Dr. Babasaheb Ambedkar Technological University (Established a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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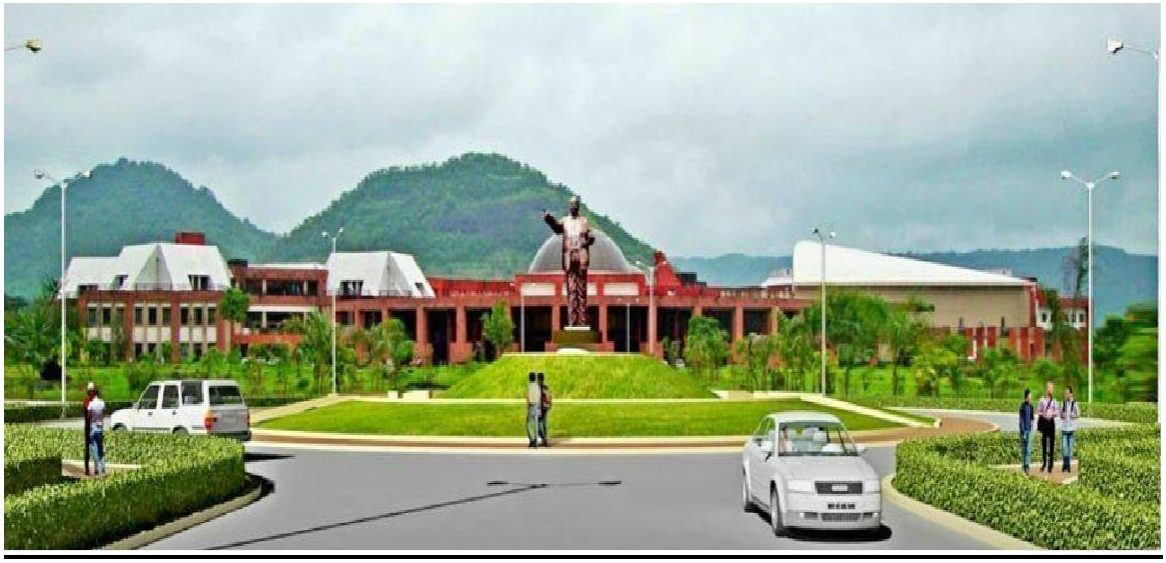
CURRICULUM UNDER GRADUATE PROGRAMME FOR B. TECH

ARTIFICIAL INTELLIGENCE & DATA SCIENCE

WITH EFFECT FROM THE ACADEMIC YEAR
SY: 2021-2022
TY: 2022-2023
B.Tech:2023-24



Course Structure for Third Year

B. Tech in Artificial Intelligence & Data Science

Semester V (Term 5)									
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				
			L	T	P	CA	MSE	ESE	Total	Credit
PCC5	BTAIC501	Computer Network and Cloud Computing	3	1	-	20	20	60	100	4
PCC6	BTAIC502	Machine Learning	3	-	-	20	20	60	100	3
HSSMC4	BTAIHM503	Humanities and Social Sciences including Management Elective Course (HSSMEC) – II	3	-	-	20	20	60	100	3
	BTAIHM503A	1. Economics and Management								
	BTAIHM503B	2. Business Communication								
	BTAIHM503C	3. Knowledge Reasoning and AI Ethics.								
PEC-2	BTAIPE504	Professional Elective Course (PEC) -II	3	1	-	20	20	60	100	4
	BTAIPE504A	1. Advanced Database System								
	BTAIPE504B	2. Soft Computing								
	BTAIPE504C	3. Sensors & Robotics Technology								
	BTAIPE504D	4. Advanced Java								
OEC-1	BTAIOE505	Open Elective Course (OEC) - I	3	1	-	20	20	60	100	4
	BTAIOE505A	1. Data Mining and Warehousing								
	BTAIOE505B	2. Digital Communication & Information Theory								
	BTAIOE505C	3. Software Engineering and Testing								
	BTAIOE505D	4. Virtual Reality								
LC3	BTAIL506	Machine Learning Lab and Competitive Programming Lab	-	-	4	60	-	40	100	2
PROJ	BTAIM507	Mini Project I	-	-	4	60	-	40	100	2
Internship	BTAIP408	Field Training / Internship / Industrial Training – II(Evaluation)	-	-	-	-	-	-	-	Audit
			15	**3**	**8**	**220**	**100**	**380**	**700**	**22**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

Semester –V

Computer Network and Cloud Computing

BTAIC501	Computer Network and Cloud Computing	PCC5	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Computer Fundamentals, Fundamentals of Digital Communication

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Theoretical and practical base in computer networks issues
2. Outline the basic network configurations
3. Understand state-of-the-art in network protocols, architectures, and applications
1. Fundamental concepts of cloud computing
2. Implementation of virtualization and various cloud services

Course Outcomes:

On completion of the course, students will be able to:

CO1	Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies
CO2	Specify and identify deficiencies in existing protocols, and then go onto select new and better protocols.
CO3	Have a basic knowledge of installing and configuring networking applications
CO4	Understand the different cloud computing environments
CO5	Apply concepts of virtualization and various cloud services to design, develop and deploying cloud applications.

Course Contents:

Unit No 1: Introduction to Computer Networks [7 Hours]

Uses of computer networks, Types of computer networks, Network technology- from local to global, Examples of networks, Network protocols, Reference models, Standardization, policy, legal, and social issues.

Unit No 2: The Data Link Layer and Network Layer [8 Hours]

Data link layer design issues, Error detection and correction, Elementary data link protocols, The channel allocation problem, Multiple access protocols, Network layer design issues, Routing algorithms in a single network, Traffic management at the network layer,

internetworking, software-defined networking, The network layer in the internet.

Unit No 3: Transport and Application Layers [7 Hours]

The transport service, Elements of transport protocols, The internet transport protocols: UDP and TCP, The Domain Name System (DNS), Electronic mail, The world wide web, Streaming audio and video, Content delivery.

Unit No 4: Introduction to Cloud Computing [7 Hours]

Definition and evolution of Cloud Computing, Enabling Technologies, Service and Deployment Models, Popular Cloud Stacks and Use Cases, Benefits, Risks, and Challenges of Cloud Computing, Economic Models and SLAs, Topics in Cloud Security. Historical Perspective of Data Centers, Data center Components.

Unit No 5: Virtualization and Cloud Services [7 Hours]

Communication-as-a-Service (CaaS), Infrastructure-as-a-Service (IaaS), Monitoring-as-a-Service (MaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS). Virtualization (CPU, Memory, I/O) Case Study: Amazon EC2.

Note: Hands-on practice of Computer Network and any cloud services (like Amazon WebServices (AWS Cloud) or Microsoft Azure or Google Cloud) should cover under Tutorialslots.

Text Books

1. A Tanenbaum, N Feamster, D Wetherall, Computer Networks, Sixth Edition, Pearson Education Limited. ISBN 10: 1-292-37406-3, 2021
2. John W. Rittinghouse, James F. Ransome, Cloud Computing Implementation, Management, and Security, CRC Press , Routledge Publisher, ISBN-10 : **1818 ,1189978311879**

Reference Books

1. B. Forouzan, Data Communications and Networking, McGraw Hill Publication, 5th Edition, 2013.
2. Larry Peterson and Bruce Davie, Computer Networks: A Systems Approach, Morgan Kufman
3. Publication, 5th Edition, 2012.Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley-India, 2010.
4. Anthony T. Velte, Toby J. Velte and Robert E, Cloud Computing – A Practical Approach, TMH, 2010

Semester –V

Machine Learning

BTAIC502	Machine Learning	PCC6	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Data Analysis, Python Programming Language

Course Objectives:

After completion of the course, students will learn:-

- To understand fundamental concepts of machine learning and its various algorithms
- To understand various strategies of generating models from data and evaluating them
- To apply ML algorithms on given data and interpret the results obtained
- To design appropriate ML solution to solve real world problems in AI domain

Course Outcomes:

On completion of the course, students will be able to:

CO1	Develop a good understanding of fundamental principles of machine learning
CO2	Formulation of a Machine Learning problem
CO3	Develop a model using supervised/unsupervised machine learning algorithms for classification/prediction/clustering
CO4	Evaluate performance of various machine learning algorithms on various data sets of a domain.
CO5	Design and Concrete implementations of various machine learning algorithms to solve a given problem using languages such as Python

Course Contents:

Unit No 1: Introduction to Machine Learning [7 Hours]

Introduction to Machine Learning: Definition of Machine Learning, Definition of learning. Classification of Machine Learning: Supervised learning, unsupervised learning, Reinforcement learning, Semi-supervised learning.

Categorizing based on required Output: Classification, Regression, and Clustering. Difference in ML and Traditional Programming, Definition of Data, Information and Knowledge.

Split data in Machine Learning: Training Data, Validation Data and Testing Data.

Machine Learning: Applications

Unit No 2: Machine Learning - Performance Metrics [7 Hours]

Performance Metrics for Classification Problems- Confusion Matrix, Classification Accuracy, Classification Report- Precision, Recall or Sensitivity, Support, F1 Score, AUC (Area Under ROC curve).

Performance Metrics for Regression Problems- Mean Absolute Error (MAE), Mean Square Error (MSE), R Squared (R2)

Unit No 3: Linear and Logistic Regression [8 Hours]

Introduction to linear regression:

Introduction to Linear Regression, Optimal Coefficients, Cost function, Coefficient of Determination, Analysis of Linear Regression using dummy Data, Linear Regression Intuition.

Multivariable regression and gradient descent:

Generic Gradient Descent, Learning Rate, Complexity Analysis of Normal Equation Linear

Regression, How to find More Complex Boundaries, Variations of Gradient Descent.
Logistic regression:
Handling Classification Problems, Logistic Regression, Cost Function, Finding Optimal Values, Solving Derivatives, Multiclass Logistic Regression, Finding Complex Boundaries and Regularization, Using Logistic Regression from Sklearn.

Unit No 4: Decision Trees and Random Forests *[7 Hours]*

Decision trees:
Decision Trees, Decision Trees for Interview call, Building Decision Trees, Getting to Best Decision Tree, Deciding Feature to Split on, Continuous Valued Features
Code using Sklearn decision tree, information gain, Gain Ratio, Gini Index, Decision Trees & Overfitting, Pruning.
Random forests:
Introduction to Random Forests, Data Bagging and Feature Selection, Extra Trees, Regression using decision Trees and Random Forest, Random Forest in Sklearn

Unit No 5: Naive Bayes, KNN and SVM *[7 Hours]*

Naive Bayes:
Bayes Theorem, Independence Assumption in Naive Bayes, Probability estimation for Discrete Values Features, How to handle zero probabilities, Implementation of Naive Bayes, Finding the probability for continuous valued features, Text Classification using Naive Bayes.
K-Nearest Neighbours:
Introduction to KNN, Feature scaling before KNN, KNN in Sklearn, Cross Validation, Finding Optimal K, Implement KNN, Curse of Dimensionality, Handling Categorical Data, Pros & Cons of KNN.
Support Vector Machine:
Intuition behind SVM, SVM Cost Function, Decision Boundary & the C parameter, using SVM from Sklearn, Finding Non Linear Decision Boundary, Choosing Landmark Points, Similarity Functions, How to move to new dimensions, Multi-class Classification, Using Sklearn SVM on Iris, Choosing Parameters using Grid Search, Using Support Vectors to Regression.

Text Books

1. Ethem Alpaydın, Introduction to Machine Learning, PHI, Third Edition, ISBN No. 978-81-203-5078-6
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Mcgraw-Hill, ISBN No. 0- 07-115467-1
3. Tom Mitchell, Machine Learning, Mcgraw-Hill, First Edition, ISBN No. 0-07-115467-1.
4. Giuseppe Bonaccorso, "Machine Learning Algorithms", Packt Publishing Limited, ISBN10: 1785889621, ISBN-13: 978-1785889622

Reference Books

1. R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification, 2/e, Wiley, 2001
2. Shai shalev-Shwartz and Shai Ben-David, Understanding Machine Learning (From Theory to Algorithms), Cambridge University Press, First Edition, ISBN No. 978-1-107-51282-5.
3. A. Rostamizadeh, A. Talwalkar, M. Mohri, Foundations of Machine Learning, MIT Press.
4. A. Webb, Statistical Pattern Recognition, 3/e, Wiley, 2011.
5. https://python-course.eu/machine-learning/

Semester –V

Economics and Management

BTAIHM503A	Economics and Management	HSSMEC4	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will learn to manage Economical things.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Study of Market Equilibrium
CO2	Understand Relevant Information and Decision Making
CO3	Aware Financial Statements
CO4	Study of Depreciation Accounting
CO5	Understand Product Development

Course Contents:

Unit No 1: Introduction: [7 Hours]

Market Equilibrium: Demand and Supply, Elasticity of Demand Forecasting, Production, Exercises on Economics, Cost-Volume-Profit Relationships, Cost Management Systems and Activity Costing System.

Unit No 2: Relevant Information and Decision Making [8 Hours]

Cost Allocation, Exercises on Economics, Double-Entry Bookkeeping, Job Casting, Process Costing, The Master Budget, Flexible Budgets and Variance Analysis.

Unit No 3: Financial Statements [7 Hours]

Analysis of Financial Statements, Time Value of Money, Comparison of Alternatives.

Unit No 4: Depreciation Accounting [7 Hours]

Evolution of Management Thoughts, Functions of Management Directing.

Unit No 5: Product Development [7 Hours]

Forecasting Revisited, Capacity Planning, Product / Services Strategies and Plant Layout, Production Planning and Control.

Text Books

1. R. Paneerselvam, Engineering Economics, PHI publication.

Reference Books

1. Robbins S.P. and Decenzo David A., Fundamentals of Management: Essential Concepts and Applications, Pearson Education.
2. L. M. Prasad, Principles and Practices of Management.

3. K. K. Dewett & M. H. Navalur, Modern Economic Theory, S. Chand Publications.

Semester –V

Business Communication

BTAIHM503B	Business Communication	HSSMEC4	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will learn business Communication

Course Outcomes:

On completion of the course, students will be able to:

CO1	Study of business
CO2	Understand Intercultural Communication
CO3	Aware Barriers to Communication
CO4	Study of Interpersonal Communication
CO5	Understand Negotiation and Conflict Management

Course Contents:

Unit No 1: Introduction: [7 Hours]

Introduction, Definitions & Concepts, Communicative Competence.

Unit No 2: Intercultural Communication [8 Hours]

Intercultural Communication, Nonverbal Communication, Thought and Speech, Translation as ProblematicDiscourse.

Unit No 3: Barriers to Communication [7 Hours]

Barriers to Communication, Listening, Communication Rules, Communication Style.

Unit No 4: Interpersonal Communication [7 Hours]

Interpersonal Communication, Relational Communication, Organizational Communication. Collaboration,Communication in Groups and Teams, Persuasive Communication.

Unit No 5: Negotiation and Conflict Management [7 Hours]

Negotiation and Conflict Management, Leadership, Written Communication in International Business, Role of Technology in international Business Communication, Moving to Another Culture, Crisis Communication,Ethics in Business Communication.

Text Books

1. Mary Ellen Guffey, Essentials of Business Communication, Sixth Edition, South-Western College Publishing.

Reference Books

1. Bovee, Courtland, John Thill & Mukesh Chaturvedi, Business Communication Today: Dorling kindersley, Delhi.

2. Kaul, Asha, Business Communication, Prentice-Hall of India, Delhi.

3. Monippally, Matthukutty M. Business Communication Strategies. Tata McGraw-Hill Publishing Company Ltd., New Delhi.

4. Sharma, Sangeeta and Binod Mishra, Communication Skills for Engineers and Scientists, PHI Learning Pvt.

Ltd., New Delhi.

Semester –V

Knowledge reasoning and AI ethics

BTAIHM503C	**Knowledge reasoning and AI ethics**	**HSSMC4**	**3L- 0T - 0P**	**3 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. To provide a strong foundation of fundamental basics of knowledge reasoning & AI Ethics
2. Demonstrate awareness and fundamental understanding of knowledge reasoning
3. To impart knowledge about AI ethics.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Apply the knowledge and reasoning based concepts
CO2	Specify and identify the logical agents.
CO3	Apply Probabilistic Reasoning & Uncertainty along with rules.
CO4	Understand the human psychology and social ethics to use AI
CO5	Apply concepts of virtualization and various cloud services to design, develop and deploying cloud applications.

Unit 1: Knowledge & Reasoning **[7 Hours]**

Knowledge representation issues, Representation & mapping, Approaches to knowledge representation, semantic nets- frames and inheritance, Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic

Unit 2: Logical Agents **[7 Hours]**

Using predicate logic: Representing simple fact in logic, Representing instant & ISA relationship, Computable functions & predicates, Resolution, Natural deduction. Representing knowledge using rules: Procedural versus declarative knowledge, Logic programming, forward versus backward reasoning, Matching, Control knowledge.

First-order logic: Representation Revisited Syntax and Semantics of First-Order Logic, Knowledge Engineering in First-Order Logic Inference in first-order logic, propositional vs. first-order inference, unification & lifts forward chaining, Backward chaining, Resolution

Unit 3: Probabilistic Reasoning & Uncertainty [7 Hours]

Quantifying Uncertainty, Acting under Uncertainty, Basic Probability Notation, Inference Using Full Joint Distributions, Independence, Bayes' Rule, and Its Use, The Wumpus World Revisited, Probabilistic Reasoning, Representing Knowledge in an Uncertain Domain, The Semantics of Bayesian Networks, Efficient Representation of Conditional Distributions Exact Inference in Bayesian Networks, Approximate Inference in Bayesian Networks, Relational and First-Order Probability Models, and Other Approaches to Uncertain Reasoning.

Unit 4: Introduction to AI Ethics [7 Hours]

Artificial intelligence, ways of implementing AI, Advantages and disadvantages of AI, Definition of morality and ethics, Descriptive Ethics, Normative Ethics, Meta-ethics, Applied Ethics, Impact on society, Impact on human psychology, Impact on the legal system, impact on Environment and planet, impact on trust (privacy issues), challenges of AI and data governance, Ethical implications and responsibilities.

Unit 5: Ethical initiatives in the field of artificial intelligence [7 Hours]

International ethical initiatives, Autonomous systems, Ethical harms, Machine Ethics, Artificial moral agents Singularity, AI standard and regulation, IEEE 'human standards' with implications for AI, Ethics in military use of AI: use of weapons, regulations governing an AWS, Ethical Arguments for and Against AI for Military Purposes.

Text / Reference Book:

1. Knowledge Representation and Reasoning, by Hector Levesque and Ronald J. Brachman
2. Foundations of Knowledge Representation and Reasoning by Gerhard Lakemeyer, Bernhard Nebel
3. AI Ethics by Mark Coeckelbergh
4. An Introduction to Ethics in Robotics and AI by Christoph Bartneck, Christoph Lütge, Alan Wagner, Sean Welsh

Semester –V

Advanced Database Systems

BTAIPE504A	Advanced Database Systems	PEC2	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Nil.

Course Objectives:

Upon completion of this course, the student should be able to study database management systems.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Summarize the basic concept of Data base System.
CO2	Understand relational database models.
CO3	Demonstrate working of advanced SQL.
CO4	Understand data warehousing and mining concepts.
CO5	Understand the advanced transaction processing.

Course Contents:

Unit 1: Introduction to Database System and E-R Models **[8 Hours]**

Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture Data modeling using the Entity Relationship Model: ER model concepts, notation for ER diagram, Constraints, keys, E-R Diagrams, Mapping Cardinality, Concepts of Super Key, candidate key, primary key, weak entity sets, Codd‘s rules, Extended ER model, Generalization, Aggregation, , Reduction of an ER diagrams to tables.

Unit 2: Relational Data Model, Relational Algebra and SQL **[7 hours]**

Structure of Relational Databases, Database Schema, Keys Relational algebra: Fundamental Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations. SQL: Overview of SQL, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operators, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database Intermediate SQL: Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schema, Authorization.

Unit 3: Advanced SQL, Relational Database Design and Data Normalization **[7 hours]**

Advanced SQL: Assessing SQL from Programming Language, JDBC, ODBC, Embedded SQL, Functions and Procedures, Triggers, Normalization: Features of good relational designs, Functional dependencies, Normal forms, First, Second, Third normal forms, BCNF, Functional Dependency Theory, Multivalued Dependencies, Fourth Normal Form, Database Design Process.

Unit 4: Data Warehousing, Data Mining, and Information Retrieval [7 hours]

Database-System Architectures: Centralized and Client –Server Architectures, Parallel Systems, Distributed Systems. Data warehousing: Decision-Support Systems, Data Warehousing, Data Mining, Classification and Clustering, Association Rules, Other Forms of Data Mining and information retrieval.

Unit 5: Advanced Transaction Processing and Concurrency Control [7 hours]

Transaction Model Concepts, A Simple Transaction Model, Serializability Concurrency Control Techniques: Lock based Protocols, Deadlock handling, Multiple Granularity, Time stamp-Based Protocols.

Note: Hands-on practice should cover under Tutorial slots.Text Books

1. Henry Korth, Abraham Silberschatz & S. Sudarshan, Database System Concepts, McGraw- Hill Publication, 6th Edition, 2011.

Reference Books

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management S ystems, McGraw- HillPublication, 3rd Edition, 2003.
2. Joel Murach, Murach's Oracle SQL and PL/SQL for Developers, Mike Murach & Associates, 2nd Edition, 2014.
3. Wiederhold, Database Design, McGraw-Hill Publication, 2nd Edition, 1983.
4. Navathe, Fundamentals of Database System, Addison-Wesley Publication, 6th Edition, 2012.
5. Mark L. Gillenson, Fundamentals of Database Management System, Wiley Publication, 2ndEdition, 2011.
6. Serge Abiteboul, Richard Hull, Victor Vianu, ―Foundations of Databases‖, Reprint by Addison-Wesley.
7. Jiawei Han, Micheline Kamber, and Jian Pei, ― Data Mining: Concepts and techniques by Morgan Kaufmann Publishers (an imprint of Elsevier)

Semester –V

Soft Computing

BTAIPE504B	Soft Computing	PEC2	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Basic Knowledge of Data Structures, Python.

Course Objectives:

Upon completion of this course, the student should be able to:

1. Differentiate between soft computing and hard computing.
2. Understand Neural Networks, its architecture, functions and various algorithms involved.
3. Understand Fuzzy Logic and Genetic algorithms.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Summarize the basic concept of soft computing and Neural network.
CO2	Choose appropriate activation and loss functions for neural network.
CO3	Demonstrate working of Feedforward and Backpropagation learning propagation.
CO4	Implement simple neural network in python.
CO5	Understand the need of fuzzy logic and genetic algorithm.

Course Contents:

Unit 1: Introduction of soft computing and Artificial Neural Networks [7 Hours]

soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing, Introduction to Neural Network, Biological Neural Network, Introduction to neuron, A simple neural network model,, training/Learning procedure of neural network, anatomy of neural network: neurons, layers, weights, bias, threshold, learning constants, learning rate, loss function, optimizer, dot product computation , McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm

Unit 2: Activation Functions, Loss Functions and optimizers [7 hours]

Need of activation Functions, Linear and non-linear activation function: Linear, RELU, sigmoid, tanh, softmax etc. Loss functions: squared error, Binary cross entropy, categorical/multiclass cross entropy. Optimizers: Derivatives, Gradient decent, stochastic gradient descent, Mini batch gradient descent.

Unit 3: Feedforward and Backpropagation learning [7 hours]

Learning propagation: forward propagation and backword propagation, Multilayer Perceptron's (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feedforward Neural Networks: Feedforward Neural Networks, Backpropagation

Unit 4: Introduction to Artificial Neural Networks with python [7 hours]

Introduction to pytorch, tensorflow and keras. Data representation for Artificial neural network: scalars, vectors, matrices, high dimensional arrays (tensors), preparing the dataset, building simple neural network, feeding data to neural network, training neural network validating network, using trained network to generate prediction on new data, working example of feedforward and backpropagation neural network, Parameters and Hyper Parameters, overfitting and underfitting, dealing with overfitting in neural networks.

Unit 5: Introduction to Fuzzy logic and Genetic Algorithms [8 hours]

Fuzzy Logic: Classical sets, Fuzzy sets, fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inferences, fuzzification and Defuzzification, fuzzy controllers, Applications.

Genetic Algorithms: basic concepts, working principle, Applications of GA.

Note: Hands-on practice of Soft Computing Algorithms should cover under Tutorialslots.

Text Books

2. Michael Nielsen, Neural Networks and Deep Learning, 2016
3. S. N. Sivanandam & S. N. Deepa, "Principles of Soft Computing", Wiley Publications.
4. B. Yegnanarayana, "Artificial Neural Networks", PHI Publications.
5. Deep Learning, An MIT Press book, Ian Goodfellow and Yoshua Bengio and Aaron Courville http://www.deeplearningbook.org.

Reference Books

1. Francois Challot, "Deep Learning with Python",second edition.
2. B. Satish Kumar, "Neural Networks - A Classroom Approach", McGrawHill Publication

S. Rajasekaran, VijaylakshmiPai, "Neural Networks, Fuzzy Logic and Genetic algorithmsSynthesis and Applications", PHI Publications.

Semester –V

Sensors and Robotics Technology

BTAIPE504C	**Sensors and Robotics Technology**	**PEC2**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Digital Electronics, Microcontrollers, Microprocessors, Computer Algorithms.

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Concepts of measurement technology.
2. Various sensors used in measuring various physical parameters.
3. Fundamentals of signal conditioning, data acquisition and communication systems used in Robotics system development
4. Mathematics manipulations of spatial coordinate representation and transformation. Able to solve basic robot forward and inverse kinematic problems
5. Design essentials of robots and End Effectors

Course Outcomes:

On completion of the course, students will be able to:

CO1	**Classify** various robot essential transducers and **explain** their working principles with examples.
CO2	**Predict** the expected performance of various sensors
CO3	**Familiar** with the history, concept development and key components of robotics technologies.
CO4	**Implement** basic mathematics manipulations of spatial coordinate representation and transformation.
CO5	**Calculate** Gripping Force required for object manipulation by various robotic end effectors

Course Contents:

Unit No 1: Measurement and Sensors: [8 Hours]

Basics of Measurement, Classification of errors, Error analysis, Static and dynamic characteristics of transducers, Performance measures of sensors, Classification of sensors Sensor calibration techniques

Temperature: RTD, Thermocouple, Thermistor, Infrared, and LM35.

Humidity Sensors: Capacitive, Resistive, Thermal conductivity, and DHT11 Sensors.

Proximity sensors: Inductive, Capacitive, Magnetic, and optical proximity sensors.

Force and Pressure Sensors: Strain Gauge, Piezoelectric

Motion: Rotary and Linear motions, Gyroscope, Accelerometer, Magnetometer, MEMS

Chemical and Bio Sensors: Gas sensors, Nano Sensors

Vision Sensing: Digital Camera

Unit No 2: Data Acquisition and Actuators [7 Hours]

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

Introduction to Actuators , Classification, **Linear Actuators:** Electrical- Relays, Pneumatic/ Hydraulic- Single and Double Acting Cylinders, **Rotary Actuators:** Electrical- AC and DC Motors, Stepper Motors, Servo Motors, Pneumatic/Hydraulic Motors.

Pneumatic/Hydraulic Control Valves: 3/2 Valves, 5/3 Valves etc.

Unit No 3: Introduction to Robotic [7 Hours]

Definition; History of Robotics, Laws of Robotics, anatomy of robot: Motion subsystem, Recognition subsystem, and Control subsystem. Robot Specifications: Number of Axes, Load Carrying Capacity, Reach, Stroke, Repeatability, Precision, Accuracy, etc. . Classification of robot based on Drive Technologies, Work Envelop Geometry and Motion Control Methods. Safety Measures in robotics. Block Diagram representation of various Industrial Applications of Robots viz. Medical, Mining, Space, Underwater, Defense, Security

Domestic, Entertainment.

Unit No 4: Robot Kinematics and Dynamics [7 Hours]

A brief overview of Robot Kinematics and Dynamics. Kinematics- coordinate transformations, DH parameters, Forward kinematics, Inverse Kinematics, Jacobians, Statics, Trajectory Planning. Robot Control – PWM, joint motion control, feedback control, Computed torque control.

Unit No 5: Robot End-Effectors and Robot Programming [7 Hours]

Different types of grippers- Mechanical, Magnetics, vacuum, Adhesive, Gripper force Analysis & Gripper Design, Perception, Localization and mapping, Probabilistic robotics, Path planning, BFS; DFS; Dijkstra; A-star; D-star; Voronoi; Potential Field; Hybrid approaches, Simultaneous Localization and Mapping, Introduction to Reinforcement Learning.

Note: Practical should cover under Tutorial slots.Text

Books

1. Sawney A K and Puneet Sawney, ―A Course in Mechanical Measurements and Instrumentation and Control‖, 12th edition, Dhanpat Rai & Co
2. Introduction to Robotics By S.K.Saha , Tata McGraw Hill
3. KS Fu, RC Gonzalez, CSG Lee , Robotics Control ,Sensing ,Vision and Intelligence, Tata McGraw Hill

Reference Books

1. Richard Zurawski, ―Industrial Communication Technology Handbook‖ 2nd edition, CRC Press, 2015
2. Robert J. Schilling , Fundamentals of Robotics- Analysis and Control, Prentics Hall india
3. J Hirchhorn, Kinematics and Dynamics of Machinery, McGraw Hill book co.

Semester –V

Advanced JAVA

BTAIPE504D	Advanced JAVA	PEC2	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Core Java Programming

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Development of GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.
2. Creating develop Web applications
3. Getting acquainted with enterprise based applications by encapsulating an application's business logic.
4. Designing applications using pre-built frameworks.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Design and develop GUI applications using Applets
CO2	Apply relevant AWT/ swing components to handle the given event.
CO3	Learn to access database through Java programs, using Java Database Connectivity (JDBC)
CO4	Invoke the remote methods in an application using Remote Method Invocation (RMI)
CO5	Develop program for client /server communication using Java Networking classes.

Course Contents:

Unit No 1: Applets and Event Handling [8 Hours]

Applet Basics Introduction, limitations of AWT, Applet architecture HTML APPLET tag Passing parameter to Appletget, DocumentBase() and getCodeBase() , Japplet: Icons and Labels Text Fields Buttons, Combo Boxes , Checkboxes, Tabbed Panes, Scroll Panes, Trees: Tables Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes. The AWT class hierarchy, user interface components- labels, button, canvas, scrollbars, text components, checkbox, checkbox groups, choices, lists panels scroll pane, dialogs, menu bar, graphics, layout manager layout manager types boarder, grid, flow, card and grib bag.

Unit No 2: Advanced GUI Programming [7 Hours]

Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework: Collections of Objects, Collection Types, Sets, Sequence, Map, Understanding Hashing, and Use of Array List & Vector.

Unit No 3: Conventional Non-Conventional Database Programming using JDBC[7 Hours]

The Concept of JDBC, JDBC Driver Types & Architecture, JDBC Packages, A Brief Overview of the JDBC process, Database Connection, Connecting to non-conventional Databases. Java Data Based Client/server, Basic JDBC program Concept, Statement, Result Set, Prepared Statement, Callable Statement, Executing SQL commands, Executing queries.

Unit No 4: Remote Method Invocation (RMI) [7 Hours]

Remote Method Invocation: Architecture, RMI registry, the RMI Programming Model; Interfaces and Implementations; Writing distributed application with RMI, Naming services, Naming and Directory Services, Setting up Remote Method Invocation RMI with Applets, Remote Object Activation; The Roles of Client and Server, Simple Client/Server Application using RMI.

Unit No 5: Networking and Servlet [7 Hours]

The java.net package, Connection oriented transmission Stream Socket Class, creating a Socket to a remote host on a port (creating TCP client and server), Simple Socket Program Example. InetAddress, Factory Methods, Instance Methods, Inet4Address and Inet6Address, TCP/IP Client Sockets. URL, URLConnection, HttpURLConnection, The URI Class, Cookies, TCP/IP Server Sockets, Datagrams, DatagramSocket, DatagramPacket, A Datagram Example. Connecting to a Server, Implementing Servers, Sending EMail, Servlet overview the Java web server The Life Cycle of a Servlet, your first servlet.

Note: Hands-on practice of Advanced Java should cover under Tutorial slots.Text Books

1. E Balagurusamy, Programming with Java, Tata Mc Graw Hill.
2. Herbert Schildt, The Complete Reference- Java2, (Seventh Edition), Tata Mc Graw Hill.
3. Steven Holzner, Java 2 Black Book, Dream Tech Press.

Reference Books

1. Java 6 Programming, Black Book, Dreamtech
2. Java Server Programming, Java EE6 (J2EE 1.6), Black Book, Dreamtech
3. M.T. Savaliya Advanced Java Technology, Dreamtech

Semester –V

Data Mining and Warehousing

BTAIOE505A	Data Mining and Warehousing	OEC1	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: Database Management Systems

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. To understand the fundamentals of Data Mining
2. To identify the appropriateness and need of mining the data
3. To learn the preprocessing, mining and post processing of the data
4. To understand various methods, techniques and algorithms in data mining

Course Outcomes:

On completion of the course, students will be able to:

CO1	Apply basic, intermediate and advanced techniques to mine the data.
CO2	Analyze the output generated by the process of data mining.
CO3	Explore the hidden patterns in the data.
CO4	Adapt to new data mining tools.
CO5	Optimize the mining process by choosing best data mining technique.

Course Contents:

Unit No 1: Introduction [8 Hours]

Data Mining, Data Mining Task Primitives, Data: Data, Information and Knowledge; Attribute Types: Nominal, Binary, Ordinal and Numeric attributes, Discrete versus Continuous Attributes; Introduction to Data Preprocessing, Data Cleaning: Missing values, Noisy data; Data integration: Correlation analysis; transformation: Min-max normalization, z-score normalization and decimal scaling; data reduction: Data Cube Aggregation, Attribute Subset Selection, sampling; and Data Discretization: Binning, Histogram Analysis.

Unit No 2: Data Warehouse *[7 Hours]*

Data Warehouse, Operational Database Systems and Data Warehouses(OLTP Vs OLAP), A Multidimensional Data Model: Data Cubes, Stars, Snowflakes, and Fact Constellations Schemas; OLAP Operations in the Multidimensional Data Model, Concept Hierarchies, Data Warehouse Architecture, The Process of Data Warehouse Design, A three-tier data warehousing architecture, Types of OLAP Servers: ROLAP versus MOLAP versus HOLAP.

Unit No 3: Measuring Data Similarity and Dissimilarity [7 Hours]

Measuring Data Similarity and Dissimilarity, Proximity Measures for Nominal Attributes and Binary Attributes, interval scaled; Dissimilarity of Numeric Data: Minskowski Distance, Euclidean distance and Manhattan distance; Proximity Measures for Categorical, Ordinal Attributes, Ratio scaled variables; Dissimilarity for Attributes of Mixed Types, Cosine Similarity.

Unit No 4: Association Rules Mining [7 Hours]

Market basket Analysis, Frequent item set, Closed item set, Association Rules, a-priori Algorithm, Generating Association Rules from Frequent Item sets, Improving the Efficiency of a-priori, Mining Frequent Item sets without Candidate Generation: FP Growth Algorithm; Mining Various Kinds of Association Rules: Mining multilevel association rules, constraint based association rule mining, Meta rule-Guided Mining of Association Rules.

Unit No 5: Classification [7 Hours]

Classification and Regression for Predictive Analysis, Decision Tree Induction, Rule-Based Classification: using IF-THEN Rules for Classification, Rule Induction Using a Sequential Covering Algorithm. Bayesian Belief Networks, Classification Using Frequent Patterns, Associative Classification, Lazy Learners-k-Nearest-Neighbor Classifiers, Case-Based Reasoning, Multiclass Classification, Semi-Supervised Classification, Reinforcement learning, Systematic Learning, Wholistic learning and multi-perspective learning.

Note: Hands-on practice should cover under Tutorial slots.Text Books

1. Han, Jiawei Kamber, Micheline Pei and Jian, “Data Mining: Concepts and Techniques”, Elsevier Publishers, ISBN:9780123814791, 9780123814807.

2. Parag Kulkarni, “Reinforcement and Systemic Machine Learning for Decision Making” by Wiley-IEEE Press, ISBN: 978-0-470-91999-6

Reference Books

1. Matthew A. Russell, "Mining the Social Web: Data Mining Facebook, Twitter, LinkedIn, Google+, GitHub, and More" , Shroff Publishers, 2nd Edition, ISBN: 9780596006068

2. Maksim Tsvetovat, Alexander Kouznetsov, "Social Network Analysis for Startups:Finding connections on the social web", Shroff Publishers , ISBN: 10: 1449306462

Semester –V

Digital Communication & Information Theory

BTAIOE505B	Digital Communication & Information Theory	OEC1	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will have an adequate background, conceptual clarity, and knowledge of appropriate solution techniques related to:

1. To provide a strong foundation of fundamental basics of Digital communication & information theory.
2. Demonstrate awareness and fundamental understanding of various pulse modulation and digital modulation techniques.
3. To impart knowledge about information and entropy.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Study basic digital modulation techniques.
CO2	Analyze the carrier modulation techniques.
CO3	Explore the the noise signals in digital communication.
CO4	Adapt to information theory.
CO5	Optimize the coding algorithms.

Unit 1: Digital Baseband Modulation Techniques and Waveform Coding Techniques

[7 Hours]

Base Band System, Formatting Textual Data, Messages, Characters & Symbols, Formatting Analog Information, PCM, Bandwidth, SNR of PCM, DPCM, DM, ADM**.**

Unit 2: Carrier Modulation Techniques [7 Hours]

Introduction to Carrier Modulation, FSK, PSK, BPSK, DPSK, QPSK, Coherent Detection and Non-Coherent Detection, Error Performance for Binary Systems, Matched filter, SNR derivation

Unit 3: Noise in digital communication [7 Hours]

Matched filter, SNR derivation, impulse response, the output of the matched filter, BER, Generalized expression of BER, BER with matched filter, BER passband, BER baseband, Probability of error examples.

Unit 4: Information Theory *[7 Hours]*

The measure of information, Joint entropy and conditional entropy, Relative entropy and mutual information, Markov sources, Source encoding, Shannon-Fano coding, and Huffman coding, Shannon's first and second fundamental theorems, Channel capacity theorem.

Unit 5: Codes **[7 Hours]**

Linear Block Coding/Decoding, Matrix description of Linear block codes, Hamming codes, optimal linear codes, Maximum Distance Separable Cyclic Codes, Polynomials, Generation of Cyclic codes, matrix description of cyclic codes

Note: Hands-on practice should cover under Tutorial slots. Text

Books:

1. Ranjan Bose, "Information Theory coding and Cryptography", McGraw-Hill Publication,
2. R. Avudaiammal, Information Coding Techniques" Second Edition. Tata McGraw-Hill 14
3. J C Moreira, P G Farrell, "Essentials of Error-Control Coding", Wiley Student Edition.
4. Simon Haykin, "Communication Systems", John Wiley & Sons, Fourth Edition
5. Amitabha Bhattacharya, "Digital Communication", TMH 2006

Reference Books:

1. Bernard Sklar, "Digital Communications fundamentals and Applications" Pearson Education, Second Edition.
2. K Sayood, "Introduction to Data Compression" 3/e, Elsevier 2006
3. Simon Haykin "Communication Systems", John Wiley& Sons, Fourth Edition.
4. A.B Carlson, "Principles of communication systems", TMH, Third Edition.
5. Taub Schilling, "Principles of Communication system", TMH, Fourth Edition.

Semester –V

Software Engineering and Testing

BTAIOE505C	Software Engineering and Testing	OEC1	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

After completion of the course, students will learn:-

1. To understand software lifecycle development models.
2. To apply software requirements engineering techniques, software design principles, modelling and software testing techniques.
3. To study fundamental concepts in software testing, including software testing objectives, processes, criteria, strategies, and methods.
4. To learn planning of a test project, designing test cases and test data, conducting test operations, managing software problems and defects, and generating a test report.
5. To develop an understanding of the meaning and importance of quality in relation to software systems and the software development process.

Course Outcomes:

On completion of the course, students will be able to:

CO1	To use the techniques, skills, and modern engineering tools necessary for engineering practice.
CO2	To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
CO3	To apply software testing knowledge and its processes to software applications.
CO4	To identify various software testing problems and solving software testing problems by designing and selecting software test models, criteria, strategies and methods.
CO5	To apply the techniques learned to improve the quality of software development.

Course Contents:

Unit No 1: **[7 Hours]**

Software crisis and myths, Software process and development: Generic view of process, Software life cycle and models, Analysis and comparison of varies models, an agile view of process. Requirements engineering tasks, Initiating requirement engineering process, Eliciting requirement, developing use-cases, Building the analysis model, Negotiating and validating requirement, Building the analysis model.

Unit No 2: *[7 Hours]*

Design process and design quality, Design concepts, Design model, Pattern based software design, Architectural design, User interface design. UML: Different methods: Rambaugh / Booch / Jakobsons, Need for standardization. Developing diagrams in UML (Use CASE, Class, Interaction, State diagrams) CASE TOOLS.

Unit No 3: *[8 Hours]*

Principles of Testing Software development life cycle model: Phases of software project, Quality, Quality assurance and quality control, Testing, Verification and validation, Process models to represent various phases, Life cycle models, Software testing life cycle.

White Box Testing (WBT) and Black Box Testing: Static testing, Structural testing, Challenges in WBT. Black box testing: Black box testing process

Unit No 4: *[7 Hours]*

Integration Testing: Definition, As a type of testing: Top-down integration, Bottom-up integration, Bidirectional integration, System integration, Choosing integration method, As a phase of testing, Scenario testing: System scenarios, Use case scenarios, Defect bash.

System and Acceptance Testing, Functional Vs non Functional, Functional system testing, Non- functional system testing, Acceptance testing.

Unit No 5: *[7 Hours]*

Performance testing, Regression testing, Internationalization testing, Adhoc testing. Factors governing performance of testing, Methodology, tools and process for performance testing. Regression Testing: Introduction, Types of Regression testing, Regression testing process. Adhoc testing: Introduction, Buddy testing, Pair testing, exploratory testing, Iterative testing, Agile and extreme testing, XP work flow, Defect seeding.

Testing Object Oriented Software: Introduction, Comparison of object oriented and procedural software, System testing example, Unit testing of classes, Tools for testing object oriented software, Testing web applications.

Note: Hands-on practice should cover under Tutorial slots.Text Books

1. Roger S. Pressman, "Software Engineering", Tata McGraw-Hill, 6th Edition, 2006.
2. G. Booch, J. Rambaugh, and I. Jacobson, "The Unified Modeling Language User Guide", Addison Wesley, 2nd Edition, 2005.
3.Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing: Principles and Practices", Pearson publication, 2nd Edition, 2006.

Reference Books

1. Shari Pfleeger, "Software Engineering", Pearson Education, 3rd Edition, 2008.
2. Ian Sommerville, "Software Engineering", Pearson Higher Education, 10th Edition, 2016.
3. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer New York, 2nd Edition, 2013.
4. Loise Tamres, "Introducing Software Testing", Pearson publication, 2002.
5. Boris Beizer, "Software Testing Techniques", Dreamtech press, 2nd Edition, 2014

Semester –V
Virtual Reality

BTAIOE505D	**Virtual Reality**	**PEC2**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial : 1 hr./week	Continuous Assessment : 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Objectives:

This course is designed to give historical and modern overviews and perspectives on virtual reality. It describes the fundamentals of sensation, perception, technical and engineering aspects of virtual reality systems.

Course Outcomes:

On completion of the course, students will be able to:

CO1	Describe how VR systems work and list the applications of VR.
CO2	Understand the design and implementation of the hardware that enables VR systems tobe built.
CO3	Understand the system of human vision and its implication on perception and rendering.
CO4	Explain the concepts of motion and tracking in VR systems.
CO5	Describe the importance of interaction and audio in VR systems.

Course Contents:

Unit No 1: Introduction to Virtual Reality: [7 Hours]

Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality.

Unit No 2: Representing the Virtual World: [7 Hours]

Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR

Unit No 3: The Geometry of Virtual Worlds & The Physiology of Human Vision: [7 Hours]

Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.

Unit No 4: Visual Perception & Rendering: **[8 Hours]**

Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information

Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates.

Unit No 5: Motion & Tracking: *[7 Hours]*

Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection

Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies.

Note: Hands-on practice of Virtual Reality should cover under Tutorial slots.Text Books

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016 2.
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.

Reference Books

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
4. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.
5. **http://lavalle.pl/vr/book.html**

Semester –V

Machine Learning Lab and Competitive Programming Lab

BTAIL506	**Machine Learning Lab and Competitive Programming Lab**	**LC3**	**0L-0T-4P**	**2 Credits**

Teaching Scheme	**Examination Scheme**
Practical: 04 hrs./week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks End Semester Examination: 40 Marks

Machine Learning Lab

List of practicals:

1. Python Libraries for Data Science-
    a. Pandas Library
    b. Numpy Library
    c. Scikit Learn Library
    d. Matplotlib
2. Evaluation Metrics-
    a. Accuracy
    b. Precision
    c. Recall
    d. F1-Score
3. Train and Test Sets by Splitting Learn and Test Data.
4. Linear Regression
5. Multivariable Regression
6. Decision Tree Algorithm implementation.
7. Random Forest Algorithm implementation.
8. Naive Bayes Classification Algorithm implementation.
9. K-Nearest Neighbor Algorithm implementation.
10. SVM Algorithm implementation.

Competitive Programming Lab

1. Problems on array
2. Problems on matrix
3. Problems on string
4. Problems on Searching & Sorting
5. Problems on LinkedList
6. Problems on Binary Trees
7. Problems on Binary Search Trees
8. Problems on Greedy
9. Problems on BackTracking
10. Problems on Stacks & Queues
11. Problems on Heap
12. Problems on Graph
13. Problems on Trie
14. Problems on Dynamic Programming
15. Problems on Bit Manipulation

Note:
At least twenty five problems solving on competitive programming platforms such as https://uva.onlinejudge.org, http://hackerrank.com/, http://codechef.com/ etc.

OR
Competitive Programming Lab

1. Defining schema for applications.
2. Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), Data insertion into a table.
3. Grouping data, aggregate functions, Oracle functions (mathematical, character functions).
4. Sub-queries, Set operations, Joins.
5. Applying Data Normalization, Procedures, Triggers and Cursors on databases.
6. Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management.
7. Deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project.
8. Studying Large objects – CLOB, NCLOB, BLOB and BFILE.
9. Data warehousing and Association rule mining.
10. Distributed data base Management, creating web-page interfaces for database applications using servlet.

Semester –V

Mini Project -I

BTAIM507	**MINI PROJECT-I**	**Project**	**0L-0T-4P**	**2 Credits**

Guidelines for Mini Project

The students shall study in group of two members (or individual) on some special topic beyond the scope of the syllabus under the subjects of Artificial Intelligence, Data Science, Electronics Engineering and Computer Science Engineering or inter discipline branch from current literature, by referring the current technical journal or reference books, under the guidance of the teacher.

In this subject head, it is expected that the student should complete the following tasks.

1. Identify problem statement / idea which is solving one problem preferably local problem may bein their University / College / near by vicinity.
2. Do the literature survey,
3. Design the solutions
4. Implement solution using latest technology
5. Write 20-25 pages report (use of latex is more suitable).
6. Present / demonstrate the solution in front of faculty member

The students shall prepare his report and execution of project for other students of his class in the presence of his guide and examiner. The student is permitted to use audio-visual aids or any other such teaching aids.

Continues Assessment:

The Continues Assessment for this head will consists of the report written in a technical reporting manner and execution of project will be assessed by the internal examiner appointed by the HOD of concern department of the institution.

Semester –V

Internship - II

BTAIP508	**Field Training / Internship / Industrial Training**	**Internship**	**Audit**

Guidelines for Internships

Guidelines for Field Training / Internship / Industrial Training Industrial Training:

1. To apply for a suitable Industrial Training, submit an application form to respective Organization concerned one semester before the Industrial Training Programmed commences.
2. Student can also apply through online platforms such as Internshala for industrial training.
3. Submit one copy of the offer letter for the Industrial Training to the Head of the department or Faculty coordinator (Industrial Training).
4. To complete the Industrial Training process within the specified time based on the Industrial Training Programme schedule.
5. Assessment within the Industrial Training context aims to evaluate the student's work quality and appropriateness to the field of study with reference to the learning outcomes of the Industrial Training Programme.
6. Evaluation of the students' performance should be done in the next upcoming semester.
7. Those students who fails, they can also complete online certification courses which are available at free of cost on various MOOC platforms.