

**Haribhai V. Desai College
of Arts, Science & Commerce, Pune.
(Autonomous)**

Faculty of Science and Technology

M.Sc. (Computer Applications) Program



**Syllabus
For
S.Y M.Sc. (Computer Applications)**

**Choice Based Credit System (CBCS)
Syllabus Under National Education Policy (NEP)
with effect from Academic Year 2025-26**

Title of the Course: M.Sc. (Computer Applications)

Objectives

The objective of the Program is to produce trained software professionals with hands-on experience on state-of-the art technologies who will be able to handle challenges in IT industry. The objectives of M.Sc. (Computer Applications) program are: -

- To produce knowledgeable and skilled human resources that is employable in IT and ITES.
- To impart knowledge required for planning, designing and building Complex Application Software Systems as well as to provide support for automated systems or applications.

Preamble :-

M.Sc. (Computer Applications) Program is of Two Years duration with four semesters. It is a Full- Time post graduate Degree Program. The program is based on credit system comprising of total 88 credit points.

It is believed that the proposed syllabus as part of the credit-based system will bring a qualitative change in the way M.Sc. (Computer Applications) is taught, which will offer a more enriched learning experience. It aims to provide students with the knowledge and ability to develop creative solutions, and better understand the effects of future developments of computer applications, systems and technology on people and society. The students shall develop self and life-long learning skills.

Eligibility

- (a) Bachelor Degree in Science/Technology/Engineering OR
- (b) Bachelor of Computer Applications (B.C.A.) OR
- (c) B.Sc.(Computer Science) OR
- (d) Bachelor of Computer Science (B.C.S.) OR
- (e) B.Sc.(Information Technology) OR
- (f) B.Sc.(Data Science) OR
- (g) B.Sc.(Cyber and Digital Science) OR
- (h) B.Sc. (Cyber Security) OR
- (i) B.Sc. (Cloud Computing) OR
- (j) Bachelor of Engineering(BE/B.Tech) in Computer Engg/Computer Science & Engg./ Computer Science and Design/ Information Technology/Electronics and Telecommunication/AI and Data Science/AI and Machine Learning/ equivalent OR

- (k) B. Voc. in Software Development/ Information Technology OR
- (l) B.Sc. with Computer Science as Principal Subject OR
- (m) General B.Sc. with Computer Science as one of the subject at TYBSc level Programme

Programme Outcomes:

After successful completion of the Programme, the students shall be able to

PO 1: Demonstrate understanding of fundamental and advance concepts in emerging areas

PO 2: Design and develop innovative computer applications.

PO 3: Analyze existing research reported in the literature

PO 4: Propose alternate solutions by undertaking research work.

PO 5: Create efficient, reliable, readable and maintainable code.

PO 6: Demonstrate a deeper understanding of the chosen domain.

PO 7: Select appropriate method to solve the given problem

PO 8: Explain complex technical concepts clearly and effectively, both in written and oral forms.

PO 9: Demonstrate ability to collaborate effectively with team members, understand different perspectives, and contribute productively to become successful professional.

PO 10: Demonstrate ability to work with integrity and a sense of social responsibility.

PO 11: Demonstrate self and life-long learning skills

PO 12: Solve computational problems innovatively

PO 13: Apply knowledge gained and critical thinking to develop real-world applications.

Haribhai V. Desai College of Arts, Science and Commerce, Pune.

Structure of UG Program as per NEP-2020

Name of Program: M.Sc (Computer Applications)

SEMESTER I

Course Type	Course Code	Course Name	Teaching Scheme		Exam Scheme			Credits		
			TH	PR	CE	EE	Total	TH	PR	Total
MC	CA-501-MJ-TH	Database Systems and SQL	04	--	30	70	100	04	--	04
	CA-502-MJ-TH	Python Programming and Data Structures	04	--	30	70	100	04	--	04
	CA-503-MJ-TH	Operating Systems	02	--	15	35	50	02	--	02
	CA-504-MJ-PR	Lab course Based on CA-501-MJ-TH & CA-503-MJ-TH	--	04	15	35	50	--	02	02
	CA-505-MJ-PR	Lab course based on CA-502-MJ-TH	--	04	15	35	50	--	02	02
ME	CA-510-MJ-TH	Java Programming	02	--	15	35	50	02	--	02
	CA-511-MJ-PR	Lab Course based on CA-510-MJ-TH	--	04	15	35	50	--	02	02
	OR									
	CA-512-MJ-TH	Cloud Computing	02	--	15	35	50	02	--	02
	CA-513-MJ-PR	Lab Course based on CA-512-MJ-TH	--	04	15	35	50	--	02	02
RM	CA-531-RM-TH	Research Methodology	04	--	30	70	100	04	--	04
Total			16	12	165	385	550	16	06	22

SEMESTER II

Course Type	Course Code	Course Name	Teaching Scheme		Exam Scheme			Credits		
			TH	PR	CE	EE	Total	TH	PR	Total
MC	CA-551-MJ-TH	Web Technologies	04	--	30	70	100	04	--	04
	CA-552-MJ-TH	Introduction to Data Science	04	--	30	70	100	04	--	04
	CA-553-MJ-TH	Computer Networks	02	--	15	35	50	02	--	02
	CA-554-MJ-PR	Lab course based on CA-551-MJ-TH	--	04	15	35	50	--	02	02
	CA-555-MJ-PR	Lab course based on CA-552-MJ-TH	--	04	15	35	50	--	02	02
ME	CA-560-MJ-TH	Advance Java Programming	02	--	15	35	50	02	--	02
	CA-561-MJ-PR	Lab Course on based on CA-560-MJ-TH	--	04	15	35	50	--	02	02
	OR									
	CA-562-MJ-TH	C# .NET	02	--	15	35	50	02	--	02
	CA-563-MJ-PR	Lab Course on based on CA-562-MJ-TH	--	04	15	35	50	--	02	02
OJT/FP	CA-581-OJT/FP	Industry Internship/Field Project	--	--	30	70	100	--	04	04
Total			12	12	165	385	550	12	10	22
ATKT :- Minimum number of credits required to take admission to S.Y.M.Sc. Computer Application is 22 credits [50%] from F.Y.M.Sc. Computer Application										

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Structure of PG Program as per NEP-2020

Name of Program: M.Sc (Computer Applications)

SEMESTER III

Course Type	Course Code	Course Name	Teaching Scheme		Exam Scheme			Credits		
			TH	PR	CE	EE	Total	TH	PR	Total
MC	CA-601-MJ-TH	Artificial Intelligence	04	--	40	60	100	04	--	04
	CA-602-MJ-TH	Machine Learning	04	--	40	60	100	04	--	04
	CA-603-MJ-TH	Software Engineering	02	--	20	30	50	02	--	02
	CA-604-MJ-PR	Lab Course based on CA-601-MJ-TH	--	04	20	30	50	--	02	02
	CA-605-MJ-PR	Lab Course based on CA-602-MJ-TH	--	04	20	30	50	--	02	02
ME	CA-610-MJ-TH	Mobile Application Development	02	--	20	30	50	02	--	02
	CA-611-MJ-PR	Lab Course based on CA-610-MJ-TH	--	04	20	30	50	--	02	02
	OR									
	CA-612-MJ-TH	Software Testing	02	--	20	30	50	02	--	02
	CA-613-MJ-PR	Lab Course based on CA-612-MJ-TH	--	04	20	30	50	--	02	02
Research Project	CA-631-RP-PR	Research work - I	--	--	40	60	100	--	04	04
Total			12	12	165	385	550	12	10	22

SEMESTER IV

Course Type	Course Code	Course Name	Teaching Scheme		Exam Scheme			Credits		
			TH	PR	CE	EE	Total	TH	PR	Total
MC	CA-651-MJ-PR	Industrial Training	--	--	120	180	300	--	12	12
ME	CA-660-MJ-TH	Online / MOOC	02	--	20	30	50	02	--	02
	CA-661-MJ-TH	Online / MOOC	02	--	20	30	50	02	--	02
Research Project	CA-681-RP-PR	Research work – II	--	--	60	90	150	--	06	06
Total			12	12	165	385	550	04	18	22

SEMESTER-III

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous)
S.Y. M.Sc. (Computer Applications) - Sem-III
Course : CA-601-MJ-TH
Course Title : Artificial Intelligence

Teaching Scheme 04 Hours/Week	No. of Credits 04	Examination Scheme CIE : 40 Marks SEE : 60 Marks
Course Objectives: • <i>To learn various types of algorithms useful in Artificial Intelligence (AI).</i> • <i>To convey the ideas in AI research related to emerging technology.</i> • <i>To introduce ideas and techniques underlying the design of intelligent computer systems</i>		
Course Outcomes: <i>After successful completion of this course, learner will be able to:</i> • <i>Apply the suitable algorithms to solve AI problems</i> • <i>Identify and apply suitable representation techniques for various AI applications</i> • <i>Build smart system using different informed search / uninformed search or heuristic approaches</i> • <i>Represent complex problems with expressive language of representation</i>		
Course Contents:		
Chapter-1	Introduction to Artificial Intelligence	Hours: 12
• Introduction to Artificial Intelligence, • Foundations of Artificial Intelligence, • History of Artificial Intelligence, • State of the Art, • Intelligent Agents, Agents and Environments, • Good Behavior: Concept of Rationality, • Nature of Environments, • Structure of Agents, • Benefits and limitation of AI, Ethics in AI, AI Components, AI Architectures • Defining AI problems as a State Space Search • Problem Characteristics • Additional Problems (Water Jug, 8 puzzle)		
Chapter-2	Searching	Hours: 12
• Uninformed Search Algorithms/Blind Search Techniques - ○ Breadth-first Search, Depth-first Search • Informed (Heuristic) search Techniques: ○ Generate-and-test, ○ Simple Hill Climbing,		

○ Best First Search, ○ Constraint Satisfaction, ○ Means End Analysis, ○ A* and AO*		
Chapter-3	Gaming	Hours: 12
● Game Theory, ● Optimal Decisions in Games, ● Heuristic Alpha–Beta Tree Search, ● Monte Carlo Tree Search, ● Stochastic Games, ● Partially Observable Games, ● Limitations of Game Search Algorithms		
Chapter-4	Knowledge Representation	Hours: 12
● Definition of Knowledge, ● Types of knowledge (Procedural and Declarative knowledge), ● Approaches to Knowledge Representation ● Knowledge representation using Propositional and Predicate logic - Conversion to clause form, ● Resolution in Propositional logic, ● Resolution in Predicate logic		
Chapter-5	Reasoning	Hours: 12
● Inference in First-Order Logic, ● Propositional vs. First-Order Inference, ● Unification and First-Order Inference, ● Forward Chaining, Backward Chaining, ● Resolution, Knowledge Representation, ● Ontological Engineering, Categories and Objects, Events, Mental Objects and Modal Logic, ● Reasoning Systems for Categories, ● Reasoning with Default Information		
Reference Books:		
1. Artificial Intelligence, Tata McGraw Hill, Elaine Rich and Kevin Knight 2. Computational Intelligence, Eberhart, Elsevier, ISBN 9788131217832 3. Artificial Intelligence: A New Synthesis, Nilsson, Elsevier, ISBN 9788181471901 4. Introduction to Artificial Intelligence and Expert System, Dan Patterson, Prentice Hall of India Pvt. Ltd., New Delhi, 1997 5. Artificial Intelligence: A Modern Approach, Russel & Norvig, Pearson Education		

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous) S.Y. M.Sc. (Computer Applications) - Sem-III Course Code : CA-602-MJ-TH Course Title : Machine Learning		
Teaching Scheme 04 Hours/Week	No. of Credits 04	Examination Scheme CIE : 40 Marks SEE : 60 Marks
Course Objectives: - To understand the need for Machine learning - To study and understand classification methods - To understand the need for multi-class classifiers. - To learn the working of clustering algorithms - To learn fundamental neural network algorithms.		
Course Outcomes: <i>After successful completion of this course, learner will be able to:</i> - Identify the needs and challenges of machine learning for real time applications. - Select and apply appropriately supervised machine learning algorithms for real time applications. - Implement variants of multi-class classifier and measure its performance. - Compare and contrast different clustering algorithms. - Design a neural network for solving engineering problems.		
Course Contents:		
Chapter-1	Introduction to Machine Learning	Hours: 12
- Introduction to Machine Learning, - Comparison of Machine learning with traditional programming, ML vs AI vs Data Science. \ - Types of learning: Supervised, Unsupervised, and semi-supervised, reinforcement learning techniques, - Models of Machine learning: Geometric model, Probabilistic Models, Logical Models, Grouping and grading models, Parametric and non-parametric models. - Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches		
Chapter-2	Supervised Learning: Regression and Classification	Hours: 12
- Linear regression, - Logistic regression, - Evaluation Metrics: MAE, RMSE, R2 - Classification: Naïve-based and Decision tree based classifier, K-nearest neighbor, Support vector machine.		
Chapter-3	Supervised Learning: Ensembles and Multi-Class classification	Hours: 12
- Ensemble Learning: Bagging, Boosting, Random Forest, Adaboost. - Binary-vs-Multiclass Classification, - Variants of Multiclass Classification: One-vs-One and One-vs-All		

● Evaluation Metrics and Score: Accuracy, Precision, Recall, Fscore, Cross-validation		
Chapter-4	Unsupervised Learning	Hours: 12
● K-Means, ● K-medoids, ● Hierarchical and Density-based Clustering, ● Outlier analysis: Introduction of isolation factor, local outlier factor. ● Evaluation metrics and score: elbow method, extrinsic and intrinsic methods		
Chapter-5	Artificial Neural Networks	Hours: 12
● Artificial Neural Networks: Single Layer Neural Network, Multilayer Perceptron, ● Back Propagation Learning, ● Functional Link Artificial Neural Network, ● Radial Basis Function Network, ● Activation functions- Linear, Non Linear(Sigmoid, Tanh, ReLU), Exponential Linear(Softmax) ● Introduction to Recurrent Neural Networks and Convolutional Neural Networks		
Reference Books: 1. Bishop, Christopher M., and Nasser M. Nasrabadi, “Pattern recognition and machine learning”, Vol. 4. No. 4. New York: springer, 2006. 2. Ethem Alpaydin, “ Introduction to Machine Learning”, PHI 2nd Edition-2013 3. Shalev-Shwartz, Shai, and Shai Ben-David, “Understanding machine learning: From theory to algorithms”, Cambridge university press, 2014. 4. Jiawei Han, Micheline Kamber, and Jian Pie, “Data Mining: Concepts and Techniques”, Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807 5. Goodfellow I.,Bengio Y. and Courville, “ A Deep Learning”, MIT Press, 2016 6. Charu Agarwal, “Neural Networks and deep learning”, A textbook		

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous)
S.Y. M.Sc. (Computer Applications) - Sem-III
Course Code : CA-603-MJ-TH
Course Title : Software Engineering

Teaching Scheme 02 Hours/Week	No. of Credits 02	Examination Scheme CIE : 20 Marks SEE : 30 Marks
Prerequisites: ● Familiarity with at least one programming language (e.g., Java, Python, C++) , necessary to implement software solutions and understand coding principles. ● <i>Knowledge of basic concepts in computer science, including data structures, algorithms.</i> ● <i>Familiarity with software development life cycle (SDLC) models.</i>		
Course Objectives: ● <i>To learn and understand the principles of Software Engineering</i> ● <i>To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.</i> ● <i>To study agile software development methodology</i>		
Course Outcomes: <i>After successful completion of this course, learner will be able to:</i> ● <i>Compare and contrast various Software Engineering models</i> ● <i>Decide on appropriate process model for a developing a software project</i> ● <i>Classify software applications and Identify unique features of various domains</i> ● <i>Prepare System Requirement Specification (SRS) for the given problem</i> ● <i>Design and analyze Data Flow diagrams</i>		
Course Contents:		
Chapter-1	Introduction to Software Engineering	Hours: 06
● Definition of Software, ● Characteristics of Software, ● Software Application Domains, ● Definition of Software Engineering, Need for software Engineering, ● Mc Call's Quality factors ● The Software Process, Software Engineering Practice		
Chapter-2	Software Development Life Cycle (SDLC)	Hours: 06
● Introduction, Activities of SDLC,		

• A Generic Process Model, Prescriptive Process models: Waterfall Model, Incremental Model, Prototyping Model, Spiral Model, • Concurrent Models, Types		
Chapter-3	Requirement Engineering	Hours: 06
• Introduction, • Requirement Engineering Tasks, • Establishing Groundwork for understanding of Software Requirement, • Requirement Gathering, • Feasibility study, • Fact Finding Techniques		
Chapter-4	Analysis and Design Engineering	Hours: 06
• Decision Tree and Decision Table, • Data Flow Diagrams (DFD), Data Dictionary (DD), • Elements of DD, Advantages of DD, Input and Output Design, Pseudocode, • Introduction to Object-oriented analysis and Design		
Chapter-5	Agile Development	Hours: 06
• Agility, Agile Process, Principles, • The Politics Of Agile Development, Human Factors, • Extreme Programming(XP), • Adaptive Software Development (ASD), • Scrum, Dynamic System Development Model (DSDM)		
Reference Books: 1. Software Engineering : A Practitioner's Approach- Roger S. Pressman, McGraw hill International Editions 2010 (Seventh Edition) 14 2. Fundamentals of Software Engineering- Rajib Mall, PHI Publication, Fourth Edition E-Resources: Software Engineering and Quality Assurance – Mrs Anuradha A. Puntambekar https://books.google.co.in/books?id=r203sZeGhhcC&printsec=frontcover&dq=Software+Engineering+ebook&hl=en&sa=X&ved=0ahUKEwi9wJrl6LpAhU46nMBHeWQCQwQ6AEINDAB#v=onepage&q&f=false Software Engineering – Bharat Bhushan Agarawal and Sumit Prakash Tayal https://books.google.co.in/books?id=CDWRq0B9e5kC&printsec=frontcover&dq=Software+Engineering+ebook&hl=en&sa=X&ved=0ahUKEwi9wJrl6LpAhU46nMBHeWQCQwQ6AEIVzAF#v=onepage&q&f=false Software Engineering – Jibitesh Mishtre and Ashok Mohanty https://books.google.co.in/books?id=YnGz2ghKFgC&printsec=frontcover&dq=Software+Engineering+ebook&hl=en&sa=X&ved=0ahUKEwi9wJr-l6LpAhU46nMBHeWQCQwQ6AEIaTAH#v=onepage&q&f=false		

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous) S.Y. M.Sc. (Computer Applications) - Sem-III Course Code : CA-604-MJ-PR Course Title : Lab course Based on CA-601-MJ-TH		
Teaching Scheme 04 Hours/Week	No. of Credits 02	Examination Scheme CIE : 20 Marks SEE : 30 Marks
Course Objectives: - To learn and apply various search strategies for AI. - To Formalize and implement constraints in search problems.		
Course Outcomes: <i>After successful completion of this course, learner will be able to:</i> - Apply informed search / uninformed search or heuristic approaches. - Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning. - Design and develop an interactive AI application.		
Course Contents:		
Guidelines for Instructor's Manual The instructor shall frame at least 14 assignments. Instructor's manual consisting of University syllabus, list of assignments, conduction & Assessment guidelines is to be developed.		
Guidelines for Student Journal The laboratory assignments are to be submitted by student in the form of journal. Journal consists of .Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, software and Hardware requirements, Date of Completion. Students shall submit softcopy of program codes with sample outputs of all performed assignments. Lab in-charge shall maintain softcopy of program codes submitted by students. For reference, one or two journals may be maintained with program prints.		
Guidelines for Assessment Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor shall assign grade/marks based on parameters such as timely completion, understanding and neatness with appropriate weightage.		
Laboratory Assignments		
- Implement depth first search algorithm - Implement Breadth first search algorithm - Implement Best first Search algorithm - Use an undirected graph and develop a recursive algorithm for searching all the vertices of a graph - Implement A star Algorithm - Implement AO star Algorithm - Use Greedy Search algorithm to implement selection sort - Use Greedy Search algorithm to find single source shortest path - Use Greedy Search algorithm to obtain Minimum Spanning Tree - Develop an elementary Chatbot. for any suitable customer interaction application. - Develop an Expert system for a Hospital or any suitable application.		

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous)
S.Y. M.Sc. (Computer Applications) - Sem-III
Course Code : CA-605-MJ-PR
Course Title : Lab course based on CA-602-MJ-TH

Teaching Scheme 04 Hours/Week	No. of Credits 02	Examination Scheme CIE : 20 Marks SEE : 30 Marks
Prerequisites: • Knowledge of Python programming Course Objectives: • Develop in depth understanding for implementation of the regression models. • Learn supervised and unsupervised machine learning algorithms. • Study Artificial Neural Networks		
Course Outcomes: <i>After successful completion of this course, learner will be able to:</i> • Implement and evaluate linear regression and random forest regression models in python programming. • Apply and evaluate classification and clustering techniques.		
Course Contents:		
Guidelines for Instructor's Manual The instructor shall frame at least 14 assignments. Instructor's manual consisting of University syllabus, list of assignments, conduction & Assessment guidelines is to be developed.		
Guidelines for Student Journal The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, software and Hardware requirements, Date of Completion. Students shall submit softcopy of program codes with sample outputs of all performed assignments. Lab in-charge shall maintain softcopy of program codes submitted by students. For reference, one or two journals may be maintained with program prints.		
Guidelines for Assessment Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor shall assign grade/marks based on parameters such as timely completion, understanding and neatness with appropriate weightage		
Assignments: 1. Write a program to use Pandas and Matplotlib by Loading Dataset in Python 2. Implement decision tree based algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample 3. Implement a linear regression model for house price dataset divide dataset into train and test data while giving it to model and predict prices of house. 4. Implement Logistic regression on dataset "crash.csv" is an accident survivor's dataset to decide if the age and speed can predict the survivability of the passengers.. The dataset contains passengers age and speed of vehicle (mph) at the time of impact and fate of passengers (1 for survived and 0 for not survived) after a crash.		

5. Classify the iris flowers dataset using SVM and find out the flower type depending on the given input data like sepal length, sepal width, petal length and petal width Find accuracy of all SVM kernels.
6. Implement Random forest ensemble method on a Iris flower dataset.
7. Create KNN model on Indian diabetes patient's database and predict whether a new patient is diabetic (1) or not (0). Find optimal value of K.
8. Implement K-means clustering model and classify the employees into various income groups or clusters. Preprocess data if require (i.e. drop missing or null values). Use elbow method to find value of k.
9. Create a two layered neural network with relu and sigmoid activation function.
10. Create an ANN and train it on house price dataset classify the house price is above average or below average.

Datasets available on: www.kaggle.com

- Using any open source software such as WEKA and its datasets, perform classification using Naïve Bayes classifier, note accuracy
- Using any open source software such as WEKA and its datasets, perform classification using C4.5 – the decision tree classifier
- Using any open source software such as WEKA and its datasets, perform classification using Neural network classifier
- Perform assignment 1 above using any available attribute selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignment 1 above
- Perform assignment 2 above using any available attribute selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignment 2 above
- Perform assignment 3 above using any available attribute selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignment 3 above
- Perform assignment 1 above using any available instant selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignment 1 above
- Perform assignment 2 above using any available attribute selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignment 2 above
- Perform assignment 3 above using any available attribute selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignment 3 above
- Perform assignment 2 above using both attribute and instance selection algorithm in WEKA and note the accuracy and compare it with accuracy obtained in assignments 2, 5 and 8 above
- Using any open source software such as WEKA and its datasets, perform clustering using 'EM' algorithm
- Implement K-Means clustering/ hierarchical clustering on sales_data_sample.csv dataset. Determine the number of clusters using the elbow method.

Dataset link : <https://www.kaggle.com/datasets/kyanyoga/sample-sales-data>

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous) S.Y. M.Sc. (Computer Applications) - Sem-III Course Code : CA-610-MJ-TH Course Title : Mobile Application Development		
Teaching Scheme 02 Hours/Week	No. of Credits 02	Examination Scheme CIE : 20 Marks SEE : 30 Marks
Prerequisites: • Concepts of Networking • Concept of Java Programming. • Familiar with the network Protocol stack • Knowledge about different mobile platform and application development • Concept of wireless communication		
Course Objectives: • To study the Android mobile application development platform • To understand the essence of Android programming • To learn Android mobile application development process		
Course Outcomes: After successful completion of the course, students will be able to • Describe architecture, components and lifecycle development of Android application • development cycle • Design simple Android applications • Apply advanced Android features		
Course Contents:		
Chapter-1	Introduction	Hours: 06
Introduction to Android - Overview and evolution of Android , Features of Android, Android architecture, Components of an Android Application, Manifest file, Android Activity Service Lifecycle		
Chapter-2	User Interface	Hours: 06
Basic UI Designing (Form widgets, Text Fields, Layouts, [dip, dp, sip, sp] versus px), Intent, All components (Button, Slider, Image view, Toast), Event Handling, Adapters and Widgets, Menus		
Chapter-3	Threads and Notifications	Hours: 06
Threads running on UI thread (runOnUiThread), Worker thread, Handlers & Runnable, Asyn Tasks , Broadcast Receivers, Services and notifications , Toast and Alarms		
Chapter-4	Advanced Android Programming	Hours: 06
Content Providers – SQLite Programming, JSON Parsing, Accessing Phone Service (Call, SMS, MMS), Location based services		
Chapter-5	ReactJs	Hours: 06
React Introduction, Setup and Create Simple Hello World App, Understanding React Foundation or Structure, React ES6, React JSX, React Components, React Classes, React Props, React Events, React DevTools, React Data Flow, React Conditionals, React Lists, React Forms, React Router, React Hooks, building a Simple To-Do List Application (Setup), Deploying React		
Reference Books: 1. Beginning Android Application Development, Wei-Meng Lee, Wiley 2. React Native in Action, nader dabit, Nickie Buckne, O'reilly Publications		

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous)
S.Y. M.Sc. (Computer Applications) - Sem-III
Course Code : CA-611-MJ-PR

Course Title : Lab Course based on CA-610-MJ-TH

Teaching Scheme 04 Hours/Week	No. of Credits 02	Examination Scheme CIE : 20 Marks SEE : 30 Marks
Prerequisites: • Concepts of Networking • Conversant with OS internals • Familiar with the network Protocol stack • Knowledge about different mobile platform and application development • Concept of wireless communication		
Course Objectives: • To study the Android mobile application development platform • To understand the essence of Android programming • To learn Android mobile application development process		
Course Outcomes: • After successful completion of the course, students will be able to • Design simple Android applications • Apply advanced Android features		
Course Contents:		
Guidelines for Instructor's Manual The instructor shall frame at least 14 assignments. Instructor's manual consisting of University syllabus, list of assignments, conduction & Assessment guidelines is to be developed.		
Guidelines for Student Journal The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, software and Hardware requirements, Date of Completion. Students shall submit softcopy of program codes with sample outputs of all performed assignments. Lab in-charge shall maintain softcopy of program codes submitted by students. For reference, one or two journals may be maintained with program prints.		
Guidelines for Assessment Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor shall assign grade/marks based on parameters such as timely completion, understanding and neatness with appropriate weightage.		
Assignments 1. Create an Application for registration of users with required fields. Provide Menu items to add, delete and edit with adequate validations 2. Create sample application with login module. Verify Check username and password. On successful login, pass username to next screen and if login fails, prompt the user 3. Create Tables Project (pno, p_name, ptype, duration) and Employee (id, e_name, qualification, join-date), assume Project – employee has a many to many relationship. Using database perform following operation. 1) Add new record into table. 2) Accept a project name from user and display information of employees working on the project.		

Create Table Project (pno, p_name, ptype, duration). Using database perform following operation. 1) Add new record into table. 2) Accept a project name from user and display information of the project.

4. Create application to send and receive messages using SMS Manager.
5. Create application to send an email.
6. Create application with a login form. Validate the user and send an email.
7. Create application to search a specific location on Google Map
8. Create application to calculate distance between two locations on Google Map
9. Create application using JSON to provide Employee information
10. Create an application to capture and send a sales order for a pharma sales agent. Application should first sync using APIs - a) products with rates from server b) customers details. Login should find sales person id based on mobile number and allow him to input a sales order with multiple products. Order should be saved locally and updated on server if connection is available (or sync later with server).
11. Create and Deploy Application covering assignments 1, 2 and 3 above using ReactJs

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous) S.Y. M.Sc. (Computer Applications) - Sem-III Course Code : CA-612-MJ-TH Course Title : Software Testing		
Teaching Scheme 02 Hours/Week	No. of Credits 02	Examination Scheme CIE : 20 Marks SEE : 30 Marks
Course Objectives - To study fundamental concepts in software testing, including software testing objectives, process, criteria, strategies, and methods - To know various software testing issues and solutions in software unit test; integration, regression, and system testing - To learn how to plan and design test cases and data, conduct tests, manage defects, and generate a test reports		
Course Outcomes - Distinguish between white box and black box testing - Define Software testing life cycle - Design test cases		
Course Contents:		
Chapter-1	Introduction	Hours: 06
Introduction, Basics of Software Testing, Testing Principles, Goals, Testing Life Cycle, Phases of Testing, Defects, Defect Life Cycle, Defect Report, Test Plan(IEEE format), verification and validation		
Chapter-2	White-box testing	Hours: 06
Introduction, Need of white box testing, Testing types, Test adequacy criteria, static testing by humans, Structural testing - logic coverage criteria, Basis path testing, Graph metrics, Loop Testing, Data flow testing, Mutation Testing, Design of test cases. Testing of Object oriented systems, Challenges in White box testing		
Chapter-3	Black-box Testing	Hours: 06
Introduction, Need of black box testing, Black box testing Concept, Requirement Analysis, Test case design criteria, Testing Methods, requirement based testing, Positive & negative testing, Boundary value analysis, Equivalence Partitioning class, state based or graph based, cause effect graph based, error guessing, documentation testing & domain testing, design of test cases, Integration testing		
Chapter-4	System testing	Hours: 06
System testing, Functional system testing, Non-functional system testing Acceptance testing, Performance testing, Regression testing, Ad-hoc testing, Internationalization testing, Usability and Accessibility testing		
Chapter-5	Test Management, Automation, metrics and measurements	Hours: 06
Test Planning, Test Management, Test Process, Test Reporting What is test Automation?, Design and Architecture for Automation, Selecting testing tool What are test metrics and measurements? Types of metrics		
Reference Books:		

1. Software testing Principle and Practices By Ramesh Desikan, Pearson Education, ISBN 81-7758-121-X 5.
2. Software Testing Principles and Tools By M.G. Limaye TMG Hill Publication, ISBN 13:978-0-07-013990-9 3.
3. Software Testing Principles and Practices By Naresh Chauhan, Oxford University Press, ISBN 0-19-806184-6 4.
4. Software Testing Concepts and Tools By Nageshwar Rao , Dreamtech ,ISBN 81-7722-712-2

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous)
S.Y. M.Sc. (Computer Applications) - Sem-III
Course Code : CA-613-MJ-PR
Course Title : Lab Course on CA-612-MJ-TH

Teaching Scheme 04 Hours/Week	No. of Credits 02	Examination Scheme CIE : 20 Marks SEE : 30 Marks
Course Objectives - To understand white box testing - To know black box testing - To be familiar with automation tool		
Course Outcomes After successful completion of the course, students will be able to - Perform white box testing activities - Apply black box testing concepts - Enlist features of a automation tool		
Course Contents:		
Guidelines for Instructor's Manual The instructor shall frame at least 14 assignments. Instructor's manual consisting of University syllabus, list of assignments, conduction & Assessment guidelines is to be developed.		
Guidelines for Student Journal The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and handwritten write-up for each assignment. Write-up shall include Title, Problem Statement, software and Hardware requirements, Date of Completion. Students shall submit softcopy of program codes with sample outputs of all performed assignments. Lab in-charge shall maintain softcopy of program codes submitted by students. For reference, one or two journals may be maintained with program prints.		
Guidelines for Assessment Continuous assessment of laboratory work is to be carried out based on overall performance of students. For each lab assignment, the instructor shall assign grade/marks based on parameters such as timely completion, understanding and neatness with appropriate weightage.		
Suggested Laboratory Assignments		
01	To study and identify defects in a given data entry form	
02	To improve user experience for a given sign-in page	
03	Compute Code Coverage (Statement, Path, Condition and Function coverage) for the given code	
04	Compute Cyclomatic complexity for a given flow graph	
05	Prepare a requirement traceability matrix for a given system	
06	Prepare test execution data for the system specified in assignment 5 above	
07	Prepare a set of positive and negative test cases for a given system	
08	From the given problem, construct a decision table	
09	Identify equivalence classes for a given problem statement	
10	Develop a use case scenario for the specified system	
11	Download, install and use any open source testing tool	

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous)
S.Y. M.Sc. (Computer Applications) - Sem-III
Course : CA-631-RP-PR
Course Title : Research Work-I

Teaching Scheme 08 Hours/Week	No. of Credits 04	Examination Scheme CIE : 40 Marks SEE : 60 Marks
Course Objectives To provide hands-on experience to research work		
Course Outcomes After successful completion of the course, students will be able to - Apply research methodology to carry out research in a chosen problem domain - Design and develop a novel methodology / framework etc - Conduct experiments and analyze results		
Course Contents:		
Guidelines for carrying out Research work Each student shall carry out the research work during semester III under the guidance of the appointed faculty Advisor/Mentor. Students shall work on a research problem and publish a paper/ file a copyright / patent based on the work carried out. The student shall prepare and submit a report based on the work carried out consisting of – Face Page, certificate, Acknowledgement, Abstract, Table of Contents, List of Tables, List of Figures, Abbreviations, and separate Chapters dealing with Introduction, Literature Review, Design details of Proposed System, Experimental Results and analysis, and a chapter providing conclusions and future scope. List of Publications, Copyright/patent, references and appendix shall also be included in the report.		
Guidelines for Assessment The work carried out shall be evaluated on a continuous basis by the assigned faculty advisor / mentor for 30 marks and panel of examiners appointed shall evaluate the work based on the report for 70 marks.		

SEMESTER-IV

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous)
S.Y. M.Sc. (Computer Application) - Sem-IV
Course : CA-651-MJ-PR
Course Title : Full Time Industrial Training (IT)

Teaching Scheme 360 Hrs.	No. of Credits 12	Examination Scheme CIE : 120 Marks SEE : 180 Marks
Objectives - To provide students with an opportunity to apply theoretical knowledge gained throughout the program in a real-world industrial setting - To foster professional skills such as teamwork, communication, time management, and problem-solving in an industrial environment. - To expose students to the practices, technologies, and challenges prevalent in the IT industry or related sectors. - To enable students to gain hands-on experience by working on projects or tasks relevant to their field of study. - To facilitate networking opportunities with professionals in the industry, potentially leading to future career prospects..		
Course Outcomes On Completion of this course, student will be able to – CO1: Apply theoretical concepts learned in the classroom to solve practical problems encountered in an industrial setting. CO2: Demonstrate proficiency in using industry-standard tools, technologies, and methodologies relevant to their area of specialization. CO3: Apply analytical and problem-solving skills to address challenges encountered during the industrial training CO4: Collaborate effectively with team members to achieve project goals and objectives. CO5: Manage time and resources efficiently to complete assigned tasks and projects within the stipulated timeframe. CO6: Prepare a comprehensive report documenting their experience, including project details, learnings, and reflections.		
Course Contents:		
Sr. No.	Guidelines for Full Time Industrial Training (IT)	
1	Students are required to secure an industrial/internship placement in any organization, institution, or IT industry relevant to their field of study.	
2	Students must submit the offer letter from the organization within two weeks of starting the industrial training/internship, detailing the terms and duration of the internship.	
3	Students must have to work full time in the organization as per their rules and regulations.	
4	A mentor will be assigned to each group of students to provide guidance and support throughout the internship period.	
5	The industrial training/ internship duration should span a minimum of 360 hours, equivalent to 12 credits.	
6	Students may be assigned specific projects or tasks or assignments by the host organization, relevant to their area of specialization.	
7	Students should provide regular updates to their mentor through progress reports time to time regarding their progress, challenges faced, and lessons learned during the industrial training.	
8	Upon completion of the industrial training/ internship, students must submit a comprehensive report documenting their internship experience, including project/ assignment details, challenges and achievements as per the format specified.	
9	Evaluation will be based on the quality content of the internship report, feedback from the host organization, and the overall performance during the internship/industrial training period.	

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous)

S.Y. M.Sc. (Computer Application) - Sem-IV

Course : CA-660-MJ-TH / CA-661-MJ-TH

Course Title : Online / MOOC course-I & II

Teaching Scheme 30 Hrs Each	No. of Credits 02 + 02	Examination Scheme
Guidelines: 1. Students are supposed to complete 2 online MOOC courses during their second semester of second year. 2. Students can opt for Swayam, NPTEL, or other online courses. 3. Students should register for these courses in parallel to their Industrial Training. 4. Each course should be of minimum 30 hours (2 credits) 5. Students will have to appear for online exams of the courses and should obtain the passing certificate to earn the credits. 6. The number of hours of the course must be mentioned on the certificate and it should be minimum 30 for gaining 2 credits. 7. The courses should be relevant to Computer Science		

Haribhai V. Desai College of Arts, Science and Commerce, Pune. (Autonomous)
S.Y. M.Sc. (Computer Application) - Sem-IV
Course : CA-681-RP-PR
Course Title : Research Work-II

Teaching Scheme 180 Hrs.	No. of Credits 06	Examination Scheme CIE : 60 Marks SEE : 90 Marks
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Objectives

- To acquire skills necessary for conducting independent research in the field of computer science.
- To apply theoretical concepts learned throughout the program to solve real-world problems.
- To foster collaboration and teamwork by working in groups under the guidance of a mentor.
- To enhance communication skills through presentation and documentation of research findings.
- To get hands-on-experience for applying research methodology

Course Outcomes

On Completion of this course, student will be able to -

CO1: Independently conduct research in a specific area of computer science

CO2: Apply appropriate research methodologies to address research problems.

CO3: Analyze and synthesize information gathered from literature reviews, experiments, or data analysis

CO4: Develop innovative solutions to research problems within the scope of computer science.

CO5: Effectively present research findings through written reports, oral presentations, or poster presentations.

CO6: Publish research work in reputable journals, present at conferences

Course Contents:

Sr. No.	Guidelines for Research Work
1	Each student carry out the research work during semester-IV under the guidance of mentor or guide appointed.
2	Student shall work on a research problem and publish paper(s) or article(s) or file a copyright or patent based on the work carried out. Student can also present a paper in national/international conferences.
3	Students are required to conduct a thorough literature review to understand the current state of research in their chosen area.
4	Students should execute the research plan outlined in their proposal, adhering to ethical guidelines and academic standards.
5	Proper documentation of the research process, including experimental setup, data collection methods, and analysis techniques, should be maintained
6	Upon completion of the research work, students must prepare a report
7	Evaluation will be as per the guidelines, based on the quality of the research work, adherence to the research plan, presentation skills, and contribution

Eligibility:

- (a) **Bachelor Degree in Science/Technology/Engineering OR**
- (b) **Bachelor of Computer Applications (B.C.A.) OR**
- (c) **B.Sc.(Computer Science) OR**
- (d) **Bachelor of Computer Science (B.C.S.) OR**
- (e) **B.Sc.(Information Technology) OR**
- (f) **B.Sc.(Data Science) OR**
- (g) **B.Sc.(Cyber and Digital Science) OR**
- (h) **B.Sc. (Cyber Security) OR**
- (i) **B.Sc. (Cloud Computing) OR**
- (j) **Bachelor of Engineering(BE/B.Tech) in Computer Engg/Computer Science & Engg./ Computer Science and Design/ Information Technology/Electronics and Telecommunication/AI and Data Science/AI and Machine Learning/ equivalent OR**
- (k) **B. Voc. in Software Development/ Information Technology OR**
- (l) **B.Sc. with Computer Science as Principal Subject OR**
- (m) **General B.Sc. with Computer Science as one of the subject at TYBSc level Programme**

Objectives:

The objective of an M.Sc. in Computer Application is to provide advanced knowledge in computing, algorithms, and software development. It equips students with problem-solving and research skills to tackle complex technological challenges. The course emphasizes practical applications, innovation, and emerging technologies like AI, Machine Learning, Android Programming etc. Graduates are prepared for careers in academia, industry, and research.

Workload

1. Each theory credit is equivalent to 15 clock hours of teaching (i.e. for 2 Credits – 30 Clock Hours) and each practical credit is equivalent to 30 clock hours (i.e. for 2 Credits – 60 Clock Hours) of teaching in a semester.
2. There is 15 weeks of teacher-student interaction during the semester.
3. The 15 week is divided into 12 weeks teaching and 3 weeks for continuous assessment including preparation time to students during the semester.
4. The workload will be calculated based on 12 weeks teaching only.
5. For the purpose of computation of work-load the following mechanism may be adopted as per UGC guidelines.
6. Workload as per credit is as follows:
 - i. 1 Credit = 1 Theory period of one hour duration per week.
 - ii. 1 Credit = 1 Tutorial period of one hour duration per week.
 - iii. 1 Credit = 1 Practical period of two-hour duration per week.
7. Each theory Lecture time for FY, SY is of 60 min.
8. Each practical session time for FY, SY is of 4 hour i.e. 240 min.

Credit Framework

Level	Seme ster	Credit Related to Major		Research Methodology (RM)	Internship On Job Training (OJT)	Research Project	Total
		Major Core	Major Elective				
6.0	I	10 (T) + 4 (P)	2 (T) + 2(T/P)	4	--	--	22
	II	10 (T) + 4 (P)	2 (T) + 2(T/P)	--	4 (OJT)	--	22
Exit Option :- Award PG diploma on Completion of 44 Credit OR Continue with PG Second Year							
6.5	III	10 (T) + 4 (P)	2 (T) + 2(T/P)	0	0	4	22
	IV	8 (T) + 4 (P)	2 (T) + 2(T/P)	0	0	6	22
Total		54	16	4	4	10	88
2 years – 4 Semester :- Award of PG Degree on completion of 88 Credit after Three years UG Degree or 1 Year -2 Semester after Four year UG Degree.							

Reference Books:-

1. Artificial Intelligence, Tata McGraw Hill, Elaine Rich and Kevin Knight
2. Computational Intelligence, Eberhart, Elsevier, ISBN 9788131217832
3. Artificial Intelligence: A New Synthesis, Nilsson, Elsevier, ISBN 9788181471901
4. Introduction to Artificial Intelligence and Expert System, Dan Patterson, Prentice Hall of India Pvt. Ltd., New Delhi, 1997
5. Artificial Intelligence: A Modern Approach, Russel & Norvig, Pearson Education
6. Bishop, Christopher M., and Nasser M. Nasrabadi, "Pattern recognition and machine learning", Vol. 4. No. 4. New York: springer, 2006.
7. Ethem Alpaydin, "Introduction to Machine Learning", PHI 2nd Edition-2013
8. Shalev-Shwartz, Shai, and Shai Ben-David, "Understanding machine learning: From theory to algorithms", Cambridge university press, 2014.
9. Jiawei Han, Micheline Kamber, and Jian Pie, "Data Mining: Concepts and Techniques", Elsevier Publishers Third Edition, ISBN: 9780123814791, 9780123814807
10. Goodfellow I., Bengio Y. and Courville, "A Deep Learning", MIT Press, 2016
11. Charu Agarwal, "Neural Networks and deep learning", A textbook
12. Software Engineering : A Practitioner's Approach- Roger S. Pressman, McGraw hill International Editions 2010 (Seventh Edition) 14
13. Fundamentals of Software Engineering- Rajib Mall, PHI Publication, Fourth Edition
14. Beginning Android Application Development, Wei-Meng Lee, Wiley
15. React Native in Action, nader dabit, Nickie Buckne, O'reilly Publications
16. Software testing Principle and Practices By Ramesh Desikan, Pearson Education, ISBN 81-7758-121-X 5.
17. Software Testing Principles and Tools By M.G. Limaye TMG Hill Publication, ISBN 13:978-0-07-013990-9 3.
18. Software Testing Principles and Practices By Naresh Chauhan, Oxford University Press, ISBN 0-19-806184-6 4.
19. Software Testing Concepts and Tools By Nageshwar Rao , Dreamtech , ISBN 81-7722-712-2

Examination Pattern

1. Exam pattern is 60-40 i.e. Semester End Examination (SEE) is of 60 % and Continuous Internal Assessment is of 40 %.

Theory, Practical/Project: -

Continuous Internal Assessment (CIA): 40 % [20 Marks / 40 Marks]

1. Internal Test- 50% Marks
2. Presentation /Open book/ Other - 25% Marks
3. Assignment : -25% Marks

Semester End Examination (SEE): - 60 % [30 Marks / 60 Marks]

Paper Pattern for 60 marks

Q1 Attempt any five out of seven of the following. $2 \times 5 = 10$

Q2 Attempt any four out of five of the following $3 \times 4 = 12$

Q3 A] Attempt Any two out of three of the following $2 \times 4 = 08$

B] Attempt the following 04

Q4 A] Attempt any two out of three of the following $2 \times 3 = 06$

B] Attempt the following 04

Q5 Attempt any two out of three of the following $2 \times 4 = 08$

Q6 Attempt any two out of three of the following $2 \times 4 = 08$

Note :- Subject teachers can make necessary changes if required.

Completion of Degree

Award of Degree:

CGPA will be calculated for students who completed 88 credits, grades are given as per the following table.

Sr. No.	Grade Letter	Grade Point	Marks
1.	O (Outstanding)	10	90<= Marks <= 100
2.	A+ (Excellent)	9	75<= Marks <= 89
3.	A (Very Good)	8	60<= Marks <= 74
4.	B+ (Good)	7	55<= Marks <= 59
5.	B (Above Average)	6	50<= Marks <= 54
6.	C (Average)	5	45<= Marks <= 49
7.	D (Pass)	4	40<= Marks <= 44
8.	F (Fail)	0	Marks <40
9.	AB (Absent)	0	-