# VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE (VJTI)

## MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)

**Curriculum**
**(Scheme of Instruction &Evaluation and Course contents)**
**(Revision)**

For
Second Year
Of
Two Year Postgraduate Program Leading to

# Master of Computer Applications (MCA)

**Implemented for the batch admitted to MCA from 2020-21**

## Vision and Mission statement of Institute:

**Vision**

To establish global leadership in the field of Technology and develop competent human resources for providing service to society

**Mission**

1) To provide students with comprehensive knowledge of principles of engineering with a multi-disciplinary approach that is challenging
2) To create an intellectually stimulating environment for research, scholarship, creativity, innovation and professional activity.
3) To foster relationship with other leading institutes of learning and research, alumni and industries in order to contribute to National and International development.

## Vision and Mission statement of MCA Department:

**Vision:**

- To create a community of Critical Thinkers, Problem Solvers, Technological Experts who will be able to excel individually and collaboratively towards development of quality applications for betterment of business and society

**Mission:**

1) Impart Quality Education to generate competent, skilled and Humane Manpower for computer application development and management.
2) To include analytical skills for development of efficient, creative, innovative and user centric computer applications to support business and social causes.
3) To create an environment for multifaceted development f students to make them industry ready in consultation with distinguished Alumni of the department
4) To undertake collaborative projects which offer opportunities for long term interaction with academy and for an industry.
5) Practice and promote high standards of professional ethics, transparence and accountability and ensure zero tolerance for lack of these core commitments.

**Program Educational Objectives (PEOs)**

1) Transcend in professional career and / or pursue higher education and research utilizing the knowledge gained in computational domain, mathematics, and management.
2) Ability to analyze real world problems, develop feasible and environmentally acceptable solutions to achieve peer recognition as an individual or in a team.
3) Work in multidisciplinary environment with ethical and sustainable computing perspectives, adaptable to the changing trends in technology and society by engaging in lifelong learning.
4) Identify opportunity to evolve as an entrepreneur and pursue the same for the benefit of individual and society.

**Program Outcomes (PO)**

1) Apply knowledge of computing fundamentals, computing specialization, mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.
2) Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.
3) Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4) Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5) Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.
6) Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.
7) Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.

8) Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
9) Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.
10) Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional computing practice.
11) Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.
12) Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.

**Program Specific Outcomes (PSOs)**

1) Analyze, Design, Test and Implement components, processes and solutions for specific application development using appropriate data modeling concepts and document the same.
2) Adapt and use appropriate modern software tools, resources and techniques to solve real-world problems within the framework of constraints.
3) Apply concepts of networking and security to build and manage infrastructure to be utilized for efficient communication

# SEMESTER III

| Scheme of Instruction | | | | | | Scheme of Evaluation | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **S. No** | **Course code** | **Course Title** | **L-T-P (Hours / week)** | | | **Credits** | **TA** | **MST** | **ESE** | **ESE hours** |
| 1. | **R5MC6011T** | Big Data Analytics and Visualization | 3 | - | - | 3.0 | 20 | 20 | 60 | 3 |
| | **R5MC6011P** | Big Data Analytics and Visualization Lab | - | - | 2 | 1.0 | 60% | | 40% | |
| 2. | **R5MC6012T** | Artificial Intelligence and Machine learning | 3 | - | - | 3.0 | 20 | 20 | 60 | 3 |
| | **R5MC6012P** | Artificial Intelligence and Machine learning Lab | - | - | 2 | 1.0 | 60% | | 40% | |
| 3. | **R5MC6013S** | Data Science | 3 | 1 | - | 4.0 | 20 | 20 | 60 | 3 |
| 4. | **R5MC6014T** | Information and network security | 3 | - | - | 3.0 | 20 | 20 | 60 | 3 |
| | **R5MC6014P** | Information and network security Lab | - | - | 2 | 1.0 | 60% | | 40% | |
| 5. | | Program Elective -3 | 3 | - | - | 3.0 | 20 | 20 | 60 | 3 |
| | | Program Elective -3 Lab | - | - | 2 | 1.0 | 60% | | 40% | |
| 6. | **R5MC6015S** | Block chain(MOOC) | 3 | - | - | 3.0 | 60 % | - | 40% | 3 |
| 7. | **R5MC6817L** | Technical Seminar 1 | - | 1 | - | 1.0 | 60% | | 40% | |
| | | **Total** | 18 | 2 | 8 | 24 | | | | |

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **MST**: In Semester Test, **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation

## SEMESTER IV

| S. No | Course code | Course Title | Credits | Evaluation pattern |
|---|---|---|---|---|
| **1** | **R5MC6822D** | Technical Seminar 2 (Stage I) | 1 | Graded evaluation by a committee of at least two examiners including supervisor (guide) **100% CIE** |
| **2** | **R5MC6823D** | Technical Seminar 2 (Stage II) | 2 | Graded evaluation by a committee of at least two examiners including supervisor (guide) **100% CIE** |
| **3** | **R5MC6824D** | Final Project (Stage I) | 4 | Graded evaluation by a committee of at least two examiners including supervisor (guide) **100% CIE** |
| 4 | **R5MC6825D** | Final Project (Stage II) | 8 | Graded evaluation by a committee of at least two examiners including supervisor (guide) **100% CIE** |
| | **Total** | | **15** | |

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **MST**: In Semester Test, **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation

## List of Electives:

**Elective III:**

| S. No | Course code | Course Title |
|---|---|---|
| 1. | R5MC6111T | Geographic Information Systems |
| | R5MC6111P | Geographic Information Systems Lab |
| 2. | R5MC6112T | Gaming Technology |
| | R5MC6112P | Gaming Technology Lab |
| 3. | R5MC6113T | Robotics |
| | R5MC6113P | Robotics Lab |
| 4. | R5MC6115T | Deep learning. |
| | R5MC6115P | Deep learning Lab |

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6011T** | |
| **Course Title** | **Big Data Analytics and Visualization** | |

## PREREQUISITES:

Basic knowledge of Java, Basic knowledge of Data mining Algorithms

## COURSE OUTCOMES

1. Understand the Distributed File System, Hadoop Architecture and Map Reduce Framework to solve simple problems.
2. Distinguish between the characteristics of high level languages and NOSQL databases used in Big Data scenario
3. Apply various Data mining techniques to Big Data and gain an understanding of the analysis of big data including methods to visualise
4. Apply various techniques of Analytics, Text Analytics and Social Network Analysis for applications in Big Data.
5. Apply the techniques to analyze real time data and the challenges of Real Time Analytics

## COURSE CONTENTS

### Big Data Overview

Introduction to Big Data, Big Data traits, Traditional vs. Big Data business approach, Case Studies of Big Data Solutions, Types of Data (at Rest, in Motion).

### Hadoop

Physical organization of Compute Nodes, Large scale File System Organization, Limitations of existing distributing systems, Hadoop Approach, Internals of Hadoop, Hadoop Architecture: Core Components, Ecosystem, HDFS and GPFS, Hadoop Limitations, Yarn, Spark, Apache Kafka.

### MapReduce and the New Software Stack

MapReduce programming paradigm, MR engine, The Map tasks, Grouping by Key, The Reduce Task, Combiners, MapReduce Execution process, Handling of Node Failures, Examples using MapReduce:

Matrix-Vector Multiplication by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step, Computing Natural Join by MapReduce.

## Finding Similar Items

Types of Analytics, Approaches to Analytics, Introduction to Text Analytics: Document Shingling, Locality Sensitive hashing, Applications of Locality-Sensitive Hashing, Applications of Nearest-Neighbour Search, Similarity Measures, Distance measures, Introduction to Sentiment analysis

## Data in Motion, Real Time Analytics:

Mining Data Streams, Sources of Stream, Sampling Data in a Stream, Stream Queries: Filtering Streams, Counting Distinct Elements in a Stream, Counting Ones in a Window, Issues in Stream Processing.

## High level language and NOSQL- PIG and HIVE

Basic syntax, Compilation process, Fundamental of Apache Hive, simple programs in Hive to query Hadoop files, Pig Data Flow Engine, simple programs

Difference between RDBMS and NoSQL, NoSQL business drivers, case studies, Types of NoSQL and available software, Ways that NoSQL systems handle Big Data problems, Fundamentals of HBase, HBase Data - Model, MongoDB, Cassandra.

## Data Mining for Big Data

**Classification** using Support Vector Machines

**Clustering** Algorithms for large data sets: CURE, BFR, Stream Computing Algorithm

**Association rule mining**: Handling Larger Datasets in Main Memory, Algorithm of Park, Chen and Yu, The Multistage Algorithm, The Multihash Algorithm.

Limited-Pass Algorithms: SON algorithm and conversion to MapReduce, Toivenen's Algorithm.

## Recommendation Systems

A model for Recommendation Systems, Content-based Recommendations, Collaborative Filtering

## Visualization

Explanation of data visualization, Challenges of big data visualization, Approaches to big data visualization, D3 and big data, Getting started with D3, Another twist on bar chart visualizations, Tableau as a Visualization tool, Dashboards for Big Data -Tableau.

## Recommended Reading


1. Mining of Massive Datasets, Anand Rajaraman and Jeffrey David Ullman, Cambridge University Press, 2012.
2. Big Data Analytics: M Vijayalaxmi, Radha Shankarmani, Wiley 1st edition
3. Hadoop – The Definitive Guide, Tom White, O'Reilly Media, 3rded
4. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses, Michael Minelli, Wiley, 2013
5. Frank Johlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS Business Series, 2012.
6. James D. Miller," Big Data Visualization" PACKT Publications.ISBN-10:1785281941

| *Programme Name* | *S.Y.M.C.A* | *SEMESTER- III* |
|---|---|---|
| **Course Code** | **R5MC6011L** | |
| **Course Title** | **Big Data Analytics and Visualization Lab** | |

## PREREQUISITES

A good knowledge of Java

## COURSE OUTCOMES

1. Run simple programs for the File I/O on Hadoop
2. Perform Analysis on at - rest data using Map Reduce, Excel
3. Write Simple programs in R to perform Analysis on Big Data using data mining techniques

## TITLE OF EXPERIMENT

1. Advanced Shell Commands, File I/O API's
2. Setup, Installation and study of Hadoop ecosystem in Standalone Mode and Pseudo Distributed Mode
3. Preprocessing the data and perform data cleaning the records using programming language. Also, perform disambiguation if necessary.
4. Data exploration using various visualization tools.
5. Perform Variable identification and latent variable discovery in given dataset
6. Implement simple programs in MapReduce to process the data and perform
   i. Word count
   ii. Matrix multiplication
   iii. Aggregation, Searching and sorting
7. Write a Pig Latin script to handle the Weather Data Set problem. [sort, group, join, project, and filter Weather data]
8. Create Hive tables and Querying Hive tables for Weather Data Set problem.
   Create, alter, and drop databases, tables, views, functions, and indexes.
9. Implement any one Frequent Item set algorithm using Big Data
10. Implement any one Clustering algorithm using Big Data
11. Implement any one Data Streaming algorithm using Big Data
12. Study various visualization technique.

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6012T** | |
| **Course Title** | **Artificial Intelligence and Machine learning** | |

## PREREQUISITES

Data Structures, Design and Analysis of Algorithms. Mathematical and statistical foundations, data mining.

## COURSE OUTCOMES:

After successful completion of this course the student should be able to:

1. Describe the fundamentals of Artificial Intelligence.
2. Distinguish between and apply different problem solving techniques.
3. Apply different planning techniques for AI problems.
4. Apply learning techniques like decision trees, Bayesian theory, clustering, SVM, ANN, etc., to solve real - world problems.
5. Apply linear regression, logistic regression and regularization to given machine learning problems.
6. Evaluate and diagnose any machine learning system.

## COURS CONTENS

## Introduction to AI

**What is artificial intelligence?**

The AI problems, the underlying assumption, AI technique, problem characteristics, Types of problems under AI umbrella and their characteristics.

**Intelligent Agents**

Concept of Rational Agent, Structure of Intelligent agents, Agent Environments.

## Problem Solving

Solving problems by searching, Problem formulation, Search Strategies, Uninformed Search Techniques: DFS, BFS, Uniform cost search, Iterative Deepening, Depth limited search, Informed search methods: Best First Search, heuristic Functions, A*,IDA*, Hill Climbing, Solving constraint

satisfaction problems with backtracking, solving cryptarithmetic problems, Game playing with game trees.

## Planning

A Simple Planning Agent, Planning in Situation calculus, Basic representation for planning, A Partial Order Planning example, A partial order planning algorithm, Blocks world, Shakey's world

## Supervised Learning

Decision tree representation, learning Algorithms, Hypothesis and Space search in decision tree learning, Inductive bias, Pruning, Rule extraction from Tree, Issues in DT learning, Bayesian theory: Bayes rule, probabilistic classifiers, Maximum Likelihood Estimation

## Evaluation metrics for Supervised Learning

Machine learning diagnostic: debugging a learning algorithm, evaluating a hypothesis [Model selection], training/validation/testing procedures, diagnosing bias versus variance and vice versa, regularization and bias/variance, learning curves Machine learning system design: error analysis, error metrics for skewed classes, Confusion metric, precision, recall, tradeoff between both, accuracy, datasets for machine learning

## Unsupervised Learning

Clustering: Unsupervised learning technique, k-means algorithm, optimization objective, random initialization, choosing value of k, EM algorithm, Hierarchical clustering, Learning rules from data, Dimensionality Reduction: Subset Selection methodologies, Factor Analysis, Multidimensional Scaling

## Linear regression, Logistic regression and Regularization

Linear regression with one variable: Model representation, cost function, gradient descent, Linear regression with multiple variables: Multiple features, Model representation, cost function, gradient descent: Feature scaling, mean normalization, learning rate, Logistic regression: Classification, hypothesis representation, decision boundary, cost function, gradient descent, advanced optimization, multiclass classification. Regularization: Problem of overfitting, cost function, regularized linear regression, regularized logistic regression

## Artificial Neural Networks and Support Vector Machine

Non-linear hypothesis, ANN representation, Perceptron, Training Perceptron, Multilayer

perceptron with backpropagation, Radial Basis Function Network, examples, multi-class classification using ANN

## RECOMMENDED READING:


1. Russell, Stuart Jonathan, et al. Artificial intelligence: a modern approach. Vol. 2. Upper Saddle River: Prentice hall, 2003.
2. Nilsson, Nils J. Principles of artificial intelligence. Morgan Kaufmann, 2014.
3. Elaine Rich, Kevin Knight, Artificial Intelligence. Tata McGraw-Hill, 2nd Edition.
4. Tom Mitchell, Machine Learning, McGraw-Hill, 1997
5. Ethem Alpaydin, Introduction to Machine Learning, PHI, 2005
6. K.P. Soman, R. Loganathan and V. Vijay, Machine Learning with SVM and Other Kernel Methods, PHI-2009
7. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer 2006

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6012L** | |
| **Course Title** | **Artificial Intelligence and Machine learning Lab** | |

## PREREQUISITES

Data Structures, Design and Analysis of Algorithms, Java/Python programming

## COURSE OUTCOMES

After successful completion of this course the student should be able to:

1. Identify and implement suitable problem solving techniques for game playing.
2. Solve the problems using various machine learning techniques such as regression methods, classification methods, clustering methods.

## TITLES OF EXPERIMENTS:

1 Write a program to play a two person zero sum game of reversi.

2 Write a program to play Backgammon.

3 Write a program to play Tetris.

4 Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

5 Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

6 Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

7 Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using the standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

8 Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for

clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

9 Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

10 Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data sets for your experiment and draw graphs.

**ASSESSMENT:** The distribution of marks for ESE practical exam is as Follows:

Viva-voce: 20 marks

Practical test : 20 marks

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6013T** | |
| **Course Title** | **Data Science** | |

## PREREQUISITES:

Mathematical and Statistical Foundations 1

## COURSE OUTCOMES:

1. Understand core concepts and technologies for effective decision making
2. Model and deploy data science systems
3. Perform statistical analysis on the data and represent results in an effective way
4. Understand the use of probability distribution in data analysis and decision making
5. Perform hypothesis testing to check the correctness/ verification of result

## COURSE CONTENTS

### Introduction to Core Concepts and Technologies.

Data Science: Introduction, Collecting Data, Storing Data, Processing Data, Describing Data; Statistical Modelling, Algorithmic Modelling; Why is Data Science so popular today, Are AI and Data Science related, Problem Solving, Knowledge Representation & Reasoning, Decision Making, Communication, Perception & Actuation, The Myths of Data Science, The Path to Data Science. Example applications.

### Engineering Data Science Systems

Engineering Aspects of Data science, System Perspective of Data Science, CRISP - DM_Business Understanding, CRISP - DM_Data Understanding, Preparation & Modelling, CRISP - DM_Evaluation & Deployment, Programming Tools, Why Python?, Python – Libraries.

### Getting and Cleaning Data

Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, How to describe relationship between variables? Data storage and management, Using multiple data sources, Static Files, SQL, Web Scraping, APIs and Messy Data

## Statistical Inference

Terminology and concepts overview, Central tendencies and distributions, Variance, What does the variance tell us about the data? Effect of Transformations on Measures of spread, How do you use mean & Variance to Standardise data. Distribution properties and arithmetic, Event Space, The Element of Chance (Nothing in life is certain), A brief overview of Set Theory, Overview Probability Distributions and Hypothesis Testing, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes

## Summarizing and Visualizing Data

Descriptive Statistics, Univariate and Multivariate Exploratory Data Analysis, Types of data visualization, Exploratory and Explanatory, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings: Technologies for visualization: Bokeh (Python)

## Hypothesis Testing

Hypothesis Testing Case Study – 1, Case Study 2, Case Study 3 & 4, Case Study 5 & 6, Three Cases, z-test vs t-test, Plotting Distribution, Chi-Square test (case studies)

## RECOMMENDED READING


1. G. Strang (2016). Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA.
2. Cathy O'Neil and Rachel Schutt (2013). Doing Data Science, O'Reilly Media
3. Mastering python for data science, Samir Madhavan.
4. Jake VanderPlas, " Python Data science Handbook",Orielly publication.
5. Joel Grus, " Data Science from Scratch", O'Reilly Media Inc., ISBN: 9781491901427

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6014T** | |
| **Course Title** | **INFORMATION AND NETWORK SECURITY** | |

## PREREQUISITE

A good knowledge of number theory, network

## COURSE OUTCOMES

1. Explain the basic concept of cryptography and network security and their mathematical models.
2. Evaluate different authentication protocols.
3. Evaluate different network security protocols
4. Identify and classify computer security threats and develop a security model to prevent, detect and recover from attacks.
5. Compare and contrast between various encryption and decryption algorithms.

## COURSE CONTENTS

### Abstract Algebra

Groups, Finite groups, subgroups, Cyclic Groups, Permutation groups, Isomorphism. Introduction to rings, integral domains, Ideal and factor rings, ring homomorphism, polynomial rings, Vector Spaces, Extension fields, Algebraic extension, finite fields

### Crypto basics

Basic concepts, Types of cryptosystems, Substitution techniques: Caesar cipher, Hill cipher, Vernam, Transposition techniques: Rail Fence technique, simple columnar, cryptography and cryptanalysis.

### Symmetric Key Cryptography

RC4, DES, AES, Block cipher modes

### Asymmetric Key Cryptography and Digital Signature

RSA, Diffie Hellman, public key applications: Digital signatures, Digital Certificate creation, certificate hierarchies, cross certification, certificate revocation (offline/online), certificate types, Public Key Infrastructure: key management, PXIX Model and Architecture, PKCS standard.

## Hash Function

Hash function, MD5, SHA1, SHA512 birthday problem, MAC, HMAC, uses of hash, Information hiding.

## Authentication Protocol

Authentication protocol, password issues, biometrics, two factor authentication, SSL, Kerberos

## Software Flaws and Malwares

Buffer overflows, malware- Trojan, Morris worm, sql slammer, malware detection. Software based attacks: salami attacks, time bombs

## Elliptic Curve Cryptography

Elliptic Curve Cryptography, Mathematical hard problems DH Problem ,ECDH Problem, ECDDH Problem, Factorization Problem, DL Problem

## Cyber Forensics

IT Act 2000, Cyber crimes and Future of cryptography

## Network Attacks

Denial of service attack, DNS spoofing, IP spoofing, port Scanning, SQL injection, session hijacking, IDS/ IPS

## Emerging Trends

Quantum cryptography, BB84 protocol Key exchange and encryption and extension**.**

## Recommended Reading

1.Stallings, William. Cryptography and Network Security: Principles and Practices. Pearson Education India, 2006.

2.Kahate, Atul. Cryptography and network security. Tata McGraw-Hill Education, 3rd Edition, 2013.

3.Forouzan, Behrouz A., and Debdeep Mukhopadhyay. Cryptography and Network Security (Sie). McGraw-Hill Education, 2011

4.Deven N. Shah, Information Security, Principles and Practice, Wiley

5.Joseph A. Gallion, Contemprary Abstract Algebra.

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6014L** | |
| **Course Title** | **INFORMATION AND NETWORK SECURITY LAB** | |

## PREREQUISITE

Knowledge of an C / C++ / Java/ Number Theory is required for this course

## COURSE OUTCOMES

1. Implement the various cryptographic systems.
2. Analyze the various authentication protocols.
3. Implement public key cryptography.

## TITLE OF EXPERIMENT

Note: program can be implemented in a C++/Java/Python

1. Write a Program to implement basic cryptographic system.
2. Write a Program to implement SDES using various algorithm modes.
3. Write a Program to implement SAES using various algorithm modes.
4. Write a program to Implement RSA.
5. Implement Diffie Hellman exploit man in the middle attack.
6. Understand and use Java cryptography Package.
7. To study any one of open source software's for calculating cryptographic hash.
8. To study any one of open source software for Digital Signature.
9. Study traffic analysis using Wireshark.
10. To implement public key cryptography using open SSL.

## ASSESSMENT:

The distribution of marks for ESE practical exam is as follows:

- Viva-voce: 10 marks
- Practical test :30 marks

## Elective 3

| *Programme Name* | *S.Y.M.C.A* | *SEMESTER III* |
|---|---|---|
| **Course Code** | **R5MC6111T** | |
| **Course Title** | **GEOGRAPHICAL INFORMATION SYSTEM** | |

## PREREQUISITE

A good knowledge of DBMS, computer graphics

## COURSE OUTCOMES

1. Describe GIS concepts and spatial data representation
2. Compare and contrast spatial data in raster form as well as vector form.
3. Describe remote sensing fundamentals.
4. Mapping various terrains for geo coding and segmentation.
5. Explain project management principles to GIS application.

## COURSE CONTENTS

### Fundamentals of GIS

Introduction, Definition of GIS, Evolution of GIS, Roots of GIS,Four M's, Definition, GIS Architecture, Models of GIS, Framework for GIS, GIS Categories, Map as a Model, Spatial Referencing System, Map Projections, Commonly Used Map Projections, Grid Systems, Cartographic Symbolization, Types of Maps, Typography, Map Design, Map Productions, Map Applications.

### Data Management, Models and Quality Issues

Conceptual Models, Geographical DataModels, Data Primitives, Data Types - Raster and Vector Approach, Digital Terrain Modeling , Approaches to digital terrain data modeling , Acquisition of digital terrain data, Data Modeling and Spatial Analysis, Sources of Geographical Data, Data Collectors and Providers, Creating Digital Data Sets, Data Presentation, Data Updating, Data Storage, Spatial Data Costs, Quality of GIS Output, Sources of Errors in Spatial Data, Factors affecting Reliability of Spatial Data, Faults from Assumptions, spatial autocorrelation, Quadrat counts and Nearest – Neighbour analysis, Trend surface analysis, Gravity models.

## GIS Data Processing, Analysis and Visualization

Raster based GIS data processing,Vector based GIS data processing, Human computer interaction and GIS, Visualization of geographic information, principles of cartographic design in GIS, Generation of information product, Image Classification and GIS, Visual Image Interpretation, Types of Pictorial Data Products, Image Interpretation Strategy, Image Interpretation Process, Overview of Image Interpretation Equipment

## Terrain Mapping, Geocoding and Segmentation

Interpolation, Visualization ofContinuous Surfaces, Data Sources for Interpolations, Methods for Interpolations, Global Interpolation, Local Deterministic Methods, Comparison of Global and Local Method, Optimal Interpolation Using Geo Statistics – Kriging, Variogram, Geocoding, Applications of Geocoding, Dynamic Segmentation, Applications of Dynamic Segmentation.

## Remote Sensing Fundamentals

Remote Sensing - Basic Principles, Electromagnetic Remote Sensing, Energy Sources, Energy Interactions with Earth's Surface Materials, Microwave Remote Sensing, The Radar Principle, Factors Affecting Microwave Measurements, Radar Wavebands, SLAR Systems, Sar, Interpreting Sar Images, Geometrical Characteristics, Remote Sensing, Platform and Sensors, Satellite System Parameters, Sensor Parameters, Imaging Sensor Systems, Earth Resources Satellites, Meteorological Satellites.

## GIS Project Design and Management

Software engineering as applied to GIS, GISproject planning, System analysis and study of user requirement, Geographic database design methodology, GIS application software design methodology, system implementation, system maintenance and support.

## Issues and Applications in GIS

Changes in Technology, Data Supply and Users, Roleof Satellite Imagery and Data Sets, Trends in GIS, GIS users, Urban and Municipal Applications, Other Applications.

## Recommended Reading


1. DeMers, Michael N. Fundamentals of geographic information systems. John Wiley & Sons, 2008.
2. Ottens, Henk. "Tor Bernhardsen, Geographic Information Systems. An Introduction." GeoJournal 48.4 (1999): 341-341.
3. Peter A Burrough and McDonell, Principles of Geographical Information Systems ,Oxford University Press, 1998
4. AnjiReddi, B. S. Publications, Remote Sensing and Geographical Information Systems , Second Edition, 2001
5. George B Korte, Onword press, The GIS Book , Thomson Learning, 5th Edition, 2003
6. Kang-tsung Chang, Introduction to Geographical Information Systems ,Tata McGraw Hill, Third Edition, 2003
7. Ian, Heywood. An introduction to geographical information systems. Pearson Education India, 2010.

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6111L** | |
| **Course Title** | **GEOGRAPHICAL INFORMATION SYSTEM LAB** | |

## PREREQUISITE

Knowledge of C / C++ / Matlab / Python programming language and DBMS.

## COURSE OUTCOMES

1. Create and manage vectors and maps.
2. Perform various operations on maps.

## TITLE OF EXPERIMENT

1. Create and manage Vector Data and calculate statistics.
2. Perform the digitization of the given Raster image.
3. Perform Raster styling and analysis.
4. Create a Map and search/download an OpenStreetMap.
5. Perform the Hill Shade analysis on the Terrain data.
6. Perform the Georeferencing on an Aerial Imagery.
7. Perform the Table and Spatial Join on a digitized map and execute spatial queries.
8. Perform the Nearest Neighbor analysis on a map.
9. Explore Web Map Service (WMS).

## ASSESSMENT:

The distribution of (total 40) marks for ESE practical exam as follows:

- Viva-voce: 10-20marks
- Practical/MCQ test: 20-30 marks

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6112T** | |
| **Course Title** | **GAMING TECHNOLOGY** | |

## PREREQUISITES

1. Proficiency in C/C++ programming

## COURSE OUTCOMES

After successful completion of this course the student should be able to:

1. Describe the software architecture for games.
2. Discuss various technologies used for game designing.
3. Build applications using various components of Game development
4. Solve problems in 2D and 3D design techniques specific to game design.
5. Use Game programming platforms, frame works and engines.

## COURSE CONTENTS

### Gaming architecture Core Design:

What is a game? Games aren't everything; games mean game play, creating the game specification with example.

### Initial Design:

The Beginning, Hardware Abstraction, the Problem Domain, Thinking in Tokens

### Use of Technology

The State of the Art, Blue-Sky Research, Reinventing the Wheel, Use of Object Technology

### Building Blocks

Game development issues, core groups in software factory and their interactions, Reusability in Software

## Initial Architecture Design

Architecture styles, The Tier System, Architecture Design, apply Tier-based architecture to architecture design

## Game Development

The Development Process, Code Quality. Coding Priorities. Debugging and Module Completion. The Seven Golden Gambits. The Three Lead Balloons

## Game programming Technologies

Display, Mixing 2D & 3D, DirectX, User Interface code, Resource caching, the main loop

## Design Practices

Smart & naked pointers, using memory correctly, Game scripting languages.

## Building your game

Creating a project, source code repositories and version control, Building the game scripts.

## User interfaces programming and input devices

Getting the Device State, Working with the Mouse (and Joystick), Working with the Keyboard, User Interface Components, More Control Properties

## 2D Drawing and DirectX

2D Drawing and DirectX, Basic 2D Drawing Concepts, Drawing Text, Working with Sprites, Graphics File Formats.

## Initialization and the Main Loop

Initialization, Some C++ Initialization Pitfalls, Initializing your Game, the Main Loop, Stick the Landing: A Nice Clean Exit.

## Loading and Caching Game Resources

Art and Sound Formats, Resource Files, Data Compression, IPac: A Resource File Builder, the Resource Cache, World Design and Cache Prediction.

## 3D Graphics & 3D Engines

3D Graphics Pipeline, Setting Up a Project, Using a Scene Graph, 3D Middleware Review, Rolling Your Own 3D Engine.

## Unity 3D Games

3D Game Assets for your games in Unity, Unity 3D interface overview, Projectcreation & importing assets into Unity, Working with lighting & materials inUnity 3D,Altering shaders in Unity 3D,Switching build platforms in Unity3D,Moving objects in Unity 3D,Coroutines & wait times in Unity 3D,Inheritance& reusability in Unity 3D ,Working with audio in Unity 3D

## RECOMMENDED READING


1. Rollings, Andrew, Dave Morris. "Game architecture and design: a new edition." (2003).
2. Mike McShaffry, Professional Game Programming Dreamtech Press
3. Harris, Andy. GAME PROGRAMMING: THE L LINE. John Wiley & Sons, 2007.
4. Murray, Jeff W. C# game programming cookbook for Unity 3D. CRC Press, 2014.
5. Paris Buttfield-addison , Jon Manning , Tim Nugent, Unity Game Development Cookbook: Essentials For Every Game, O'reilly Media, ISBN: 1491999152
6. Geig, Mike. Sams Teach Yourself Unity Game Development in 24 Hours. Pearson Education, 2014. ISBN-13: 978-0-672-33696-6
7. Norton, Terry. Learning C# by developing games with unity 3D. Packt Publishing Ltd, 2013. ISBN: 1849696586
8. Saunders, Kevin, and Jeannie Novak. Game development essentials: Game interface design. Cengage Learning, 2012. ISBN-13: 978-1-305-11054-0

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6112L** | |
| **Course Title** | **Gaming Technology Lab** | |

## COURSE OUTCOMES;

1. Build Games using  Object Oriented Programming Concepts
2. Simplify Game Development Process using Unity Framework
3. Develop state of art 2D games
4. Plan creation of 3D games and Test them

## TITLE OF EXPERIMENTS:

1. Design of Amazing Racer Game
2. Design of Chaos Ball Game
3. Design of Captain Blaster Game
4. Design of zombie rush game
5. Design of Mini Golf
6. Design of PinBall Game
7. Design of DodgeBall Game
8. Design of Defender Game
9. Design of Gauntlet Runner game

***All experiments should be performed considering above list of games (any four)**

## ASSESSMENT:

The distribution of (total 40) marks for ESE practical exam is as follows:

- Viva-voce: 10marks
- Practical/MCQ test: 30 marks

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6113T** | |
| **Course Title** | **Robotics** | |

## COURSE OUTCOMES:

The objective of this course is to

1. Understand the fundamentals of robotic systems.
2. Discuss the basics of various Robot Components and Algorithms
3. Solve simple problems to perform Transformations
4. Explain simple commands using various Robotic Languages and write simple programs
5. Design basic robotic systems and to program them for functioning.

## COURSE CONTENT:

### INTRODUCTION

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems- Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems- Hydraulic, Pneumatic and Electric system.

### END EFFECTORS AND ROBOT CONTROLS

Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems-Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control.

### ROBOT TRANSFORMATIONS AND SENSORS

Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.

## BASICS OF ROBOT PROGRAMMING

Robot programming-Introduction-Types- Flex Pendant- Lead through programming, Coordinate systems of Robot, Robot controller- major components, functions-Wrist Mechanism-InterpolationInterlock commands- Operating mode of robot, Jogging-Types, Robot specifications-Motion commands, end effectors and sensors commands.

## RAPID AND AML LANGUAGE

Robot Languages-Classifications, Structures- VAL- language commands motion control, hand control, program control, pick and place applications, palletizing applications using VAL, Robot welding application using VAL program-WAIT, SIGNAL and DELAY command for communications using simple applications. RAPID- language basic commands- Motion Instructions Pick and place operation using Industrial robot- manual mode, automatic mode, subroutine command based programming. Move-master command language- Introduction, syntax, simple problems. VALII programming-basic commands, applications- Simple problem using conditional statements-Simple pick and place applications-Production rate calculations using robot. AML Language-General description, elements and functions, Statements, constants and variables-Program control statements- Operating systems, Motion, Sensor commands Data processing

## ADVANCES IN ROBOTICS

Automatization, Product defect detection, Unmanned manufacturing, Automation measurement and control, Artificial Intelligence, Machine Learning

## References


1. Craig. J. J. “Introduction to Robotics mechanics and control”, Addison- Wesley,1999.
2. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
3. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012
4. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning.,2009.
5. Deb. S. R. “Robotics technology and flexible automation”, Tata McGraw Hill publishing company limited, 1994
6. Mikell. P. Groover, “Industrial Robotics Technology”, Programming and Applications, McGraw Hill Co, 1995.
7. Klafter. R.D, Chmielewski.T.A. and Noggin‟s., “Robot Engineering : An Integrated Approach”, Prentice Hall of India Pvt. Ltd.,1994

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6113L** | |
| **Course Title** | **Robotics Laboratory** | |

**Course Outcomes**

1. Understand and be able to apply a variety of techniques to solve problems in areas such as robot control and navigation
2. Describe different mechanical configurations of robot manipulators
3. To be able to program a robot to perform a specified task (e.g obstacle avoidance or wall following) in a target environment
4. Understand how simulations of robots work, where they can be useful and where they can break down.
5. Appreciate the current state and potential for robotics in new application areas.

**Course Contents**

1. Study the major equipment/Software/Components in Robotics Lab, e.g. Robotic Arm components, Arena etc.

2. Learn various commands and syntax of robotic programming language. Also study various robotics software available.

3. Recoding Robot positions

   1. Absolute positions,
   2. Delete Positions
   3. Save and load positions
   4. Move the Robot to recorded positions

4. Writing and running Robot programs – Activity of PICK and Place of an object.

5. Writing a program for path tracing of a Robot.

6. Make simulation model using any robotic software to particular robotic application chosen by student.

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6114T** | |
| **Course Title** | **Deep Learning** | |

## PREREQUISITIES

1. Basic Machine Learning and Data mining algorithms
2. Mathematical and statistical Foundations

## COURSE OUTCOMES:

1. Demonstrate concepts, architectures and algorithms of Neural Networks to solve real world problems.
2. Identify deep feed-forward networks and different regularization techniques used in Deep Learning.
3. Identify challenges in Neural Network optimization and different optimizationalgorithms used in Deep learning models
4. Analyze deep learning algorithms which are more appropriate for varioustypes of learning tasks in various domains
5. Apply deep neural networks from building to training models
6. Analyse detection and recognition tasks using convolution/adversarial neural networks.

## COURSE CONTENT:

**ANN Algorithms:**

Supervised Learning Network- McCulloch–Pitts Unit and Thresholding logic, LinearSeparability, Multi-layer Perceptron Networks, Back-Propagation Network, factorsaffecting Backpropagation Training, Unsupervised Learning Networks- MaxNet.Mexican Hat Net.

**Deep Feed-forward Networks:**

Introduction to Deep Learning, Learning XOR, Gradient-Based Learning, Hidden Units,Architecture Design, Other Architectural Considerations, Applications of Deep neural networks.

**Regularization:**

Regularization for Deep Learning - Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying andParameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods,Dropout.Regularized Linear Regression.

**Optimization for Training Deep Models**:

Need for Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, and Algorithms with Adaptive Learning Rates-AdaGrad, RMSProp, and Approximate Second-Order Methods-Newton's Method, Conjugate Gradients Method.

**Convolutional Networks:**

Motivation, Pooling, Convolutional layers, Additional layers, Residual Nets, Applications of deep learning, Application of CNN.

**Recurrent and Recursive Nets:**

Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs,Encoder -Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, Application of RNN.

## Recommended Reading:


1. Deep Learning, Ian Goodfellow, Yoshua Bengio and Aeron Courville, MIT Press,First Edition, 2016.
2. Deep Learning, A practitioner's approach, Adam Gibson and Josh Patterson, O'Reilly, First Edition, 2017.
3. Yoav Goldberg, A Primer on Neural Network Models for Natural Language Processing, 2015
4. Hands-On Learning with Scikit-Learn and Tensorflow, Aurelien Geron, O'Reilly, First Edition, 2017.
5. Deep Learning with Python, Francois Chollet, Manning Publications Co, First Edition, 2018.
6. Python Machine Learning by Example, Yuxi (Hayden) Liu, First Edition, 2017.
7. A Practical Guide to Training Restricted Boltzmann Machines(link is external), Geoffrey Hinton, 2010

| | | |
|---|---|---|
| ***Programme Name*** | ***S.Y. M.C.A.*** | ***SEMESTER III*** |
| **Course Code** | **R5MC6114L** | |
| **Course Title** | **Deep Learning Laboratory** | |

## PREREQUISITES:

Programming in Python, MatLab /other equivalent Languages

## COURSE OUTCOMES:

1 Demonstrate Tensor flow/Keras deep-learning workstations.

2 Choose appropriate data preprocessing techniques to build neural network models.

3 Analyze different regularization and optimization techniques used in deep learning.

4 Build neural network models using deep learning algorithms-CNN and RNN to solve real world problems.

## TITLES OF EXPERIMENTS

1. Study of Tensor flow /Keras -Importing Libraries and Modules.
2. Loading the dataset, Splitting dataset into training and testing data sets.
3. Implementation of Data preprocessing techniques.
4. Implementation of Artificial Neural Networks -McCulloch-Pitts neuron with ANDNOTfunction, single layer perceptron network, multi-layer perceptron network for an AND function,Back propagation Network for XOR function with Binary Input and Output
5. Implementation of Regularization Techniques.
6. Implementation and analysis of Deep Neural network algorithm: Convolutional neural network (CNN) - Object identification and classification, image recognition
7. Implementation and analysis of Deep Neural network algorithm: Recurrent neural network (RNN) - Character recognition and web traffic Image classification.

## ASSESSMENT:

The distribution of (total 40) marks for ESE practical exam is as follows:

- Viva-voce: 20marks
- Practical/MCQ test: 20 marks

## SEMESTER IV

| S. No | Course code | Course Title | Credits | Evaluation pattern |
|---|---|---|---|---|
| **1** | **R5MC6822D** | Technical Seminar 2 (Stage I) | 1 | Graded evaluation by a committee of at least two examiners including supervisor (guide) |
| **2** | **R5MC6823D** | Technical Seminar 2 (Stage II) | 2 | Graded evaluation by a committee of at least two examiners including supervisor (guide) |
| **3** | **R5MC6824D** | Final Project (Stage I) | 4 | Graded evaluation by a committee of at least two examiners including supervisor (guide) |
| 4 | **R5MC6825D** | Final Project (Stage II) | 8 | Graded evaluation by a committee of at least two examiners including supervisor (guide) |
| | **Total** | | **15** | |

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **MST**: In Semester Test, **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation