Seva Mandal Education Society's
Smt. Kamlaben Gambhirchand Shah Department of Computer Applications
under
Dr. Bhanuben Mahendra Nanavati College of Home Science (Autonomous)
NAAC Re-Accredited 'A+' Grade with CGPA 3.69 / 4
UGC Status: College with Potential for Excellence
'Best College Award 2016-17' adjudged by S.N.D.T. Women's University
Smt. Parmeshwari Devi Gordhandas Garodia Educational Complex
338, R.A. Kidwai Road, Matunga, Mumbai - 400019. Tel: 24095792 Email: smesedu@gmail.com

APPROVED SYLLABUS UNDER AUTONOMY AND NEW EDUCATION POLICY

PROGRAMME: MASTER OF SCIENCE (COMPUTER SCIENCE)

DEPARTMENT OF COMPUTER APPLICATIONS
SEMESTER – I (2023-24)

PROGRAM OBJECTIVES

This program will enable the students to:

1. Gain in-depth knowledge in the key areas of computer science and practice in emerging, cutting edge Computational Technologies.
2. Develop software solutions to real world problems through Information Technological skills with international standards and facilitate them to be outstanding professionals.
3. Contribute to scientific research by independently designing, conducting and presenting the results of small-scale research.
4. Be a part of skilled manpower in the various areas of computer science such as Algorithm Analysis and Design, Data warehousing and Mining, Software Engineering, Advanced Computing technologies, Web-based Applications Development, and Data Science.

PROGRAM OUTCOME

The completion of the post-graduation programme:

1. Takes forward the knowledge gained by the students at the undergraduate level and provides them with an advanced level of learning and understanding of the subject.

2. Provides students with higher educational degree of technical skills in problem solving and application development.
3. Helps students to acquire an analytical and managerial skills to enhance employment potential.

PROGRAM SPECIFIC OUTCOME

1. The main outcome of this programme is enhancement in the Technical and Analytical skills of computer science enthusiasts and provide them with the perfect amalgamation of theory as well as practical knowledge in the various thrust areas of the field.
2. The students will acquire broad knowledge in core areas of computer science, current and emerging computing technologies.
3. The students also acquire a research oriented professional approach to provide sustainable solution to real life problems which can be solved using computational technologies.

Eligibility

- A Science Graduates in
  - BSc. (Physics),
  - BSc. (Maths.),
  - BSc (Elect.),
  - BSc. (IT),
  - B.Sc. (CS) or
  - BCA or
  - any engineering graduate in allied subject from the recognized university

  with an aggregate mark not less than 50% (Open Category) and 45% (Reserved category).

- Mathematics at 12th Level or 100 marks mathematics studied at graduation level is minimum requirement.

Master of Science (Computer Science)

SYLLABUS

M.Sc. (COMPUTER SCIENCE) SEMESTER - I (FIRST YEAR)

SYLLABUS FOR THE ACADEMC YEAR 2023-24

Course Code	Course	Course Type	L	Pr./ Tu	Cr	Ext. Exam.	Int. Exam.	Total Marks
MCS101	Programming Concepts and Design, Analysis of Algorithms	Major (Core)	4	-	4	50	50	100
MCS102	Advanced Software Engineering (Th)	Major (Core)	4	-	4	50	50	100
MCSL103	Statistics Lab (Pr)	Major (Core)	-	2	2	25	25	50
MCSL104	Programming Concept (Pr)	Major (Core)	-	2	2	25	25	50
MCSL105	Advanced Web Technology Lab (Pr)	Major (Core)	-	2	2	25	25	50
MCS106A /MCS106B	Blockchain Technology / Natural Language Processing (Th)	Major (Elective)	4	-	4	50	50	100
MCS107	Research Methods and Statistical Analysis	Minor Stream (RM)	4	-	4	50	50	100
	Total				22	275	275	550

SEMESTER-I	**1 Credit=25 Marks** **Total Credits = 24** **Total Marks = 22*25=550**

COURSE TITLE : PROGRAMMING CONCEPTS AND DESIGN, ANALYSIS OF ALGORITHMS

COURSE OBJECTIVES::

- To introduce students to the programming concepts
- To introduce the classic algorithms in various computer domains, and techniques for designing efficient algorithms.
- To make the students aware of and well-trained in the use of the tools and Techniques of designing and analyzing algorithms.

LEARNING OUTCOMES:

The course will help:

- To prove the correctness and analyze the running time of the basic algorithms for those classic problems in various domains;
- To apply the algorithms and design techniques to solve problems
- To appreciate the impact of algorithm design in practice
- To analyze the complexities of various problems in different domains.

Code No.	Course	Course Type	TC	Th C	Pr C	Int	Ext	Total
MCS101	**Programming Concepts and Design, Analysis of Algorithms**	Major (Core)	**4**	**4**	**-**	**50**	**50**	**100**

Module No.	Objective	Content	Evaluation
1	To introduce students to programming concepts	**Programming Concepts** Object Oriented Programming, Review of OOP - Objects and classes, inheritance, polymorphism, abstraction, Event driven programming, graphics programming, event handling, generic programming – generic classes – generic methods – generic code and virtual machine	Assignment (Marks–05)
2	To explain and use various types of analyses of algorithms To study the role of available tools in solving a problem;	**Design strategies and Analysis of Algorithms** Role of Algorithms in Computing: Algorithms as a technology, Characteristics and building blocks of Algorithm. Getting Started: Designing algorithms, Well known Sorting algorithms (Insertion sort, Bubble Sort, Selection Sort, Shell Sort, Heap Sort). Divide-and-Conquer Technique: The maximum-subarray problem, Integer Multiplication, Strassen's algorithm for matrix multiplication, the substitution method for solving recurrences. Probabilistic Analysis and Randomized Algorithms: The hiring problem, Indicator random variables, Randomized algorithms. Analyzing algorithms, Growth of Functions: Some Useful Mathematical Functions & Notations, Asymptotic Functions & Notation.	Unit Test-1 (Marks-25)
3	To study and apply the dynamic programming and greedy algorithms for solving problems.	**Advanced Design** Dynamic Programming: Rod cutting, Elements of dynamic programming, longest common subsequence, The Problem of Making Change, Matrix Multiplication Using Dynamic Programming. Greedy Algorithms: An activity-selection problem, Elements of the greedy strategy, Huffman codes, Minimum Spanning Trees, Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm.	Oral Presentation (Marks 10)
4	To study and apply various graph search techniques.	**Graph Algorithms** Representations of graphs, Traversing Trees, Breadth-first search, Depth-first search, Best-First Search & Minimax Principle, Topological Sort. Single-Source Shortest Paths: The Bellman-Ford algorithm, Single-source shortest paths in directed acyclic graphs	Class Test (Marks 10)

EVALUATION:

Evaluation	Details **(* please give details of assessment in terms of Unit test/**	Marks

Project/ quiz /or other assignments and marks allotted for it)		
Internal	• **Unit test** • **Oral Test** • **Class Test** • **Assignments**	**50 Marks**
External	**Final Examination**	**50 Marks**
Total marks		**100 Marks**

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, (2009), *Introduction to Algorithms*, Third Edition, PHI Learning Pvt. Ltd-New Delhi
2. Richard F Gilberg, Behrouz A Forouzan , (2005), *Data Structure A Pseudocode Approach with C*. Second edition, Cengage Publisher

REFERENCE BOOKS:

1. Sanjoy Dasgupta, Christos H. Papadimitriou, Umesh Vazirani, (2006), *Algorithms*, McGraw-Hill Higher Education
2. Grokking Algorithms: An illustrated guide for programmers and other curious people, MEAP, Aditya Bhargava,(2010) http://www.manning.com/bhargava
3. Shaum‟s Outlines Data Structure Seymour Lipschutz TMH (2012)
4. Michael T.Goodrich, *Data Structures and Algorithms in C++*, (2015) Wiley Publications

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COURSE TITLE : SOFTWARE ENGINEERING

Course Objectives:

- The basic objective of software engineering is to develop methods and procedures for software development that can scale up for large systems.
- It can be used consistently to produce high-quality software at low cost and with a small cycle of time.

Learning Outcomes:

Students will be able to:

- Apply use of knowledge of Software Life Cycle to successfully implement the projects in the corporate world
- Identify the Inputs, Tools and techniques to get the required Project deliverable and Product deliverable using knowledge areas of Project Management.

Code No.	Course	Course Type	TC	Th C	Pr C	Int	Ext	Total
MCS102	**Advanced Software Engineering**	Major (Core)	**4**	**4**	**-**	**50**	**50**	**100**

Module No	Objective	Content	Evaluation
1	The objective of this module is to introduce the student to the basic foundations of software development using software engineering principles.	**Introduction to software engineering and project management** Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional, Engineering Processes, Software Quality Attributes. Software Development Life Cycle (SDLC), Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models.	Unit Test-1 (Marks-25)
2	To introduce students to Software Requirement elicitation techniques	**Software Requirement Analysis and Specification** Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Data Dictionary Decision Tables, SRS Document, IEEE Standards for SRS. Requirement Elicitation: Interviews, Questionnaire, Brainstorming, Facilitated Application Specification Technique (FAST), Use Case Approach. SRS Case study.	Online Test (Marks-15)
3	This will introduce the students to the basic concepts of software project scheduling & design	**Software Project Planning and Scheduling** Business Case, Project selection and Approval, Project charter, Project Scope management: Scope definition and Project Scope management, Creating the Work Breakdown Structures, Scope Verification, Scope Control. Staffing Level Estimation, Effect of schedule Change on Cost, Degree of Rigor & Task set selector, Project Schedule, Schedule Control **Software Design** Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based	

		Measures, Cyclomatic Complexity Measures: Control Flow Graphs.	
4	To understand the importance of Software Testing strategies and Quality Assurance during the software development process.	**Software Testing and Quality Assurance** Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards Software Quality Assurance (SQA): Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI-CMM Model.	Assignment (Marks-5)
5	The objectives of this module is to introduce the fundamentals of software costing and maintenance To describe three metrics for software productivity assessment.	**Software Maintenance and Software Project Management** Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re- Engineering, Reverse Engineering. Software Configuration Management Activities, Change Control Process, Software Version Control, An Overview of CASE Tools. Software Estimation: Size Estimation: Function Point (Numericals). Cost Estimation: COCOMO (Numericals), COCOMO-II (Numericals). Software Risk Analysis and Management.	Assignment (Marks-5)

EVALUATION:

Evaluation	Details (* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)	Marks
Internal	• **Unit test** • **Online Test** • **Assignment**	**50 Marks**
External	**Final Examination**	**50 Marks**
Total marks		**100 Marks**

TEXT BOOKS:

1) Roger S Pressman, *Software Engineering*, 5th and 7th edition, (2018)McGraw Hill publication.
2) Kathy Schwalbe, *Managing Information Technology Project*, 6edition, (2016) Cengage Learning publication.

REFERENCE BOOKS:

1) Jack T Marchewka , *Information Technology Project Management* , (2010) Wiley India publication.
2) KK Agrawal, Yogesh Singh, *Software Engineering* 3rd edition (2015)by New Age International publication.
3) Richard H. Thayer, *Software Engineering Project Management*, (2016) Wiley India Publication.
4) Douglas Bell, *Software Engineering for students: A Programming Approach*, (2018) Pearson publication.

COURSE TITLE : STATISTICS LAB

COURSE OBJECTIVES:

- To equip the students with a working knowledge of probability, statistics, and modelling in the presence of uncertainties.
- To understand the concept of hypothesis and significance tests
- To help the students to develop an intuition and an interest for random phenomena and to introduce both theoretical issues and applications that may be useful in real life.

LEARNING OUTCOMES:

The students will be able to:

- Distinguish between quantitative and categorical data
- Apply different statistical measures on data
- Identify, formulate and solve problems
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Code No.	Course	Course Type	TC	Th C	Pr C	Int	Ext	Total
MCSL103	**Advanced Software Engineering**	Major (Core)	**2**	**-**	**2**	**25**	**25**	**50**

Module No.	Objective	Content	Evaluation
1	To elaborate software for data analysis	**Introduction to the software used for data analysis** Environment, entering data and formatting, handling data files, performing calculations, handling utilities, formulae and functions	Lab manual for 05 marks
2	To demonstrate visualization of data	**Visualizing** Handling different types of data variables, creating tables, frequency distribution tables and presenting the data in the forms	Online test of 10 marks

		of Charts, Diagrams, graphs, polygons and plots	
3	To implement the methods to find Measures of Central Tendency, dispersion, Skewness	**Data Descriptors and Hypothesis Testing** Measure of Central Tendencies, Dispersions, skewness, Hypothesis testing and estimation, Goodness of Fit	Practical test of 10 marks
4	To perform Correlation and regression to analyse data	**Correlation and Regression** Using SPSS Statistics find correlation and regression in sample data	
Note: Softwares used: Advanced Excel, XLMiner, IBM SPSS Statistics			

EVALUATION:

Evaluation	Details (* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)	Marks
Internal	• **Lab Manuals** • **Practical Test** • **Online Test**	**25 Marks**
External	**Final Examination (Practical)**	**25 Marks**
Total marks		**50 Marks**

TEXT BOOKS:

1. S. C. Gupta, V. K. Kapoor, (2016) *Fundamental of Mathematical Statistics*

REFERENCE BOOKS:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, David King, (2013), *Business Intelligence* (2nd Edition), Pearson
2. Swain Scheps, (2008), *Business Intelligence for Dummies*, Wiley Publications
3. Healy, K. (2019). Data Visualization – A Practical Introduction. USA: Princeton University Press .
4. Keith McCormick, J. S. (2017). SPSS Statistics for Data Analysis and Visualization Kindle Edition. USA: WileY.

COURSE TITLE : PROGRAMMING CONCEPTS LAB

COURSE OBJECTIVES:

- Identify the way of implementation algorithms required for sorting searching, sorting array
- Identify the method of implementation of graph related algorithms

LEARNING OUTCOMES:

The students will be able to:

- Understand the concept of implementation of various algorithms
- Understand the measuring of performance values of various algorithms

Code No.	Course	Course Type	TC	Th C	Pr C	Int	Ext	Total
MCSL104	**Programming Concepts Lab**	Major (Core)	**2**	**-**	**2**	**25**	**25**	**50**

Module No	Objective	Content	Evaluation
1	To implement sorting algorithms	**Implementation of Sorting Algorithms** Insertion sort, Bubble Sort, Selection Sort, Shell Sort	Students will be evaluated using Lab Manual. (Marks 5)
2	To implement divide and conquer method-based algorithms	**Implementation of Algorithms based on divide and conquer** Quick sort implementation, Binary search algorithm	Class Test (Marks 10)
3	To implement shortest path and minimum spanning tree algorithm	**Implementation of MST and Shortest path algorithm** Find Minimum Cost Spanning Tree of a given undirected graph using Kristal‟s algorithm, from a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijikstra‟s algorithm.	
4	To implement graph traversal algorithms	**Implementation of Graph Algorithms** Traverse a graph using Breadth-first search, Depth-first search	Practical Exam will be conducted. (Marks 10)
Programming Language: C/C++			

EVALUATION:

Evaluation	Details **(* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)**	Marks
Internal	• **Lab Manuals** • **Class Test** • **Practical Test**	**25 Marks**
External	**Final Examination (Practical)**	**25 Marks**
Total marks		**50 Marks**

TEXT BOOKS:

1) Narasimha Karumanchi, (2016), *Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles*, CareerMonk Plublications
2) Dorothy Graham, E. P. (2006). Foundations of Software Testing: ISTQB Certification. USA: 2006.
3) James F. Kurose, K. W. (2007). Computer Networking: A Top-down Approach Featuring the Internet. USA: Pearson/Addison Wesley.

REFERENCE BOOKS:

1) Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, (2009), *Introduction to Algorithms*, Third Edition, PHI Learning Pvt. Ltd-New Delhi
2) Sanjoy Dasgupta, Christos H. Papadimitriou, Umesh Vazirani, (2006), *Algorithms*, McGraw-Hill Higher Education
3) Grokking Algorithms: An illustrated guide for programmers and other curious people, MEAP, Aditya Bhargava, http://www.manning.com/bhargava

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COURSE TITLE : ADVANCED WEB TECHNOLOGY LAB

Course Objectives:

- The students will Study the architecture of Dot Net framework
- Understand the basic principles of website development using IDE
- Learn advanced windows and web development techniques using dot NET

Learning Outcomes:

- The students will be able to create user interface-based applications
- Design and develop secure web applications using asp.net according to industry standards

Code No.	Course	Course Type	TC	Th C	Pr C	Int	Ext	Total
MCSL105	**Advanced Web Technology Lab**	Major (Core)	**2**	**-**	**2**	**25**	**25**	**50**

Module No.	Objective	Content	Evaluation
1	To introduce students to IDE of Asp.net web application	**Asp.Net Web Application** ASP.net server controls: Button, TextBox, Labels, CheckBoxex, Radio Buttons, List Controls. Web config and global.aspx files, data types, variables, statements, organizing code	Lab manual for 05 marks
2	To elaborate the use of validation	**Validation Control** Validation techniques, state, management using view state, using session state, using application state, using cookies and URL encoding, Master	Online test of 10 marks

	controls in asp.net	page, content pages, nesting master pages, accessing master page controls from a control page, Site navigation Controls	
3	To demonstrate the use of data base connectivity	**Database Connectivity** Introduction, using SQL data sources, GridView Control, DetailView and FormView Controls, ListView and DataPager Controls in ASP.NET	Practical exam of 10 marks
4	To implement LINQ with asp.net	**LINQ** Operators, implementation, LINQ to objects, XML and ADO.net, AJAX: Introduction and working, asp.net Ajax server control, JQuery: Introduction, UI Library, working	

EVALUATION:

Evaluation	Details **(* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)**	Marks
Internal	• **Lab Manuals** • **Online Test** • **Practical Test**	**25 Marks**
External	**Final Examination (Practical)**	**25 Marks**
Total marks		**50 Marks**

TEXT BOOKS:

1) Stephen Walther,(2011), ASP.NET 3.5 Unleashed,SAMS Publishing,ISBN0-672-33011-3.
2) Stephen Walther, (2010), ASP.NET MVC Framework, Unleashed

REFERENCE BOOKS:

1) Beginning C# - Wrox Publication (2012)
2) Chirag Patel, (2010), Advance .NET Technology second edition, DreamTech Press
3) Jonathan Chaffer and Karl Swedberg, Learning jQuery Third Edition - SPD Publication (2010)
4) Professional C# (2012) and .NET 4.5- Wrox Publication
5) Raj Kamal, Internet and Web Technologies, Tata McGraw Hill (2015)
6) .NET programming Black Book (2015)
7) Murach's ASP. Net 4. 0 Web Programming with C# 2010
8) Andrew Trolsen, *Pro C# 5.0 and the .NET 4.5 Framework*, APress (2011)
9) Vijay Mukhi , *C# with Visual Studio* –BPB (2010)
10) Heard First C# Second Edition , O'Reilly (2015)
11) Murach's ADO. Net 4 Database Programming with C# 2010 4th Edition
12) Web Technologies Black book , DreamTech Press (2016)
13) Ralph Moseley & M. T. Savaliya, (2011), *Developing Web Application*- Second Editon - Wiley

1) Amrendra Sinha, ArunUdai, (2007), *Computer Graphics* –Tata McGraw-Hill Education
2) Rajesh K. Maurya- Computer Graphics -- Wiley India Pvt. Limited, 2011

REFERENCE BOOKS:

1) Donald Hearn and M Pauline Baker, (2007), *Computer Graphics C Version -- Computer Graphics, C Version*, 2/E, Pearson Education.
2) Rafael C. Gonzalez and Richard E. Woods, (2010), *Digital Image Processing* (3rd Edition), Pearson Education.
3) Roy A. Plastock, Roy A. Plastock- (2009), *Schaum's Outline of Computer Graphics* 2/E
4) James D. Foley, Andries van Dam, Steven K. Feiner, John F. Hughes,(2000), *Computer Graphics: Principles and Practice in C*, Pearson Education.
5) David F. Rogers, James Alan Adams, (1990), *Mathematical elements for computer graphics, McGraw-Hill*
6) Peter Shirley, Stephen Robert Marschner (2009) *Fundamentals of Computer Graphics* A K Peters, Limited, 3rd ed.
7) Anil K. Jain, (1989), *Fundamentals of digital image processing*, Prentice Hall

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COURSE: ELECTIVE II – ROBOTICS
CREDIT - 4

Objectives:

- To enable students to design an agent that is Robot
- To enhance understanding in implementation of Robot

Outcomes:

The students will be able to:

- Understand Robots design and implementation in detail
- Understand detailed working of Robot

Code	Course	Teaching Period / Week		Credit			Duration of Theory Exam (in Hrs.)
		L	Pr./ Tu	Int.	Ext.	Total	
MCS402B	**Robotics**	**4**	**-**	**2**	**2**	**4**	**2**

Module No.	Objective	Content	Evaluation
1	To study the basics of the robot and the theory behind it.	**Introduction to Robotics** What is a Robot? Definition, History of Robots: Control Theory, Cybernetics, Grey Walter Tortoise, Analog Electronic Circuit, Reactive Theory, Braitenberg's Vehicle, Artificial Intelligence, Vision Based Navigation, Types of Robot Control.	Written Unit Test – I (Marks 25)
2	To study the different	**Robot Components**	Assignments

	components of the Robot and the actions the robot would perform	Embodiment, Sensors, States, Action, Brains and Brawn, Autonomy, Arms, Legs, Wheels, Tracks, and What really drives them effectors and actuators: Effector, Actuator, Passive and Active Actuation, Types of Actuator, Motors, Degree of freedom Locomotion: Stability, Moving and Gaits, Wheels and Steering, Staying on the path. Manipulators: End effectors, Teleoperation, why is manipulation hard? Sensors: Types of Sensors, Levels of Processing, Passive and Active sensors, Switches, Light sensors, Resistive position sensor.	will be given for the above topics. (Marks 5)
3	To elaborate on sensing through Sonar, Lasers and Cameras	**Sonar, Lasers and Cameras** Ultrasonic and Sonar sensing, Specular Reflection, Laser Sensing, Visual Sensing, Cameras, Edge Detection, Motion Vision, Stereo Vision, Biological Vision, Vision for Robots, Feedback or Closed Loop Control: Example of Feedback Control Robot, Types of feedback control, Feed forward or Open loop control.	Assignments will be given for the above topics. (Marks 5)
4	To study languages to program Robot	**Languages for Programming Robot** Algorithm, Architecture, many ways to make a map, what is planning, Cost of planning, Reactive systems, Action selection, Subsumption architecture, How to sequence behavior through world, hybrid control, Behavior based control and Behavior Coordination, Behavior Arbitration, Distributed mapping, Navigation and Path planning.	Online Class test will be conducted. (Marks 15)

EVALUATION:

1) On Four Modules of 50 marks
2) Final examination of 50 marks
3) Total marks = Internal 50 + External 50 = 100

TEXT BOOK:

1) Deepak Khemani, (2013), *A First course in Artificial Intelligence*, Tata McGraw Hill Education (India) private limited

REFERENCE BOOKS:

1) Maja J Matarić, (2007), *The Robotics Primer*, MIT press Cambridge, Massachusetts, London, England
2) Milan Sonka,Vaclav Hlavac, Roger Boyle, *Image Processing, Analysis, and Machine Vision*, Thomson Learning
3) Robert Haralick and Linda Shapiro, *Computer and Robot Vision*, Vol I, II, Addison-Wesley, 1993.

COURSE: BLOCKCHAIN TECHNOLOGY

CREDIT - 4

Objectives:

- To elaborate the functional/operational aspects of cryptocurrency ECOSYSTEM.
- To Understand emerging abstract models for Blockchain Technology.
- To Identify major research challenges and technical gaps existing between theory and practice in cryptocurrency domain

Outcomes:

The students will be able to:

- Understand various Blockchain, Ethereum Blockchain, and Algorithms and Techniques
- Understand the concept of Trust Essentials, Hyperledger, Smart Contracts, Fabric Composition

Code No.	Course	Course Type	TC	Th C	Pr C	Int	Ext	Total
MCS106A	**Blockchain Technology**	Major (Elective)	**4**	**4**	**-**	**50**	**50**	**100**

Module No.	Objective	Content	Evaluation
1	To introduce students to Blockchain technology and its fundamentals	**Introduction to centralized/decentralized currency** Intent of centralized/decentralized currency, the consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on permission-less, nameless, peer-to-peer network - Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS)	Written Unit Test – I (Marks 25)
2	To introduce students to the basics of cryptography and cryptocurrency	**Cryptographic basics for cryptocurrency** Short overview of Hashing, signature schemes, encryption schemes and elliptic curve cryptography, Bitcoin - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin	Assignments will be given for the above topics. (Marks 5)
3	To elaborate the concept of EVM	**Ethereum** Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity - Smart Contracts - some attacks on smart contracts.	Assignments will be given for the above topics. (Marks 5)
4	To demonstrate new trends in Blockchain	**Trends and Topics** Zero Knowledge proofs and protocols in	Online Class test will be

	technology	Blockchain - Succinct non interactive argument for Knowledge (SNARK) - pairing on Elliptic curves - Zcash.	conducted. (Marks 15)

EVALUATION:

1) On Four Modules of 50 marks
2) Final examination of 50 marks
3) Total marks = Internal 50 + External 50 = 100

TEXT BOOKS:

1) Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016

REFERENCE BOOKS:

1) Joseph Bonneau et al, SoK: Research perspectives and challenges for Bitcoin and cryptocurrency, IEEE Symposium on security and Privacy, 2015
2) J.A.Garay et al, The bitcoin backbone protocol - analysis and applications EUROCRYPT 2015 LNCS VOl 9057, (VOLII), pp 281-310. (eprint.iacr.org/2016/1048)
3) R.Pass et al, Analysis of Blockchain protocol in Asynchronous networks , EUROCRYPT 2017, (eprint.iacr.org/2016/454) . A significant progress and consolidation of several principles). 4. R.Pass et al, Fruitchain, a fair blockchain, PODC 2017 (eprint.iacr.org/2016/916).

COURSE TITLE : NATURAL LANGUAGE PROCESSING

Course Objectives:

- This course introduces the fundamental concepts and techniques of natural language processing (NLP).
- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.

Learning Outcomes:

The students will be able to:

- Understand key concepts from NLP those are used to describe and analyze language
- Understand POS tagging and context free grammar for English language
- Understand semantics and pragmatics of English language for processing

Code No.	Course	Course Type	TC	Th C	Pr C	Int	Ext	Total
MCS106B	**Natural Language Processing**	Major (Elective)	**4**	**4**	**-**	**50**	**50**	**100**

Module No.	Objective	Content	Evaluation
1	To introduce students to text representation in computers	**Introduction** Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications., Text representation in computers, encoding	Written Unit Test – I (Marks 25)

		schemes., Linguistics resources- Introduction to corpus, elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. Resource management with XML, Management of linguistic data with the help of GATE, NLTK.	
2	To elaborate on finite state automata	**Language Grammar** Regular expressions, Finite State Automata, word recognition, lexicon, Morphology, acquisition models, Finite State Transducer, N-grams, smoothing, entropy, HMM, ME, SVM, CRF. Part of Speech tagging- Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions. A survey on natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect and mood and agreement, Context Free Grammar, spoken language syntax.	Assignments will be given for the above topics. (Marks 10)
3	To introduce students on parsing	**Parsing** Unification, probabilistic parsing, TreeBank. Semantics- Meaning representation, semantic analysis, lexical semantics, WordNet Word Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary-based approaches. Discourse- Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure	Assignments will be given for the above topics. (Marks 5)
4	To demonstrate uses of NLP	**Applications of NLP** Spell-checking, Summarization Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries. Machine Translation– Overview.	Online Class test will be conducted. (Marks 10)

EVALUATION:

Evaluation	Details (* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)	Marks
Internal	• **Unit test** • **Online Test** • **Assignments**	**50 Marks**
External	**Final Examination**	**50 Marks**
Total marks		**100 Marks**

TEXT BOOKS:

1) Daniel Jurafsky and James H Martin. (2009), *Speech and Language Processing*, 2e, Pearson Education

2) Dwight Gunning, S. G. (2019). Natural Language Processing Fundamentals: Build Intelligent Applications that Can Interpret the Human Language to Deliver Impactful Results. USA: Packt publishing.

REFERENCE BOOKS:

1) James A. (1994), *Natural language Understanding* 2e, Pearson Education
2) Bharati A., Sangal R., Chaitanya V.. (2000), *Natural language processing: a Paninian perspective*, PHI
3) Siddiqui T., Tiwary U. S.. (2008), *Natural language processing and Information retrieval*, OUP

COURSE TITLE : RESEARCH METHODS AND STATISTICAL ANALYSIS

COURSE OBJECTIVES:

- To understand Research and Research Process
- To acquaint students with identifying problems for research and develop research strategies
- To familiarize students with the techniques of data collection, analysis of data and interpretation

LEARNING OUTCOMES:

Students will be able to:

- Prepare a preliminary research design for projects in their subject matter areas
- Accurately collect, analyse and report data
- Present complex data or situations clearly
- Review and analyse research findings Get the knowledge of objectives and types of research

Code No.	Course	Course Type	TC	Th C	Pr C	Int	Ext	Total
MCS107	**Research Methods and Statistical Analysis**	Minar Stream (RM)	**4**	**4**	**-**	**50**	**50**	**100**

Module No	Objective	Content	Evaluation
1	To introduce students to the concept of research	**Introduction to Research methodology** An Introduction Objectives of Research, Types of Research, Research Methods and Methodology, defining a Research Problem, Techniques involved in Defining a Problem	Unit Test-1 (Marks-25)
2	To elaborate importance of literature review and research design	**Review of Literature, Research Design** Need for Research Design, Features of Good Design, Different Research Designs, Basic Principles of Experimental Designs, Sampling Design, Steps in Sampling Design, Types of Sampling Design, Sampling Fundamentals,	

		Estimation, Sample size Determination, Random sampling. Measurement and Scaling Techniques Measurement in Research	
3	To learn data collection and processing methods	**Data Collection and Processing** Methods of Data Collection and Analysis Collection of Primary and Secondary Data, Selection of appropriate method Data Processing Operations, Elements of Analysis.	Assignment (Marks-10)
4	To learn data analysis and presentation of the results	**Statistical Analysis and Presentation** Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation, Quantitative data analysis, Techniques of Hypotheses, Parametric or Standard Tests Basic concepts, Tests for Hypotheses I and II, Important parameters limitations of the tests of Hypotheses, Chi-square Test, Comparing Variance, As a non-parametric Test, Conversion of Chi to Phi, Caution in using Chi-square test, representation of research.	Online Test (Marks-15)

EVALUATION:

Evaluation	Details (* please give details of assessment in terms of Unit test/ Project/ quiz /or other assignments and marks allotted for it)	Marks
Internal	• **Unit test** • **Online Test** • **Assignments**	**50 Marks**
External	**Final Examination**	**50 Marks**
Total marks		**100 Marks**

TEXT BOOKS:

1) Brinoy J Oates, (2006), *Researching Information Systems and Computing*, Sage Publications India Pvt Ltd

REFERENCE BOOKS:

1) Kothari, C.R., (1985), Research Methodology, Methods and Techniques, third edition, New Age International
2) Juliet Corbin & Anselm Strauss, (2008), Basic of Qualitative Research (3rd Edition), Sage Publications
3) Willkinson K.P, L Bhandarkar, (2010), Formulation of Hypothesis, Hymalaya Publication, Mumbai
4) John W Best and V. Kahn, (2010), Research in Education, PHI Publication.

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