

Gujarat University

School of Emerging Science and Technology

M.Sc. (Integrated) Five Years Program

Artificial Intelligence and Machine Learning

SEMESTER - 6

Sr No.	Course No.	Subject	Credit	Exam
1	(#)FC-311	Personality Development	2	Theory
2	CC-311	Operations Research	4	Theory
3	CC-312	Research Methodology	3	Theory
4	CC-313	Unsupervised Machine Learning	4	Theory
5	CC-314 & CC-315	PROJECT - I: Mini - Project	6	Submission/ Presentation/ Viva
6				
7	CC-316 (P)	R Programming - II	3	Practical
8	CC-317 (P)	Practical Based on CC-313	3	Practical
		Total	25	

(#) Marks and credits of this subject will not be considered for class or total.

FC-311 Personality Development

- Define Personality, Introvert, Extrovert & Ambivert person, Significance & Determinants of Personality Development, Perceptions, Perceptual Process, Self Esteem and Maslow, Self Esteem & Erik Erikson.
- Mind Mapping, Competency Mapping & 360 Degree Assessment
- Emotional intelligence and emotional quotient – Use and improvement
- Decision Making skills, Assertiveness Skills, Leadership & Qualities of Successful Leader, Attitude - Concept - Significance - Factors affecting attitudes
- Personal Branding; Golden rules of Personal branding

Reference Books:

1. Hurlock, E.B (2006). Personality Development, 28th Reprint. New Delhi: Tata McGraw Hill.
2. Stephen P. Robbins and Timothy A. Judge (2014), Organizational Behavior 16th Edition: Prentice Hall.
3. Andrews, Sudhir. How to Succeed at Interviews. 21st (rep.) New Delhi. Tata McGraw-Hill 1988.
4. Heller, Robert. Effective leadership. Essential Manager series. Dk Publishing, 2002
5. Hindle, Tim. Reducing Stress. Essential Manager series. Dk Publishing, 2003

CC-311 Operations Research

Unit - 1: Linear Programming Problem and its solution techniques

Introduction to LPP, Formulation techniques of LP problems, Solution techniques of LP: Graphical Method and Simplex Method

Unit - 2: Transportation Problem and Assignment Problem

Transportation Problem: Introduction, Mathematical formulation, Tabular representation, Methods for finding initial basic feasible solution: North West Corner Rule, Least Cost Method, Vogel's Approximation Method, Optimality test: MODI Method, Degeneracy in TP, Unbalanced TP

Assignment Problem: Introduction, Mathematical formulation, Method for solving AP: Hungarian Method, Unbalanced AP

Unit - 3: PERT and CPM

Definition of a project, Job and events, Construction of project network, Rules for network construction, Critical Path Method (CPM), Concepts of float, total float and free float and its interpretations, Uncertain duration, PERT

Unit - 4: Inventory Problems

Introduction, Types of inventories, Cost involved problems, Notations, EOQ model, Limitations of EOQ formula, EOQ model with finite replenishment rate, EOQ model with shortages

Reference books:

1. Nita H. Shah, Ravi M. Gor, Hardik Soni, "Operations Research", Prentice-Hall India (2007).
2. J. K. Sharma, "Operations Research".
3. A. M. Natarajan, P. Balasubramani, A. Tamilarasi, "Operations Research", Pearson Education.
4. Hiller and Liberman, "Introduction to Operations Research", 9th edition, Tata McGraw-Hill
5. Hamdy A. Taha, "Operations Research: An Introduction", 8th edition, Prentice-Hall India (2007)
6. Wayne L. Winston, "Operations Research: Applications and Algorithms", 4th edition, Thomson
7. Anderson, Sweeney, Williams, "An Introduction to Management Science: Quantitative Approaches to Decision Making", 13th edition, South-Western College Publishing

CC-312 Research Methodology

Unit - 1: Introduction to Research Methodology

Meaning of Research, Objectives of Research, Types of Research, Process of Research, Research Applications in Business Decisions, how to define Research Problem, Formulation of Research Hypotheses, Structuring of Research Proposal

Unit - 2: Research Design and Data Collection

The Nature of Research Methodology, Formulation of the Research Design, Classification of Research Designs, Necessary Conditions for making Causal Inferences, Concepts used in Experiments, Classification of Data, Research Applications of Secondary Data, Benefits and Drawbacks of Secondary Data, Evaluation and Classification of Secondary Data

Unit - 3 Measurement and Scaling

Distinguishing Qualitative from Quantitative Data Methods, Methods of Qualitative Research, Focus Group Method, Personal Interview Method, Scale Characteristics and Levels of Measurement, Primary Scales of Measurement, Single vs Multiple item Scale and Comparative vs Non-comparative Scales, Comparative Scaling Techniques, Noncomparative Scaling Techniques, graphic Rating Scale, Itemized Rating Scale, Nonitemized Rating Scale, Multi item Scale, Measurement Error

Unit - 4 Questionnaire Design

Types of questionnaires, Determining the type of questions, Criteria for question designing, Questionnaire structure, Physical characteristics of Questionnaire, Pilot testing of the Questionnaire, Administering the Questionnaire

Reference Books:

1. Research Methodology: Concepts and Cases, Deepak Chawla and Neena Sondhi, Vikas Publishing House, 2nd edition
2. Marketing Research and Applied Orientation, Naresh Malhotra, Daniel Nunan, David Briks, Pearson Education, Above 5th edition

CC-313 Unsupervised Machine Learning

Unit - 1: Introduction to Unsupervised Machine Learning

What is Unsupervised Machine Learning, why use Unsupervised Learning, Working of Unsupervised Learning, Types of Unsupervised Learning, Unsupervised Learning Algorithms, Advantages and Disadvantages of Unsupervised Learning, Application of Unsupervised Learning, Supervised vs. Unsupervised Machine Learning

Unit - 2: Unsupervised Machine Learning - Part 1

Different Distance methods, Develop various algorithms viz K-means, Fuzzy C means and Mean Shift Clustering. Pros and Cons of each algorithm, Importance of Dimensionality Reduction, PCA-Dimensionality Reduction, Singular Value Decomposition (SVD), Factor Analysis

Unit - 3: Unsupervised Machine Learning - Part 2

Implementation of Hierarchical Clustering algorithm, Density-Based Spatial Clustering (DBSCAN) and Gaussian Mixed Models (GMM). Pros and Cons of each algorithm

Unit - 4: Machine Learning in Practice

Utilization of Unsupervised Machine Learning to solve real world problems:

1. Customer segmentation
2. Market research
3. Market segmentation
4. Inventory management
5. Data preparation and visualization

Reference Books:

1. Machine Learning for Absolute Beginners: A Plain English Introduction by Oliver Theobald
2. Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas C. Müller (Author), Sarah Guido (Author)
3. Machine Learning by Tom M. Mitchell
4. Machine Learning using Python by U Dinesh Kumar and Manaranjan Pradhan

CC-314 & CC-315

PROJECT – I: Mini - Project

CC-316 (P) Programming with R-II

Unit - 1: Testing of Hypothesis

Construction of Hypothesis: Null hypothesis, Alternative hypothesis, simple and composite hypothesis

Inference about Mean for (σ -known & σ -unknown): One-Tailed test and Two-Tailed test, Type-I & Type-II Errors, Power of Test

Inference about Proportion, Inference about Two-Population (σ -known & σ -unknown): Population mean between Two Matched Sample, Population between Two Independent Sample, Comparison of Two Sample

Unit - 2: Inference about Population variance, Goodness of Fit Tests and Non-Parametric Tests

Inference about Population variance: Interval Estimation, Hypothesis Testing for Variance, Inference about Two Population Variance

Goodness of Fit Tests: Multinomial Population, Test of Independence, Distribution Fitting (Normal and Poisson Distribution)

Non-Parametric Tests: Sign Test, Wilcoxon Signed Rank Test, Mann-Whitney-Wilcoxon Test, Kruskal-Wallis Test

Unit - 3: Analysis of Variance and Simple Linear Regression Model

Analysis of Variance: Completely Randomized Design, Randomized Block Design, Factorial Design

Simple Linear Regression Model: Estimated Simple Linear Regression Equation, Coefficient of Determination, Testing for Significance, Confidence Interval, Prediction Interval, Residual Plots, Correlation

Unit - 4: Package ‘deSolve’ for differential equations

Ordinary Differential Equations (ODE): Initial Value Problems, Runge-Kutta Method, Euler Method, Model Diagnostics, Plotting

Differential Algebraic Equations (DAE): DAE solver in R, A Simple DAE (up to 3), Nonlinear Implicit ODE, Plotting

Partial Differential Equations (PDE): Methods for solving PDE, Heat Equation, Wave Equation, Laplace's Equation, Plotting

Delay Differential Equations (DeDE): DeDE solver in R, Events & Roots, Difference Equation, Plotting

Reference Books:

1. Peter Dalgaard "Statistics and computing: Introductory Statistics with R", Springer (2002)
2. Tilman M. Davies "The Book of R: A First Course in Programming and Statistics", no starch press, San Francisco (2016)
3. Karline Soetaert, Jeff Cash, Francesca Mazzia "Solving Differential Equation in R" Springer (2012)
4. Dr. Marcel Dettling "Applied Time Series Analysis" Institute for Data Analysis and Process Design, Zurich University of Applied Sciences.
5. Jonathan D. Cryer and Kung-Sik Chan "Time Series Analysis with Application in R" 2nd Edition Springer (2008)
6. Jared P. Lander, "R for Everyone", 2nd edition, Addison Wesley Data & Analytics Series (2017)
7. Maindonald J. and Braum, J., "Data Analysis and Graphics Using R: An example-based approach", 3rd edition, Cambridge Series in Statistical and Probabilistic Mathematics (2010)
8. Hey-Jahans, C., "An R Companion to Linear Statistical Models", CRC Press (2012)

CC-317 Practical Based on CC-315

Unit - 1: Introduction to Unsupervised Machine Learning

What is Unsupervised Machine Learning, why use Unsupervised Learning, Working of Unsupervised Learning, Types of Unsupervised Learning, Unsupervised Learning Algorithms, Advantages and Disadvantages of Unsupervised Learning, Application of Unsupervised Learning, Supervised vs. Unsupervised Machine Learning

Unit - 2: Unsupervised Machine Learning - Part 1

Different Distance methods, Develop various algorithms viz **K-means, Fuzzy C means** and Mean Shift Clustering. Pros and Cons of each algorithm, PCA-Dimensionality Reduction

Unit - 3: Unsupervised Machine Learning - Part 2

Implementation of Hierarchical Clustering algorithm, Density-Based Spatial Clustering (DBSCAN) and Gaussian Mixed Models (GMM). Pros and Cons of each algorithm

Unit - 4: Machine Learning in Practice

Utilization of Unsupervised Machine Learning to solve real world problems:

1. Customer segmentation
2. Market research
3. Market segmentation
4. Inventory management
5. Data preparation and visualization

Practical Manual:

1. Implementation of K-means Clustering on self-made dataset
2. Implement K-means Clustering on Iris dataset to cluster different flower species based on their features
3. Implementation of K-means Clustering using Titanic dataset
4. Implementation of Fuzzy-C means Clustering on self-made dataset
5. Implement Fuzzy-C means Clustering using Iris dataset to cluster different flower species based on their features
6. Implement Mean Shift Clustering
7. Implement Density-Based Spatial Clustering (DBSCAN)
8. Implement Gaussian Mixed Models (GMM)
9. Solving the Wholesale Customer Segmentation problem using Hierarchical Clustering

10. Find out how much a customer has spent in the mall based on Annual Income using Hierarchical Clustering
11. Find out relations between purchased product using Association Rules
12. How to use Principal Component Analysis (PCA)

Reference Books:

1. Machine Learning for Absolute Beginners: A Plain English Introduction by Oliver Theobald
2. Introduction to Machine Learning with Python: A Guide for Data Scientists by Andreas C. Müller (Author), Sarah Guido (Author)
3. Machine Learning by Tom M. Mitchell
4. Machine Learning using Python by U Dinesh Kumar and Manaranjan Pradhan