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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 2022,World 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

Computer Science & Engineering (AI&ML)

(2024 Scheme)

Core Values

Spiritual, Judicious, Commitment, Integrity, Trustworthy



nirf NATIONAL INSTITUTIONAL RANKING FRAMEWORK 151-300

QS I-GAUGE GOLD

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. –

Computer Science and Engineering (Artificial Intelligence and Machine Learning)

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

5th Semester

Computer Science and Engineering (Artificial Intelligence and Machine Learning)

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	TD:CI PSD:CI	3	0	0	**3**	**50**	**50**	**100**	**3**
2	BCI502	Introduction to Machine Learning	IPCC	TD:CI PSD:CI	3	0	2	**3**	**50**	**50**	**100**	**4**
3	BCI503	Natural Language Processing and Generative AI	PCC	TD:CI PSD:CI	3	0	0	**3**	**50**	**50**	**100**	**4**
4	BADL504	Data Analytics and Visualization Lab	PCCL	TD:CI PSD:CI	0	0	2	**3**	**50**	**50**	**100**	**1**
5	BXX525x	Professional Elective Course – I	PEC	TD:CI PSD:CI	3	0	0	**3**	**50**	**50**	**100**	**3**
6	BCIMP536	Mini Project	PROJ	TD:CI PSD:CI	0	0	2	**3**	**50**	**50**	**100**	**2**
7	BRM507	Research Methodology and IPR	AEC	TD:CI PSD:CI	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	NCMC	NSS Coordinator	0	0	2	-	**100**	-	**100**	**0**
	BPE509	Physical Education		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
BCI525A	IOT and Computing Paradigms	BCI525C	Multimodal AI
BCI525B	Data Engineering for AI	BCI525D	Cyber Law and Ethics

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, Physical Education, 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					
Course Code	**:**	BCS501	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40Hrs	**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	**08Hrs**
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	**08Hrs**
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	**08Hrs**
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	**08Hrs**
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	**08Hrs**
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.

Textbooks	
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 – PSO MAPPING

	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					
Introduction to Machine Learning					
Course Code	:	BCI502	**Credits**	:	04
Hours/Week (L:T:P)	:	3:0:2	**CIE**	:	50 Marks
Total Hours	:	40L+14P	**SEE**	:	50 Marks
Course Type	:	IPCC	**SEE Duration**	:	03 Hours

Prerequisites:	
Courses	Mathematics Foundation, Artificial Intelligence
Knowledge on Fundamental Concepts	Statistics, Data Analysis and Data Visualization
Knowledge on Connected Tools (If any)	Jupyter Notebook

Course Learning Objectives: This course will enable the students to	
CLO1	Infer the fundamental concepts, principles and techniques of machine learning.
CLO2	Illustrate the core components which is essential to design a functional learning system.
CLO3	Analyze the machine learning algorithms such as regression, decision trees, Bayesian models, clustering and neural networks.
CLO4	Explore the advanced concept like reinforcement learning and provide practical insight into its applications.
CLO5	Enable students to model and evaluate machine learning solutions for different types of real world problems.

Module – 1	**08 Hrs**
Introduction: Need for Machine Learning, Machine Learning Explained, Machine Learning in Relation to other Fields, Types of Machine Learning, Challenges of Machine Learning, Machine Learning Process, Machine Learning Applications. **Understanding Data:** What is Data?, Big Data Analytics and Types of Analytics, Big Data Analysis Framework, Descriptive Statistics, Univariate Data Analysis and Visualization. **Text Book 1: Ch 1: 1.1 to 1.7 & Ch 2: 2.1 to 2.5**	
Module – 2	**08 Hrs**
Understanding Data: Bivariate Data and Multivariate Data, Multivariate Statistics, Essential Mathematics for Multivariate Data, Feature Engineering and Dimensionality Reduction Techniques. **Basic Learning Theory:** Design of Learning System, Introduction to Concept of Learning**,** Induction Biases, Modelling in Machine Learning. **Text Book 1: Ch 2: 2.6 to 2.8, 2.10 & Ch 3: 3.3 to 3.6**	
Module – 3	**08 Hrs**
Similarity-Based Learning: Nearest-Neighbor Learning, Weighted K-Nearest-Neighbor Algorithm, Nearest Centroid Classifier, Locally Weighted Regression (LWR). **Regression Analysis:** Introduction to Regression, Introduction to Linear Regression, Validation of Regression Methods, Multiple Linear Regression, Polynomial Regression, Logistic Regression. **Decision Tree Learning:** Introduction to Decision Tree Learning Model, Decision Tree Induction Algorithms. **Text Book 1: Ch 4: 4.2 to 4.5, Ch 5: 5.1 to 5.7 & Ch 6: 6.1 to 6.2**	
Module – 4	**08 Hrs**

Bayesian Learning: Introduction to Probability-Based Learning, Fundamentals of Bayes Theorem, Classification Using Bayes Model, Naïve Bayes Algorithm for Continuous Attributes.
Artificial Neural Networks: Introduction, Biological Neurons, Artificial Neurons, Perceptron and Learning Theory, Types of Artificial Neural Networks, Popular Applications of Artificial Neural Networks, Advantages and Disadvantages of ANN, Challenges of ANN.
Text Book 1: Ch 8: 8.1 to 8.4, Ch 10: 10.1 to 10.5 & 10.9 to 10.11

Module – 5	**08 Hrs**

Clustering Algorithms: Introduction to Clustering Approaches, Proximity Measures, Hierarchical Clustering Algorithms, Partitional Clustering Algorithm, Density-Based Methods, Grid-Based Approach, Probability Model-Based Methods.
Reinforcement Learning: Overview of Reinforcement Learning, Scope of Reinforcement Learning, Reinforcement Learning as Machine Learning, Components of Reinforcement Learning, Markov Decision Process, Multi-Arm Bandit Problem and Reinforcement Problem Types, Model-Based Learning, Model Free Methods, Q-Learning, SARSA Learning.
Text Book 1: Ch 13: 13.1 to 13.7 & Ch 14: 14-1 to 14.10

PRACTICAL COMPONENT OF IPCC

SL.NO	Experiments
1	Develop a program to create histograms for all numerical features and analyse the distribution of each feature. Generate box plots for all numerical features and identify any outliers. Use California Housing dataset.
2	Implement a program to Compute the correlation matrix to understand the relationships between pairs of features. Visualize the correlation matrix using a heat map to know which variables have strong positive/negative correlations. Create a pair plot to visualize pairwise relationships between features. Use California Housing dataset.
3	Develop a program to implement Principal Component Analysis (PCA) for reducing the dimensionality of the Iris dataset from 4 features to 2.
4	For a given set of training data examples stored in a CSV file, implement and demonstrate the Find-S algorithm to output a description of the set of all hypotheses consistent with the training examples.
5	Build a program to implement k-Nearest Neighbour algorithm to classify the randomly generated 100 values of x in the range of [0,1]. Perform the following based on dataset generated. 1. Label the first 50 points {x1,……,x50} as follows: if (xi ≤ 0.5), then xi ∈ Class1, else xi ∈ Class1 Classify the remaining points, x51,……,x100 using KNN. Perform this for k=1,2,3,4,5,20,30
6	Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs
7	Build a program to demonstrate the working of Linear Regression and Polynomial Regression. Use Boston Housing Dataset for Linear Regression and Auto MPG Dataset (for vehicle fuel efficiency prediction) for Polynomial Regression.
8	Develop a program to demonstrate the working of the decision tree algorithm. Use Breast Cancer Data set for building the decision tree and apply this knowledge to classify a new sample.
9	Develop a program to implement the Naive Bayesian classifier considering Olivetti Face

	Data set for training. Compute the accuracy of the classifier, considering a few test data sets.
10	Develop a program to implement k-means clustering using Wisconsin Breast Cancer data set and visualize the clustering result.

Course Outcomes: After completing the course, the students will be able to	
CO1	Outline the core concepts of machine learning techniques effectively.
CO2	Build the real-world challenges by assessing strengths and limitations across different ML paradigms.
CO3	Apply regression, decision trees, and similarity-based methods to solve practical problems.
CO4	Evaluate Bayesian and neural network approaches to address and mitigate training issues.
CO5	Interpret reinforcement learning and clustering fundamentals to learn from interactions and discover patterns.

Text Books	
1	Machine Learning, S Sridhar & Vijayalakshmi,1st Edition, 2021,OXFORD University Press, ISBN-13**:** 978-0-19-012727-5
2	Machine Learning: Theory And Practice, Murty M.N & V. S. Ananthanarayana,1st Edition, 2024, Universities Press, ISBN-13: 978-93-93330-69-7

Reference Books	
1	Machine Learning, T. M. Mitchell, 1st Edition, 1997, Mcgraw Hill, ISBN-10:1-25-909695-5
2	The Hundred-Page Machine Learning Book, Burkov & Andriy, Vol.1, 2019, Quebec City, QC Canada, ISBN-13**:** 978-1999579500
3	Hands-On Machine Learning With Scikit-Learn and Tensor Flow: Concepts, Tools and Techniques To Build Intelligent Systems, Aureliengeron Shroff, 3rd Edition,2022, O'Reilly Media, ISBN-10: 1098125975

Web links and Video Lectures (e – Resources)	
1	Machine Learning Tutorials: https://www.geeksforgeeks.org/machine-learning/
2	Introduction to Machine Learning: https://nptel.ac.in/courses/106105152
3	Python for Machine Learning: https://www.w3schools.com/python/python_ml_getting_started.asp

CO – PO MAPPING

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

Semester: V					
Natural Language Processing and Generative AI					
Course Code	:	BCI503	**Credits**	:	03
Hours/Week (L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40	**SEE**	:	50 Marks
Course Type	:	PCC	**SEE Duration**	:	03 Hours

Prerequisites:	
Courses	Artificial Intelligence
Knowledge on Fundamental Concepts	Basic Text Processing & Pattern Matching, Object-Oriented Programming (OOP) Principles
Knowledge on Connected Tools (If any)	Anaconda

Course Learning Objectives: This course will enable the students to	
CLO1	Learn the algorithmic description of the main language levels: morphology, syntax, semantics and pragmatics, as well as the resources of natural language data – corpora.
CLO2	Understand knowledge representation, inference, and relations to artificial intelligence.
CLO3	Explore linguistic phenomena and linguistic features relevant to each NP task.
CLO4	Implement NLP tools like classifiers, translators, pos taggers, stemmers for Indian and other languages.
CLO5	Develop generative models to synthesize data such as images, text, and music using modern deep learning architectures.

Module – 1	**08 Hrs**
Introduction: What is Natural Language Processing? Origins of NLP, Language and Knowledge, The Challenges of NLP, Language and Grammar, Processing Indian Languages, NLP Applications. **Language Modelling:** Statistical Language Model - N-gram model (unigram, bigram), Paninion Framework, Karaka theory. **Text Book 1: Ch 1, 2**	
Module – 2	**08 Hrs**
Word Level Analysis: Regular Expressions, Finite-State Automata, Morphological Parsing, Spelling Error Detection and Correction, Words and Word Classes, Part-of Speech Tagging. **Syntactic Analysis:** Context-Free Grammar, Constituency, Top-down and Bottom-up Parsing, CYK Parsing. **Text Book 1: Ch 3, 4**	
Module – 3	**08 Hrs**
Naive Bayes, Text Classification and Sentiment: Naive Bayes Classifiers, Training the Naive Bayes Classifier, Worked Example, Optimizing for Sentiment Analysis, Naive Bayes for Other Text Classification Tasks, Naive Bayes as a Language Model. **Machine Translation:** Language Divergences and Typology, Machine Translation using Encoder Decoder, Details of the Encoder-Decoder Model, Translating in Low-Resource Situations, MT Evaluation. **Text Book 2: Ch. 4, 6, 13**	
Module – 4	**08 Hrs**
Information Retrieval: Design Features of Information Retrieval Systems, Information Retrieval Models - Classical, Non-classical, Alternative Models of Information Retrieval - Custer model, Fuzzy model, LSTM model, Major Issues in Information Retrieval. **Lexical Resources:** WordNet, FrameNet, Stemmers, Parts-of-Speech Tagger, Research	

Corpora. **Text Book 1: Ch 9, 12**

Module – 5	**08 Hrs**
Generative Modeling : What Is Generative Modeling?, Generative Versus Discriminative Modeling, The Rise of Generative Modeling, Generative Modeling and AI, Our First Generative Model, Hello World!, The Generative Modeling Framework, Representation Learning **Transformers:** Introduction, GPT, The Wine Reviews Dataset, Attention, Queries, Keys, and Values, Multihead Attention, Causal Masking, The Transformer Block, Positional Encoding, Training GPT, Analysis of GPT, Other Transformers,T5, GPT-3 and GPT-4, ChatGPT **Text Book 3: Ch. 1, Ch. 9**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Apply the fundamental concept of NLP, grammar-based language model and statistical-based language model.
CO2	Model morphological analysis using Finite State Transducers and parsing using context-free grammar and different parsing approaches.
CO3	Develop the Naïve Bayes classifier and sentiment analysis for Natural language problems and text classifications and Identify the Machine Translation applications of NLP using Encode and Decoder.
CO4	Use the concepts of information retrieval, lexical semantics, lexical dictionaries such as WordNet, lexical computational semantics, distributional word similarity.
CO5	Implement the concepts and principles of Generative Artificial Intelligence to engineering requirements.

Text Books	
1	Natural Language Processing and Information Retrieval, Tanveer Siddiqui, U.S. Tiwary, 1st edition,2008, reprint 2014, Oxford University Press, ISBN: 9780195692327.
2	Speech and Language Processing: An Introduction to Natural Language Processing, Daniel Jurafsky, James H. Martin, 2nd Edition, 2014, Pearson Education, ISBN: 9780131873216.
3	Generative Deep Learning: Teaching Machines To Paint, Write, Compose, and Play, David Foster, Second Edition,2023, O'Reilly Media, ISBN: 978-1-098-13418-1
Reference Books	
1	Computer Networks – A Systems Approach, Larry L. Peterson and Bruce S. Davie: 4th Edition,2019, Elsevier, ISBN-13: 978-0123705488
2	Computer and Communication Networks, Nader F. Mir, 2nd Edition, 2015, Pearson Education, ISBN-13: 978-0-13-381474-3
3	Data and Computer Communication, William Stallings, 10th Edition, 2014, Pearson Education, Inc, ISBN-13: 978-0-13-350648-8

Web links and Video Lectures (e – Resources)	
1	https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2	https://archive.nptel.ac.in/courses/106/106/106106211/

CO – PO MAPPING

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

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					
IOT and Computing Paradigms					
Course Code	**:**	BCI525A	**Credits**	**:**	3
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40L	**SEE**	**:**	50 Marks
Course Type	**:**	PEC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	DDCO, Operating Systems
Knowledge on Fundamental Concepts	Fundamentals of networking, IP addressing and routing, Wireless communication basics (Wi-Fi, Bluetooth, ZigBee)
Knowledge on Connected Tools	--

Course Learning Objectives: This course will enable the students to	
CLO1	Understand the fundamentals, architecture, and design principles of the Internet of Things (IoT).
CLO2	Infer IoT communication technologies, networking protocols, and application protocols.
CLO3	Analyze IoT data analytics techniques and security mechanisms.
CLO4	Evaluate Industrial Internet of Things (IIoT) and smart city applications.
CLO5	Apply IoT concepts to solve real-world engineering problems.

Module – 1	**08 Hrs**
Internet of Things: An Overview: Internet of Things, IoT conceptual Framework, IoT architectural view, Technology Behing Iot, Sources of IoT,M2M communication, Examples of IoT. **Design Principles for Connected Devices:** IoT/M2M Systems Layers and Design Standardisation, Communication Technologies, Data Enrichment, Data Consolidation and Device Management at Gateway, Ease of Design and Affordability **Text book 1**: Ch1, Ch 2	
Module – 2	**08 Hrs**
Connecting Smart Objects: Communication Criteria, IoT Access Technologies, IEEE 802.15.4, IEEE 802.11ah, LoRaWAN, NB-IoT and LTE Variations. **IP as the IoT Network Layer:** Internet Protocol Version 6 (IPv6), IPv6 for IoT, 6LoWPAN, Routing Protocol for Low-Power and Lossy Networks (RPL). **Application Protocols for IoT:** IoT Transport Layer, Constrained Application Protocol (CoAP), Message Queuing Telemetry Transport (MQTT), SCADA and IoT**.** **Text book 2**: Ch 4, Ch5, and Ch 6	
Module – 3	**08 Hrs**
Data and Analytics for IoT: Introduction to IoT Data, Structured and Unstructured Data, Data in Motion and Data at Rest, IoT Data Analytics, Machine Learning, Predictive Analytics, Hadoop Ecosystem, Edge Streaming Analytics. **Text book 2:** Ch 7	
Module – 4	**08 Hrs**
Securing IoT: Introduction to IoT Security, Operational Technology (OT) Security, Common Security Challenges, Risk Analysis, Device Security, Securing Network Infrastructure, Network Monitoring and Security Management. **Industrial IoT (IIoT):** Introduction to Industrial IoT, Connected Manufacturing, IoT in Manufacturing, IoT in Oil and Gas Industry, Smart Grid, IoT in Utilities, Benefits and Challenges of Industrial IoT Applications. **Text book 2:** Ch 8, Ch 9, Ch 10, and Ch 11	

Module – 5	**08 Hrs**
Smart and Connected Cities: Introduction, Smart City Architecture, Smart City Services, Smart Infrastructure, IoT-enabled Urban Services**.** **IoT in Transportation:** Intelligent Transportation Systems (ITS), Connected Vehicles, Traffic Monitoring and Management, Fleet Management, Transportation Safety. **IoT in Public Safety:** Public Safety Applications, Emergency Response Systems, Disaster Management, Smart Surveillance, Challenges and Future Scope of IoT Applications. **Text Book 2:** Ch 12, Ch13, and Ch 15	

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the fundamental concepts, architecture, design principles, and enabling technologies of the Internet of Things (IoT).
CO2	Examine IoT devices, communication technologies, networking protocols, and application protocols used in IoT systems.
CO3	Interpret IoT data analytics techniques and security mechanisms for secure IoT environments.
CO4	Analyze Industrial Internet of Things (IIoT) applications and IoT-based solutions in manufacturing, utilities, and other industrial domains.
CO5	Evaluate IoT applications for smart cities, intelligent transportation, and public safety to address real-world engineering problems.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning	
1	Group discussion on Real world examples.
2	Project based learning.

Text Books	
1	INTERNET OF THINGS:Architecture and Design Principles-Dr.Rajkamal, McGraw Hill Education (India) Private Limited, 2017, ISBN-13: 978-93-5260-522-4
2	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, Cisco Press, 1st Edition, 2017. ISBN-13: 978-1587144569

Reference Books	
1	Internet of Things: A Hands-on Approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 1st Edition, 2015. ISBN-13: 978-8173719545
2	Internet of Things: Architecture, Design Principles and Applications, Raj Kamal, McGraw Hill Education, 2nd Edition, 2017. ISBN-13: 978-9352605222
3	The Internet of Things: Key Applications and Protocols | Olivier Hersent, David Boswarthick, Omar Elloumi, John Wiley & Sons, 2nd Edition, 2012, ISBN-13: 978-1119994358.

Web links and Video Lectures (e – Resources)	
1	https://www.youtube.com/watch?v=6mBO2vqLv38&t=28s
2	https://www.youtube.com/playlist?list=PLEiEAq2VkUUImmTXP_YC2j5qIGOV9NPLy

CO – PO MAPPING

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

Semester: V					
Data Engineering for AI Applications					
Course Code	**:**	BCI525B	**Credits**	**:**	3
Hours/Week (L:T:P)	**:**	3:0:0	**CIE**	**:**	50 Marks
Total Hours	**:**	40 L	**SEE**	**:**	50 Marks
Course Type	**:**	PCC	**SEE Duration**	**:**	3 Hours

Prerequisites:	
Courses	Problem Solving through Programming
Knowledge on Fundamental Concepts	Basic programming concepts, data types, control structures, and fundamentals of databases
Knowledge on Connected Tools (If any)	Text Editor

Course Learning Objectives: This course will enable the students to	
CLO1	Define the fundamentals, lifecycle, and roles of Data Engineering.
CLO2	Analyze data architecture principles and technology choices.
CLO3	Identify data sources and storage systems in data engineering.
CLO4	Apply ingestion, ETL, and data transformation concepts.
CLO5	Evaluate data serving methods, security aspects, and future trends.

Module – 1	**08 Hrs.**
Data Engineering Described: What Is Data Engineering? Data Engineering Skills and Activities, Data Engineers Inside an Organization, **The Data Engineering Lifecycle:** What Is the Data Engineering Lifecycle? Major Undercurrents Across the Data Engineering Lifecycle **Textbook1: Ch.1, Ch.2**	
Module – 2	**08 Hrs.**
Designing Good Data Architecture: What Is Data Architecture?, Principles of Good Data Architecture, Major Architecture Concepts, Examples and Types of Data Architecture **Choosing Technologies Across the Data Engineering Lifecycle:** Team Size and Capabilities, Speed to Market , Interoperability, Cost Optimization and Business Value, Today Versus the Future: Immutable Versus Transitory Technologies, Location, Build Versus Buy, Monolith Versus Modular , Serverless Versus Servers **Textbook1: Ch.3, Ch.4**	
Module – 3	**08 Hrs.**
Data Generation in Source Systems: Sources of Data: How Is Data Created?, Source Systems: Main Ideas **Storage:** Raw Ingredients of Data Storage, Data Storage Systems, Data Engineering Storage Abstractions, Big Ideas and Trends in Storage **Textbook1: Ch.5, Ch.6**	
Module – 4	**08 Hrs.**
Ingestion: What Is Data Ingestion?, Key Engineering Considerations for the Ingestion Phase, Batch Ingestion Considerations, Message and Stream Ingestion Considerations, Ways to Ingest Data **Queries, Modeling, and Transformation:** Queries, Data Modeling, Transformations. **Textbook1: Ch.7, Ch.8**	

Module – 5	**08 Hrs.**
Serving Data for Analytics, Machine Learning, and Reverse ETL: General Considerations for Serving Data, Analytics, Machine Learning, What a Data Engineer Should Know About ML, Ways to Serve Data for Analytics and ML **Security and Privacy:** People, Processes, Technology **The Future of Data Engineering:** The Data Engineering Lifecycle Isn't Going Away, The Decline of Complexity and the Rise of Easy-to-Use Data Tools, The Cloud-Scale Data OS and Improved Interoperability, "Enterprisey" Data Engineering, Titles and Responsibilities Will Morph, Moving Beyond the Modern Data Stack, Toward the Live Data Stack **Textbook1: Ch.9, Ch.10, Ch. 11**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe the fundamentals, lifecycle, and roles of Data Engineering.
CO2	Interpret data architecture principles and technology choices.
CO3	Distinguish data sources and storage systems.
CO4	Demonstrate understanding of ingestion, ETL, and data transformation workflows.
CO5	Assess data serving approaches, security considerations, and future trends.

Text Books	
1	Fundamentals of Data Engineering: Plan and Build Robust Data Systems, Joe Reis, Matt Housley,O'Reilly Media, 2022. ISBN: 978-1098108304.

Reference Books	
1	Designing Data-Intensive Applications, Martin Kleppmann, O'Reilly Media, 2017. ISBN: 978-1449373320.
2	Hadoop: The Definitive Guide, Tom White, 4th Edition, O'Reilly Media, 2015. ISBN: 978-1491901632.
3	Streaming Systems: The What, Where, When, and How of Large-Scale Data Processing, Tyler Akidau, Slava Chernyak, Reuven Lax,O'Reilly Media, 2018. ISBN: 978-1491983874.

Web links and Video Lectures (e – Resources)	
1	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01415596506118553696/overview
2	https://nptel.ac.in/courses/106104189
3	https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01350159097584844812597/overview
4	https://www.youtube.com/watch?v=PHsC_t0j1dU
5	https://www.youtube.com/watch?v=Tyg1FVNq40g&t=2903s

CO – PO MAPPING

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

Semester: V					
Multimodal AI					
Course Code	:	BCI525C	**Credits**	:	03
Hours/Week (L:T:P)	:	3:0:0	**CIE**	:	50 Marks
Total Hours	:	40 Hrs	**SEE**	:	50 Marks
Course Type	:	PEC	**SEE Duration**	:	03 Hours

Prerequisites:	
Courses	Probability & Statistics, Basic Calculus
Knowledge on Fundamental Concepts	Python Programming, Data Structures & Algorithms
Knowledge on Connected Tools (If any)	Jupyter Notebook, Google Colab and Anaconda

Course Learning Objectives: This course will enable the students to	
CLO1	Understand and apply various data visualization techniques for effective data exploration and communication.
CLO2	Interpret the visualization distributions corresponding to different data types and analytical contexts.
CLO3	Analyze the fundamental working principles of Multimodal Machine Learning and Multimodal Artificial Intelligence systems.
CLO4	Illustrate and explain the topologies and architectures of Multi-View Long Short-Term Memory (MV-LSTM) models.
CLO5	Demonstrate multimodal alignment strategies and attention-based deep learning models for cross-modal learning and integration.

Module – 1	**08 Hrs**
Introduction: Analytics, Need of Data Visualization, Types of Data, Data Visualization in practice. **Selecting a Chart Type:** Defining the Goal of Your Data Visualization, Creating and Editing Charts in Excel, Scatter Charts and Bubble Charts, Line Charts, Column Charts and Bar Charts, Maps, When to Use Tables, Other Specialized Charts, A Summary Guide to Chart Selection. **Text Book 1: Ch 1: 1.1 to 1.4, Ch 2: 2.1 to 2.8**	
Module – 2	**08 Hrs**
Data Visualization and Design: Preattentive Attributes, Gestalt Principles, Data-Ink Ratio, Other Data Visualization Design Issues, Common Mistakes in Data Visualization Design. **Purposeful Use of Color:** Color and Perception, Color Schemes and Types of Data, Custom Color using the HSL Color System,Common mistakes in the use of Color in Data Visualization. **Text Book 1: Ch 3: 3.1 to 3.5 & Ch 4: 4.1 to 4.4**	
Module – 3	**08 Hrs**
Visualizing Variability: Creating Distributions from Data, Statistical Analysis of Distributions of Quantitative Variables, Uncertainty in Sample Statistics, Uncertainty in Predictive Models. **Exploring Data Visually:** Introduction to Exploratory Data Analysis, Analyzing Variables One at a Time, Relationships between Variables, Analysis of Missing Data, Visualizing Time Series and Geospatial Data. **Text Book 1: Ch 5: 5.1 to 5.4 & Ch 6: 6.1 to 6.6**	

Module – 4	**08 Hrs**
Explaining Visually to Influence with Data: Know Your Audience, Know Your Message, Storytelling with Charts, Bringing It All Together: Storytelling and Presentation Design. **Data Dashboards:** What is a Data Dashboards? Data Dashboards Taxonomies, Data Dashboard Design, Using Excel Tools to Build a Data Dashboard, Common Mistakes in Data Dashboard Design. **Text Book 1: Ch 7: 7.1 to 7.4 & Ch 8: 8.1 to 8.5**	
Module – 5	**08 Hrs**
Telling the Truth with Data Visualization: Missing Data and Data Errors, Biased Data, Adjusting for Inflation, Deceptive Design, Design of Chart Axes, Dual-Axis Charts, Data Selection and Temporal Frequency, Issues Related to Geographic Maps. **Text Book 1: Ch 9: 9.1 to 9.4**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the various data Visualization Techniques.
CO2	Interpret the visualization distributions for different types of data.
CO3	Analyze the working principles of Multimodal Machine Learning and Multimodal Artificial Intelligence.
CO4	Illustrate topologies for Multi-View Long Short-Term Memory.
CO5	Demonstrate the multimodal alignment and attention-based deep learning models

Text Books	
1	Data Visualization: Exploring and Explaining with Data, Jeffrey D. Camm/James J Cochran/Michael J. Fry/Jeffrey W. Ohlmann, 1st Edition, 2022, Cengage Publishers, ISBN-13: 9780357631348

Reference Books	
1	Multimodal Scene Understanding: Algorithms, Applications and Deep Learning, M Yang, B Rosenhahn, V Murino, 1st Edition, 2019, Academic Press Inc,ISBN-13: 9780128173589
2	Multimodal Deep Learning with Tensorflow: Translate mathematics into robust TensorFlow applications with Python, A But, A Miasnikov, G Ortolani, 1st Edition, 2019, Packt Publishing Limited, ISBN-10: 978-1789343649
3	Multimodal Signal Processing Theory and Applications for Human-Computer Interaction, Jean- Philippe Thira, Ferran Marques, Hervk Bourlard,1st Edition, 2010,Academic Press, ISBN-10: 0123748259

Web links and Video Lectures (e – Resources)	
1	https://drive.google.com/file/d/1xtXj95tJeBGxD4quXCDYoKqyQTg-BoUf/view
2	https://piazza.com/class_profile/get_resource/jjyt9xcoem64k5/jmicotl4p4l5xy
3	https://cmu-multicomp-lab.github.io/mmml-tutorial/schedule/
4	https://piazza.com/cmu/fall2018/11777/resources

CO – PO MAPPING

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

Semester: V					
Cyber Law and Ethics					
Course Code	**:**	BCI525D	**Credits**	:	03
Hours/Week(L:T:P)	**:**	3:0:0	**CIE**	:	50 Marks
Total Hours	**:**	40 Hrs	**SEE**	:	50 Marks
Course Type	**:**	PEC	**SEE Duration**	:	03 Hours

Prerequisites:	
Courses	Ethics
Knowledge on Fundamental Concepts	Cyber security Basics
Knowledge on Connected Tools (If any)	Opencv

Course Learning Objectives: This course will enable the students to	
CLO 1	Illustrate the fundamental concepts of cybercrime, cybersecurity, information security, and the legal perspectives governing cyberspace
CLO 2	Understand effective mechanisms for forensics applications
CLO 3	Identify issues in detection and investigation of Cyber Crime
CLO 4	Learn various acts related to cyber security world
CLO 5	Analyze the cyber laws, ethical issues, research challenges, and professional responsibilities to promote secure and lawful use of information technologies

Module–1	**08 Hrs**
Introduction to Cybercrime: Introduction, Definition and Origins of the Word, Cybercrime and Information Security, who are Cybercriminals, Classifications of Cybercrimes, the Legal Perspectives, Cybercrimes, An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era, Survival Mantra for the Netizens. **Text Book 1: Ch 1**	
Module–2	**08 Hrs**
Cyber offenses How Criminals Plan Them: Introduction, How Criminals Plan the Attacks, Social Engineering, Cybers talking, Cyber cafe and Cybercrimes, Botnets the Fuel for Cybercrime, Attack Vector, Cloud Computing. **Text Book 1:Ch 2**	
Module–3	**08 Hrs**
Cybercrime Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones. **Mobile Devices**: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops. **Text Book 1:Ch 3**	
Module–4	**08 Hrs**
Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks. **Phishing and Identity Theft**: Introduction, Phishing, Identity Theft (ID Theft). **Text Book 1:Ch 4**	
Module–5	**08 Hrs**
Understanding Computer Forensics: Introduction, Historical Background of Cyber-forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber-forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approachinga Computer Forensics Investigation. **Text Book 1:Ch 7**	

Course Outcomes: After completing the course, the students will be able to	
CO1	Demonstrate cyber security, cybercrime and forensics
CO2	Illustrate evidence collection and legal challenges
CO3	Analyze the cybercrime with the support tools and methods
CO4	Analyze the possible research opportunities and challenges with in the cyber laws and security
CO5	Apply ethical, legal, and lifelong learning principles in cybersecurity practice

Text Book	
1	Cybercrime, Digital Forensics and Legal Perspectives ,Sunit Belapure and Nina Godbole, Cybersecurity, 3rd Edition ,2023, ISBN:978-8126521791

Reference Books	
1	Cybersecurity Essentials, Charles J. Brooks et al,3rd Edition, 2023. ISBN: 9781119853435
2	Introduction to information security and cyber laws, Surya Prakash Tripathi, Ritendra Goyal, Praveen Kumar Shukla, ,2nd Edition ,2024, ISBN: 978-9351194736

CO–PO MAPPING

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

Semester: V					
Research Methodology and IPR (Common to all Branches)					
Course Code	:	BRM507	**Credits**	:	3
Hours/Week (L: T :P)	:	2:2:0	**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. 3, Ch. 4**	
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. 2

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. 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. 4, Ch. 7**

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.
- Imparting Value based Professional Education with a sense of Social Responsibility.

Department Vision

Nurturing AI&ML technocrats to become proficient in solving real – world problems.

Department Mission

- Providing fundamentals to enhance niche expertise in AI&M, cognitive computing robotics and neural networks.
- 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 innovation and research.
- Establishing a stimulating learning environment to create value – based and pioneering.

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P.B. No.20, B.B Road,

Chikkaballapur - 562 101, Karnataka