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||Jai Sri Gurudev||

Sri Adichunchanagiri Shikshana Trust (R.)

SJC INSTITUTE OF TECHNOLOGY

An Autonomous Institution under VTU from 2024-25

AICTE Approved, Accredited by NAAC with A+ Grade & NBA (CSE, ISE, ECE, ME & CV), NIRF(151-300) in 2023,Gold Rated by QS I-Gauge

P.B. No.20, B.B Road, Chikkaballapur - 562 101, Karnataka

Estd : 1986

V Semester

Scheme & Syllabus of B.E. Programme

Artificial Intelligence and Data Science

(2024 Scheme)

Core Values

Spiritual, **J**udicious, **C**ommitment, **I**ntegrity, **T**rustworthy



NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

A+ NAAC

QS I-GAUGE GOLD

INSTITUTION'S INNOVATION COUNCIL (Ministry of HRD Initiative) 4-Star Rating

SJC INSTITUTE OF TECHNOLOGY, CHIKKABALLAPURA

An Autonomous institution Under VTU from 2024 – 2025

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SCHEME OF TEACHING AND EXAMINATION – B.E. – Artificial Intelligence & Data Science

(Applicable for students admitted from the Academic Year 2024-25 and onwards)

V Semester

Sl. No.	Course Code	Course Title	Course Type	TD/ PSB	Teaching Hours / Week			Examination				
					L	T	P	SEE Duration (Hrs)	CIE Marks	SEE Marks	Total Marks	Credits
1	BCS501	Software Engineering and Project Management	PCC	AD	3	0	0	3	50	50	100	3
2	BAD502	Machine Learning	IPCC	AD	3	0	2	3	50	50	100	4
3	BAD503	Operating Systems	PCC	AD	3	2	0	3	50	50	100	4
4	BADL504	Data Analytics and Visualization Lab	PCCL	AD	0	0	2	3	50	50	100	1
5	BXX525x	Professional Elective Course – I	PEC	AD	3	0	0	3	50	50	100	3
6	BAD536	Mini Project	PROJ	AD	0	0	2	3	50	50	100	2
7	BRM507	Research Methodology and IPR	AEC	AD	2	2	0	3	50	50	100	3
8	BCE508	Competency Enhancement Course-3	NCMC	CDCAC	0	2	0	-	100	-	100	0
9	BNS509	National Service Scheme (NSS)	NCMC	NSS Coordinator	0	0	2	-	100	-	100	0
	BPE509	Physical Education (PE) (Sports and Athletics)		Physical Education Director								
	BYO509	Yoga		Yoga Teacher								
	BMU509	Music		Music Teacher								
									550	350	900	20

ASC: Applied Science Course, PCC: Professional Core Course, IPCC: Integrated Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, NCMC: Non Credit Mandatory Course, AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course, L: Lecture, T: Tutorial, P: Practical, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.

Professional Elective Course – I			
Course Code	**Course Name**	**Course Code**	**Course Name**
BAD525A	Data Warehousing and Data Mining	BAD525C	Computer Vision
BAD525B	Cloud Computing	BAD525D	AI in Cyber Security

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical's of the same course. Credit for IPCC can be 04 and its Teaching– Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering (B.E.) 2024-25 may please be referred.

National Service Scheme /Physical Education/Yoga/Music: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), Yoga and Music with the concerned coordinator / teacher of the course during the first week of 3rd semester. Activities shall be carried out between 3rd semester to the 6th semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, Yoga and Music activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Semester: V					
Software Engineering and Project Management					
Course Code	**:**	BIS501	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40	**SEE**	**:**	50 Marks
Course Type	**:**	PCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Data Structures and Algorithms, Object-Oriented Programming
Knowledge on Fundamental Concepts	Analytical thinking, Critical thinking
Knowledge on Connected Tools (If any)	UML Tools Star UML, Debuggers

Course Learning Objectives: This course will enable the students to	
CLO1	Outline software engineering principles and activities involved in building large software programs.
CLO2	Illustrate the methods used for gathering, categorizing, documenting, and validating software requirements
CLO3	Understand the Unified Modeling Language (UML) and its application in software design.
CLO4	Analyze software requirements to design effective test cases.
CLO5	Identify software quality parameters and quantify software using measurements and metrics. List software quality standards and outline the practices involved.

Module – 1	**08 Hrs**
Introduction: Professional software development, Software engineering ethics, Case studies. **Software Processes**: Software Process models: The Waterfall model – A Case study, Incremental development, Reuse-oriented software engineering, Process activities: Software specification, Software design and implementation, Software validation, Coping with Change: Prototyping, Incremental Delivery, Boehm's Spiral Model. **Textbook 1: Ch. 1:** 1.1 to 1.3, **Ch. 2:** 2.1 to 2.3	
Module – 2	**08 Hrs**
Requirements Engineering: Functional and non-functional requirements: Functional requirements. Non-functional requirements, Introduction to Requirements specification. **Agile Software Development:** Agile methods- Plan driven and Agile Development, Introduction to Extreme Programming. **Textbook 1: Ch. 3:** 3.1 to 3.3, **Ch. 4:** 4.1 to 4.4	
Module – 3	**08 Hrs**

Design and Implementation: Object-oriented design using UML: System Context and Interaction, Architectural design, Object Class identification, design Models, Interface Specification, Design Patterns, Implementation issues, Open Source development. **Textbook 1: Ch. 7:** 7.1 to 7.4

Module – 4	**08 Hrs**
Software Testing: Development Testing: Unit Testing, Choosing Unit Test Cases, Component Testing, System Testing, Test Driven Development, Release Testing: Requirements Based Testing, Scenario Testing, Performance Testing, User Testing. A Demo of Selenium. **Textbook 1: Ch. 8:** 8.1 to 8.4	

Module – 5	**08 Hrs**
Introduction to Project Management: Introduction Project and Importance of Project Management, Contract Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Some ways of categorizing Software Projects, Stakeholders, Setting Objectives, Business Case, Project Success and Failure, Management and Management Control, Project Management life cycle. **Textbook 2: Ch. 1:**1.1 to 1.17	

Course Outcomes: After completing the course, the students will be able to	
CO1	Interpret the basic principles and practices of Software Engineering.
CO2	Apply Software Engineering Design Techniques and practices for developing Software.
CO3	Integrate requirement analysis, design strategies, and testing techniques to develop high-quality software systems
CO4	Design Models for different phases of software development to solve real world problems
CO5	Develop Projects by Estimating cost and time required for developing the Software Product.

Text Books	
1	"Software Engineering", Ian Summerville, 9th Edition, Pearson Education, 2017 ISBN-13. 978-0137035151.
2	"Software Project Management", Bob Hughes, Mike Cotterell, Rajib Mall, 6th Edition, McGraw Hill Education, 2017. ISBN 0077122798.

Reference Books	
1	"Software Engineering an Engineering approach", James F. Peters, Witold Pedrycz, John Wiley. ISBN: 978-0-471-18964-0
2	"Software Engineering principles and practice", Waman S Jawadekar, The Mc Graw-Hill Companies. ISBN: 9780070583719
3	"Fundamentals of object-oriented design using UML Meiler page", Jones: Pearson Education. ISBN: 817808344

Web links and Video Lectures (e – Resources)	
1	https://onlinecourses.nptel.ac.in/noc20_cs68/preview
2	https://onlinecourses.nptel.ac.in/noc24_mg01/preview
3	https://nptel.ac.in/courses/106101061

CO – PO MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2			1								2	1
CO2	3		2		2					1	1	2	1
CO3		3	3	1						2	1	2	1
CO4				3	3					1	2	2	1
CO5			2					1	2	2	1	2	1

Semester : V					
MACHINE LEARNING					
Course Code	:	BAD502	**Credits**	:	04
Hours/Week (L:T:P)	:	3:2:0	**CIE**	:	50 Marks
Total Hours	:	42	**SEE**	:	50 Marks
Course Type	:	IPCC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Introduction to python, numpy, pandas, matplotlib, seabron
Knowledge on Fundamental Concepts	Programming skills
Knowledge on Connected Tools (If any)	Jupyter Notebook, Sypider

Course Learning Objectives: this course will enable the students to	
CLO1	Define machine learning and understand the basic theory underlying machine learning.
CLO2	Differentiate supervised, unsupervised and reinforcement learning
CLO3	Understand the basic concepts of learning and decision trees.
CLO4	Understand Bayesian techniques for problems appear in machine learning
CLO5	Perform statistical analysis of machine learning techniques.

Module 1	**8 Hrs**
Concept learning and Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Find S-Version Spaces and Candidate Elimination Algorithm – Remarks on VS-Inductive bias **–** **(T1:Chapter 1 and 2)**	
Module 2	**8 Hrs**
Decision Tree Learning: Introduction, Decision tree representation, Appropriate problems, Basic decision tree learning algorithm, hypothesis space search in decision tree learning **Texbook1: Chapter 3 (3.1-3.5)**	
Module 3	**8 Hrs**
Aritificil Nueral Network: Introduction, NN representation, Appropriate problems, Perceptrons, Backpropagation algorithm. **Texbook1: Chapter 4 (4.1-4.5)**	
Module 4	**8 Hrs**
Bayesian Learning: Introduction, Bayes theorem, Bayes theorem and concept learning, ML and LS error hypothesis, ML for predicting, MDL principle, Bates optimal classifier, Gibbs algorithm, Navie Bayes classifier, BBN, EM Algorithm **Texbook1: Chapter 6**	
Module 5	**8 Hrs**
Instance-Base Learning: Introduction, k-Nearest Neighbour Learning, Locally weighted regression, Radial basis function, Case-Based reasoning. **Reinforcement Learning:** Introduction, The learning task, Q-Learning. **Texbook 1: Chapter 8 (8.1-8.5), Chapter 13 (13.1 – 13.3)**	

Practical component	
Module – 1	1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
	2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

Module – 2	3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
Module – 3	4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
Module – 4	5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
	6. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
Module – 5	7.Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
	8. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the fundamental principles of machine learning and formulate concept learning using algorithms like Find-S and Candidate Elimination.
CO2	Implement supervised learning techniques such as decision trees and artificial neural networks for classification and prediction tasks.
CO3	Apply statistical and probabilistic methods like Bayesian networks, Naïve Bayes, and the Expectation-Maximization algorithm to solve classification problems.
CO4	Analyze and apply instance-based learning methods including K-Nearest Neighbors, Locally Weighted Regression, and Case-Based Reasoning.
CO5	Understand and implement reinforcement learning models, specifically Q-learning, for decision-making under uncertainty.

Text Book	
1	Machine Learning, Tom M. Mitchell, McGraw-Hill Education, 2013, ISBN-13: 978-1259096952.

Reference Books	
1	Introduction to Machine Learning, EthemAlpaydin, PHI Learning Pvt. Ltd, 2nd Ed., 2013
2	The Elements of Statistical Learning, T. Hastie, R. Tibshirani, J. H. Friedman, Springer, 1st edition, 2001
3	Machine Learning using Python ,Manaranjan Pradhan, U Dinesh kumar, Wiley, 2019
4	Machine Learning, SaikatDutt, Subramanian Chandramouli, Amit Kumar Das, Pearson,2020

CO \ PO/PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	-	-	-	-	-	1	1	2	2	1
CO2	3	3	3	2	2	-	-	2	2	2	2	3	2
CO3	3	3	3	2	3	1	-	2	2	3	2	3	2
CO4	3	3	3	3	3	2	-	2	2	3	3	3	3
CO5	3	2	3	2	3	1	-	2	2	3	3	3	3

Semester: V					
OPERATING SYSTEMS					
Course Code	:	BAD503	**Credits**	:	4
Hours/Week(L:T:P)	:	3:2:0	**CIE**	:	50 Marks
Total Hours	:	40	**SEE**	:	50 Marks
Course Type	:	PCC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Basic Programming, Data Structures and Algorithms, Discrete Mathematics, Digital Logic Design, Computer Organization and Architecture
Knowledge on Fundamental Concepts	Basic programming, Data structures, Mathematical logic and set theory, Computer Organization and Architecture
Knowledge on Connected Tools (If any)	Command Line Interface, Basic Shell Commands, Process Management Tools, Text Editors, File System Tools, User and Permission Tools, Networking Basics, Basic Scripting Knowledge, Software Installation Tools

Course Learning Objectives: This course will enable the students to	
CLO1	To Demonstrate the need for OS and different types of OS
CLO2	To discuss suitable techniques for management of different resources
CLO3	To demonstrate different APIs/Commands related to processor, memory, Storage and file system management.
CLO4	To discuss the need for information protection mechanisms

Module – 1	**08 Hrs**
Introduction to operating systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and Security; Distributed system; Special-purpose systems; Computing environments. **Operating System Services:** User - Operating System interface; System calls; Types of system calls; System programs; Operating system design and implementation; Operating System structure; Virtual machines; Operating System debugging, Operating System generation; System boot. **Textbook 1: Ch 1: 1.1-1.12, Ch 2: 2.2-2.11**	
Module – 2	**08 Hrs**
Process Management: Process concept; Process scheduling; Operations on processes; Inter process communication **Multi-threaded Programming:** Overview; Multithreading models, POSIX Thread; Threading issues. **Process Scheduling**: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Thread scheduling Multiple-processor scheduling,	

Textbook 1: Ch 3: 3.1-3.4, Ch 4: 4.1-4.4, Ch 5: 5.1 -5.5
Textbook 2: Ch 2: 2.2.3

Module – 3	**08 Hrs**

Process Synchronization: Synchronization: The critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization;

Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock.

Textbook 1: Ch 6: 6.1-6.6, Ch 7: 7.1 -7.7

Module – 4	**08 Hrs**

Memory Management: Memory management strategies: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation.

Virtual Memory Management: Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing.

Textbook 1: Ch 8: 8.1-8.6, Ch 9: 9.1-9.6

Module – 5	**08 Hrs**

File Systems: File system: Files; Directories **Implementing File system:** File system structure; File system implementation; Directory implementation; Allocation methods; Free space management.

Secondary Storage Structure, Protection: Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; **Protection**: Goals of protection, Principles of protection, Domain of protection, Access matrix and its Implementation.

Textbook 1: Ch 11:11.1-11.5, Ch 12:12.1-12.5, Ch 17: 17.1 - 17.5
Textbook 2: Ch 4: 4.1-4.2

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the structure and functionality of operating system
CO2	Implement appropriate CPU scheduling algorithms for the given problem.
CO3	Analyse the various techniques for process synchronization and deadlock handling.
CO4	Apply the various techniques for memory management
CO5	Illustrate file, secondary storage management strategies and information protection mechanisms

Text Books	
1	Operating System Principles, Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, 8th edition, Wiley-India, 2015, ISBN: 978-8126554270.
2	Modern operating systems, Tanenbaum, Andrew, 4th Edition, Pearson Education, Inc 2009. ISBN 013359162X, 978-0133591620

Reference Books

1	Operating Systems: A Modern Perspective, Gary J. Nutt, Addison Wesley, 2002, the University of Virginia, 20 Aug 2009, ISBN 0201741962
2	Understanding Operating System, Ann McHoes Ida M Fylnn, Cengage Learning, 6th Edition
3	Operating Systems: A Concept Based Approach, D.M Dhamdhere, 3rd Ed, McGraw-Hill, 2013.
4	An Introduction to Operating Systems: Concepts and Practice, P.C.P. Bhatt, 4th Edition, PHI(EEE), 2014.
5	Operating Systems: Internals and Design Principles, William Stallings, 6th Edition, Pearson.

Web links and Video Lectures (e – Resources)	
1	https://nptel.ac.in/courses/106105214
2	https://nptel.ac.in/courses/106106144
3	https://youtu.be/mXw9ruZaxzQ
4	https://youtu.be/vBURTt97EkA
5	https://archive.nptel.ac.in/courses/106/105/106105214/
6	https://www.youtube.com/watch?v=3-ITLMMeeXY&list=PL3pGy4HtqwD0n7bQfHjPnsWzkeRn6mkO

CO – PO MAPPING

CO/ PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	2	1				1	1		1
CO2	3	2	2	2	2						2
CO3	2	2	2	1		1	1	1	1		1
CO4	2	2	1	1							1
CO5	2	2	2	2							1

Semester: V					
Data Analytic and Data Visualization Lab					
Course Code	**:**	**BADL504**	**CIE**	**:**	50 Marks
Hours/Week (L:T:P)	**:**	0:0:2	**SEE**	**:**	50 Marks
Credits	**:**	01	**SEE Duration**	**:**	3 Hours
Course Type	**:**	AEC			

Prerequisites:	
Courses	Data per processing, Data Manipulation, Regression
Knowledge on Fundamental Concepts	NumPy, Pandas, Matplotlib, Seaborn, R programming.
Knowledge on Connected Tools (If any)	R studio, jupyter notepad.

Course Learning Objectives: this course will enable the students to	
CLO1	Understand the Importance of data Visualization for business intelligence and decision making.
CLO2	Learn different approaches to understand the importance of visual perception
CLO3	Gain knowledge of effective data visuals to solve workplace problems.
CLO4	Learn different data visualization techniques and tools.

SI.NO	**Experiments**
1	a.Write a Python Program to Get Total Price of all FuelType from Toyota.csv file and show it using a line plot with the following Style properties. Generated line plot must include following Style properties: • Line Style dotted and Line-color should be red • Show legend at the lower right location. • X label name = Fuel Type • Y label name = Price • Add a circle marker. • Line marker color as red • Line width should be 3. b.Write a Python Program to Read 'Petrol' and 'CNG' FuelType sales data from Toyota.csv file and show it using the bar chart.
2	a.Write a Python in Python to insert a column named “AGE_IN_MONTH” and then fill the values into inserted column on the basis of “AGE” column using user defined function where function return a value. AGE_IN_MONTH=AGE*12 b. Write a Python program to create and display a DataFrame from a specified dictionary data which has the index labels. exam_data = {'name': ['Dinesh', 'Suresh', 'Rahul', 'Ravi', 'Manoj', 'Hari', 'Yatharth', 'Saurabh', 'Kapil', 'Salini'], 'score': [12.5, 9, 16.5, np.nan, 9, 20, 14.5, np.nan, 8, 19], 'attempts': [1, 3, 2, 3, 2, 3, 1, 1, 2, 1], 'qualify': ['yes', 'no', 'yes', 'no', 'no', 'yes', 'yes', 'no', 'no', 'yes']} labels = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j']
3	Getting Started - Tableau Workspace, Tableau terminologies, basic functionalities. Connecting to Data Source – Connecting to Database, Different types of Tableau Joins. Creating a View - formatting charts, adding filters, creating calculated fields and defining parameters. Dashboard Design and Storytelling – Components of Dashboard for superstores dataset.
4	In the United States, there are many stores in which a survey was conducted based on students i.e. how much they are spending on different kinds of purchases like Video games, Indoor games, Toys, Books, Gadgets etc. In the data set (Student Survey), Store setting is the column that explains the Type of location in which the store is present. By using a data set (Student Survey), try to extract meaningful insights. 1.Tabular Visualization: Format the total amount of purchase (TAP) based on ‘Store location’ and ‘Store setting’: - ● If 0<TAP<=TAP=60000, then records should be in Blue color 2. Matrix Visualization: Create Matrix Visualization to show the amount spent on Outdoor sports across different ages and ‘Store setting’. Do the color formatting for the amount spent

	in total outdoor sports. 3. Funnel Chart: Create a Funnel chart to show Total amount of purchase by 'Store setting'. Show the data labels as Percentage of First. 4. Pie Chart: Show the total amount of purchase by different 'Store location' for Suburban 'Store setting' only. 5. a) Scatter plot - Video games purchase and Outdoor sports spent across the different ages. b) Sand dance plot - Indoor sports and Video games spent across the different age groups.
5	Introducing Power BI –Components and the flow of work. Power BI Desktop Interface-The Report has five main areas.nQuerying Data from CSV - Query Editor, Connecting the data from the Excel Source, Clean, Transform the data. Creating Reports & Visualizations - Different types of charts, Formatting charts with Title, Colors - Filters in Power BI, Formatting dashboards
6	Analysis of revenue in sales dataset: i) Create a choropleth map (fill the map) to spot the special trends to show the state which has the highest revenue. ii) Create a line chart to show the revenue based on the month of the year. iii) Create a bin of size 10 for the age measure to create a new dimension to show the revenue. iv) Create a donut chart view to show the percentage of revenue per region by creating zero access in the calculated field. v) Create a butterfly chart by reversing the bar chart to compare female & male revenue based on product category. vi) Create a calculated field to show the average revenue per state & display profitable & non-profitable state. vii) Build a dashboard.
7	Analysis of GDP dataset: i) Visualize the countries data given in the dataset with respect to latitude and longitude along with country name using symbol maps. ii) Create a bar graph to compare GDP of Belgium between 2006 – 2026. iii) Using pie chart, Romania, South Asia, Singapore by the year 2010. iv) Visualize the countries Bhutan & Costa Rica competing in terms of GDP. v) Create a scatter plot or circle views of GDP of Mexico, Algeria, Fiji, Estonia from 2004 to 2006. vi) Build an interactive dashboard
8	Analysis of Amazon Prime Dataset: i) Create a Donut chart to show the percentage of movie and tv shows ii) Create a area chart to shows by release year and type iii) Create a horizontal bar chart to show Top 10 genre iv) Create a map to display total shows by country v) Create a text sheet to show the description of any movie/movies. vi) Build an interactive Dashboard
9	Analysis of HR Dataset: i)Create KPI to show employee count, attrition count, attrition rate, attrition count, active employees, and average age. ii) Create a Lollipop Chart to show the attrition rate based on gender category. iii) Create a pie chart to show the attrition percentage based on Department Category- Drag department into colours and change automatic to pie. Entire view, Drag attrition count to angle. Label attrition count, change to percent, add total also, edit label. iv) Create a bar chart to display the number of employees by Age group, v) Create a highlight table to show the Job Satisfaction Rating for each job role based on employee count. vi) Create a horizontal bar chart to show the attrition count for each Education field Education field wise attrition – drag education field to rows, sum attrition count to col, vii) Create multiple donut chart to show the Attrition Rate by Gender for different Age group.
10	You have published an Excel workbook to SharePoint, and you next need to see how this compares to Power BI. You will create a report and add data, and then add visualizations to the report. Add Visualizations to the Report 1. Drag the SalesAmount field from the FactInternetSales table onto the report to create a column chart. 2. Add the EnglishDayNameOfWeek field from DimDate to the Axis. 3. Move the chart to the top left-hand corner of the report and expand it to show all the days of the week. 4. Change the title to Sales by Day of Week.

	5. Center align the chart title. 6. Drag the SalesAmount field from FactInternetSales onto the report and add CalendarQuarter from DimDate. 7. Move the CalendarQuarter to the Axis property. 8. Rename the title of the chart Sales by Calendar Quarter, and center align the text. 9. Change the data colors so quarter 1 is red, quarter 2 is blue, and quarter 3 is yellow. 10. Move the chart to the right of the Sales by Day of Week chart and make them the same size. 11. Drag SalesTerritoryCountry into the report to create a map visual and add SalesAmount from FactInternetSales

Course Outcomes: After completing the course, the students will be able to	
CO1	Design the experiment to create basic charts and graphs using Tableau and Power BI
CO2	Develop the solution for the given real world problem
CO3	Analyze the results and produce substantial written documentation.
CO4	Define Calculate, Implement Probability and Probability Distributions to solve a wide variety of problems.
CO5	Apply mathematical concepts for feature engineering and perform dimensionality reduction to enhance model performance.

Suggested Learning Resources:

1. Microsoft Power BI Dashboards Step by Step by Errin O'Connor, 2019 by Pearson Education, Inc
2. Information Dashboard Design: Displaying Data for At-a-glance Monitoring" by Stephen Few 3. https://help.tableau.com/current/guides/get-started-tutorial/en-us/get-started-tutorial- home.htm
4.https://www.tutorialspoint.com/tableau/index.htm
5. https://www.simplilearn.com/tutorials/power-bi-tutorial/power-bi-vs-tableau

CO – PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	2	3	-	-	1	2	-	2
CO2	3	3	2	2	3	-	-	1	2	-	2
CO3	3	3	2	2	3	-	-	1	2	-	2
CO4	3	3	2	3	3	-	-	1	2	-	2
CO5	3	3	3	3	3	-	-	1	2	1	2

Semester : V					
Data Warehousing and Data Mining					
Course Code	**:**	**BAD525A**	**Credits**	**:**	03
Hours/Week (L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40	**SEE**	**:**	50 Marks
Course Type	**:**	PEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	DBMS, Data Structures and Algorithms
Knowledge on Fundamental Concepts	Classifications, Clustering
Knowledge on Connected Tools (If any)	

Course Learning Objectives: this course will enable the students to	
CLO1	Be familiar with mathematical foundations of data warehousing and OLAP..
CLO2	Implement classical models and algorithms in data warehouses and data mining & OLAP queries.
CLO3	Discover interesting patterns using clustering, classification, association finding on real world data.
CLO4	Develop skill in selecting the different algorithms and analyse it with the support of tools for solving practical problems.
CLO5	Apply clustering techniques and evaluate data mining models for extracting meaningful knowledge from large-scale data warehouses.

Module 1	**8 Hrs**
Data warehousing and OLAP: Data Warehouse basic concepts, Data Warehouse Modeling, Data Cube and OLAP: Characteristics of OLAP systems, Multidimensional view and Data cube, Data Cube Implementations, Data Cube operations, Implementation of OLAP and overview on OLAP Software, Typical OLAP Operations. **Textbook 2**: Ch.4.1,4.2 , **R1**(Ch-8: 8.1 - 8.5)	
Module 2	**8 Hrs**
Data warehouse implementation &Data Mining : Introduction, What is Data Mining?, Motivating Challenges, Data Mining Tasks, Which technologies are used for data mining, Kinds of pattern that can be mined, Data Mining Applications, Data Pre-processing, Data cleaning, data integration, data reduction and data transformation, An overview, Indexing OLAP Data: Bitmap index and join index, Efficient processing of OLAP Queries, OLAP server Architecture ROLAP versus MOLAP Versus HOLAP. **Textbook1:** Ch-1: 1.1 – 1.4, Ch-2: 2.3.1 – 2.3.7 **Textbook 2:** Ch.4.4	
Module 3	**8 Hrs**
Association Analysis: Problem Definition, Frequent Item set Generation, Rule generation. Alternative Methods for Generating Frequent Item sets, FPGrowth Algorithm, Evaluation of Association Patterns. **Textbook 1:** Ch 6.1 to 6.7 (Excluding 6.4)	
Module 4	**8 Hrs**
Classification: Decision Trees Induction, Method for Comparing Classifiers, Rule Based Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers. **Textbook 1** Ch-4: 4.1 - 4.3	
Module 5	**8 Hrs**
Clustering Techniques: Overview, Features of cluster analysis, Types of Data and Computing Distance, Types of Cluster Analysis Methods, Partitional Methods, Hierarchical Methods, Density Based Methods, Quality and Validity of Cluster Analysis. **Textbook 1** Ch-7: 7.1 - 7.5	

Course Outcomes: After completing the course, the students will be able to	
CO1	**Demonstrate** knowledge of the basic concepts and modelling involved in data Ware housing..
CO2	**Examine** data and select suitable methods for applying data mining techniques and methods to data sets.
CO3	**Analyze** the frequent patterns using association analysis algorithms.
CO4	**Demonstrate** various algorithms based on data mining tools & OLAP.
CO5	**Evaluate** clustering and classification techniques for real-world data using mining tools.

Text Book	
1	"Introduction to Data Mining", Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Addison Wesley, First impression,2014. ISBN:9789332518650
2	Data Mining -Concepts and Techniques, Jiawei Han, Micheline Kamber, Jian Pei, 3rd Edition, Morgan Kaufmann Publisher, 2012. ISBN-13: 9780123814791

Reference Books	
1	"Introduction to Data Mining with Case Studies", G. K. Gupta, 3rd Edition, PHI, New Delhi, 2009.
2	Data Warehousing in the Real World, Sam Anahory, Dennis Murray, Pearson, Tenth Impression,2012.

Web links and Video Lectures (e – Resources)	
1	https://www.pearsonhighered.com/assets/preface/0/1/3/3/0133128903.pdf
2	https://developers.google.com/machine-learning/clustering/clustering-algorithms

CO – PO MAPPING

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	–	2	1	–	–	–	–	–	–
CO2	3	3	2	2	2	–	–	–	–	–	1
CO3	3	2	2	3	2	–	–	–	–	–	–
CO4	2	2	2	2	3	–	–	–	–	–	2
CO5	3	3	2	3	3	–	–	–	–	–	2

Semester: V						
Cloud Computing						
Course Code	:	BAD525B		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40 L		**SEE**	:	50 Marks
Course Type	:	PEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Operating Systems, Computer Networks, Basics of Virtualization
Knowledge on Fundamental Concepts	Understanding of cloud service models (IaaS, PaaS, SaaS), virtualization, distributed computing, and networking fundamentals
Knowledge on Connected Tools (If any)	OpenStack dashboard, Google Cloud Console, CLI tools, and basic scripting for cloud resource management

Course Learning Objectives: This course will enable the students to	
CLO1	Introduce the rationale behind the cloud computing revolution and the business drivers
CLO2	Understand various models, types and challenges of cloud computing
CLO3	Understand the design of cloud native applications, the necessary tools and the design tradeoffs.
CLO4	Realize the importance of Cloud Virtualization, Abstraction`s, Enabling Technologies and cloud security

Module – 1	**08Hrs**
Distributed System Models and Enabling Technologies: Scalable Computing Over the Internet, Technologies for Network Based Systems, System Models for Distributed and Cloud Computing, Software Environments for Distributed Systems and Clouds, Performance, Security and Energy Efficiency. **Text Book 1: Ch-1**: 1.1 - 1.5	
Module – 2	**08Hrs**
Virtual Machines and Virtualization of Clusters and Data Centers: Implementation Levels of Virtualization, Virtualization Structure/Tools and Mechanisms, Virtualization of CPU/Memory and I/O devices, Virtual Clusters and Resource Management, Virtualization for Data Center Automation. **Text Book 1: Ch-3 :** 3.1 - 3.5	
Module – 3	**08Hrs**
Cloud Platform Architecture over Virtualized Datacenters: Cloud Computing and Service Models, Data Center Design and Interconnection Networks, Architectural Design of Compute and Storage Clouds, Public Cloud Platforms: GAE, AWS and Azure, Inter-Cloud Resource Management. **Text Book 1: Ch-4:** 4.1 - 4.5	
Module – 4	**08Hrs**

Cloud Security: Top concern for cloud users, Risks, Privacy Impact Assessment, Cloud Data Encryption, Security of Database Services, OS security, VM Security, Security Risks Posed by Shared Images and Management OS, XOAR, A Trusted Hypervisor, Mobile Devices and Cloud **Security Cloud Security and Trust Management:** Cloud Security Defense Strategies, Distributed Intrusion/Anomaly Detection, Data and Software Protection Techniques, Reputation-Guided Protection of Data Centers. **Test Book 1: Ch-4:** 4.6 **Test Book 2**: **Ch-11:** 11.1 - 11.3, 11.5 - 11.8, 11.10 - 11.14

Module – 5	**08Hrs**
Cloud Programming and Software Environments: Features of Cloud and Grid Platforms, Parallel and Distributed Computing Paradigms, Programming Support for Google App Engine, Programming on Amazon AWS and Microsoft, Emerging Cloud Software Environments. **Test Book 1**: **Ch-6:** 6.1 to 6.5	

Course Outcomes : After completing the course, the students will be able to	
CO1	Describe various cloud computing platforms and service providers.
CO2	Illustrate the significance of various types of virtualization.
CO3	Identify the architecture, delivery models and industrial platforms for cloud computing based applications.
CO4	Analyze the role of security aspects in cloud computing.
CO5	Demonstrate cloud applications in various fields using suitable cloud platforms.

Text Books	
1	Distributed and Cloud Computing, Kai Hwang, Geoffrey C Fox, and Jack J Dongarra, Morgan Kaufmann, Elsevier 2012, ISBN: 978-0123858801
2	Cloud Computing Theory and Practice, Dan C. Marinescu, Morgan Kaufmann, 2nd Edition, Elsevier 2018, ISBN: 978-0128128104
3	Google Cloud Teaching Resources – LMS [for practical component]
4	AWS Cloud Developing – AWS Academy Courses [for practical component]

Reference Books	
1	Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, and Thamrai Selvi, McGrawHill Education, 1st Edition, 2017
2	Cloud Computing: A Practical Approach, Toby Velte, Anthony Velte, McGraw-Hill Education, 2017.
3	Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, O'Reilly Publication, 1st Edition, 2009
4	Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Recursive Press, 2nd Edition, 2009.

Web links and Video Lectures (e – Resources)	
1	https://freevideolectures.com/course/4639/nptel-cloud-computing/1.
2	https://www.youtube.com/playlist?list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J
3	https://www.youtube.com/watch?v=EN4fEbcFZ_E
4	https://www.youtube.com/watch?v=RWgW-CgdIk0
5	https://www.geeksforgeeks.org/virtualization-cloud-computing-types/

6	https://www.javatpoint.com/cloud-service-provider-companies

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2			2						1
CO2	3	2			3						2
CO3	3	2	2		2					2	2
CO4	3	3				2	3				2
CO5	2	2	3	2	3	2		2	2	2	3

Semester: V						
Computer Vision						
Course Code	:	**BAD525C**		**Credits**	:	3
Hours/Week(L:T:P)	:	3:0:0		**CIE**	:	50 Marks
Total Hours	:	40		**SEE**	:	50 Marks
Course Type	:	PEC		**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Linear Algebra, Probability & Statistics, Programming (Python/Matlab), Digital Image Processing
Knowledge on Fundamental Concepts	Understanding of image formation, filtering, feature extraction, and basic machine learning concepts
Knowledge on Connected Tools (If any)	OpenCV, MATLAB Image Processing Toolbox, and deep learning frameworks like TensorFlow or PyTorch

Course Learning Objectives: This course will enable the students to	
CLO1	To understand the fundamentals of computer vision and digital image processing
CLO2	To introduce the processes involved image enhancement and restoration.
CLO3	To facilitate the students to gain understanding color image processing and morphology.
CLO4	To impart the knowledge of image segmentation and object recognition techniques.

Module – 1	**08Hrs**
Introduction: What is computer vision? A brief history. **Image Formation:** Photometric image formation, The digital camera. Image processing: Point operators, Linear filtering. **Test Book 1**:**Ch-1**:1.1, 1.2, **Ch-2**: 2.2, 2.3, **Ch-3**: 3.1, 3.2	
Module – 2	**08Hrs**
Image processing: More neighborhood operators, Fourier transforms, Pyramids and wavelets, and Geometric transformations. **Test Book 1**: **Ch-3:** 3.3 - 3.6	
Module – 3	**08Hrs**
Image Restoration and Reconstruction: A model of Image degradation/restoration process, restoration in the presence of noise only, periodic noise reduction by frequency domain filtering. **Image Segmentation:** Fundamentals, Point, Line and edge detection, thresholding (Foundation & Basic global thresholding only), Segmentation by region growing & region splitting & merging.	

Test Book 2: **Ch-5:** 5.1 to 5.4, **Ch-10:** 10.1 to 10.3.2, 10.4	
Module – 4	**08Hrs**
Color Image Processing: Color fundamentals, color models, Pseudo color image processing, full color image processing, color transformations, color image smoothing and sharpening, Using color in image segmentation, Noise in color images. **Test Book 2**: **Ch-6:** 6.1-6.8	
Module – 5	**08Hrs**
Morphological Image Processing: Preliminaries, Erosion and Dilation, opening and closing, Hit-or-miss transform, some basic morphological algorithms. **Feature Extraction:** Background, Boundary preprocessing (Boundary following & Chain codes only). **Image pattern Classification:** Background, Patterns and classes, Pattern classification by prototype matching (Minimum distance classifier only). **Test Book 2**: **Ch-9:** 9.1-9.5, **Ch-11**: 11.1-11.2.2, **Ch-12**: 12.1-12.3.1	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the fundamentals of computer vision and its applications.
CO2	Apply the image enhancement techniques for smoothing and sharpening of images.
CO3	Compare the different image restoration and segmentation techniques.
CO4	Demonstrate the smoothing and sharpening techniques for color images.
CO5	Explain morphological, feature extraction, and pattern classification techniques for object recognition

Text Books	
1	Richard Szeliski, Computer Vision: Algorithms and Applications (Texts in Computer Science), 2nd Edition, 2022, Springer. ISBN: 9783031343773
2	Rafael C G., Woods R E. and Eddins S L, Digital Image Processing, Pearson, 4th edition, 2019. ISBN: 9780133356724

Reference Books	
1	David Forsyth and Jean Ponce, Computer Vision: A Modern Approach, 2nd Edition, Pearson, 2015.
2	Reinhard Klette, Concise Computer Vision - An Introduction into Theory and Algorithms, Springer, 2014

Web links and Video Lectures (e – Resources)	
1	**Virtual Labs:** https://cse19-iiith.vlabs.ac.in/
2	https://onlinecourses.nptel.ac.in/noc21_ee78/preview
3	**Introduction to Machine Vision:** https://www.youtube.com/watch?v=tY2gczObpfU
4	https://coral.ise.lehigh.edu/optml/files/2019/10/OptML_CV_tutorial_1_compressed.pdf

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2				2					2
CO2	3	3			3						2
CO3	3	3			2						2
CO4	3	2		2	3						2
CO5	3	3	2	2	3	2					3

Semester: V						
AI IN CYBER SECURITY						
Course Code	**:**	**BAD525D**		**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0		**CIE**	**:**	50 Marks
Total Hours	**:**	40 L		**SEE**	**:**	50 Marks
Course Type	**:**	PEC		**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Data Structures and Algorithms, Basics of Cyber security, and Introduction to AI
Knowledge on Fundamental Concepts	Concepts of authentication, privacy, ML basics, classification, and anomaly detection
Knowledge on Connected Tools (If any)	Basic understanding of Python, scikit-learn, and AI tools

Course Learning Objectives: This course will enable the students	
CLO1	To Analyze and improving cyber security posture.
CLO2	To understand AI & CS systems are being trained to identify malware, execute pattern recognition.
CLO3	To study better Vulnerability Management.
CLO4	To understand the concepts of AI by Adversaries.
CLO5	To understand AI enabled cyber security.

Module – 1	**08Hrs**
Fundamentals of Cyber Security & AI: Identity, authentication, confidentiality, privacy, anonymity, availability and integrity, deep learning fundamentals from a security perspective. fundamentals of AI and how AI can solve problems in the cyber security space, Examples of companies using AI for Security, such as Cylance and FireEye. **TextBook 1:** Ch 1: 1.1-1.5, Ch 2: 2.1-2.6, Ch 3: 3.1-3.5, **TextBook 2:** Ch 1: 1.1-1.4	
Module – 2	**08Hrs**
Secure Web: Security using AI techniques for injection using regular expressions, identifying patterns and matching with existing scores, Vulnerability measures, statistical patterns and Bayesian statistics, statistical distributions. **TextBook 1:** Ch 4: 4.1-4.6, Ch 5: 5.1-5.5, **TextBook 2:** Ch 3: 3.1-3.6	
Module – 3	**08Hrs**
Cyber Security Threat: Web Application Security, Injection, Broken authentication, Sensitive data exposure, XML External Entities (XXE),Broken access control, Security misconfiguration Cross-Site Scripting (XSS),Insecure deserialization, Using components with known vulnerabilities Insufficient logging and monitoring. **TextBook 1:** Ch 7: 7.1-7.4, **TextBook 2:** Ch 5: 5.1-5.7, Ch 6: 6.1-6.5	
Module – 4	**08Hrs**
Securing Infrastructure: Security issues in systems, secure software design, secure programming, and security testing, covering security analysis as well as the secure development of software-based systems both on architectural level and system level. **TextBook 1:** Ch 8: 8.1-8.5, **TextBook 2:** Ch 7: 7.1-7.6, Ch 8: 8.1-8.5	
Module – 5	**08Hrs**

Impact of AI on Cyber Security: Threat hunting in memory, file system and network data, cyber threat hunting and digital investigation, introductory analysis of malicious programs. KNN (K- Nearest Neighbors) for threat visualisers, Isolation forest for anomaly detection, LSTM for multi-vector correlation DBSCAN for riskware detection and fraud LSTM (Autoencoder) for endpoint protection **TextBook 1:** Ch 10: 10.1-10.5, **TextBook 2:** Ch 9: 9.1-9.6, Ch 10: 10.1-10.7

Course Outcomes: After completing the course, the students will be able to	
CO1	Analyze the role of AI/ML in enhancing cyber security practices.
CO2	Apply ML techniques to detect cyber security threats.
CO3	Design AI/ML-based solutions for real-world security applications.
CO4	Evaluate ethical, societal, and legal aspects in AI-powered cyber security.
CO5	Demonstrate awareness of AI-driven cyber security trends and adapt to emerging technologies.

Text Books	
1	Artificial Intelligence for Cybersecurity: Implement smart AI systems for preventing cyber attacks and detecting threats and network anomalies Alessandro Parisi , 1st edition (2 August 2019). ISBN: 9781789804027.
2	AI-Enabled Threat Detection and Security Analysis,by Hadis Karimipour (Editor), Farnaz Derakhshan 3 August 2021. ISBN: 9783030766122.

Reference Books	
1	Cyber Security Incident Response Guide.– Alan J White
2	Cybersecurity– Attack and Defense Strategies: Counter Modern Threats and Employ State-of-the Art Tools and Techniques to Protect Your Organization Against Cybercriminals.– Yuri Diogenes, Erdal Ozkaya, August 2019.
3	Cybersecurity: An Essential Guide to Computer and Cyber Security for Beginners, Including Ethical Hacking, Risk Assessment, Social Engineering, Attack and Defense Strategies, and Cyber warfare.– Latest Edition.

Web links and Video Lectures (e – Resources)	
1	AI in Cybersecurity – Geeks for Geeks
2	AI for cybersecurity | Cloudflare

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	2	2	3	2			2		3
CO2	3	3	2	3	3	2			2		2
CO3	2	2	3	3	3	2		2	2	2	2
CO4	-	2	2	-	2	3	3		3	-	2
CO5	2	2	2	-	2	2	2		2	2	3

Semester: V					
Research Methodology and IPR (Common to all Branches)					
Course Code	:	BRM507	**Credits**	:	3
Hours/Week (L: T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40Hrs	**SEE**	:	50 Marks
Course Type	:	AEC	**SEE Duration**	:	3 Hours

Prerequisites:	
Courses	Engineering / Technical Communication
Knowledge on Fundamental Concepts	Fundamentals of engineering problem solving, technical report writing, information retrieval, analytical thinking, and professional ethics
Knowledge on Connected Tools (If any)	Familiarity with web search engines, digital libraries, scholarly databases (e.g., Google Scholar), reference management tools, and basic office productivity software

Course Learning Objectives: This course will enable the students to	
CLO1	Familiarize students with research methodologies, problem formulation, and research ethics.
CLO2	Equip students with techniques for literature search, review, and analysis using scholarly databases.
CLO3	Strengthen technical reading and interpretation skills for research documents, algorithms, and datasets.
CLO4	Introduce Intellectual Property Rights and innovation protection procedures.
CLO5	Enhance awareness of IP management, commercialization, and significant IPR case studies.

Module – 1	**08Hrs**
Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship. **Textbook 1**: **Ch. 1, Ch. 2**	
Module – 2	**08Hrs**
Literature Review and Technical Reading: New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet. **Attributions and Citations**: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments. **Textbook 1**: **Ch. 2, Ch. 3**	
Module – 3	**08Hrs**
Introduction To Intellectual Property: Role of IP in the Economic and Cultural, Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of	

IP History of IP in India. Major Amendments in IP Laws and Acts in India.

Patents: Conditions for Obtaining a Patent Protection. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non-Patentable Matters. Patent Infringements. Avoid Public Disclosure of an Invention before Patenting. Process of Patenting. Process of Patenting. Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. Commercialization of a Patent. Need for a Patent Attorney/Agent. Patent Related Forms. Fee Structure. Types of Patent Applications. Commonly Used Terms in Patenting. National Bodies Dealing with Patent Affairs. Utility Models**.**

Textbook 2: Ch. 1, Ch.2.1

Module – 4	**08Hrs**

Copyrights and Related Rights: Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Fair Use Doctrine. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. @#@26092024 Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transfer of Copyrights to a Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'Indian Work'. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC). International Copyright Agreements, Conventions and Treaties. Interesting Copyrights Cases.

Trademarks: Eligibility Criteria. Acts and Laws. Classification of Trademarks. Validity of Trademark. Types of Trademark Registered in India. Trademark Registry. Process for Trademarks Registration. Prior Art Search. Famous Case Law: Coca-Cola Company vs. Bisleri International Pvt. Ltd.

Textbook 2: Ch. 2.2-2.3

Module – 5	**08Hrs**

Industrial Designs: Eligibility Criteria. Acts and Laws to Govern Industrial Designs. Design Rights. Enforcement of Design Rights. Non-Protectable Industrial Designs India. Protection Term. Procedure for Registration of Industrial Designs. Prior Art Search. Application for Registration. Duration of the Registration of a Design. Importance of Design Registration. Cancellation of the Registered Design. Application Forms. Classification of Industrial Designs. Designs Registration Trend in India. International Treaties. Famous Case Law: Apple Inc. vs. Samsung Electronics Co.

Geographical Indications: Acts, Laws and Rules Pertaining to GI. Ownership of GI. Rights Granted to the Holders. Registered GI in India. Identification of Registered GI. Classes of GI. Non-Registerable GI. Protection of GI. Collective or Certification Marks. Enforcement of GI Rights. Procedure for GI Registration Documents Required for GI Registration. GI Ecosystem in India. Case Studies on Patents. Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, Case study of Basmati patent. IP Organizations in India. Schemes and Programmes.

Textbook 2: **Ch. 2.4-2.5ss**

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply research methodologies and ethical practices to address engineering research problems.
CO2	Analyze technical literature and synthesize research findings using appropriate citation practices.
CO3	Interpret research articles, algorithms, datasets, and technical documents in computing domains.

CO4	Implement intellectual property rights procedures for protecting technological innovations
CO5	Evaluate intellectual property case studies and determine suitable protection strategies for research outcomes

Textbooks	
1	"Research Methodology: Methods and Techniques", C.R. Kothari and Gaurav Garg, 5th Edition, New Age International Publishers, 2024. ISBN: 9389802555
2	"Intellectual property rights under WTO", T Ramappa, 2nd revised edition, Asia Law House Publisher, 2016, ISBN: 9385556819

Reference Books	
1	"Research Methodology: A Step-by-Step Guide for Beginners", Ranjit Kumar, SAGE Publications 2018, ISBN: 9781526457080
2	"Principles of Intellectual Property", Dr. N. S. Gopalakrishnan and T. G. Agitha, Eastern Book Company Publisher, 3rd edition, 2023. ISBN: 9788170121572

Web links and Video Lectures (e – Resources)	
1	https://online.vtu.ac.in/course/1-research-methodologies-and-ipr
2	https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr24_ed08

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	3		3			3				2
CO2	2	3		3	1		2		2		3
CO3	2	3		2	2				2		3
CO4	1	1	2			2	3			2	2
CO5	1	3	2	2		2	3		1	2	2

Institute Vision

Preparing Competent Engineering and Management Professionals to Serve the Society

Institute Mission

- **Providing Students with a Sound Knowledge in Fundamentals of their branch of Study.**
- **Promoting Excellence in Teaching, Training, Research and Consultancy.**
- **Exposing Students to Emerging Frontiers in various domains enabling Continuous Learning.**
- **Developing Entrepreneurial acumen to venture into Innovative areas.**

Department of Artificial Intelligence & Data Science

VISION

Nurturing AI & DS technocrats to be proficient in solving real-world problems

MISSION

- **Providing fundamentals to enhance niche expertise in AI & DS, cognitive computing, robotics and neural network architectures**
- **Enhancing the analytical and problem-solving abilities to meet the challenges of the future**
- **Training the students with the latest technology to become sustainable professionals**
- **Fostering a culture of collaboration and propagating industry-oriented innovations and research**
- **Establishing a stimulating learning environment to create value-based and**

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