excellent**	**Good**	**Fair**	**Poor**
Criteria	**9-10 marks.**	**6-8 marks.**	**4-5 marks.**	**0-3 marks**
Capstone Project Completion	Excellent **The project is completed as per tasks described in synopsis.**	Good **The project is completed but require minor modifications.**	Fair **The project is completed but require several modifications.**	Poor **The project is not completed as per tasks described in synopsis.**

CAPSTONE PROJECT **Course Code : 316004**

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

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

C. Self Learning Assessment

Self Learning Assessment **Max Marks -50**

Sr.No.	Criteria	Max Marks	Marks Obtained
1	Project Selection & Problem definition	10	
2	Literature survey and data collection/ Gathering	05	
3	Design / concept of project/ Working - Execution of Project	15	
4	Stage wise progress as per Action plan/milestone/ psychomotor motor skills acquired	10	
5	Quality Report Writing	10	

VIII. CO-PO Mapping

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

IX. Typographical instructions/guidelines for Project report writing

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

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

X. Project Report

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

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

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

NOTE:

1. Project report must contain only a relevant and short mention – technology or platform or tools used. It must be more focussed on project work and its implementation
2. Students can add/remove/edit chapter names as per the discussion with their guide

Formats

Project Report

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

as a partial fulfilment of requirement of the

THIRD YEAR DIPLOMA IN

Submitted by

1)Name Of Student Enrollment Number

2)Name Of Student Enrollment Number

3)Name Of Student Enrollment Number

4)Name Of Student Enrollment Number

Are the bonafide on

FOR THE ACADEMIC YEAR

20-----20---

(H.O.D)

(Principal)

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

Department Name

(If NBA Accredited mention that)
Institute Name

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

CAPSTONE PROJECT **Course Code : 316004**

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Note:

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

CAPSTONE PROJECT **Course Code : 316004**

Annexure

PROJECT DIARY (Weekly/Daily)

Name of the Student : _____

Name of Guide (Faculty) : _____

Enrollment Number : _____ Semester: _____Project batch Number : _____

WEEK : _____

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

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

MSBTE LOGO INST LOGO

Certificate

This is to certify that

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

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

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

Diploma Course in

< PROGRAMME NAME>

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

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

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

18-11-2025 02:12:25 PM

NETWORK MANAGMENT AND ADMINISTRATION **Course Code : 316007**

Programme Name/s	**: Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Data Sciences/ Computer Hardware & Maintenance/**
Programme Code	**: AI/ AN/ DS/ HA**
Semester	**: Sixth**
Course Title	**: NETWORK MANAGMENT AND ADMINISTRATION**
Course Code	**: 316007**

I. RATIONALE

Network Management and Administration is an important aspect of networking and computing technologies. Network administrators utilize various tools, protocols, and processes to maintain and optimize network operations. This course aims to provide students with hands-on experience in both the Windows Server operating system and the Linux platform, focusing on server configuration, virtualization, and backup and recovery in network environments.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified outcomes through various teaching learning experiences: Perform Network Management and Administration with Windows and Linux Server.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Explain critical features of Windows Server and Linux Operating System.
- CO2 - Configure Active Directory for managing objects.
- CO3 - Configure different web services.
- CO4 - Create virtual environment.
- CO5 - Apply Backup and Recovery services.

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	
316007	NETWORK MANAGMENT AND ADMINISTRATION	NMA	AEC	2	-	4	-	6	3	-	-	-	-	-	25	10	25@	10	-	-	50

Total IKS Hrs for Sem. : 0 Hrs

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

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

Note :

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

NETWORK MANAGMENT AND ADMINISTRATION **Course Code : 316007**

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 the features of Network Operating Systems. TLO 1.2 Differentiate the features of different editions of Windows Server. TLO 1.3 Explain the features of Linux Environment w.r.t. Server Management and Administration.	**Unit - I Introduction to Network Server Environment** 1.1 Network Operating Systems (NOS), Key features of NOS 1.2 The Windows Server family(and editions), Key features - Security features, support for hybrid cloud environments, performance and scalability, Hardware requirements 1.3 Overview of Linux Environment w.r.t. Server Management and Administration	Lecture Using Chalk-Board Demonstration
2	TLO 2.1 Explain the process of configuring Active Directory. TLO 2.2 Illustrate the process of deploying Domain Controller. TLO 2.3 Describe the significance of group policies.	**Unit - II Server Deployment** 2.1 Active Directory and Domain Services (ADDS) - Fundamentals -Domain, tree domain, Forest, Organizational Units (OUs), Comparing a domain with a workgroup 2.2 Installing and configuring ADDS - Promoting a server to a domain controller, Managing domain users, groups, and computers, Organizational Units 2.3 Group Policy - Managing, Configuring and Processing Group Policy Objects, Group Policy Editors	Lecture Using Chalk-Board Demonstration
3	TLO 3.1 Configure Web Server. TLO 3.2 Install DNS, DHCP Server. TLO 3.3 Manage Remote access services.	**Unit - III Role Assignment for Server Environment** 3.1 IP address –IPV4, Classification of IP address, overview of IPV6, Subnetting, Supernetting a network 3.2 Server Roles – Web Server, FTP, DNS, DHCP, telnet 3.3 Installing Server Roles Using Server Manager – Add Roles and Features Wizard, Select Server Role and features 3.4 Post installation tasks for server roles, Managing and Removing Roles	Hands-on Demonstration
4	TLO 4.1 Explain Virtualization. TLO 4.2 Install Virtual Machine. TLO 4.3 Implement Active Directory to the Cloud for Hybrid environments.	**Unit - IV Introduction to Server Virtualization** 4.1 Hyper-V Architecture, Installing and Configuring Hyper-V 4.2 Creating a Virtual Machine (VM), Managing a VM’s memory 4.3 Hybrid cloud environments, Active Directory and Hybrid Identity, Hybrid cloud environments, Active Directory and Hybrid Identity	Demonstration Hands-on

NETWORK MANAGMENT AND ADMINISTRATION **Course Code : 316007**

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 Deploy file sharing permissions. TLO 5.2 Configure disk volumes. TLO 5.3 Apply backup and recovery strategy.	**Unit - V File and Storage Management** 5.1 File Server Role-Configuring file sharing, File permissions and NTFS vs Share permissions, Advanced file sharing features (Access-based enumeration) 5.2 Storage Management – Introduction to storage technologies, Creating and managing volumes using Disk Management, Dynamic Disks and RAID configurations (RAID 0, 1, 5, etc.) 5.3 Backup and Data Recovery - Configuring Windows Server Backup, Restoring data from backups, File and Folder Backup, Recovery options (VSS, system state backup)	Demonstration 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 Network Operating System.	1	* Installation of Network Operating System on a. Windows Server b. Linux	2	CO1
LLO 2.1 Install device drivers. LLO 2.2 Uninstall device drivers .	2	* Install device drivers a. Install and configure hardware device drivers b. Uninstall device drivers	1	CO1
LLO 3.1 Install Active Directory for creating various objects.	3	* Install the Active Directory on a Windows Server	1	CO2
LLO 4.1 Implement Domain Controller.	4	Promote the Server to a Domain Controller on Windows Server	1	CO2
LLO 5.1 Create Domains, Tree Domains and Forests to manage objects.	5	* Creating Domains, Tree Domains and Forests on Windows Server	2	CO2
LLO 6.1 Deploy trust relationship of objects across domains.	6	Set up trust relationships between different domains for resource sharing on Windows Server	1	CO2
LLO 7.1 Create and manage user accounts.	7	* Creating user accounts a. Create Domain users in Windows Server with rights and permissions b. Create user accounts in Linux using command-line / GUI with rights and permissions	4	CO2
LLO 8.1 Create and manage groups to organize users.	8	Create groups using a. Windows Server b. Linux	2	CO2
LLO 9.1 Add computers with access rights in domain.	9	Add computer accounts in the domain using Windows Server	1	CO2
LLO 10.1 Create Organizational Units.	10	* Create Organizational Units (OUs) in Windows Server	1	CO2

NETWORK MANAGMENT AND ADMINISTRATION **Course Code : 316007**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 11.1 Assign permissions to specific users and groups under OU.	11	* Delegate administrative control over an OU to specific users or groups in Windows Server	2	CO2
LLO 12.1 Create Group Policy Object. LLO 12.2 Link Group Policy Object (GPO) to OU.	12	* Create a Group Policy Object (GPO) and link to OU in Windows Server	2	CO2
LLO 13.1 Manage GPO.	13	Perform operations on GPO in Windows Server a. Modify existing GPO b. Copy existing GPO c. Delete existing GPO	2	CO2
LLO 14.1 Implement Backup and Restore GPOs.	14	Backup and Restore GPOs in Windows Server	2	CO2
LLO 15.1 Configure HTTP services. LLO 15.2 Configure FTP Server.	15	* Install the Web Server to configure a. HTTP Server on Windows and Linux Server b. FTP Server Windows and Linux Server	4	CO3
LLO 16.1 Assign permissions to access web resources.	16	* Set the correct directory permissions for the website to allow proper access to web applications hosted on a. Windows Server b. Linux Server	2	CO3
LLO 17.1 Install Domain Name Server (DNS).	17	* Install the DNS on a. Windows Server b. Linux Server	2	CO3
LLO 18.1 Configure DNS Zones. LLO 18.2 Assign DNS Records. LLO 18.3 Integrate DNS Zones to Active Directory.	18	* Create and configure DNS zones on a. Windows Server b. Linux	4	CO3
LLO 19.1 Install DHCP. LLO 19.2 Configure DHCP Scope.	19	* Install and configure DHCP server on a. Windows Server b. Linux Server	2	CO3
LLO 20.1 Install Remote login utility.	20	* Install telnet / SSL services on a. Windows Server b. Linux Server	4	CO3
LLO 21.1 Install Hyper-V.	21	* Install the Hyper-V to enable virtualization on Windows Server.	2	CO4

NETWORK MANAGMENT AND ADMINISTRATION **Course Code : 316007**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 22.1 Create virtual machine.	22	a.Create a virtual machine to run guest operating systems on Hyper-V using Windows Server b.Manage VMs Using Power Shell using Windows Server	2	CO4
LLO 23.1 Install Remote login utility.	23	Create a virtual machine to run guest operating system on Linux	2	CO4
LLO 24.1 Create Disk volumes. LLO 24.2 Manage Disk volumes.	24	a.Create and Manage Volumes on Windows Server b.Convert a basic disk to a dynamic disk and manage dynamic volumes on Windows Server	2	CO5
LLO 25.1 Create Disk volumes.	25	* Create Disk volumes in Linux a Mount and Unmount Local Disks b Create Partition and Logical Volume	2	CO4
LLO 26.1 Configure RAID.	26	Configure RAID (0-3)	2	CO5
LLO 27.1 Configure Server Backup.	27	* Install/ Configure Server Backup in a. Windows Server b. Linux Server	2	CO5
LLO 28.1 Configure System State Backup.	28	Configure and perform a System State Backup to protect server configurations in Windows Server	2	CO5
LLO 29.1 Implement Volume Shadow Copy Service.	29	Implement Volume Shadow Copy Service (VSS) for Backup to create snapshots of data in Windows Server	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) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Server Computer (64-bit processor, 2GB RAM, 32GB HDD)	All
2	Networking Equipment (Switches, Routers, Cables)	All
3	Virtualization Platform	All
4	External Hard Drives or Network Attached Storage	All
5	Client Machines	All
6	Windows Server 2022 and onwards	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Network Server Environment	CO1	4	0	0	0	0

NETWORK MANAGMENT AND ADMINISTRATION **Course Code : 316007**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
2	II	Server Deployment	CO2	8	0	0	0	0
3	III	Role Assignment for Server Environment	CO3	6	0	0	0	0
4	IV	Introduction to Server Virtualization	CO4	6	0	0	0	0
5	V	File and Storage Management	CO5	6	0	0	0	0
Grand Total				**30**	**0**	**0**	**0**	**0**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

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

Summative Assessment (Assessment of Learning)

- 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	-	-	3	1	-	3			
CO2	2	2	2	2	2	2	3			
CO3	2	2	2	3	1	3	2			
CO4	2	2	3	3	2	3	3			
CO5	2	2	2	3	1	2	3			

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Jordan Krause	Mastering Windows Server 2022	Packt Publishing; 4th ed. edition ISBN-10 - 1837634505
2	Bekim DautiBekim Dauti	Windows Server 2022 Administration Fundamentals	Packt Publishing; 3rd ed. edition ISBN-1803232153
3	Alexandru Calcatinge	Mastering Linux Administration	Packt Publishing; 2nd ed. edition, ISBN-10-1837630690
4	Wale Soyinka	Linux Administration A Beginner's Guide	McGraw Hill Education, ISBN-10-1259061183

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description

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NETWORK MANAGMENT AND ADMINISTRATION **Course Code : 316007**

Sr.No	Link / Portal	Description
1	https://youtu.be/uFWaxzk6VfU?si=1dKiDehJ1RrCdjYu	Practical guidance
2	https://learn.microsoft.com/en-us/windows-server/get-started/get-started-with-windows-server	Windows Server Administration
3	https://www.tutorialspoint.com/linux_admin/index.htm	User Management, FTP, Disk Management, Backup and Recovery
4	https://www.serveracademy.com/blog/active-directory-101-a-step-by-step-tutorial-for-beginners/	Active Directory Object Mangement
5	https://learn.microsoft.com/en-us/windows-server/virtualization/hyper-v/get-started/install-hyper-v?pivots=windows	Hyper-V

Note :

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

MSBTE Approval Dt. 04/09/2025 **Semester - 6, K Scheme**

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MOBILE APPLICATION DEVELOPMENT **Course Code : 316006**

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

I. RATIONALE

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

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the students to attain the following Industry Identified Outcomes through various teaching learning experiences:

• Build real-time Android applications.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

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

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

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

MOBILE APPLICATION DEVELOPMENT **Course Code : 316006**

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

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

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

MOBILE APPLICATION DEVELOPMENT **Course Code : 316006**

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

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Install any Android IDE .	1	*Install Android IDE and create Android virtual device	2	CO1
LLO 2.1 Use IDE to wirte and exceute Java program for Android application.	2	Develop a program to display “Hello World” on screen	2	CO2
LLO 3.1 Change the attributes in the directory structure.	3	*Explore the directory structure in Android IDE	2	CO2
LLO 4.1 Develop a program to implement Auto complete Text View and Edit Text.	4	* Develop android application using View Text and Edit Text.	2	CO3
LLO 5.1 Use different types of buttons in Android application.	5	*Develop a program to implement Button, Image Button and Toggle Button	2	CO3

MOBILE APPLICATION DEVELOPMENT **Course Code : 316006**

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

MOBILE APPLICATION DEVELOPMENT **Course Code : 316006**

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

Note : Out of above suggestive LLOs -

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

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

Micro project

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

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

Other

- Complete course of Android App Development on NPTEL

• Complete course of Android Development Courses on Spoken Tutorial

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

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

MOBILE APPLICATION DEVELOPMENT **Course Code : 316006**

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

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

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

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

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

Summative Assessment (Assessment of Learning)

- Laboratory Performance, Viva Voce

XI. SUGGESTED COS - POS MATRIX FORM

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

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

MOBILE APPLICATION DEVELOPMENT **Course Code : 316006**

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

XIII . LEARNING WEBSITES & PORTALS

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

Note :

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

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PRINCIPLES OF IMAGE PROCESSING **Course Code : 316319**

Programme Name/s : **Artificial Intelligence/ Artificial Intelligence and Machine Learning**
Programme Code : **AI/ AN**
Semester : **Sixth**
Course Title : **PRINCIPLES OF IMAGE PROCESSING**
Course Code : **316319**

I. RATIONALE

Digital Image processing allows computers to extract meaningful information from images or various day-to-day applications, which also enhance visual quality and enable automated analysis of image data. Image processing is important for applications where immediate responses are needed. This course provides the skills to manipulate and analyze digital images, including techniques to enhance image quality, extract features, segment objects and perform analysis on visual data.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attain following Industry Identified Competency through various Teaching Learning Experiences:
Use image processing techniques to retrieve useful information from the image.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Explain concepts of digital image processing.
- CO2 - Elaborate image processing techniques to enhance image quality.
- CO3 - Identify image compression and segmentation techniques.
- CO4 - Use image restoration techniques.
- CO5 - Identify image processing techniques for feature detection.

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	
316319	PRINCIPLES OF IMAGE PROCESSING	PIP	DSC	3	-	-	1	4	2	3	30	70	100	40	-	-	-	-	25	10	125

PRINCIPLES OF IMAGE PROCESSING **Course Code : 316319**

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 types of image processing techniques. TLO 1.2 Differentiate Megapixels and Image Quality. TLO 1.3 Explain steps involved in digital image processing with diagram. TLO 1.4 Explain components of an Image Processing System. TLO 1.5 Compare different image file formats. TLO 1.6 State different operation on images. TLO 1.7 Describe applications of Digital Image Processing.	**Unit - I Introduction to Image Processing** 1.1 Image : Pixel, Distance measures, Color fundamentals & models – RGB , HIS, YIQ, Types of an image : Vector and Raster , Types of image processing, Formation of digital image , resolution(Spatial and gray level), Megapixels and Image Quality. Image Acquisition: Cameras and sensors 1.2 Block Diagram: Fundamental Steps in Digital Image Processing, Advantages and disadvantages 1.3 Components of an Image Processing System, Difference between Image Sampling & quantization 1.4 Image file formats : JPEG , PNG, GIF, TIFF, BMP , Image Histogram 1.5 Operations on images : image addition, subtraction, logical operations, scaling, translation, rotation. Applications of Digital Image Processing	Presentations Video Demonstrations Lecture Using Chalk-Board
2	TLO 2.1 Explain Gray Level Transformations. TLO 2.2 Describe techniques of Spatial domain enhancement. TLO 2.3 Describe techniques of Frequency domain enhancement. TLO 2.4 Explain Homomorphic filtering.	**Unit - II Image Enhancement in Spatial Domain and Frequency Domain** 2.1 Basic Gray Level Transformations (Linear ,Logarithmic, Power – law) , Histogram Processing , Enhancement Using Arithmetic/Logic Operation 2.2 Spatial domain enhancement : Point operations- Log transformation, Power-law transformation, Piecewise linear transformations, Histogram equalization. Filtering operations- Image smoothing, Image sharpening 2.3 Frequency domain enhancement: 2-D Discrete Fourier Transform (DFT) ,Smoothing and Sharpening in frequency domain. Homomorphic filtering	Presentations Video Demonstrations Lecture Using Chalk-Board

PRINCIPLES OF IMAGE PROCESSING **Course Code : 316319**

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 types of redundancy. TLO 3.2 Describe Image and Video Compression Standards. TLO 3.3 Describe various coding compression techniques. TLO 3.4 Use Huffman coding to compress the text data in a string.. TLO 3.5 Use DCT to analyze the performance of image compression. TLO 3.6 Compare Point Detections, Line Detection and Edge Detection. TLO 3.7 Explain Laplacian of Gaussian (LoG), Difference of Gaussian (DoG).	**Unit - III Image Compression and Image Segmentation** 3.1 Types of redundancy: Spatial Redundancy, Spectral Redundancy, Temporal Redundancy 3.2 Fidelity criteria : Objectives, Importance. Image and Video Compression Standards – JPEG, MPEG-1,MPEG-3 3.3 Lossless compression: Run length coding, Huffman coding 3.4 Lossy compression techniques – Discrete Cosine Transform (DCT) based compression 3.5 Image Segmentation: Comparison of Point Detections, Line detection and Edge Detection, First order derivative - Prewitt and Sobel. Second order derivative – Laplacian of Gaussian (LoG), Difference of Gaussian (DoG)	Presentations Hands-on Lecture Using Chalk-Board Video Demonstrations
4	TLO 4.1 Compare constraint, unconstraint, and interactive restoration. TLO 4.2 Explain Image Degradation Model. TLO 4.3 Describe various noise models. TLO 4.4 Identify image processing techniques to reduce the noise and restore the image to its original quality. TLO 4.5 Compare Harmonic Mean Filter and Arithmetic Mean Filter. TLO 4.6 Compare Inverse Filtering and Wiener filtering. TLO 4.7 Write the applications of Image restoration.	**Unit - IV Image Restoration** 4.1 Image restoration: Definition, Concepts of restoration: constraint and unconstraint restoration, interactive restoration, Image Degradation/ Restoration Model, Difference between restoration and enhancement 4.2 Noise models: Gaussian Noise, Exponential Noise, Uniform Noise 4.3 Mean Filters : Overview of Arithmetic Mean Filter, Geometric Mean Filter, Harmonic Mean Filter, Band reject Filters, Band pass Filters 4.4 Overview of Inverse Filtering and Wiener filtering, applications of Image restoration	Presentations Lecture Using Chalk-Board Demonstration

PRINCIPLES OF IMAGE PROCESSING **Course Code : 316319**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	TLO 5.1 Explain importance of Texture Analysis. TLO 5.2 Explain Types of Shapes. TLO 5.3 Identify the method to enhance the contrast of a blurry image taken in low light to make it clear. TLO 5.4 Describe Color Feature Extraction. TLO 5.5 Draw components of an object recognition system. TLO 5.6 Identify object detection technique to detect and count the vehicles from a traffic surveillance camera. TLO 5.7 Elaborate feature extraction methods to recognize specific patterns to detect defects in a manufactured product.	**Unit - V Image Analysis** 5.1 Feature Extraction: Texture analysis: Definition, Importance of Texture Analysis, overview of Texture Analysis Methods Shape analysis: Definition, Types of Shapes, concept of Shape Representation Color analysis: Definition, Color Spaces, Color Feature Extraction : Color Histogram , Color Moments , Color Coherence Vector (CCV) , Color Correlogram , Color Transfer 5.2 Object Recognition : components of an object recognition system (Model database , Feature detector , Hypothesizer, Hypothesis verifier) , Complexity of Object Recognition : Two-dimensional, Three-dimensional. Overview of Methods for Object Recognition : Feature-Based Recognition, Template Matching, Deep Learning (CNNs), Point Cloud Matching (3D Recognition), Object Detection Algorithms (YOLO, SSD) 5.3 Feature Detection : Global Features, Local Features, Relational Features 5.4 Overview of Advanced Image Processing concepts: Deep Learning and Convolutional Neural Networks (CNNs), 3D Image Processing and Computer Vision, Computer-Aided Diagnosis (CAD) in Medical system	Presentations Lecture Using Chalk-Board Demonstration

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

- Use Fourier Transform to analyze the frequency domain of an image.
- Use image compression algorithms like JPEG or PNG and compare the quality of the compressed and original image.
- Perform basic operations like resizing, rotating, and cropping images.
- Differentiate between 3-D and 2-D image processing.
- Explain how applying filters affects the fidelity of an image.

Micro project

- Make a collage by arranging multiple images into a single image.
- Rotate an image by a specific angle.
- Convert an image from RGB to grayscale.
- Display the color histogram of an image.
- Resize an image to user-defined dimensions (height and width).

Other

- Complete course of Digital Image Processing on NPTEL.
- Complete course of Fundamentals of Digital Image and Video Processing on Coursera.

PRINCIPLES OF IMAGE PROCESSING **Course Code : 316319**

Note :

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

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

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

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Image Processing	CO1	5	4	6	2	12
2	II	Image Enhancement in Spatial Domain and Frequency Domain	CO2	8	4	4	6	14
3	III	Image Compression and Image Segmentation	CO3	10	4	6	4	14
4	IV	Image Restoration	CO4	10	2	8	4	14
5	V	Image Analysis	CO5	12	4	8	4	16
Grand Total				**45**	**18**	**32**	**20**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- Two unit tests of 30 marks will be conducted and average of two unit tests will be considered.
- Formative assessment of self learning of 25 marks should be assessed based on self learning activity such as Infosys Springboard Certification/Microprojects/Assignment(60% weightage to process and 40% to product)

Summative Assessment (Assessment of Learning)

- End Semester Exam

XI. SUGGESTED COS - POS MATRIX FORM

PRINCIPLES OF IMAGE PROCESSING **Course Code : 316319**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	2	-	-	-	-	-	-			
CO2	2	2	1	-	-	-	-			
CO3	2	2	2	2	1	-	1			
CO4	2	2	2	2	1	1	1			
CO5	2	2	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	S. Annadurai	Fundamentals of Digital Image Processing	Pearson Education India, ISBN: 9788177584790, 9788177584790
2	Rafael C. Gonzalez, Richard E. Woods	Digital Image Processing Fourth edition (30 July 2018)	Pearson Education; ISBN-13 978-9353062989
3	Alasdair McAndrew	A Computational Introduction to Digital Image Processing, 2nd Edition	Chapman and Hall/CRC, ISBN-13 ? : ? 978-0367783334
4	William K. Pratt	Digital Image Processing: PIKS Scientific Inside	Wiley India Private Limited; Fourth edition ,ISBN-13 ? : ? 978-8126526840
5	Kenneth R. Castleman	Digital Image Processing	Pearson Education India, ISBN-13 978-8131712863

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.geeksforgeeks.org/digital-image-processing-basics/	Digital Image Processing Basics
2	https://www.tutorialspoint.com/dip/index.htm	Image Processing for Beginners
3	https://www.tpointtech.com/digital-image-processing-tutorial	Digital Image Processing Tutorial
4	https://onlinecourses.nptel.ac.in/noc22_ee116/preview	Image processing techniques, algorithms and their applications
5	https://www.coursera.org/learn/digital	Fundamentals of Digital Image and Video Processing
6	https://www.coursera.org/learn/introduction-image-processing	Introduction to Image Processing

Note :

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

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BIG DATA ANALYTICS **Course Code : 316318**

Programme Name/s : **Artificial Intelligence/ Artificial Intelligence and Machine Learning/ Data Sciences**
Programme Code : **AI/ AN/ DS**
Semester : **Sixth**
Course Title : **BIG DATA ANALYTICS**
Course Code : **316318**

I. RATIONALE

Big data analytics has many applications, including in healthcare, finance, transportation, and more. It helps businesses make better decisions, improve customer experience, and reduce costs. This course on Big Data Analytics introduces learners to the fundamental concepts of handling large and diverse datasets, including data classification, architecture, and processing techniques. The course provides hands-on experience with basic Big Data tools like Hadoop, NoSQL, Hive, Pig, and Spark. By developing foundational skills, learners will understand how to manage Big Data efficiently and support data handling tasks in various contexts, preparing them for future advanced applications.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry relevant outcome through various teaching learning experiences:
Apply big data analytics to manage and analyze large datasets.

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

- CO1 - Illustrate different phases of big data with respect to real world application.
- CO2 - Demonstrate the use of Hadoop core components for big data processing.
- CO3 - Apply NoSQL database concepts and architecture patterns to manage big data.
- CO4 - Use Hive and Pig for data processing and transformation within big data environments.
- CO5 - Use Spark to process and analyze big data in real-time or archives.

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	
316318	BIG DATA ANALYTICS	BDA	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	-	-	25	10	150

BIG DATA ANALYTICS **Course Code : 316318**

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 Classify the given data. TLO 1.2 Explain the characteristics of Big Data. TLO 1.3 Describe different types of Big Data. TLO 1.4 Explain the architecture of Big Data Processing. TLO 1.5 Illustrate different phases of big data analytics. TLO 1.6 Describe real-world applications of Big Data analytics.	**Unit - I Introduction to Big Data Analytics and Data Architecture** 1.1 Classification of Data : Structured, Semi-structured and Unstructured 1.2 Introduction :Big Data Definitions, Need of Big Data 1.3 Big Data Characteristics : Volume, Velocity, Variety, Veracity 1.4 Big Data Types 1.5 Big Data Processing Architecture Design 1.6 Big Data Analytics : Data analytics Definitions, Phases in Analytics 1.7 Big Data Analytics Applications : Big Data in Marketing and Sales, Big Data and Healthcare, Big Data in Medicine, Big Data in Advertising	Lecture Using Chalk-Board Presentations Video Demonstrations Case Study Sample Dataset Handling (Demonstration Only)

BIG DATA ANALYTICS **Course Code : 316318**

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 the feature of Hadoop framework and its ecosystem. TLO 2.2 Explain the functioning of Hadoop Distributed File System (HDFS) for data storage and interaction. TLO 2.3 Explain the processing workflow of MapReduce Framework. TLO 2.4 Describe the MapReduce Programming Model. TLO 2.5 Describe the functioning of YARN in Hadoop's execution model. TLO 2.6 Explain MapReduce processing, including map tasks, reduce tasks, and combiners.	**Unit - II Introduction to Hadoop and MapReduce** 2.1 Introduction to Hadoop 2.2 Hadoop and its Ecosystem : Hadoop Core Components, Features of Hadoop, Hadoop Ecosystem Components 2.3 Hadoop Distributed File System : HDFS data storage, HDFS Commands for interacting with files in HDFS 2.4 MapReduce Framework and Programming Model : Hadoop MapReduce Framework, MapReduce Programming Model 2.5 Hadoop Yarn : Hadoop 2 Execution Model 2.6 MapReduce : Map Tasks, Key-Value Pair, Grouping by Key, Partitioning, Combiners, Reduce Tasks, Details of MapReduce Processing Steps	Lecture Using Chalk-Board Presentations Demonstration
3	TLO 3.1 Describe the purpose and importance of NoSQL in Big Data. TLO 3.2 Explain the CAP theorem. TLO 3.3 Explain the schema-less data models. TLO 3.4 Describe various NoSQL data architecture patterns, including key-value, document, tabular, object, and graph stores. TLO 3.5 Explain the use of NoSQL database for managing Big Data. TLO 3.6 Describe the features of MongoDB for Big Data storage and management.	**Unit - III NoSQL Databases and Big Data Management** 3.1 Introduction NoSQL in Big Data 3.2 NoSQL Data Store : NoSQL, CAP theorem, Schema-less Models 3.3 NoSQL Data Architecture Patterns : Key-Value Store, Document Store, Tabular Data, Object Data Store.Graph Database 3.4 NoSQL to manage Big Data 3.5 MongoDB Database	Lecture Using Chalk-Board Presentations Demonstration
4	TLO 4.1 Describe the characteristics of Hive. TLO 4.2 Describe the architecture of Hive. TLO 4.3 Explain Hive data types, file formats. TLO 4.4 Explain Hive integration workflow. TLO 4.5 Write the process of applying HiveQL for data definition, manipulation, and querying. TLO 4.6 Compare Pig with SQL, MapReduce, and Hive. TLO 4.7 Describe the architecture of Pig. TLO 4.8 Explain the approach of Pig Scripting with Pig Latin Data Model.	**Unit - IV Hive and Pig** 4.1 Introduction to Hive : Hive Characteristics, Limitations 4.2 Hive Architecture 4.3 Hive Data Types and File Formats 4.4 Hive Integration and Workflow Steps 4.5 Hive Built-in functions 4.6 HiveQL : HiveQL DDL, HiveQL DML, HiveQL for Querying the Data 4.7 Introduction to Pig : Applications of Apache Pig, Features of Pig, Compare Pig with SQL, MapReduce, and Hive 4.8 Pig Architecture 4.9 Pig Latin Data Model	Lecture Using Chalk-Board Presentations Demonstration

BIG DATA ANALYTICS **Course Code : 316318**

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 architecture of Apache Spark. TLO 5.2 Write a query using Spark SQL for data analysis. TLO 5.3 Write the purpose of various commands used with Resilient Distributed Dataset (RDDs). TLO 5.4 Explain the use of MLib library for machine learning programming. TLO 5.5 Explain the process of composing Spark program steps for ETL. TLO 5.6 Explain methods for analytics, reporting, and visualization using Spark. TLO 5.7 Compare Spark Streaming with Structured Streaming. TLO 5.8 Describe Spark Streaming Architecture. TLO 5.9 Explain Spark Streaming characteristics including scalability, fault tolerance, and load balancing.	**Unit - V Spark and Real-Time Analytics** 5.1 Introduction to Big Data tool Spark : Main components of Spark Architecture, Features of Spark, Spark Software Stack 5.2 Introduction to Data Analysis with Spark : Spark SQL 5.3 Programming with RDDs and Machine learning with MLib 5.4 Data ETL (Extract, Transform and Load) Process: Composing Spark Program steps for ETL 5.5 Analytics, Reporting and Visualization 5.6 Apache Spark Streaming Platform: Spark Streaming Architecture, Spark streaming vs Structured streaming, Internal Working of Spark Streaming 5.7 Spark streaming characteristics: Scalable, Fault Tolerance and Load Balancing	Lecture Using Chalk-Board Presentations Demonstration

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

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Identify Big Data use cases and explain the analytics process applied.	1	*Conduct a Case Study on Big Data and Big Data Analysis	2	CO1
LLO 2.1 Setup a Hadoop ecosystem on a local cluster.	2	*Install Hadoop Ecosystem on Local Cluster	2	CO2
LLO 3.1 Configure Hadoop Ecosystem on Local Cluster.	3	*Configure Hadoop Ecosystem on Local Cluster 1. Configure core-site.xml, hdfs-site.xml, mapred-site.xml 2. Start HDFS daemons 3. Upload any dataset to HDFS	2	CO2
LLO 4.1 Setup multi-node hadoop cluster.	4	Install Hadoop on multiple nodes	2	CO2
LLO 5.1 Configure multi-node hadoop cluster.	5	Configure Multi-Node Hadoop Cluster 1. Configure core-site.xml and hdfs-site.xml for multi-node HDFS setup 2. Start NameNode, DataNode daemons across nodes 3. Upload any dataset to HDFS and verify distributed storage	2	CO2

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Use resource utilization and performance tools in Hadoop Cluster.	6	Use Monitoring tools to Observe Cluster Resources 1. Access Hadoop monitoring interfaces (CLI or web UI) 2. Locate resource usage indicators (CPU, memory, disk) 3. Run basic monitoring commands 4. Record resource values during cluster operation	2	CO2
LLO 7.1 Execute file operations using HDFS commands.	7	*Perform Basic File Operation using HDFS 1. Create directories and Files in HDFS 2. Perform read, write, update and delete operations 3. Set directory permissions 4. Verify file replication	2	CO2
LLO 8.1 Execute basic backup and restore operations for Big Data stored in HDFS.	8	Perform Backup and Restore of Datasets in HDFS 1. Load any datasets in HDFS 2. Copy datasets to a backup directory 3. Simulate accidental data removal 4. Restore the dataset from the backup	2	CO2
LLO 9.1 Develop a MapReduce program.	9	*Execute WordCount MapReduce Program 1. Load any text file into HDFS 2. Develop a Word-Count program in Java 3. Compile, execute, and validate output	2	CO2
LLO 10.1 Execute a data processing workflow with MapReduce for CSV files.	10	*Process Large CSV Dataset Using MapReduce 1. Load a CSV dataset into HDFS 2. Run a MapReduce job to extract specific fields 3. Aggregate data using the Reducer	2	CO2
LLO 11.1 Setup a MongoDB NoSQL database with collections.	11	*Install NoSQL Database (MongoDB) and Create Collections	2	CO3
LLO 12.1 Create a schema for unstructured data in MongoDB using any dataset.	12	*Create a schema for unstructured data in MongoDB 1. Select any unstructured dataset in JSON format (e.g., reviews, logs, or profiles) 2. Identify common fields and structure 3. Define a suitable document schema for storing the data in MongoDB	2	CO3

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 13.1 Run basic aggregation queries on Unstructured dataset in MongoDB.	13	*Run basic aggregation queries on Unstructured dataset in MongoDB 1. Import the dataset created in the previous experiment into a MongoDB collection 2. Run basic aggregation queries to validate the schema (such as counting records, grouping by a field, or calculating averages)	2	CO3
LLO 14.1 Apply basic operations in MongoDB to observe the behavior of CAP theorem properties.	14	Perform Basic MongoDB Operations Demonstrating CAP Theorem Behavior 1. Install and set up MongoDB with replica sets 2. Perform basic write and read operations across replica sets 3. Simulate a simple network delay or temporary disconnection between nodes (using basic server control commands) 4. Observe whether read and write operations continue or pause during the disruption 5. Record the status of the system (whether operations succeed or wait) during normal and disrupted states 6. Save sample outputs (screenshots or logs) showing system behavior	2	CO3
LLO 15.1 Install Hive within a Hadoop environment.	15	*Install and Configure Hive 1. Install Hive on Hadoop environment 2. Load a dataset into Hive 3. Run basic HiveQL queries (select, insert, delete)	2	CO4
LLO 16.1 Execute after writing complex data queries using HiveQL.	16	*Execute Data Queries Using HiveQL 1. Load any dataset into Hive 2. Execute joins, group by, and aggregate queries	2	CO4
LLO 17.1 Run after writing Pig scripts for data transformation.	17	Run Pig Scripts for data transformation 1. Load any dataset into Pig 2. Apply filtering and grouping operations	2	CO4

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 18.1 Use after writing User Defined Functions (UDF) in Pig.	18	*Execute User Defined Functions (UDF) in Pig for Data Normalization 1. Load any numerical dataset into Pig 2. Develop a custom UDF to normalize numerical readings 3. Register the UDF Script Apply the UDF for normalization	2	CO4
LLO 19.1 Install Spark on a cluster and verify installation.	19	*Install Spark on Cluster environment and verify installation with any dataset 1. Install Spark on the cluster 2. Start spark shell 3. Load a sample dataset 4. Verify basic operations	2	CO5
LLO 20.1 Perform data transformations with RDDs in Spark.	20	*Perform Data Transformations with RDDs and apply map, filter, reduce operations 1. Load any dataset into an RDD 2. Apply map, filter and reduce operations	2	CO5
LLO 21.1 Execute an end-to-end ETL process using Spark.	21	*Perform ETL Process on Big Data Using Spark 1. Load dataset from local storage or HDFS 2. Apply basic transformations (such as filtering and aggregation) on the dataset 3. Store the transformed data back into local storage, or HDFS	2	CO5
LLO 22.1 Load structured data and create temporary views in Spark SQL.	22	Load Structured Dataset and Create Temporary Views in Spark SQL 1. Select and load any structured dataset (such as CSV or JSON) into Spark 2. Inspect the dataset to understand its structure (columns and data types) 3. Create a temporary view from the loaded dataset 4. Display basic records from the view to verify successful creation	2	CO5
LLO 23.1 Run after writing basic SQL queries on datasets using Spark SQL.	23	Perform Select, Join, and Group By Queries in Spark SQL 1. Use the temporary view created from a structured dataset in a previous experiment 2. Execute SELECT queries to retrieve specific columns 3. Perform JOIN operations between two views or datasets (if applicable) 4. Apply GROUP BY queries to aggregate data (such as sums or averages) 5. Display and save the query results	2	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 24.1 Stream real- time text and count words using Spark streaming.	24	Perform Real-Time Word Count Using Spark Streaming 1. Connect to socket or stream text data 2. Process incoming lines 3. Count word frequency in real-time 4. Display live results	2	CO5
LLO 25.1 Save after extracting streaming data into persistent storage using Spark Streaming.	25	Store Real-Time Streamed Data from Spark streaming into HDFS 1. Connect to a text stream (such as socket input or generated logs) 2. Capture real-time data using Spark Streaming 3. Write the incoming stream to HDFS in regular intervals	2	CO5
LLO 26.1 Run after creating a regression model on a large dataset in Spark.	26	*Apply Simple Regression on Large Dataset in Spark 1. Load any numerical dataset 2. Build and train a simple regression model 3. Train and apply the model 4. Predict target values	2	CO5
LLO 27.1 Apply the K-Means clustering algorithm in Spark MLlib.	27	*Apply K-Means Clustering on any Dataset using Spark MLlib 1. Select any structured dataset suitable for clustering (e.g., customer data, product features) 2. Load the dataset into Spark and prepare it for clustering (select relevant numerical features) 3. Apply the K-Means clustering algorithm with a defined number of clusters (K) 4. Output the cluster assignments for each data point 5. Save the clustering result for further use	2	CO5
LLO 28.1 Visualize clustering results of a dataset processed with Spark MLlib.	28	*Visualize K-Means Clustering Results Using Spark MLlib 1. Load the cluster assignment results from the previous experiment 2. Use visualization tools (such as Matplotlib, Seaborn, or any Spark-compatible library) 3. Plot the clusters on a 2D graph based on two key features 4. Color-code data points according to cluster labels 5. Export the visualization as an image or report	2	CO5

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Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 29.1 Classify a dataset using the Decision Tree algorithm in Spark MLlib.	29	Apply Decision Tree Classification on any Dataset using Spark MLlib 1. Select any labeled dataset suitable for classification (e.g., spam detection, loan approval) 2. Load the dataset into Spark and preprocess it (select features and label) 3. Apply the Decision Tree classification algorithm to train the model 4. Generate predictions for the dataset 5. Save the prediction results for further processing	2	CO5
LLO 30.1 Display classification outputs from Decision Tree results.	30	Display Classification Results from Decision Tree Model in Spark MLlib 1. Load the saved classification results from the previous experiment 2. Display the predicted class labels alongside the original data 3. Use simple metrics (such as counts of predicted classes) to observe results 4. Save the final classified dataset to a file 5. Generate a basic summary of the output	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

- Store and query weather data to create visualization of temperature patterns.
- Analyze customer purchase data to identify buying patterns by collecting e-commerce dataset. Identify top selling products, frequently purchased items and trends.
- Analyze real-time tweets to determine public sentiment on a topic and display sentiment analysis results.
- Analyze student records using a NoSQL database to summarize insights of student performance.
- Process and transform sales data to generate a report showing sales trends.

Assignment

- Collect and classify real-world datasets (structured, semi-structured, unstructured) from publicly available sources and create a comparison table.
- Prepare a poster or infographic explaining the 4 Vs (Volume, Velocity, Variety, Veracity) using real-life examples.
- Compare features of different NoSQL models (Key-Value, Document, Graph, Tabular) in a table with real-life use cases.

Other

- Swayam NPTEL Course on Big Data Computing

BIG DATA ANALYTICS **Course Code : 316318**

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	MongoDB Community Server (version 6.x)	10,11,12,13
2	Apache Hive (version 3.x)	14,15,16
3	Apache Pig (version 0.17.x)	17,18
4	Apache Spark (version 3.x)	19,20,21,22,23,24,25,26,27,28,29,30
5	Apache Hadoop (version 3.x)	2,3,4,5,6,7,8,9
6	Personal Computer (i5 or higher), Minimum 8GB RAM (16 GB Recommended), 500 GB HDD/SSD	All
7	Operating System:Windows 10 or higher/Ubuntu 20.04 LTS or higher.	All

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

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Introduction to Big Data Analytics and Data Architecture	CO1	8	4	8	0	12
2	II	Introduction to Hadoop and MapReduce	CO2	10	4	6	6	16
3	III	NoSQL Databases and Big Data Management	CO3	8	4	4	4	12
4	IV	Hive and Pig	CO4	9	4	6	4	14
5	V	Spark and Real-Time Analytics	CO5	10	4	6	6	16
Grand Total				**45**	**20**	**30**	**20**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- For theory two offline unit tests of 30 marks and average of two unit test marks will be considered for out of 30 marks.
- Each practical will be assessed considering 60% weightage to process, 40% weightage to product.

Summative Assessment (Assessment of Learning)

- End Semester Examination, Viva-Voce.

XI. SUGGESTED COS - POS MATRIX FORM

BIG DATA ANALYTICS **Course Code : 316318**

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

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Raj Kamal, Preeti Saxena	Big Data Analytics: Introduction to Hadoop, Spark, and Machine-Learning	McGraw Hill Education, New Delhi. ISBN: 9789353164962
2	Seema Acharya, Subhashini Chellappan	Big Data and Analytics	Wiley India Pvt. Ltd., ISBN: 9788126554782
3	M. Vijayalakshmi, Radha Shankarmani	Big Data Analytics	Publication details: Wiley c2017, 2022 N. Delhi Edition: 2nd ed. c2017,ISBN: 9788126565757
4	Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia	Learning Spark: Lightning-Fast Data Analytics	O'Reilly Media Publication Date: January 28, 2015 ISBN-10: 1449358624 ISBN-13: 978-1449358624
5	Pramod J. Sadalage, Martin Fowler	NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence	Addison-Wesley August 10, 2012 ISBN: 978-0321826626
6	Tom White	Hadoop: The Definitive Guide	4th Edition, Released April 2015, Publisher(s): O'Reilly Media, Inc. ISBN: 9781491901632.

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://hadoop.apache.org/	Official website for Apache Hadoop, including documentation, downloads, and tutorials.
2	https://spark.apache.org/	Official website for Apache Spark, providing guides, API references, and use case examples.
3	https://pig.apache.org/	Official site for Apache Pig, with resources for learning Pig Latin and building scripts.
4	https://hive.apache.org/	Official resource for Apache Hive, including installation guides and HiveQL references.
5	https://www.mongodb.com/	MongoDB official site offering documentation, downloads, and free learning courses.

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Sr.No	Link / Portal	Description
6	https://onlinecourses.nptel.ac.in/noc20_cs92/preview	This course provides an in-depth understanding of terminologies and the core concepts behind big data problems, applications, systems and the techniques, that underlie todays big data computing technologies. It provides an introduction to some of the most common frameworks such as Apache Spark, Hadoop, MapReduce.
7	https://www.tutorialspoint.com/hadoop/index.htm	This brief tutorial provides a quick introduction to Big Data, MapReduce algorithm, and Hadoop Distributed File System.
8	https://www.w3schools.com/mongodb/	This brief tutorial provides a quick introduction to MongoDB.

Note :

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

MSBTE Approval Dt. 04/09/2025 **Semester - 6, K Scheme**

MANAGEMENT **Course Code : 315301**

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

I. RATIONALE

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

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

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

III. COURSE LEVEL LEARNING OUTCOMES (COS)

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

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

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

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MANAGEMENT **Course Code : 315301**

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

Total IKS Hrs for Sem. : 1 Hrs

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

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

Note :

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

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

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

MANAGEMENT **Course Code : 315301**

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

MANAGEMENT **Course Code : 315301**

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

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

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

Assignment / Article

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

Note Taking

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

Case Study

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

Quizes

- Participate in online quizzes related to areas of management .

Assignment

MANAGEMENT **Course Code : 315301**

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

Note :

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

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

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

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

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- MCQ Based Class Test, Self Learning Activities / Assignment

Summative Assessment (Assessment of Learning)

- Summative Assessment (Assessment of Learning) MCQ based

XI. SUGGESTED COS - POS MATRIX FORM

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

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CO1	1	1	1	-	-	2	3			
CO2	1	3	3	-	1	3	3			
CO3	1	3	1	-	1	1	3			
CO4	1	2	2	-	1	2	3			
CO5	1	1	2	-	1	2	3			

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

XII. SUGGESTED LEARNING MATERIALS / BOOKS

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

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://www.debonogroup.com/services/core-programs/six-thinking-hats/	Six Thinking Hats
2	https://hbr.org/1981/09/managing-human-resources	HR Management
3	https://theproductmanager.com/topics/agile-product-management/	Agile Product Management
4	https://www.cdlogistics.ca/freight-news/the-5-components-of-supply-chain-management	Supply Chain Management
5	https://www.infosectrain.com/blog/understanding-the-concepts-of-gantt-chart-and-critical-path-methodology-cpm	PERT, CPM, GANTT Chart
6	https://www.simplilearn.com/best-management-tools-article	Management Tools
7	https://www.psychometrica.in/free-online-psychometric-tests.html	Psychometric Tests
8	https://www.investopedia.com/terms/e/erp.asp	ERP
9	https://asq.org/quality-resources/quality-management-system	QMS
10	https://testlify.com/test-library/creative-thinking/	Psychometric Tests
11	https://www.mindtools.com/	Management Skills
12	https://www.investopedia.com/terms/d/digital-marketing.asp	Digital Marketing

Note :

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

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MSBTE Approval Dt. 24/02/2025 **Semester - 5 / 6, K Scheme**