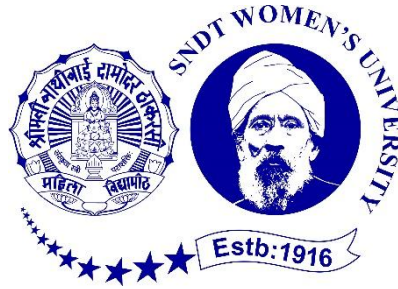# SNDT Women's University, Mumbai

Syllabus

Master Of Computer Applications (M.C.A.)

(2020-2021)

1, Nathibai Thackersey Road, Mumbai- 400020

www.sndt.ac.in

GENESIS

The SNDT Women's University, the pioneer Women's University in India, was founded on June 2, 1916 by Maharshi Karve with 5 students.

Today, the University has an enrolment of over 50000 students (including those from Junior Colleges) in the formal as well as the non-formal streams, 166 Colleges, 39 University Departments, 4 Faculties and 4 Campuses.

The pioneer Women's University has been in the service of Indian women from all walks of life in a variety of ways for the last nine decades. In its endeavor to give the best in science and technology, as well as to enhance research functions, the University established its computer center in 1985 with the assistance of U.G.C. for an 'O' level and higher level system and has a well-functioning computer center with adequate trained staff. The University was selected by the U.G.C. for conducting the Postgraduate Diploma in Computer Science and Applications (PGDCSA) in 1985 and for conducting the Master of Computer Applications (MCA), now AICTE approved, in 1989 and Master of Science in Computer Science [M. Sc. (CS)] from 2013. These courses follow the prescribed syllabus with a thrust for both theoretical computer science as well as applications.

The response to these courses conducted by the University is overwhelming. Thirty three batches of PGDCSA and twenty nine of MCA students have completed the course and are employed in India and abroad. The alumnae work for some of the best institutions in the world.

The SNDT Women's University is affirmative in its commitment to the empowerment of women through education and pursues excellence unstintingly. The University has obtained an A grade from the National Assessment and Accreditation Council (NAAC).

Vision: *SanskritaStreeParashakti*
An Enlightened Woman is a source of Infinite Strength

Mission: Empowerment of Women through Education

OPPORTUNITY

In the rapidly changing area of computer science and technology there is an ever-growing shortage of trained manpower required in educational institutions as well as industry. This problem has been identified as early as 1980 by Rajaraman Committee on Computer Manpower Development and has been reiterated by various panels and study groups set up by the DoE since then. In order to enable one to cope with the ever growing and fast changing technology it is essential for one to acquire appropriate formal training. India has set up priorities, made plans and visualized grand schemes to enter the information technology era, the 21st century. It is clear that this will bring about advances in technology especially in areas such as electronics, space research, biomedical engineering, computer science, communications and genetics.

Computer science is both a pure science as well as an applied science, hence requires a large number of highly qualified personnel. The requirement of personnel can be identified to be in the following sectors viz. manufacturing and maintenance of computer, computer users such as industry and data center, government departments, educational and research organizations, national projects such as that of railways and defense and the growing area of software export.

Computer software development is also a profession particularly suitable for women. As the infra-structural facilities grow, many women will be able to work from their homes, meeting the needs of both the home and the job. This department has so far trained over 755 PGDCSA students and about 946 MCA's who are well placed around the globe. We shall not let any opportunity pass lest they may never come back. The department is proud of its students and its own performance during the last 34 years.

POSTGRADUATE DEPARTMENT OF COMPUTER SCIENCE

The ShreematiNathibaiDamodarThackersey (SNDT) Women's University Post-Graduate Department of Computer Science offers three courses at the post-graduate level, Master of Computer Applications (MCA – 2 years, full-time), Master of Science (Computer Science) (M.Sc.(CS) – 2 years, full-time) and Post Graduate Diploma in Computer Science and Applications (PGDCSA – 1 year, full time). SNDT admits candidates to MCA based on performance in the state level entrance examination conducted by Directorate of Technical Education (DTE), subject to the eligibility criteria set by DTE. Admission to the PGDCSA course is given by the P.G. Department of Computer Science directly.

1. **Objectives**
   - To provide technical education to women to catalyzes their empowerment.
   - To fulfill the national need for trained teachers and researchers in Computer Science.
   - To promote advanced research, doctoral and postdoctoral work.
   - To support the efforts of the University to promote computer awareness and utilization in the various departments.

2. **Major Thrust Areas**
   - Train highly competent computer software professionals needed by the industry.
   - Strengthen teaching, research and consulting in the area of computer applications.
   - Develop software for the improvement of educational testing and software for students with learning disability.
   - Promote teaching materials and manpower for computer science education.
   - Participate actively in professional bodies and industry to contribute to the society at large.
   - Interact with some of the best in the computing profession to give exposure to students and faculty.
   - Establish links with national and international organizations for advanced training and research in computer science.

3. **Computing Facility**
   There are three computer laboratories with best hardware and latest software.

4. **Interaction with Industry and Employment**
   The Department makes consistent efforts to improve the courses to make them relevant. Various industries and Computer organizations are involved in this effort. They do so by functioning on the Department's advisory bodies. The Department gets support from industries for teaching as well. Our past students are employed in some of the finest companies in the world. Some of the students are pursuing higher studies in Computer Science, in India and abroad.

5. **Association with Research and Development Organizations**
   In addition to its linkages with industry the University had signed Memoranda of Understanding with several R&D endeavors with a view to strengthening its academic programs, and enhancing research facilities of the Department of Computer Science. The co-signatories are:
   a. Centre for Development of Advanced Computing (CDAC), formerly NCST, Mumbai.
   b. Nuclear Power Corporation of India Limited

c. The Tata Power Company Limited, Andheri, Mumbai
d. Renaissance Mumbai Convention Centre Hotel & Lakeside Chalet- Mumbai, Marriott Executive Apartments.
e. Safe Pvt. Ltd, Andheri(E), Mumbai
f. Selec Controls Pvt. Ltd, Mumbai
g. School of Education and Communication, Jonkoping University, Sweden The department is an institutional member of professional bodies such as Computer Society of India.

6. **Research Activities**

The Department is actively involved in research in the following areas:
a. Artificial Intelligence (AI)
b. Image Processing
c. Secure Communication
d. Web Technologies
e. Software Engineering and project management
f. Geographical Information System
g. Internet of Things
h. Cyber Security
i. Data Warehousing & Data Mining
j. Machine Learning

7. **Self-Enrichment Courses**

A series of programs in the areas of personality development, interview techniques, communication etc. will be arranged.

8. **Faculty**

The Department has its own full time qualified and experienced faculties for lectures and practical. Several faculty members are actively involved in various areas of research and software development.

9. **Visiting Faculty**

The University has been receiving the support of research and educational institutions in Mumbai such as IIT (Mumbai), BARC, C-DAC, etc. The Department also receives support from several talented and well-experienced professionals from the Industry as visiting faculty.

10. **Library**

The University has excellent library facilities having about 2000 volumes of recent editions pure as well as applied computer science. The library subscribes to several leading Indian as well as foreign journals in computer science and related areas. In order to supplement these, the department maintains an appreciable collection of books and journals that are available to the students all the time.

11. **Service to other Departments**

This department has played a significant role in helping other departments set up computer laboratories; conduct computer related courses and computer awareness programs.

12. **Students and Departmental Activities**

The Department makes consistent efforts to improve the quality of the courses it conducts

as well as to maintain acceptable standards. In order to develop as well as to assess the individual competence there are regular tests as well as assignments. There is a continuous internal assessment for 50marks. The end of semester examination has a weightage of 50 marks. Group work and collaborative efforts are inculcated by having departmental projects as well as by attaching a group of students to a member of the faculty for discussions, etc. The problem-solving capabilities are developed and reinforced by administering aptitude tests, programming assignments and even by organizing various contests. Visits to Computer Centers and Research and Development Organizations with advanced and sophisticated facilities widen the horizon and perspective of students. Experts from Industry, Consultancies and Research Institutes are invited to give lectures on specialized topics. Efforts are made to develop leadership qualities, and other desirable personality traits through extra-curricular activities as well as workshops on personality development, problem solving, etc. Interview techniques and lectures on 'job expectations' prepare them to face the challenges of job seeking. Student participation in the running of the department is achieved by having well-functioning Students Council. There are active student chapters of the Association for Computing Machinery (ACM) and Computer Society of India (CSI). Digital library access is available to the members of the ACM. Students are involved in National Service Scheme (NSS) a community service.

13. Students Council:
Students Council Objectives:
The Students council formally represents the students and endeavors to improve the department. The council shall strive to solve the problems of students being a liaison between the students and the faculty.
Composition:
The student's council is a body composed of
The General Secretary (GS)
Two Assistant General Secretaries (AGS)
Treasurer
Eight Council Members

14. Extra-Curricular Activities
The Juhu Campus of the University has excellent facilities for indoor as well as outdoor activities.

15. Vacation
Students normally get Diwali, Christmas, and summer vacations as per university norms.

16. Eligibility
MCA: Passed BCA/ Bachelor Degree in Computer Science Engineering or equivalent Degree. OR passed B.Sc./ B.Com./ B.A. with Mathematics at l0+2 Level or at Graduation Level (with aOOitional bridge Courses as per the norms of the concerned University). Obtained at least 50% marks (45% marks in case of candidates belonging to reserved category) in the qualifying Examination

MCA SEMESTER-I

Code	Subject	L	T	Pr.	Cr.	Int. Exam.	Ext. Exam.	Total Marks
1101	Mathematical Foundation of Computer Science	3	2	-	4	50	50	100
1102	Research Methodology and IPR	3	2	-	4	50	50	100
1103	Advanced Data Structure	3		-	3	25	50	75
1104	Advanced Java (Contents: spring, MVC, Net Beans and Hibernate)	3		-	3	25	50	75
1105	Computer Network Programming using Linux	3		-	3	25	50	75
1201	Advanced Data Structure Lab			4	2	25	25	50
1202	Advanced Java lab	-		4	2	25	25	50
1203	Computer Network Programming Lab	-		4	2	25	25	50
1204	Research paper I - Literature Review (review paper)	-		2	1	25	-	25
	Total				**24**			**600**

MCA SEMESTER-II

Code	Subject	L	T	Pr.	Cr.	Int. Exam.	Ext. Exam.	Total Marks
2101	Managerial Economics	3	2	-	4	50	50	100
2102	Software Architecture	3	2	-	4	50	50	100
2103	Artificial Intelligence	3		-	3	25	50	75
2104	Advanced Databases	3		-	3	25	50	75
2105	Elective-I	3		-	3	25	50	75
2201	Web Engineering Lab(Contents: CSS, Angular js, node js, PhP, Mysql,etc)	-		4	2	25	25	50
2202	Software Testing and Quality Assurance Lab	-		4	2	25	25	50
2203	Mobile Computing lab	-		4	2	25	25	50
2204	Artificial Intelligence Lab	-		4	2	25	25	50
2205	Advanced Databases Lab	-		4	2	25	25	50
2206	Research paper II - Research Mini Project	-		2	1	25	-	25
	Total				**28**			**700**

MCA SEMESTER-III

Code	Subject	L	Pr.	Cr.	Int. Exam.	Ext. Exam.	Total Marks
3101	Cyber Security	3	-	3	25	50	75
3102	Data science and Analytics	3	-	3	25	50	75
3103	Cloud Computing	3	-	3	25	50	75
3104	Machine learning	3	-	3	25	50	75
3105	Elective-II	3	-	3	25	50	75
3201	Data science and Analytics lab (Content: Implementation using Python)	-	4	2	25	25	50
3202	Cloud computing Lab	-	4	2	25	25	50
3203	Elective-II Lab	-	4	2	25	25	50
3204	Machine learning lab	-	4	2	25	25	50
3205	Research Paper III- Presentation / Publication (Content: Technical communication for Research Paper Writing, Rubrics for evaluation)	-	2	1	25	-	25
	Total			**24**			**600**

MCA SEMESTER-IV

Code	Subject	L	P/T	Cr	Int. Exam.	Ext. Exam.	Total
4101	Project	-	-	16	200	200	400
4102	Swayam based MOOC	-	-	4	-	100	100
	Total			**20**			**500**

Names of Elective-I
Digital Image Processing
Ethical hacking
IOT
Game theory
Block Chain

Names of Elective-II
Soft Computing
GIS
Cyber Physical System
NLP
Big Data Analytics

SEMESTER CREDITS				1 Credit (Practical)=2 Hrs
I	II	III	IV	1 Credit (Tutorial)=2 Hrs
				1Credit (Theory)=1 Hr
24	28	24	20	1 Credit = 25 marks
				Total Credits=96
				Total Marks=96*25=2400

- **Lab Components are practical oriented and no theory examinations will be conducted. Practical examinations will be conducted and evaluated by Internal and External Examiners.**
- **Int. Exam: C.A.: Internal examination and continuous assessment involves two internal test + Assignments/ Presentation/ Oral/ Viva/Group Discussion etc**

Terms Used:
Pr.:   Practical
C.A.:   Continuous Assessment
Tw.:   Term Work
Cr.:   Credits
Int.:   Internal
Ext.:   External

ASSESSMENT:
(I) The final total assessment of the candidate is made in terms of an internal assessment and an external assessment for each course.
1. For each theory paper, credit will be based on internal assessment and 2 credits for end examination (external assessment), whereas the lab papers 1 credits for internal and one for external.
2. It is mandatory to pass the internal exam of each Subject and hence is eligible for external exams.
3. The division of the internal marks allotted to internal assessment of theory papers is on the basis of Attendance and assignment throughout the semester and two written test of each taken during the semester.
4. The marks of the practical's / lab would be given on external practical exam & oral. No Theory Questions or Exams to be conducted. Only Programs will be asked. Output Questions can be asked.
5. The internal marks will be communicated to the University at the end of each semester. These marks will be considered for the declaration of the results.

(II) Examination:
Examinations shall be conducted at the end of the semester i.e. During December and in May, However supplementary examinations will also be held in December and May.
Students have to pass both the internal assessment and external assessment separately.

Total marks obtained = Internal marks + External marks

MCA DETAILED SYLLABUS

SEMESTER - I

Branch: MCA	Semester-I
Subject Code: 1101	Lecture: 03 + Tutorial :01 Credit: 04
Subject Title	Mathematical Foundation of Computer Science

COURSE OBJECTIVES:
1. To understand the mathematical fundamentals that is prerequisites for a variety of courses in computer Science and Applications.

COURSE OUTCOMES:
After completion of course, students would be able to:
1. To understand the basic notions of Induction and state machine.
2. To understand graphs and its applications in Computer Science.
3. To understand the methods of statistical inference, and the role probability in computer science.
4. To be able to perform correct and meaningful statistical analyses of simple to moderate complexity.

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	Induction: Ordinary Induction, Strong Induction. State Machines: States and Transitions, The Invariant Principle, Partial Correctness & Termination.	5	10
	2	Recursive Data Types, Recursive Definitions and Structural Induction, Strings of Matched Brackets, Recursive Functions on Nonnegative Integers, Arithmetic Expressions, Games as a Recursive Data Type, Search Trees, Induction in Computer Science.	8	16
UNIT-II	3	Graph Theory, Graph Variations, Applications of Graphs, Some Common Graphs, Isomorphism, Connectivity, A Simple Connectivity Theorem, Distance and Diameter, Adjacency. Matrices.	8	16
	4	Trees, Spanning Trees, Tree Variations, Graph Theory: Coloring Graphs, k-Coloring, Planar Graphs, Euler's Formula, Directed graphs & Partial	8	16

UNIT-III	5	Introduction to data: Types of variables; data collection principles; types of studies. Graphical methods: histograms and other graphs Frequency distribution, measures of central tendency, measures of dispersion, Descriptive Statistics Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of over fitting model assessment.	8	16
	6	Elementary probability theory, Conditional probability, Bayes theorem, Random variable Expected values, Discrete Probability distributions: Uniform, Binomial, Poisson, distribution. Continuous distributions: Uniform, Exponential, Normal, Relationship between Poisson and exponential distribution.	8	16
UNIT-IV	7	Recent Trends in various distribution functions in mathematical field of computer science for varying fields.	3	10

Reference books:

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi. Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley

Branch: MCA	Semester-I
Subject Code: 1102	**Lecture: 03 + Tutorial :01**
	Credit: 04
Subject Title	**RESEARCH METHODOLOGY AND IPR**

Course objectives:
• To give an overview of the research methodology and explain the technique of defining a research problem
• To explain the functions of the literature review in research.
• To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
• To explain various research designs and their characteristics.
• To explain the details of sampling designs, measurement and scaling techniques and also different methods of data collections.
• To explain several parametric tests of hypotheses and Chi-square test.
• To explain the art of interpretation and the art of writing research reports.
• To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment.
• To discuss leading International Instruments concerning Intellectual Property Rights.

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
	1	Research methodology: An Introduction Objectives of Research, Types of Research, Research Methods and Methodology, defining a Research Problem, Techniques involved in Defining a Problem.	5	10

UNIT-I	2	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.	5	10
	3	Measurement and Scaling Techniques Measurement in Research, Measurement Scales, Sources in Error, Techniques of Developing Measurement Tools, Scaling, Meaning of Scale, Scale Construction Techniques.	5	10
UNIT-II	4	Methods of Data Collection and Analysis Collection of Primary and Secondary Data, Selection of appropriate method Data Processing Operations, Elements of Analysis, Statistics in Research, Measures of Dispersion, Measures of skewness, Regression Analysis, Correlation.	5	10
UNIT-III	5	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.	8	20
	6	Analysis of Variance and Co-variance ANOVA, One-way ANOVA, Two Way ANOVA, ANOCOVA Assumptions in ANOCOVA, Multivariate Analysis Technique Classification of Multivariate Analysis, factor Analysis, R-type Q Type factor Analysis, Path Analysis	10	20
UNIT – IV	7	INTELLECTUAL PROPERTY RIGHTS: Basic Principles and Acquisition of Intellectual Property Rights: Philosophical Aspects of Intellectual Property Laws, Basic Principles of Patent Law, Patent Application procedure, drafting of a Patent Specification, Understanding Copyright Law, Basic Principles of Trade Mark, Basic Principles of Design Rights, International Background of Intellectual Property Information Technology Related Intellectual Property Rights.	10	20

Reference Books:
1. "Research Methodology", C.R. Kothari, Wiley Eastern.
2. "Formulation of Hypothesis", Wilkinson K.P, L Bhandarkar, Himalaya Publication, Bombay.
3. "Research in Education", John W Best and V. Kahn, PHI Publication.
4. "Research Methodology- A step by step guide for beginners", Ranjit Kumar, Pearson
5. "Management Research Methodology-Integration of principles, methods and
6. Techniques", K.N. Krishna swami and others, Pearson Education

Branch: MCA	Semester-I
Subject Code: 1103	Lecture: 03 Credit: 03
Subject Title	Advanced Data Structure

COURSE OBJECTIVES:
1. Understand and apply linear data structures-List, Stack and Queue.
2. Understand the graph algorithms.
3. Learn different algorithms analysis techniques.
4. Apply data structures and algorithms in real time applications
5. Able to analyze the efficiency of algorithm.

COURSE OUTCOMES:
After completion of course, students would be able to:
1. Describe, explain and use abstract data types including stacks, queues and lists.
2. Design and Implement Tree data structures and Sets.
3. Able to understand and implement nonlinear data structures – graphs
4. Able to understand various algorithm design and implementation

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	**LINEAR DATA STRUCTURES:** Introduction - Abstract Data Types (ADT) – Stack – Queue – Circular Queue - Double Ended Queue - Applications of stack – Evaluating Arithmetic Expressions - Other Applications - Applications of Queue - Linked Lists - Singly Linked List - Circularly Linked List - Doubly Linked lists – Applications of linked list – Polynomial Manipulation.	12	15
UNIT-II	2	**NON-LINEAR TREE STRUCTURES:** Binary Tree – expression trees – Binary tree traversals – applications of trees – Huffman Algorithm - Binary search tree - Balanced Trees - AVL Tree - B-Tree - Splay Trees – Heap. Heap operations- -Binomial Heaps - Fibonacci Heaps- Hash set.	12	20
UNIT-III	3	**GRAPHS:** Representation of graph - Graph Traversals - Depth-first and breadth-first traversal - Applications of graphs - Topological sort – shortest-path algorithms - Dijkstra's algorithm – Bellman-Ford algorithm – Floyd's Algorithm - minimum spanning tree – Prim's and Kruskal's algorithms.	12	20
UNIT-IV	4	**ALGORITHM DESIGN AND ANALYSIS:** Algorithm Analysis – Asymptotic Notations - Divide and Conquer – Merge Sort – Quick Sort - Binary Search - Greedy Algorithms – Knapsack Problem – Dynamic Programming – Optimal Binary Search Tree – Warshall's Algorithm for Finding Transitive Closure.	12	20

Reference Books:

1. Anany Levitin "Introduction to the Design and Analysis of Algorithms" Pearson Education, 2015
2. E. Horowitz, S.Sahni and Dinesh Mehta, "Fundamentals of Data structures in C++", University Press, 2007
3. E. Horowitz, S. Sahni and S. Rajasekaran, "Computer Algorithms/C++", Second Edition, University Press, 2007
4. Gilles Brassard, "Fundamentals of Algorithms", Pearson Education 2015
5. Harsh Bhasin, "Algorithms Design and Analysis", Oxford University Press 2015
6. John R.Hubbard, "Data Structures with Java", Pearson Education, 2015
7. M. A. Weiss, "Data Structures and Algorithm Analysis in Java", Pearson Education Asia, 2013
8. Peter Drake, "Data Structures and Algorithms in Java", Pearson Education 2014
9. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", Third Edition, PHI Learning Private Ltd, 2012
10. Tanenbaum A.S, Langram Y. Agdestein M.J, "Data Structures using C" Pearson Education, 2004.
11. V. Aho, J. E. Hopcroft, and J. D. Ullman, "Data Structures and Algorithms", Pearson Education, 1983

Branch: MCA		Semester-I	
Subject Code: 1104		**Lecture: 03**	
		Credit: 03	
Subject Title		**Advanced JAVA**	

COURSE OBJECTIVES:
1. Understanding the basic concepts regarding J2EE
2. To understand GUI based applications and events associated with it.
3. Students will also be exposed to advanced topics including multithreading, internet networking, and JDBC database connectivity.
4. Understanding server-side computing with servlets and embedding html pages with JSP, jQuery, JS, JS and JSON.
5. Students will also be exposed to Spring framework with MVC architecture.
6. Understanding to JMS support to Springs.
7. Understanding to hibernate and querying with HQL.

COURSE OUTCOMES:
After completion of course, students would be able to:
1. Understanding of advance web concepts associated with JAVA.
2. Familiarization with hibernate.
3. Familiarization with the MVC architecture.
4. Familiarization with the Spring framework.

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT- I	1	**Introduction**: History, architecture and its components, Java Class File, Java Runtime Environment, The Java Virtual Machine, JVM Components, The Java API, java platform, java development kit, Lambda Expressions, Methods References, Type Annotations, Method Parameter Reflection. Object Oriented Programming, packages, enumerations, Multi-threading, Exception Handling. Abstract Window Toolkit: Window Fundamentals, Component, Container, Panel, Window, Frame, Canvas. Components – Labels, Buttons, Check Boxes, Radio Buttons, Choice Menus, Text Fields, Text, Scrolling List, Scrollbars, Panels, Frames, JAVA adapter classes. Swing components. AWT vs Swings.	5	10
	2	**Introduction to Event Handling:** Identifying the source of Event, Event Listeners and Event Handlers, the Delegation Event Model, Event classes, Event Listener Interface, Action Listener interface, Mouse Listener Interface Adapter classes- the Mouse Adapter class, the Mouse Motion Listener Interface.	5	10
	3	**Introduction to JDBC**: What is JDBC. Database connectivity, JDBC Architecture, JDBC drivers, Using JDBC API – Loading a Driver,		

		connecting and executing JDBC statement, Handling SQL Exceptions. Accessing Result Sets, method of Result Set interface, Methods of Prepared Statement interface, retrieving row, inserting row, Managing Database Transactions, creating and calling stored procedures in JDBC, using Metadata in JDBC.	6	10
UNIT- II	4	**Introduction to servlets:** Servlet vs CGI, Servlet API overview, Servlet Life cycle, Generic servlet, HTTP Servlet, ServletConfig, Servlet Context, Handling HTTP Request and response –GET / POST method, request dispatching, Using cookies, Session tracking.	5	10
	5	**Web development using JSP:** Introduction to JSP, JSP Architecture, JSP Directives, JSP scripting elements, Default objects in JSP, JSP Actions, JSP with beans and JSP with Database, Error handling in JSP, tracking techniques in JSP, Introduction to custom tags, JSTL tags in detail. Introduction to jQuery, JS, JS JSON, jQuery vs JS.	5	10
UNIT- III	6	**Introduction to Spring Framework:** Spring Architecture, Spring Aspect of Object-Oriented Concepts – Join Point and Point Cuts. Spring web applications with Spring MVC. Features of the Spring Boot. Use of Spring Boot to create and configure a Spring application. Customize Spring Boot features. REST web services with Spring. Spring Data Secure with Spring Security. JMS- Introduction, requirement, JMS Programming model. JMS support of Spring.	12	15
UNIT- IV	7	**Introduction to Hibernate**: Problem with JDBC - paradigm mismatch, ORM. Different components of Hibernate, How to persist objects using Hibernate, mapping files in hibernate, configuration files and Session object, Instance states, Implementing Inheritance in Hibernate, Transactions in Hibernate, Querying with HQL (Hibernate Query Language), Named and native queries, Working with Criteria Interface, Query by example – QBE, Caching and fetching.	10	10

Reference Books:

1. The Complete Reference, Third Edition, by Patrick Naughton and Herbert Schildt, Tata McGraw Hill Edition 1999.
2. Java Enterprise in a Nutshell: A Desktop Quick Reference (Nutshell Handbook) or any other book with similar contents.
3. Mastering Java2 J2SE1.4 by John Zukouski PBP Publication
4. JavaTM How to Program Sixth Edition by H.M Deitel, P.J. Deitel
5. Core Servlets & JavaServer Pages by Marty Hall, Larry Brown
6. Spring Boot in Action 1st Edition by Craig Walls
7. Beginning Hibernate Second Edition by Jeff Linwood, Dave Minter is the third book for Hibernate beginners.

Branch: MCA	Semester-I
Subject Code: 1105	**Lecture: 03** **Credit: 03**
Subject Title	Computer Network Programming using Linux

COURSE OBJECTIVES:

1. Understanding the basic concepts regarding networking.
2. To understand to Linux utilities.
3. To understand file handling, signals.
4. To understand IPC, network programming in Java.
5. To understand processes to communicate with each other across a Computer Network.

COURSE OUTCOMES:

After completion of course, students would be able to:

1. Understanding of the working principle of Socket programming.
2. Familiarization with the IPC using Linux

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	**Introduction to Networking:** Introduction to computer network, network application, network software and hardware components (Interconnection networking devices), Network Operating Systems, Network topology, protocol hierarchies, design issues for the layers, connection oriented and connectionless services. Reference models: Layer details of OSI, TCP/IP models. Communication between layer.	6	10
	2	**Directory Services:** a) Active directory services Active directory architecture, deploying active directory, designing active directory, Managing Active directory. b) Novel directory services: NDS architecture, NDS tree design, Building the tree NDS security.	5	10
	3	**Linux Utilities:** File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking utilities, Filters, Text processing utilities and Backup utilities. Bourne again shell(bash) – Introduction, pipes and redirection, here documents, running a shell script, the shell as a programming language, shell meta characters, file name substitution, shell variables, command substitution, shell commands, the environment, quoting, test command, control structures, arithmetic in shell, shell script examples.	6	10

UNIT-II	4	**Files :**File Concept, File types File System Structure, I nodes, File Attributes, file I/O in C using system calls, kernel support for files, file status information-stat family, file and record locking-lockf and fcntl functions, file permissions- chmod fchmod,\ file ownership-chown, lchown , fchown, links-soft links and hard links – symlink, link, unlink. **File and Directory management** – Directory contents, Scanning Directories- Directory file APIs. Process- Process concept, Kernel support for process, process attributes, process control – process creation, replacing a process image, waiting for a process, process termination, zombie process, orphan process.	6	10
	5	**Signals**- Introduction to signals, Signal generation and handling, Kernel support for signals, Signal function, unreliable signals, reliable signals, kill, raise, alarm, pause, abort, sleep functions. **Interprocess Communication** – Introduction to IPC mechanisms, Pipes- creation, IPC between related processes using unnamed pipes, FIFOs-creation, IPC between unrelated processes using FIFOs (Named pipes), differences between unnamed and named pipes, popen and pclose library functions, Message Queues- Kernel support for messages, UNIX system V APIs for messages, client/server example. Semaphores-Kernel support for semaphores, UNIX system V APIs for semaphores.	5	10
UNIT-III	6	Shared Memory- Kernel support for shared memory, UNIX system V APIs for shared memory, client/server example. Network IPC – Introduction to Unix Sockets, IPC over a network, Client-Server model ,Address formats(Unix domain and Internet domain), Socket system calls for Connection Oriented – Communication, Socket system calls for Connectionless-Communication, Example-Client/Server Programs- Single Server-Client connection, Multiple simultaneous clients, Socket options – setsockopt, getsockopt, fcntl.	12	15
UNIT-IV	7	**Network Programming in Java-** TCP sockets, UDP sockets (datagram sockets), Server programs that can handle one connection at a time and multiple connections (using multithreaded server), Remote Method Invocation (Java RMI)-Basic RMI Process, Implementation Details-Client-Server Application.	8	10

Reference Books:

1. The complete Reference Networking by Craig Zacker TMH Publication.
2. Distributed Systems and Networks by William Buchanan TMH Publication.
3. Windows 2000 Server Bible by Jeffrey R.S shapiro and Jim Boyee IDG Books India.
4. Linux System Programming, Robert Love, O'Reilly, SPD.
5. Advanced Programming in the UNIX environment, 2nd Edition, W.R.Stevens, Pearson Education.
6. Introduction to Computer Networks - Andrew S. Tanenbaum
7. UNIX Network Programming, Volume I and II - W. Richard Stevens
8. Power Programming with RPC - John Bloomer
9. RPC handbook, Java Programming Language - Ken Arnold, James Gosling
10. JDK 1.2 Documentation

Branch: MCA	Semester-I
Subject Code:1201	**Practical: 04** **Credit: 02**
Subject Title	**ADVANCED DATA STRUCTURE LAB**

COURSE OBJECTIVES:
1. Understand and apply linear data structures-List, Stack and Queue.
2. Understand the graph algorithms.
3. Learn different algorithms analysis techniques.
4. Apply data structures and algorithms in real time applications
5. Able to analyze the efficiency of algorithm.

COURSE OUTCOMES:
After completion of course, students would be able to:
1. The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
2. Students should be able to understand the necessary mathematical abstraction to solve problems.
3. To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
4. Student should be able to come up with analysis of efficiency and proofs of correctness.

Sample Exercises:
1. Write a program to insert, delete and traverse elements in sorted singly linked list.
2. Write a program to insert, delete and traverse elements in sorted doubly linked list.
3. Write a program to implement static hashing using linear probing as overflow technique.
4. Write a program to implement static hashing using chaining as overflow technique.
5. Write a program to implement Directory based dynamic hashing technique.
6. Write a program to implement Directory less dynamic hashing technique.
7. Write a program to insertion and updation in skip lists.
8. Write a program to implement Boyer-Moore algorithm for String matching
9. Write a program to implement Binary Search tree.
10. Write a program to implement AVL tree.
11. Write a program to implement B tree.
12. Write a program to implement Splay tree
13. Write a program to implement Digital search tree.
14. Write a program to implement Binary heap structure.
15. Write a program to implement Leftist heaps.
16. Write a program to implement Boyer-Moore algorithm for String matching.
17. Write a program to implement Knuth-Morris-Pratt algorithm for String matching.
18. Write a program to compress text using Huffman coding algorithm.
19. Write a program to implement Tries to perform pattern matching.
20. Write a program to construct priority search tress.

Branch: MCA	SEMESTER-I
Subject Code:1202	Practical: 04 Credit: 02
Subject Title	**ADVANCED JAVA LAB**

COURSE OBJECTIVES:
1. To understand GUI based applications and events associated with it.
2. Understanding the advance multithreading, internet networking, and JDBC database connectivity concepts.
3. Understanding server-side computing with servlets and embedding html pages with JSP, jQuery, JS, JS and JSON.
4. Students will also be exposed to Spring framework with MVC architecture.
5. Understanding to JMS support to Springs.
6. Understanding to hibernate and querying with HQL.

COURSE OUTCOMES:
After completion of course, students would be able to:
1. Understanding of advance web concepts associated with JAVA.
2. Familiarization with hibernate.
3. Familiarization with the MVC architecture.
4. Familiarization with the Spring framework.

Modules	Sr. No.	Topics and Details
	1	OOPs, AWT and Swings
	2	Event Handling with Swings
UNIT-I	3	JDBC
	4	Servlet
UNIT-II	5	JSP
	6	Introduction to jQuery, JS, JS JSON, jQuery vs JS
UNIT-III	8	JMS support of Spring.
UNIT-IV	9	Introduction to Hibernate, Querying with HQL

Branch: MCA	SEMESTER-I
Subject Code:1203	Practical: 04 Credit: 02
Subject Title	Computer Network Programming Lab

COURSE OBJECTIVES:

Understanding the basic concepts regarding networking

1. To understand to Linux utilities
2. To understand file handling, signals.
3. To understand IPC, network programming in Java.
4. To understand processes to communicate with each other across a Computer Network.

COURSE OUTCOMES:

After completion of course, students would be able to:

1. Understanding of the working principle of Socket programming
2. Familiarization with the IPC using Linux

Modules	Sr. No.	Topic and Details
UNIT-I	1	Programs using TCP Sockets (like date and time server & client, echo server & client, etc.)
	2	Programs using UDP Sockets (like simple DNS)
	3	Programs using Raw sockets (like packet capturing and
UNIT-II	4	Programs using RPC
	5	Simulation of sliding window protocols
	6	Experiments using simulators
UNIT-III	7	Introduction to Spring Framework
	8	Performance comparison of Routing protocols
UNIT-IV	9	Study of TCP/UDP performance

Branch: MCA	SEMESTER-I
Subject Code: 1204	Practical: 02 Credit: 01
Subject Title	Research paper I - Literature Review (Review paper)

The literature review is a required course in the Master of Computer Science and Application (MCA). It is an individual research activity which student has to undergo under the supervision of one faculty member from the department. This syllabus sets out the requirements of the literature review in the area of the choice of the student to inculcate research aptitude in the students.

The review should contain anywhere between seven to ten thousand words (20 to 30 pages) in well-readable and grammatically correct English language. It should be based on (i) three to five "key articles" from the journals specified in UGC care List and (ii) an additional 15 to 20 articles from other sources.

The student tasks and responsibilities are detailed in the list below:
1. Choose a topic and submit it to the allotted faculty supervisor for approval.
2. Once topic is approved, make research plan with help from supervisor.
3. Work on review in consultation with the supervisor.
4. Hand-in final version of review to supervisor.
5. Internal presentation of the review paper will be conducted in the department.
6. The evaluation of the review paper will be done on the basis of Rubrics.
7. Supervisor hand over marks to office for the result purpose.

Branch: MCA	SEMESTER-II
Subject Code: 2101	Lecture: 03 + Tutorial :01 Credit: 04
Subject Title	MANAGERIAL ECONOMICS

COURSE OBJECTIVES:
1. To integrate the basic concepts of economics with the tools of mathematics and statistics in order to analyze and make optimal business decisions.

COURSE OUTCOMES:
After the completion of the course, students will be able to –
1. Understand the roles of managers in firms.
2. Understand the internal and external decisions to be made by managers.
3. Analyze the demand and supply conditions and assess the position of a company.
4. Design competition strategies, including costing, pricing, product differentiation, and market environment according to thes natures of products and the structures of the markets.
5. Analyze real-world business problems with a systematic theoretical framework.
6. Make optimal business decisions by integrating the concepts of economics, mathematics and statistics.

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	Economic analysis, Microeconomics and macroeconomics, Analysis of consumer behavior:	3	8
	2	Law of demand and supply, Utility analysis/indifference curves, Revealed preference theory, Elasticity of demand, Consumer surplus. 1.Breakeven point 2. Demand Forecasting.	6	11
UNIT-II	3	The Firm: Theory of production: Production function, ISO product curves, Cost analysis, Optimum firm	10	20
	4	Theory of product pricing: Revenue concepts, Equilibrium of the firm & industry under perfect Competition, monopoly, monopolistic competition, Oligopoly & duopoly.	8	18
UNIT-III	5	Theory of Factory pricing: Marginal productivity theory of distribution and Modern theory: Theories of rent, wages, interest & profit, Risk and uncertainly.	10	20
UNIT-IV	6	The economy: National income Concepts: Savings – investments, Applications of Harrod - Domar Model, International trade and balance of payments.	**8**	15

	7	The financial system, Money: Definition and uses, Demand and supply of money, Commercial banking systems.	3	8

Reference Books:

1. R.L.Varshney , KL Maheshwari " Managerial Economics Sultan Chand & Sons
2. D.N. DWIVEDI "Managerial Economics Vikas Publication.
3. I.C. DHINGRA "Essential of Managerial Economics Sultan Chand & Sons Publications.
4. RUDDAR DATT K.P.M. SUNDRAM "Indian Economy" 54th edition S. Chand & Company Ltd.

Branch: MCA	Semester-II
Subject Code: 2102	Lecture: 03 Credit: 04
Subject Title	SOFTWARE ARCHITECTURE

COURSE OBJECTIVES:

1. To understand importance of architecture in building effective, efficient, competitive software product.
2. To understand principal design decisions governing the system.
3. To understand role of architecture in software engineering.
4. To understand designing application from architectural perspective.
5. To understand different notations used for capturing design decisions.
6. To understand different functional and non-functional properties of complex software systems.

COURSE OUTCOMES:
1. Students will cite knowledge of various approaches to document a software system (Remembering).
2. Students will be able to describe functional and non-functional requirements (Understanding).
3. Students will be able to use proper architecture for software (Applying).
4. Students will be able to categorize different components used in the software system (Analyzing).
5. Students will be able to choose from different architectural styles (Evaluating).
6. Students will be able to improve quality of software by selecting proper architecture (Creating).

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT I	1	**Basic Concepts** Concepts of Software Architecture, Models, Processes, Stakeholders.	02	05
	2	**Designing Architectures** The Design Process, Architectural Conception, Refined Experience in Action: Styles and Architectural Patterns. Architectural Conception in Absence of Experience.	03	05
	3	**Connectors** Connectors in Action: A Motivating Example, Connector Foundations, Connector Roles, Connector Types and Their Variation Dimensions, Example Connectors.	05	15

UNIT II	4	**Modeling** Modeling Concepts, Ambiguity, Accuracy, and Precision, Complex Modeling: Mixed Content and Multiple Views, Evaluating Modeling Techniques, Specific Modeling Techniques.	05	10
	5	**Analysis** Analysis Goals, Scope of Analysis, Architectural Concern being Analyzed, Level of Formality of Architectural Models, Type of Analysis, Analysis Techniques.	06	20
UNIT III	6	**Implementation and Deployment** Concepts, Existing Frameworks, Software Architecture and Deployment, Software Architecture and Mobility.	05	05
	7	**Conventional Architectural styles** Pipes and Filters, Event- based, Implicit Invocation, Layered systems, Repositories, Interpreters, Process control	05	10
	8	**Applied Architectures and Styles** Distributed and Networked Architectures, Architectures for Network-Based Applications, Decentralized Architectures, Service-Oriented Architectures and Web Services.	07	15
UNIT IV	9	**Designing for Non-Functional Properties** Efficiency, Complexity, Scalability and Heterogeneity, Adaptability, Dependability.	05	10
	10	**Domain-Specific Software Engineering** Domain-Specific Software Engineering in a Nutshell, Domain-Specific Software Architecture, DSSAs, Product Lines, and Architectural Styles.	05	05

Reference Books:

1. "Software Architecture: Foundations, Theory, and Practice" by Richard N. Taylor, Nenad Medvidovic, Eric Dashofy, ISBN: 978-0-470-16774-8
2. M. Shaw: Software Architecture Perspectives on an Emerging Discipline, Prentice-Hall.
3. Len Bass, Paul Clements, Rick Kazman: Software Architecture in Practice, Pearson.
4. "Pattern Oriented Software Architecture" by Frank Buchnan et al, Wiley India.
5. "The Art of Software Architecture" by Stephen T. Albin

Branch: MCA	SEMESTER-II
Subject Code: 2103	Lecture: 03 Credit: 03
Subject Title	ARTIFICIAL INTELLIGENCE

COURSE OBJECTIVES:
Students will be able to
1. Understand fuzzy logic, ANN Model Curriculum of Engineering & Technology PG Courses [Volume-I] [354].
2. Understand GA & EP.

COURSE OUTCOMES:
Students will be able to-
1. Learn the concepts of biological foundations of artificial neural networks.
2. Learn Feedback networks and radial basis function networks and fuzzy logics.
3. Identify fuzzy and neural network.
4. Acquire the knowledge of GA.

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	**Introduction:** Overview of AI, Importance of AI, History, related fields, Representation of Knowledge, Knowledge Base Systems, State Space Search Problem Characteristics of 8- Queens, Traveling Salesman, Missionary & Cannibals, Crypt, Arithmetic, Monkey Banana Problem, Tower of Hanoi and Block World.	8	10
UNIT-II	2	**Searching Methods:** Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Methods: Greedy best first Search, A* Search, Memory bounded heuristic Search. Local Search Algorithms and Optimization Problems: Hill climbing search Simulated annealing, Local beam search, Genetic algorithms. Adversarial Search: Games, Optimal strategies, The minimax algorithm, Alpha-Beta Pruning.	10	15

	3	**Predicate & Logic:** Representing simple facts in Logic -Computable functions in predicates, resolution – unification – forward vs. backward reasoning., Probabilistic reasoning – Bayes's Theorem – Certainty Factors– Demphster–Shafer Theory – Fuzzy, Sets, Reasoning with Fuzzy Logic, Natural Language Computation with Fuzzy Logic.	9	15
UNIT-III	4	**Structured Knowledge Representation:** Associative Networks, Semantic Nets, Frames Structures, Conceptual, Dependencies & Scripts, Learning – Concept of Learning – Learning Automata, Learning by induction. **Natural Language Processing:** Overview of Linguistics, Grammars and Languages, basic Parsing techniques, semantic analysis, and representation structures. Natural Language generation and Natural Language Systems.	11	15
UNIT-IV	5	**Expert Systems:** Architecture – Need and Justification of Expert Systems –Knowledge acquisition and validation. Perception and Action, Real time search, perception, action, vision, robot architecture, Learning in Neural Networks – Applications – Hopfield Networks, Back propagation, Case Study - XCON, PROSPECTOR	10	15

Reference Books:

1. Introduction to AI and Expert Systems - Patterson.
2. Artificial Intelligence A Modern Approach- Stuart Rushell.
3. Artificial Intelligence - Rich E and Knight K.
4. Principles of Artificial Intelligence - Nilsson.
5. Artificial Intelligence – An Engineering Approach – Schalkoff R J.
6. Introduction to Expert System - Peter Jackson.
7. Artificial Intelligence – Janakiraman.

Branch: MCA	SEMESTER-II
Subject Code: 2104	**Lecture: 03** **Credit: 03**
Subject Title	**Advanced Databases**

COURSE OBJECTIVES:

1. The objective of course is to provide insight to advance database architectures, normalization techniques and integrity rules. It also includes parallel database systems, object-oriented models along with spatial and temporal databases.

COURSE OUTCOMES:

After completion of course, students would be able to:

1. Able to understand relational database management systems, normalization to make efficient retrieval from database and query.

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	**Introduction:** Review of Relational Database model, ER Modelling	7	10
UNIT-II	2	**Distributed Database Management System (DDBMS):** Introduction to distributed database, Advantages and disadvantages of distributed database, Homogenous and Heterogeneous distributed databases, Functions and architecture of DDBMS, Data fragmentation, Data allocation, Distributed transactions, Distributed concurrency control, Distributed deadlock management and Distributed database recovery	15	25
UNIT-III	3	**Object Oriented Database Management System (OODBMS):** Concepts of OODBMS, Storing objects in relational database, Object oriented data models and DBMS, Issues in OODBMS, Advantages and disadvantages of OODBMS.	14	20
UNIT-IV	5	**Spatial and Temporal Data and Mobility:** Motivations, Terms in databases, Spatial and geographic data, Multimedia database, Mobility and personal databases.	12	20

Reference Books:

1. Database Management Systems by Raghu Ram Krishnan. Second edition
2. Database System Design Implementation & Management by Rob & Control (Thomson Learning)
3. An Introduction to database system" By Date, Addison Wesley Pub.
4. "Principles of Repagination database" By Desai Galgotia Publications.
5. Decision support and data warehouse systems By Mallach (TMH).
6. Principles of Distributed Database Systems, Second Edition, M. Tamer Ozsu Patrick Valduriez.
7. Distributed Databases principles and systems, Stefano Ceri, Giuseppe Pelagatti, Tata McGraw Hill.

Branch: MCA	SEMESTER-II
Subject Code: 2105	Lecture: 03 Credit: 03
Subject Title	Elective-I: Digital Image Processing

COURSE OBJECTIVES:
1. To introduce the fundamental problems of digital image processing (DIP).
2. To introduce the main concepts and techniques used to solve those.
3. To enable participants to implement solutions for reasonably complex problems, and to apply those to own images.
4. To enable participants to understand basic DIP methodology that is discussed in the Digital image processing literature, and applications of DIP across a broad range of scientific disciplines.
5. To motivate students to experience that DIP is a field where signal processing algorithms and methods become visual.

COURSE OUTCOMES:
After completion of course, students would be able to:
1. Understand image representation in digital form.
2. Enhance image quality using image enhancement techniques.
3. Filter given image using frequency domain filtering technique.
4. Select the right image restoration technique to remove degradation from given image.
5. Represent image using minimum number of bits using image compression.
6. Understand image segmentation technique.
7. Do morphological operations on given image.

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	**Digital Image Fundamentals:** Light, brightness adaption and discrimination, Human visual system, Image as a 2D data, Image representation Gray scale and Color images, Image sampling and quantization.	5	5
		Image enhancement and filtering in spatial domain: Intensity transformation functions: Contrast stretching, Thresholding, Image negative, Log transformation, Power-low transformation, Intensity level slicing and Bit-plane slicing. Image histogram, Histogram equalization process. Fundamentals of spatial filtering, Correlation and convolution, Spatial filtering mask for low pass filtering (smoothing) and high pass filtering (sharpening).	10	10
UNIT-II	2	**Image filtering in the frequency domain:** Preliminary Concepts, Extension to functions of two variables, Image Smoothing, Image Sharpening, Homomorphic filtering, 2D- DFT,	8	10

		2DFFT, 2D- DCT, Fundamentals of 2D-wavelet transform, Image pyramids, sub-band coding.		
		Image restoration: Reasons for image degradation, Model of image degradation/restoration process, Noise probability density functions, Image restoration using spatial filtering (Mean filters, Order statistic filters and adaptive filters), Inverse Filtering, MMSE (Wiener) Filtering.	5	10
UNIT-III	3	**Color Image Processing:** Color Fundamentals, Color Models, Pseudo-color image processing.	5	10
		Image Compression: Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Arithmetic coding, LZW coding, JPEG Compression standard, Wavelet based image compression.	5	10
UNIT-IV	5	**Image Segmentation:** Edge based segmentation, Region based segmentation, Region split and merge techniques, Region growing by pixel aggregation, optimal thresholding.	5	10
	6	**Morphological Image Processing:** Basic morphological operations, Erosion, dilation, opening, closing, Structuring elements, Hit-or-Miss transform, Basic Morphological Algorithms: hole filling, connected components, thinning, skeletons, Reconstruction by erosion and dilation.	5	10

Text Book:

1. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, Third Edition, Pearson Education.

Reference Books:

1. Digital Image Processing, S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill Publication.
2. Digital Image Processing, S Sridhar, Oxford University Press.

Branch: MCA	Semester-II
Subject Code: 2105	Lecture: 03 Credit: 03
Subject Title	Elective-I Ethical Hacking

Prerequisite:

1. Computer Programming, Web Programming, Computer Networks.

COURSE OBJECTIVES:

1. Introduces the concepts of Ethical Hacking and gives the students the opportunity to learn about different tools and techniques in Ethical hacking and security and practically apply some of the tools.

COURSE OUTCOMES:

After completion of course, students would be able to:

1. Understand the core concepts related to malware, hardware and software vulnerabilities and their causes.
2. Understand ethics behind hacking and vulnerability disclosure.
3. Appreciate the Cyber Laws and impact of hacking.
4. Exploit the vulnerabilities related to computer system and networks using state of the art tools and technologies.

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	**Introduction to Ethical Disclosure:** Ethics of Ethical Hacking, Ethical Hacking and the legal system, Proper and Ethical Disclosure	6	10
UNIT-II	2	**Penetration Testing and Tools:** Using Metasploit, Using BackTrackLiveCD Linux Distribution.	10	15
UNIT-III	3	**Vulnerability Analysis:** Passive Analysis, Advanced Static Analysis with IDA Pro, Advanced Reverse Engineering.	10	15
	4	**Client-side browser exploits:** Exploiting Windows Access Control Model for Local Elevation Privilege, Intelligent Fuzzing with Sulley, From Vulnerability to Exploit.	10	15
UNIT-IV	5	**Malware Analysis:** Collecting Malware and Initial Analysis, Hacking Malware.	06	10
	6	Case study of vulnerability of cloud platforms and mobile platforms & devices.	06	10

Reference Books:

1. Shon Harris, Allen Harper, Chris Eagle and Jonathan Ness, Gray Hat Hacking: The Ethical Hackers' Handbook, TMH Edition.
2. Jon Erickson, Hacking: The Art of Exploitation, SPD.

Branch: MCA	SEMESTER-II
Subject Code: 2105	Lecture: 03 Credit: 03
Subject Title	Elective - I IOT

Prerequisite:
1. Fundamentals of Communication and Computer Network.
2. Computer Network Technology.

COURSE OBJECTIVES:
1. To understand what is Internet of things.
2. Describe architecture, Design, underlying technologies, platforms and cloud interface.

COURSE OUTCOMES:
By the end of the course, students should be able to -
1. Explain what is internet of things.
2. Explain architecture and design of IoT.
3. Describe the objects connected in IoT.
4. Understand the underlying Technologies.
5. Understand the platforms in IoT.
6. Understand cloud interface to IoT.

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	**INTRODUCTION TO INTERNET OF THINGS:** What is the Internet of Things? Internet of Things Definitions and Frameworks : IoT Definitions, IoT Architecture, General Observations, ITU-T Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities, Physical Design of IoT: IoT Protocols, Logical Design of IoT: Functional block, communication Model, Communication API's, IoT Enabling Technologies: WSN, cloud computing, Big data Analytics, communication Protocols, Embedded systems, IoT levels and Deployment templates: Level 1 to Level 5.	10	10
UNIT-II	2	**IoT NETWORK ARCHITECTURE AND DESIGN:** The one M2M IoT Standardized Architecture, The IoT World Forum (IoTWF) Standardized Architecture, A Simplified IoT Architecture, IoT protocol stack, The Core IoT Functional Stack, IoT Data Management and Compute Stack: Fog Computing, Edge Computing, The Hierarchy of Edge, Fog, and Cloud IoT and M2M: Introduction to M2M, Difference between IoT and M2M, SDN and NFV for IoT.	9	15

UNIT-III	3	**ADDRESSING TECHNIQUES FOR THE IoT** Capabilities, IPv6 Protocol Overview, IPv6 Tunneling, IPsec in IPv6, Header Compression Schemes, Quality of Service in IPv6, Migration Strategies to IPv6, Mobile IPV6 technologies for the IoT: Protocol Details, IPv6 over low-power WPAN (6LoWPAN).	10	15
UNIT-IV	4	**SMART OBJECTS: THE "THINGS" IN IoT** Address Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects: Communications Criteria, IoT Access Technologies: IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e, IEEE 1901.2a, LoRaWAN.	6	15
UNIT - V	5	**IoT PLATFORMS** What is an IoT Device, Exemplary Devices: Raspberry Pi, Raspberry Pi Interfaces, Other IoT Devices: pcDuino, Beagle Bone Black, CubieBoard, ARDUINO.	5	10
UNIT - VI		**IoT PHYSICAL SERVERS AND CLOUD OFFEREINGS** Introduction to cloud storage models and communication API's, WAMP-AutoBahn for IoT, Python web application framework, Designing a RESTful web API, AMAZON web services for IoT, SkyNet IoT messaging platform, IoT case studies: Home Automation, Cities, Environment.	8	10

Text Book:
1. Internet of Things: A Hands-On Approach Arshdeep Bahga, Vijay Madisetti VPT – Paperback 2015 978- 0996025515 628/-
2. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things David Hanes, Gonzalo Salgueiro, Patrick Grossetete Cisco Press – Paperback – 16 Aug 2017 978-1- 58714-456- 1 599.
3. Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications Daniel Minoli Willy Publication s - 2013 978-1-118- 47347-4, 466.

Reference Books:
1. Smart Internet of things projects Agus Kurniawan Packt - Sep 2016 978-1- 78646- 651-8.
2. The Internet of Things Key Olivier Willy Publication 2nd Edition 978
3. Applications and protocols Hersent s 119- 99435-0,

Branch: MCA	Sem
Subject Code: 2105	Lecture:03 Credit: 03
Subject Title	ELECTIVE I – GAME Theory

COURSE OBJECTIVES:

After leaving this class, the student will:

1. Appreciate that game programming is really programming first, game second
2. Understand how to architect a game codebase so that it is flexible and easy to work amongst a team of programmers working concurrently
3. know how to debug code, and how to write code to be debugged
4. Understand the importance of data-driving initialization (properties) and execution (scripting) so that iteration can be done by non-programmers
5. understand common modern asset management practices
6. have some instinct for the performance tuning of video game code
7. understand cross-platform porting issues, and the implications of platform
8. understand the role of the programmer in a typical professional game company setting

COURSE OUTCOMES:

After completion of course, students would be able to:

Be a better C++ programmer than they were when they entered the class.

Modules	Topic Details	No. of Lectures Assigned	Marks Weightage %
UNIT-I	Intro to game design and production Unity production basics: Lighting, materials, effects, etc. Creating a simple game C# in game development Working with 3D games Rigid body physics User input and UI Game Design 101: Balancing games, analyzing games, the MDA framework Cube Ship Game Game Programming 101 Working with Animations.	8	15
UNIT-II	Game Programming 102 Game Design 102: Choice, agency, aesthetics, and more UI Development Unity Editor Intermediate Topics Raycasting Start on Game Design 1 Game Programming 103 3D Characters: Animation & control Intermediate Game Production Event Systems & Delegates	8	10
UNIT-III	Game Design 1 wrap-up Intermediate Game Production Topics Game Programming 104 Useful code libraries Data Structures Global Illumination.	6	12
UNIT-IV	2D Game Jam Exam 2 Game Design 103: Level Design & Tutorials. Start on Last major game design 3D Models Debugging Introduction to Git Editor extensions I/ O	7	7

UNIT - V	Intro to AI FSMs Game design project Procedural generation Game design project Beyond Game Design: Programming applications Algorithms & Trees Game design project	6	8
UNIT - VI	Affordances & User Experience Design Patterns Final game design presentations Networking intro & JSON Creating non-Unity C# applications Web server basics	6	10
UNIT - VII	Deploying web servers Creating a RESTful interface Connecting games to services Databases Other networking topics. Course Wrap-Up Advanced programming topics (TBD)	7	13

Reference book:

1. Recommended bibliography LEYTON-BROWN, K., SHOHAM, Y., Essentials of Game Theory: A Concise, Multidisciplinary Introduction, Morgan & Claypool Publishers. 2008.
2. OSBORNE, M.J., Introduction to Game Theory, Oxford Univ. Press. 2004.
3. OSBORNE, M.J., RUBINSTEIN, A., A Course in Game Theory, MIT Press. 1994.
4. BINMORE, K., Game Theory: A Very Short Introduction, Oxford Univ. Press. 2007.
5. BINMORE, K., Playing for Real, Course pack Edition: A Text on Game Theory, Oxford University Press. 2012.
6. CAMERER, C.F., Behavioral Game Theory: Experiments in Strategic Interaction, Princeton University Press. 2003.
7. FUDENBERG, D., TIROLE, J., Game Theory, MIT Press. 1992.
8. HEIFETZ, A., Game Theory: Interactive Strategies in Economics and Management, Cambridge University Press, 2012.
9. MYERSON, R.B., Game Theory: Analysis of Conflict, Harvard Univ. Press. 1991. WATSON, J., Strategy: An Introduction to Game Theory, Norton & Co., 2008.
10. VON NEUMANN, J., MORGENSTERN, O., Theory of Games and Economic Behavior, Princeton University Press. 1944.

Branch: MCA	Semester-II
Subject Code: 2105	**Lecture: 03** **Credit: 03**
Subject Title	**Elective-I Block Chain**

Prerequisite:
1. Expertise in Programming, Basic Knowledge Of Computer Security, Cryptography, Networking, Concurrent Or Parallel Programming Would Help A Student To Understand The Topics.

COURSE OBJECTIVES:
By the end of the course, students will be able to
1. Understand how blockchain systems (mainly Bitcoin and Ethereum) work and to securely interact with them.
2. Design, build, and deploy smart contracts and distributed applications.

COURSE OUTCOMES:
1. Explain design principles of Bitcoin and Ethereum.
2. Explain Nakamoto consensus.
3. Explain the Simplified Payment Verification protocol.
4. List and describe differences between proof-of-work and proof-of-stake consensus.
5. Interact with a blockchain system by sending and reading transactions.
6. Design, build, and deploy a distributed application.
7. Evaluate security, privacy, and efficiency of a given blockchain system.

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weightage %
UNIT-I	1	**Basics:** Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. • Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.	10	15
UNIT-II	2	**Blockchain:** Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.	12	20
UNIT-III	3	**Distributed Consensus:** Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.	11	15

UNIT-IV	4	**Cryptocurrency:** History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin.	5	15
	5	**Cryptocurrency Regulation:** Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.	10	10

Text Book:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

Reference Books:

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies.
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System.
3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts.

Branch: MCA	Semester-II
Subject Code:2201	Practical: 04 Credit: 02
Subject Title	Web Engineering LAB

COURSE OBJECTIVES:
1. To develop an ability to design and implement static and dynamic website.
2. Choose best technologies for solving web client/server problems.
3. Create conforming web pages.
4. Use JavaScript for dynamic effects.
5. To prepare PHP scripts.
6. Use JavaScript & PHP to validate form input entry.
7. Understand, analyze and create XML documents and XML Schema.
8. Understand, analyze and build web applications using PHP.
9. Use appropriate client-side or Server-side applications.

COURSE OUTCOMES:
Upon completion of the course, graduates will be able to –
1. Design and implement dynamic websites with good aesthetic sense of designing and latest technical know-how.
2. Create web pages using HTML and Cascading Styles sheets.
3. Analyze a web page and identify its elements and attributes.
4. Create dynamic web pages using JavaScript.
5. Build web applications using PHP.
6. Create XML documents and XML Schema.
7. Understand, analyze and apply the role of languages like HTML, CSS, XML, JavaScript, PHP and protocols in the workings of the web and web applications.
8. Have a Good grounding of Web Application Terminologies like JSON, jQuery, Angular Js, Node.js.

EXERCISES:

Unit-1: Basics of HTML5, CSS3, Web Server.
1. Basic HTML Tags, Table Tags, List Tags, Image Tags, Forms.
2. Implement forms using HTML5 and CSS3.
3. Install the following on local machine
   • Apache web server
   • Tomcat application server locally,
   • Install MySQL
   • PHP and configure it to work with Apache web server and MySQL.

Unit-II: JavaScript, XML:
1. Write a JavaScript program using to design a simple calculator to perform the following operations: sum, product, difference and quotient.

2. Write a JavaScript that calculates the squares and cubes of the numbers from 0 to 10 and outputs HTML text that displays the resulting values in an HTML table format.
3. Write a JavaScript code that displays text "TEXT-GROWING" with increasing font size in the interval of 100ms in RED COLOR, when the font size reaches 50pt it displays "TEXT-SHRINKING" in BLUE color. Then the font size decreases to 5pt.
4. Develop and demonstrate a HTML5 file that includes JavaScript script that uses functions for the following problems:
   a. Parameter: A string
   b. Output: The position in the string of the left-most vowel
   c. Parameter: A number
   d. Output: The number with its digits in the reverse order.
5. Write an HTML page that has one input, which can take multi-line text and a submit button. Once the user clicks the submit button, it should show the number of characters, lines and words in the text entered using an alert message. Words are separated with white space and lines are separated with new line character.
6. Design an XML document to store information about a student in an MCA college affiliated to SNDT WU. The information must include PRN of student, Name of Student, and Name of the College, Year of Joining, and email id. Make up sample data for 3 students. Create a CSS style sheet and use it to display the document.
7. Write an HTML page that contains a selection box with a list of 5 countries. In the above page when the user selects a country, its capital should be printed next to the list, and add CSS to customize the properties of the font of the capital.
8. Create an XML document that contains 10 users information. Write a java program, which takes user id as input and returns the user details by taking the user information from XML document using
   a. DOM parser
   b. SAX parser

Unit-III:PHP, MySQL, JSP, Servlet.

1. Write a PHP program to keep track of the number of visitors visiting the web page and to display this count of visitors, with proper headings.
2. Write a PHP program to display a digital clock which displays the current time of the server.
3. Write the PHP programs to do the following:
   a. Implement simple calculator operations.
   b. Find the transpose of a matrix.
   c. Multiplication of two matrices.
4. Write a PHP program named states.py that declares a variable state with value "Mississippi Alabama Texas Massachusetts Kansas". Write a PHP program that does the following:
   a. Search for a word in variable states that ends in xas. Store this word in element 0 of a list named statesList.
   b. Search for a word in states that begins with k and ends in s. Perform a case-insensitive comparison. [Note: Passing re.Ias a second parameter to method compile performs a case-insensitive comparison.] Store this word in element1 of states List.
   c. Search for a word in states that begins with M and ends in s. Store this word in element 2 of the list.
   d. Search for a word in states that ends in a. Store this word in element 3 of the list.
5. Write a PHP program to sort the student records which are stored in the database using selection sort.

6. Implement the following web application using: a) PHP   b) Servlets   c) JSP
    i. A user validation web application, where user submits the login name and password to server. These are checked against the data already available in database and if the data matches a successful login page is returned. Otherwise a failure message is shown to the user.
    ii. Modify the above program to use an xml file instead of database.
    iii. Modify the above program to use AJAX to show the result on the same page below the submit button.
    iv. Modify the above program such that it stores each query in a database and checks the database first for the results .If the query is already available in the DB, it returns the value that was previously computed (from DB) or it computes the result and returns it after storing the new query and result in DB.
    v. A web application takes a name as input and on submit it shows a hello page where is taken from the request and it shows a start time at the right top corner of the page and provides the logout button on clicking this button it should shoe a logout page with thank you message with the duration of Usage.
    vi. A web application that takes name and age from an HTML page. If the age is less than 18, it should send a page with "Hello, you are not authorized to visit this site" otherwise it should send "welcome to this site" message where name should be replaced with the entered name otherwise it should send welcome to the site message.
    vii. A web application that lists all cookies stored in the browser on clicking "list cookies" button, add cookies if necessary.

Unit-IV: Introduction to jQuery, JSON, Angular JS, Node.js, Bootstrap.
1. Prepare a chat application using Node.js.
2. Create a responsive web application using Bootstrap.
3. Prepare a company's annual growth chart application using AngularJS.

Branch: MCA	SEMESTER-II
Subject Code:2202	Practical: 04 Credit: 02
Subject Title	Software Testing and Quality Assurance LAB

COURSE OBJECTIVES:
1. To understand software testing and quality assurance as a fundamental component of software life cycle.
2. To define the scope of SW T & QA projects.
3. To efficiently perform T & QA activities using modern software tools.
4. To estimate cost of a T & QA project and manage budgets.
5. To prepare test plans and schedules for a T&QA project.
6. To develop T & QA project staffing requirements.
7. To effectively manage a T & QA project.

COURSE OUTCOMES:
Upon completion of the course, graduates will be able to –
1. Select and classify measurement scales and models, software metrics and measures addressing software quality and reliability.
2. Conduct unit and integration tests by determining test design, test automation, test coverage criteria using testing frameworks and test adequacy assessment using control flow, data flow, and program mutations.
3. Apply suitable higher order testing techniques and methods in order to achieve verified and validated software by following testing best practices.
4. Demonstrate the skillset as a tester to neutralize the consequences of wicked problems by narrating effective test cases and test procedures.
5. Adapt to various test processes, types of errors and fault models and methods of test generation from requirements for continuous quality improvement of the software system along with Software Quality best practices usage.
6. Apply software testing cycle in relation to software development and project management focusing incidents and risks management within a project towards efficient delivery of software solutions and implement improvements in the software development processes by making use of standards and baselines.

Exercises:

1. To Prepare Test Plan for the implemented system under test. The Test Plan shall be based on System Requirement Specification. The Test plan consists of following issues. a. Purpose of the test. /Location and schedule of the test. b. Test descriptions. /Pass and Fail Criteria.
2. To identify and narrate Test cases, Test scripts/procedures and Test incident Report identifier for the system under test. Refer Use case analysis document to prepare mentioned/ identified test documents. The expected specifications/ behaviors can be stated with the help of Test Oracle.

3. To perform Unit testing especially indicating the traced Independent data paths, Control paths and Error handling paths. Prepare control flow graphs for the unit under test. Compute the Cyclomatic complexity of the unit.
4. To perform Data Flow testing for the Program Segments by identifying the Definition-Use chain and type of data flow anomaly.
5. To perform Mutation Analysis of the Program Segments along with mutant history, mutation score and type of mutation by using any Code analysis Tool / Mutation Testing Tool (JUNIT, MuJava).
6. To perform Black-Box Testing for all the units contained in the architectural segments using Equivalence Partitioning, Boundary Value Analysis and Orthogonal Array testing methods. To study exploratory Testing for the Module under Test and merits/demerits of this technique.
7. To perform Regression Testing / GUI Testing of the System under construction with Unit and Integration profiles by using any Functional Testing Tool.
8. To perform Automated Testing using suitable CASE tool addressing Higher Order testing strategies.
9. To perform Web Based Testing for Web Application incorporating any Open Source Tool. To study Performance Testing, Load Testing, Security Testing, Stress Testing, Demonstrate on link Test expectation.
10. To perform Software Audit (Checklist and Template-based) for the software developed and improve the Code Quality.

Branch: MCA	Semester-II
Subject Code: 2203	Practical: 04 Credit: 02
Subject Title	MOBILE COMPUTING LAB

COURSE OBJECTIVES:
1. Know the components and structure of mobile application development frameworks for Android and windows OS-based mobiles.
2. Understand how to work with various mobile application development frameworks.
3. Learn the basic and important design concepts and issues of development of mobile applications.
4. Understand the capabilities and limitations of mobile devices. Demonstrate the android features and create

COURSE OUTCOMES:
1. Design and Implement various mobile applications using emulators.
2. Deploy applications to hand-held devices

Modules	Sr. No.	Topics and Details
UNIT-I	1	**Introduction to Android** What is Android? Setting up development environment, Dalvik Virtual Machine & .apk file extension, Fundamentals: a) Basic Building blocks–Activities, Services, Broadcast Receivers & Content providers b) UI Componentss- Views & notifications c) Components for communication -Intents & Intent Filters, Android API levels (versions & version names)
	2	**Application Structure (in detail)** AndroidManifest.xml, uses-permission &uses-sdk Activity/services/receiver declarations, Resources&R.java, Assets, Values – strings .xml Layouts &Drawable Resources, Activities and Activity lifecycle, First sample Application, Deploying sample application on a real Device
	3	**Emulator-Android Virtual Device:** Launching emulator, Editing emulator settings, Emulator shortcuts, Logcat usage, Introduction to DDMS, File explorer,

UNIT-II	4	**Second App:** (switching between activities), Develop an app for demonstrating the communication between Intents **Basic UI design:** Form widgets, Text Fields, Layouts, Relative Layout, Table Layout,Frame Layout ,Linear Layout, Nested layouts, [dip,dp,sip,sp] versuspx**Preferences,** Shared Preferences, Preferences from xml,Examples, **Menu** Option menu, Context menu, Submenu, menu from xml, menu via code, Examples, **Intents (in detail),** Explicit Intents, Implicit intents, Examples, **UI design** Time and Date, Images and media, Composite, Alert Dialogs & Toast, Popup, Examples, **Tabs and Tab Activity,** Examples, **Styles & Themes,** styles.xml, colors.xml- declaring colors and drawables,Drawableresources for shapes, gradients(selectors), •Shapes drawable, State drawable, Transition drawable, Patch drawable style attribute in layout fileApplyingthemes via code and manifest file, Examples.
		SQLite Programming: SQLite Programming, SQLiteOpenHelper, SQLite Database, Cursor Content providers, Defining and using content providers, Example- Sharing database among two different applications using content, providers, Reading and updating Contacts, Reading bookmarks, Example: - Develop an App to demonstrate database usage. CRUD operations must be, implemented. Final details should be viewed in GridView as well as in, List View., Do the same application with database operations in a single class (As a Model class) and do the CRUD operations with this class object
UNIT-III	5	**Android Debug Bridge(adb)toolLinkify**Web URLs, Email address, text, map address, phone numbers, Match Filter&, Transform Filter, Examples **Adapters and Widgets:** Adapters: -, a) Array Adapters, b) Base Adapters, Example - Efficient Adapter, List View and List Activity, Custom list view, Grid View using adapters, Gallery using adapters, Examples **Notifications:** Broadcast Receivers, Services and notifications, Toast, Alarms, Examples **Custom components:** Custom Toast, Custom dialogs, Custom Tabs, Custom animated popup, panels, Other components, Examples
UNIT IV	6	**Threads:** Threads running on UIthread (run On UiThread), Worker thread, Handlers & Runnable, AsynTask (in detail), Examples

UNIT-IV	7	Advanced: Live Folders, Using sdcards – Reading and writing, XML Parsing, JSON Parsing, Including external libraries in our application, Maps via intent and Map Activity, GPS, Location based Services, Accessing Phone services (Call, SMS, MMS), Network connectivity services, Sensors, Using WIFI & Bluetooth, Actionbartabsand custom views on Action bars, Introduction to fragments, A brief introduction to Ice Cream Sandwich.

Reference Books:

1. Professional Android 2 Application Development Paperback, John Wiley & Sons, Inc (10)RetoMeier

Branch: MCA	SEMESTER-II
Subject Code: 2204	Practical: 04 Credit: 02
Subject Title	ARTIFICIAL INTELLIGENCE LAB

COURSE OBJECTIVES:
To create appreciation and understanding of both the achievements of AI
Students will able to:
Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
To impart basic proficiency in representing difficult real-life problems in a state space representation so as to solve them using AI techniques like searching and game playing.

COURSE OUTCOMES:
  Students will be able to -
1. Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents. function networks and fuzzy logics.
2. Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing

EXERCISE -
1.   Study of Prolog.
2.   WAP for using Input, Output and fail predicates in Prolog
3.   Write simple fact for the statements using PROLOG.
4.   WAP for Usage of rules in Prolog. Create a family tree program (of EXP2) to include following rules -
      1. M is the mother of P if she is a parent of P and is female
      2. F is the father of P if he is a parent of P and is male
      3. X is a sibling of Y if they both have the same parent.
       4. Then add rules for grandparents, uncle-aunt, sister and brother. Based on the facts, define goals to answer questions related to family tree
5.   Write predicates One converts centigrade temperatures to Fahrenheit, the other checks   if a temperature is below freezing.
6.   Write a program to solve the Monkey Banana problem.
7.   WAP in turbo prolog for medical diagnosis and show the advantage and disadvantage of green and red cuts.
8.   WAP to implement factorial, Fibonacci of a given number.
9.   Write a program to solve 4-Queen problem.
10.   Write a program to solve traveling salesman problem.
11.   Write a program to solve water jug problem using LISP.
12.   All structures objects in Prolog are trees. Draw tree diagrams for the following expressions:- /(*(x,y),+(z,1))
13.   How are conjunction and disjunction used in Prolog programming? Explain with an example for each using relations from the family tree.
14.   Trace the steps involved in concluding "Seema is talkative" from the facts "All girls are talkative" and "Seem is a girl".
15.   Write a program to create Kohonen Self Organizing Feature Map. A provision should be made for the user to enter inputs and initialize the weights of his choice.

Branch: MCA	Semester-II
Subject Code: 2205	Practical: 04 Credit: 02
Subject Title	Advanced Database LAB

COURSE OBJECTIVES:
1. Understand the syntax to query various databases.
2. To design and implement various algorithms and techniques.

COURSE OUTCOMES: On completion of course the student should be able to
1. Effectively use the various databases.
2. To implement the queries on various databases.

Sr. No:	Topics and Details
1	Basic SQL and PL SQL
2	Distributed Database Partitioning and queries on distributed database
3	Parallel Database and queries.
4	Temporal and Spatial Database and queries
5	NoSQL

Branch: MCA	SEMESTER-II
Subject Code: 2206	Practical: 02 Credit: 01
Subject Title	Research paper II - Research Mini Project

The mini-project has to be done in **SEMESTER** - II. Students will use their review paper done in Semester - I, propose a solution, Implement and document it.

Finally, a conference paper should be prepared on the basis of work done.

There will be internal exam at the end of **SEMESTER** - II.

Evaluation will be done on the basis of Rubrics.

Branch: MCA	SEMESTER-III
Subject Code: 3101	**Lecture: 03** **Credit: 03**
Subject Title	**CYBER SECURITY**

COURSE OBJECTIVES:
1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

COURSE OUTCOMES:
Learner will be able to…
1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	**Introduction to Cyber Security** Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats: - Cyber Warfare-Cyber Crime-Cyber, terrorism-Cyber Espionage, need for a Comprehensive Cyber Security Policy, need for a Nodal Authority, Need for an International convention on Cyberspace	5	10
	2	**Cyber Security Vulnerabilities and Cyber Security Safeguards** Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning,	8	11

		Security policy, Threat Management.		
UNIT-II	3	**Securing Web Application, Services and Servers** Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.	8	11
	4	**Intrusion Detection and Prevention** Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.	8	11
UNIT -III	5	**Basic Concepts of Technology and Law:** Understanding the Technology of Internet, Scope of Cyber Laws, Cyber Jurisprudence.	5	10
	6	**Law of Digital Contracts:** The Essence of Digital Contracts, The System of Digital Signatures, The Role and Function of Certifying Authorities, The Science of Cryptography, Intellectual Property Issues in Cyber, Space: Copyright in the Digital Media, Patents in the Cyber World.	7	11
UNIT-IV	7	**Rights of citizens and E-Governance:** Privacy and Freedom Issues in the Cyber World, E-Governance, Cyber Crimes and Cyber Laws, Ethical hacking. Information Technology Act 2000: Information Technology Act-2000- (Sec 1 to 94). **Cyber Law Issues for Management:** Cyber Law Issues in E-Business Management, Major issues in Cyber Evidence Management, Cyber Law Compliancy Audit.	7	11

Reference Books:

1. How to Register Your Own Copyright by Marx Warda, Sphinx Publishing
2. Licensing Art & Design by Caryn R. Leland, Allworth Press
3. A Professional's Guide to Licensing and Royalty Agreements by Caryn R. Leland Allworth Press IT2000 Bill
4. Web sites: online information, handouts
5. Digital Privacy and Security Using Windows: A Practical Guide By Nihad Hassan, Rami Hijazi, Apress
6. Cyber Crime Investigation, DSCI - Nasscom, 2013.
7. Information Systems Security: Security Management, Metrics, Frameworks And Best Practices (With Cd) : Nina Gobole
8. Information systems control and Audit by Ron Weber, Pearson Pub.
9. Information security policies, procedures and standards by Thomas Pettier.
10. Information security Management Hand book- 5th Edition-HAROLD F.TIPTON
11. Computer security by Alfred Basta, Wolf Halton
12. Information security policies- Thomas R.Peltier, Pel

Branch: MCA	SEMESTER-III
Subject Code: 3102	Lecture: 03 Credit: 03
Subject Title	DATA SCIENCE AND ANALYTICS

COURSE OBJECTIVE
1. Provide you with the knowledge and expertise to become a proficient data scientist.
2. Demonstrate an understanding of statistics and machine learning concepts that are vital for data science
3. Produce Python code to statistically analyze a dataset
4. Critically evaluate data visualizations based on their design and use for communicating stories from data

COURSE OUTCOME
1. Explain how data is collected, managed and stored for data science
2. Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists
3. Implement data collection and management scripts using MongoDB

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.	5	10
	2	Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources	8	11
UNIT-II	3	Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT,	8	11
	4	Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.	8	11
UNIT-III	5	Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.	5	10
		Applications of Data Science, Technologies for visualization,	7	11

UNIT-IV	6	Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science	7	11

References:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Branch: MCA	Semester-III
Subject Code: 3103	Lecture: 03 Credit: 03
Subject Title	Cloud Computing

COURSE OBJECTIVES:
1. The student will learn how to apply trust-based security model to real-world security problems.
2. An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
3. Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

COURSE OUTCOMES:
After completion of course, students would be able to:
1. Identify security aspects of each cloud model
2. Develop a risk-management strategy for moving to the Cloud
3. Implement a public cloud instance using a public cloud service provider
4. Apply trust-based security model to different layer

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	**Introduction to Cloud Computing:** Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing.	5	10
UNIT-II	2	**Cloud Computing Architecture:** Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model.	8	11
	3	**Cloud Deployment Models:** Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise	7	11

UNIT-III	4	**Security Issues in Cloud Computing:** Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security.	7	11
	5	**Identity and Access Management:** Trust Boundaries and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management.	5	10
UNIT-IV	6	**Security Management in the Cloud:** Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS. **Privacy Issues:** Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations.	8	11
	7	**Audit and Compliance:** Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud. **Advanced Topics:** Recent developments in hybrid cloud and cloud security.	8	11

Reference Books:

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2, 2009
2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765, O'Reilly Media, September 2009

Branch: MCA	Semester-III
Subject Code: 3104	**Lecture: 03** **Credit: 03**
Subject Title	**Machine Learning**

COURSE OBJECTIVES:
1. Able to analyze the efficiency of algorithm.
2. Understand the features of machine learning to apply on real world problems.
3. To learn the concept of how to learn patterns and concepts from data.
4. To design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
5. Explore supervised and unsupervised learning paradigms of machine learning.

COURSE OUTCOMES:
After completion of course, students would be able to:
1. Extract features that can be used for a particular machine learning approach in various applications.
2. To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
3. To mathematically analyze various machine learning approaches and paradigms.

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	**Introduction:** What is Machine Learning, Examples of Machine Learning applications, Training versus Testing, Positive and Negative Class, Cross-validation. Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning. Dimensionality Reduction: Introduction to Dimensionality Reduction, Subset Selection, Introduction to Principal Component Analysis.	10	15
UNIT-II	2	**Binary and Multiclass Classification:** Assessing Classification Performance, Handling more than two classes, Multiclass Classification-One vs One, One vs Rest Linear Models: Perceptron, Support Vector Machines (SVM), Soft Margin SVM, Kernel methods for non-linearity	9	15
UNIT-III	3	**Regression:** Assessing performance of Regression – Error measures, Overfitting and Underfitting, Catalysts for Overfitting, VC Dimensions Linear Models: Least Square method, Univariate Regression, Multivariate Linear Regression, Regularized Regression - Ridge Regression and	10	15

		Lasso Theory of Generalization: Bias and Variance Dilemma, Training and Testing Curves Case Study of Polynomial Curve Fitting.		
UNIT-IV	4	**LOGIC BASED AND ALGEBRAIC MODELS** Distance Based Models: Neighbors and Examples, Nearest Neighbor Classification, Distance based clustering algorithms - K-means and K-medoids, Hierarchical clustering. Rule Based Models: Rule learning for subgroup discovery, Association rules mining – Apriori Algorithm, Confidence and Support parameters. Tree Based Models: Decision Trees, Minority Class, Impurity Measures – Gini Index and Entropy, Best Split	10	15
UNIT-V	5	**TRENDS IN MACHINE LEARNING :** Ensemble Learning: Combining Multiple Models, Bagging, Randomization, Boosting, Stacking Reinforcement Learning: Exploration, Exploitation, Rewards, Penalties Deep Learning: The Neuron, Expressing Linear Perceptron as Neurons, Feed Forward Neural Networks, Linear Neurons and their Limitations, Sigmoid, Tanh and ReLU Neurons .	9	15

Text Book:

1. Ethem Alpaydsin: Introduction to Machine Learning, PHI 2nd Edition-2013.
2. Peter Flach: Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.

Reference Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009
3. David Barber, Bayesian Reasoning and Machine Learning (Cambridge University Press). Online version available here.
4. Tom Mitchell. Machine Learning (McGraw Hill) , First Edition
5. Richard O. Duda, Peter E. Hart, David G. Stork. Pattern Classification (John Wiley & Sons)
6. Ethern Alpaydin, Introduction to Machine Learning, MIT Press, 3rd Edition.

Branch: MCA		Semester-III
Subject Code: 3105		Lecture: 03
		Credit: 03
Subject Title		ELECTIVE II - SOFT COMPUTING

COURSE OBJECTIVES:
1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
2. To implement soft computing-based solutions for real-world problems.
3. To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
4. To provide students hand-on experience on Scilab to implement various strategies.

COURSE OUTCOMES:
After completion of course, students would be able to:
1. Identify and describe soft computing techniques and their roles in building intelligent machines
2. Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering Model Curriculum of Engineering & Technology PG Courses [Volume-I][18] problems.
3. Apply genetic algorithms to combinatorial optimization problems.
4. Evaluate and compare solutions by various soft computing approaches for a given problem.

Modules	Sr. No	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT – I	1	Basic concepts of Soft Computing, Historical Developments and Definitions, Soft Computing Characteristics and Problem Solving– Strengths and Weaknesses, Constitutes of Soft Computing : Neural Computing, Fuzzy Logic and Computing, Evolutionary Computing and Genetic Algorithms, Probabilistic Reasoning.	7	12
UNIT – II	**2**	Fundamentals: Biological Neurons and Model of Artificial Neuron. Neural Network Architectures: Single Layer Network, Multi-Layer Feed Forward Neural Networks, and Feedback Networks. Perceptron Model and Learning in Perceptron, Limitation of Learning in Perceptron, Error Back Propagation learning in Multilayer FFNN. Performance Issues of EBP algorithm for MLFFNN.	7	12

UNIT – III	3	Complex Architectures Learning: Competitive Learning-Self Organizing Maps, Hebbian Learning-Hopfield Networks, Boltzmann Machines, Adaptive Resonance Theory (ART) Networks, Bayesian Neural Networks, Deep Learning Architecture of Neural Networks, Applications of Neural Networks.	7	12
UNIT - IV	4	Fuzzy Logic, Fuzzy Sets and Operations, Fuzzy Relations, Fuzzy Arithmetic and Fuzzy Measures. Fuzzy to Crisp Conversions: Lambda Cuts for fuzzy sets, Fuzzy Relations, Defuzzification Methods. Fuzzy Rules and Reasoning, Fuzzy Inference Systems, Mamdani Fuzzy Models – Sugeno Fuzzy Models, Applications of Fuzzy Modeling for Decision Making.	9	13
UNIT - V	5	Introduction, Encoding, Operators of Genetic Algorithm, Basic Genetic Algorithm, Simple GA, Crossover and Mutation, Multi-objective Genetic Algorithm (MOGA). Genetic algorithms in search and optimization, Ant colony optimization (ACO), Particle Swarm Optimization (PSO). Applications of GA for Clustering.	9	13
UNIT - VI	6	Soft Computing Paradigms and Hybrid Approaches. Neuro-Fuzzy modeling, Genetic Algorithm Based Back- propagation Network, Fuzzy logic based Backpropagation, Fuzzy Logic Controlled Genetic Algorithms, Simplified Fuzzy ARTMAP.	9	13

Reference Books:

1. Jyh : Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing, Prentice: Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall, 1995.
3. Scilab Toolkit Manual

Branch: MCA	SEMESTER-III
SubjectCode:3105	Lecture:03 Credit:03
Subject Title	ELECTIVE II GEOGRAPHICAL INFORMATION SYSTEMS

COURSE OBJECTIVE:
1. To introduce the fundamentals and components of Geographic Information System.
2. To provide details of spatial data structures and input, management and output processes.

COURSE OUTCOME:
1. The basic concepts and components of GIS.
2. The techniques used for storage of spatial data and data compression.
3. The practices used for input, management and output of spatial data.
4. Concepts of spatial data quality and data standards.

Modules	Sr. No.	Topic Details	No. of Lectures Assigned	Marks Weightage %
UNIT-I	1	**Fundamentals of GIS:** Defining GIS, components of GIS, spatial data, spatial data-maps, characteristics, spatial data modeling, attribute data management-database data model, GIS applications and developments in database.	10	15
UNIT-II	2	**Input-Output and Data Analysis in GIS:** Data input and editing– methods, editing, integration, Dataanalysis-measurements,queries, reclassification, buffering, map overlay, interpolation, analysis of surfaces, network analysis, spatial analysis, Analytical modeling in GIS-physical, environment and human processes, output from GIS –maps, non-cartographic output, spatial multimedia, decision support.	10	15
UNIT-III	3	**Issues in GIS:** Development of computer methods for spatial data, Issues in GIS- data quality and errors, sources of errors, human and organizational issues, GIS project design and management–problem identification, designing a data model, project management, Implementation, evaluation, the future of GIS, Internet resources of GIS.	10	15
UNIT-IV	4	**Remote Sensing:** Principles of remote sensing, remote sensing system-classification, Imaging, characteristics, extraction of information from images–metric and thematic, Integration of RS and GIS.	9	15

	5	**Global Positioning Systems (GPS):** Introduction to GPS, Accuracy of GPS, Differential GPS, Applications of GPS, Integration of GIS and GPS.	9	15

Reference Books:

1. An Introduction to Geographical Information Systems by Heywood, Cornelius and Carver(Person Education Asia2000)
2. Concepts and techniques of Geographic Information Systems by C. P. Lo and AlbertYeung(PHI, NewDelhi)
3. Fundamentals of Geographic information Systems 2nd Edition by Michael N. Demers(JohnWiley & Sons (ASIA) PteLtd)
5. ArcGIS Developer's Guide for Visual Basic Applications by Razvi (Onword Press,2002)

Branch: MCA	SEMESTER-III
Subject Code: 3105	Lecture: 03 Credit: 03
Subject Title	ELECTIVE II – CYBER PHYSICAL SYSTEM

COURSE OBJECTIVES:

The objective of this course is to develop an exposition of the challenges in implementing a cyber-physical system from a computational perspective, but based equally on the principles of automated control. The course aims to expose the student to real world problems in this domain and provide a walk through the design and validation problems for such systems.

COURSE OUTCOMES:

After completion of course, students would be able to:

1) The general nature of distributed cyber-physical systems, how they can be modeled and the role of modeling to ensure system quality and timeliness in development processes.

2) Analyzing existing cyber-physical systems. Specifying, design and implementation of new cyber-physical systems according to the defined requirements.

3) Application of the principles for software design of distributed cyber-physical systems.

Modules	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT - I	**What are Cyber-Physical Systems?** Cyber-Physical Systems (CPS) in the real-world Basic principles of design and validation of CPS Industry 4.0, Auto SAR, IIOT implications Building Automation, Medical CPS	7	12
UNIT - II	**CPS - Platform components** CPS HW platforms - Processors, Sensors, Actuators, CPS Network - Wireless Hart, CAN, Automotive Ethernet Scheduling Real Time CPS tasks	7	12
UNIT - III	**Principles of Dynamical Systems** Dynamical Systems and Stability Controller Design Techniques Performance under Packet drop and Noise	7	12

UNIT - IV	CPS implementation issues From features to automotive software components, Mapping software components to ECUs CPS Performance Analysis - effect of scheduling, bus latency, sense and actuation faults on control performance, network congestion, Building real-time networks for CPS	9	13
UNIT - V	Intelligent CPS, Safe Reinforcement Learning, Robot motion control, Autonomous Vehicle control, Gaussian Process Learning Smart Grid Demand Response Building Automation	9	13
UNIT - VI	Secure Deployment of CPS Secure Task mapping and Partitioning State estimation for attack detection Automotive Case study: Vehicle ABS hacking Power Distribution Case study: Attacks on Smart Grids	9	13

Reference Books:
a. "Introduction to Embedded Systems – A Cyber–Physical Systems Approach" - E. . Lee, Sanjit Seshia
b. "Principles of Cyber-Physical Systems" - Rajeev Alur

Branch: MCA	SEMESTER-III
Subject Code: 3105	Lecture: 03 Credit: 03
Subject Title	Elective-II: Natural Language Processing

COURSE OBJECTIVES:

1. To learn the basics of Natural Language Processing and its applications.
2. To learn linguistics essentials and building blocks of Natural Language Processing.
3. To learn the techniques in natural language processing.
4. Be familiar with natural language understanding and generation.
5. To understand the information retrieval techniques.

COURSE OUTCOMES:

After completion of course, students would be able to:

1. Understand different building blocks of NLP.
2. Design algorithms for NLP problems.
3. Understand machine translation and its techniques.
4. Learn and use different tools for NLP.

Modules	Sr. No.	Topic and Details	No of Lectures Assigned	Marks Weight age %
UNIT-I	1	**Introduction:** Need for processing of natural languages, Language processing levels, Issues and challenges in NLP, History, Classical approaches to NLP with knowledge bases and linguistic rules. Introduction to formal languages, finite state automata and regular expressions. Applications of NLP.	10	15
UNIT-II	2	**Morphology and Phonology:** Morphology fundamentals, Inflectional and Derivational morphology, Morphological parsing, Finite State transducers, N- gram language models, phonetics fundamentals, phoneme and phonological rules, machine learning of phonology, phonological aspects of prosody and speech synthesis.	10	15
UNIT-III	3	**Part-of-Speech Tagging and Parsing:** Word Classes, Part of speech tagging, Tagsets, Rule based, Stochastic and Transformation based POS tagging. Basic parsing strategies, top down parsing, bottom up parsing, parsing with context free grammars, a basic top down parser, Earley parser, CYK parser, Finite state parsing methods, Unification of feature structures.	10	15

UNIT-IV	4	**Semantic Analysis and Pragmatics:** Lexical Semantics, Lexemes, Relations among lexemes and their senses, WordNet, Internal structure of words, metaphor and metonymy & their computational approaches, Word Sense Disambiguation.	9	15
UNIT-V	5	Discourse, Reference resolution, syntactic and semantic constraints on coreference, pronoun resolution reference, text coherence, discourse structure, Dialogue- Acts, structure, conversational agents, Introduction to language generation, architecture, discourse planning.	9	15

Text Book:

1. D. Jurafsky and J. H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Pearson Education.
2. J. Allen, "Natural Language Understanding", Addison Wesley.
3. T. Siddiqui and U.S. Tiwary, "Natural Languauge Processing and Information Retrieval", Oxford University Press.

Reference Books:

1. J. Handke, "The Structure of the Lexicon: Human Versus Machine (Natural Language Processing)", Mouton de Gruyter.
2. Bharati, V. Chaitanya and R. Sangal, "Natural Language Processing: A Paninian Perspective", Prentice Hall of India.

Branch: MCA	SEMESTER-III
Subject Code:3105	**Lecture:03** **Credit:03**
Subject Title	**ELECTIVE II** **BIG DATA ANALYTICS**

COURSE OBJECTIVES:

1. Understand big data for business intelligence. Learn business case studies for big data analytics.
2. Understand no sql big data management. Perform map-reduce analytics using Hadoop and related too.

COURSE OUTCOMES:

1. Describe big data and use cases from selected business domains.
2. Explain NoSQL big data management.
3. Install, configure, and run Hadoop and HDFS.
4. Perform map-reduce analytics using Hadoop.
5. Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

Modules	Sr. No.	Topic and Details	No. of Lectures Assigned	Marks Weightage %
UNIT-I	1	What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytic.	7	12
UNIT-II	2	Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharding, master-slave replication, peer peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.	7	12

UNIT					
UNIT-III	3	Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures.	7	12
UNIT-IV	4	MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats,	9	13
UNIT-V	5	HBase, data model and implementations, HBase clients, HBase examples, praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.	9	13
UNIT-VI	6	Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.	9	13

References:
1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging
2. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of
4. Polyglot Persistence", Addison-Wesley Professional, 2012.
5. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
6. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
7. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
8. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
9. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
10. Alan Gates, "Programming Pig", O'Reilley, 2011.

Branch: MCA	SEMESTER - III
Subject Code:3201	Practical:04 Credit:02
Subject Title	Data science and Analytics lab (Content: Implementation using Python)

COURSE OBJECTIVE:
1. To introduce the fundamentals and components of Data science and Analytics
2. To provide practical python programming for Data science and Analytics

COURSE OUT COME:
1. Use Pandas Data Frames, Numpy multi-dimensional arrays, and SciPy libraries to work with a various dataset.
2. We will introduce you to pandas, an open-source library, and we will use it to load, manipulate, analyze, and visualize cool datasets.

Modules	Sr. No.	Topic and Details
UNIT-I	1	Learning Objectives, Understanding the Domain, Understanding the Dataset, Python package for data science, Importing and Exporting Data in Python, Basic Insights from Datasets.
UNIT-II	2	Identify and Handle Missing Values, Data Formatting, Data Normalization Sets, Binning, Indicator variables.
UNIT-III	3	Descriptive Statistics, Basic of Grouping, ANOVA, Correlation More on Correlation.
UNIT-IV	4	Simple and Multiple Linear Regression, Model Evaluation Using Visualization, Polynomial Regression and Pipelines, R-squared and MSE for In-Sample Evaluation, Prediction and Decision Making.
	5	Model Evaluation, Over-fitting, Under-fitting and Model, Regression Grid, Search Model Refinement.

Branch: MCA	Semester-III
Subject Code:3202	Practical: 04 Credit: 02
Subject Title	Cloud Computing LAB

COURSE OBJECTIVES:
1. To develop web applications in cloud
2. To learn the design and development process involved in creating a cloud-based application
3. To learn to implement and use parallel programming using Hadoop

COURSE OUTCOMES:
After completion of course, students would be able to:
1. Configure various virtualization tools such as Virtual Box, VMware workstation.
2. Design and deploy a web application in a PaaS environment.
3. Learn how to simulate a cloud environment to implement new schedulers.
4. Install and use a generic cloud environment that can be used as a private cloud.
5. Manipulate large data sets in a parallel environment.

EXERCISES:

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
8. Install Hadoop single node cluster and run simple applications like wordcount.

Branch: MCA	Semester-III
Subject Code: 3203	**Practical: 04** **Credit: 02**
Subject Title	**SOFT COMPUTING LAB**

COURSE OBJECTIVES:
1. The main objective of the Soft Computing Techniques to Improve Data Analysis Solutions is to strengthen the dialogue between the statistics and soft computing research communities in order to cross-pollinate both fields and generate mutual improvement activities.
2. Soft Computing is a consortium of methodologies which collectively provide a body of concepts and techniques for designing intelligent systems.

COURSE OUTCOMES:
After completion of course, students would be able to:
1. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
2. Apply genetic algorithms to combinatorial optimization problems
3. Apply neural networks to pattern classification and regression problems

SAMPLE EXERCISES:
1. To perform Union, Intersection and Complement operations.
2. To implement De-Morgan's Law.
3. To plot various membership functions.
4. To implement FIS Editor. Use Fuzzy toolbox to model tip value that is given after a dinner based on quality ans service.
5. To implement FIS Editor.
6. Generate ANDNOT function using McCulloch-Pitts neural net.
7. Generate XOR function using McCulloch-Pitts neural net.
8. Hebb Net to classify two-dimensional input patterns in bipolar with given targets.
9. Perceptron net for an AND function with bipolar inputs and targets.
10. To calculate the weights for given patterns using hetero associative neural net.
11. To store vector in an auto-associative net. Find weight matrix & test the net with input
12. Create a perceptron with appropriate no. of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights.
13. Create a simple ADALINE network with appropriate no. of input and output nodes. Train it using delta learning rule until no change in weights is required. Output the final weights.
14. Train the autocorrelator by given patterns: A1= (-1,1, -1,1), A2= (1,1,1, -1), A3= (-1, -1, 1, 1). Test it using patterns: Ax= (-1,1, -1,1), Ay= (1,1,1,1), Az= (-1, -1, -1, -1).
15. Train the hetrocorrelator using multiple training encoding strategy for given patterns: A1=(000111001) B1=(010000111), A2=(111001110) B2=(100000001), A3=(110110101) B3(101001010). Test it using pattern A2.
Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform maxmin composition on any two fuzzy relations. 6 Solve Greg Viot's fuzzy cruise controller using Scilab Fuzzy logic toolbox. 7 Solve Air Conditioner Controller using Scilab Fuzzy logic toolbox 8 Implement TSP using GA.

Branch: MCA	SEMESTER - III
Subject Code:3203	**Practical:04** **Credit:02**
Subject Title	**ELECTIVE II** **GEOGRAPHICAL INFORMATION SYSTEMS(LAB)**

COURSE OBJECTIVE:
1. To introduce the fundamentals and components of Geographic Information System.
2. To provide practical on spatial data structures and input, management and output processes.

COURSE OUTCOME:
1. Prepare the different geospatial layers.
2. Compute geometric measurements and perform spatial analysis.
3. Create high-quality maps and associated graphics.

SAMPLE EXERCISES:
1. Prerequisites to GIS Practical.
2. Creating and Managing Vector Data.
3. Calculating line lengths and statistics.
4. Adding raster layers.
5. Raster Styling and Analysis.
6. Raster Mosaicking and Clipping.
7. Making a Map.
8. Importing Spreadsheets or CSV files.
9. Using Plugin.
10. Searching and Downloading OpenStreetMap Data.
11. Working with attributes.
12. Terrain Data and Hill shade analysis.
13. Working with Projections and WMS Data.
14. Georeferencing Topo Sheets and Scanned Maps.
15. Georeferencing Aerial Imagery.
16. Digitizing Map Data.
17. Table Join.
18. Spatial Join.
19. Points in polygon.
20. Performing spatial queries.
21. Nearest Neighbor Analysis.
22. Sampling Raster Data using Points or Polygons.
23. Interpolating Point Data.
24. Batch Processing using Processing Framework.

Branch: MCA	SEMESTER-III
Subject Code: 3203	**Practical: 04** **Credit: 02**
Subject Title	**ELECTIVE II – CYBER PHYSICAL SYSTEM LAB**

COURSE OBJECTIVES:
1. Students will prove that their robots always operate within safety specifications, even when malicious robots (called rogue-bots) designed by other students are added to the environment.
2. The 6th and final lab will be open-ended, allowing students to creatively demonstrate what they have learned.

COURSE OUTCOMES:
After completion of course, students would be able to:
1) Analyzing existing cyber-physical systems. Specifying, design and implementation of new cyber-physical systems according to the defined requirements.

SAMPLE EXERCISES:

1. **Lab 1a:** Robot on Rails (Autobots, Roll Out)
2. **Lab 1b:** Robot on Rails (Charging Station)
3. **Lab 2a:** Follow the Leader, Robot on Highways (with event-driven control)
4. **Lab 2b:** Follow the Leader, Robot on Highways (with time-triggered control)
5. **Lab 3a:** Robot on Racetracks (stay on the circular racetrack)
6. **Lab 3b:** Robot on Racetracks (slow down to avoid collisions)
7. **Lab 4a:** Robot in a Plane (motion with obstacle avoidance)
8. **Lab 4b:** Robot in a Plane (avoiding collisions with Roguebot and moving obstacles)

Final project lab 6: Robot in Star-lab (self-defined course project entering the CPS V&V Grand Prix

Branch: MCA	Semester-III
Subject Code:3203	**Practical: 04** **Credit: 02**
Subject Title	**Natural Language Processing LAB**

COURSE OBJECTIVES:
1. To understand and implement the basics of Natural Language Processing.
2. Learn and use different tools for NLP like NLTK.
3. To implement NLP task like Names Entity Recognition, Syntactic and Semantic analysis and Word Sense disambiguation.

COURSE OUTCOMES:
After completion of course, students would be able to:
1. Understand different building blocks of NLP.
2. Design algorithms for NLP problems.
3. Understand machine translation and its techniques.
4. Learn and use different tools for NLP.

SAMPLE EXERCISES:

Experiment 1: Part-of-Speech Tagging
Choose 2 sentences from each of the 3 sets below (6 total) and assign part-of-speech (POS) tags to each token of each sentence.
 Sentences
(1)
   a. The old car broke down in the car park
   b. At least two men broke in and stole my TV
   c. The horses were broken in and ridden in two weeks d Kim and Sandy both broke up with their partners
(2)
   a. The horse which Kim sometimes rides is more bad tempered than mine
   b. The horse as well as the rabbits which we wanted to eat has escaped
   c. It was my aunt's car which we sold at auction last year in February
   d. The only rabbit that I ever liked was eaten by my parents one summer
   e. The veterans who I thought that we would meet at the reunion were dead
(3)
   a. Natural disasters – storms, flooding, hurricanes – occur infrequently but cause devastation that strains resources to breaking point
   b. Letters delivered on time by old-fashioned means are increasingly rare, so it is as well that that is not the only option available
   c. It won't rain but there might be snow on high ground if the temperature stays about the same over the next 24 hours
   d. The long and lonely road to redemption begins with self-reflection: the need to delve inwards to deconstruct layers of psychological obfuscation
   e. My wildest dream is to build a POS tagger which processes 10K words per second and uses only 1MB of RAM, but it may prove too hard

Experiment 2: Task   phrase-structure tree (PST)
Choose 2 sentences from sets below (4 total) and bracket all the noun phrases (NPs) in each sentence. Then for each NP found, draw a phrase-structure tree (PST) using non-terminal

labels (NP, AP etcYou can invent your own labels for constituents motivated by distrbutional analysis as necessary, and base your PST on the tokenization and PoS tags assigned in the first handout. For instance the PST analysis of the first two NPs in: My aunt's can opener can open a drum should look something like this:
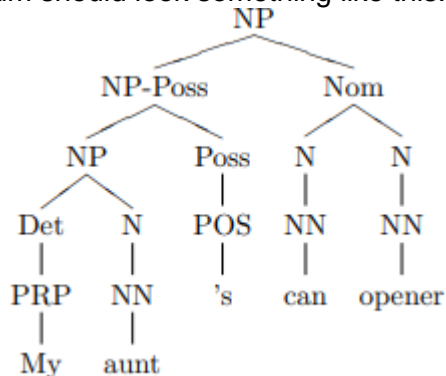
Sentences
(1)
   a. The old car broke down in the car park
   b. At least two men broke in and stole my TV
   c. The horses were broken in and ridden in two weeks
   d. Kim and Sandy both broke up with their partners

(2)
   a. The horse which Kim sometimes rides is worse tempered than mine
   b. The horse as well as the rabbits which we wanted to eat have escaped
   c. It was my aunt's car which we sold at auction last year in February
   d. The only rabbit that I ever liked was eaten by my parents one summer
   e. The veterans who I thought that we would meet at the reunion were dead

Experiment 3: Named entity recognition (NER),
Identifying person, location, and organization names in a given document

Experiment 4: Syntactic analysis of a given document

Experiment 5: Semantic analysis of a given document

Experiment 6: To implement word Sense Disambiguation for a specific scenario using wordnet.

Branch: MCA	SEMESTER-III
Subject Code:3203	**Practical:04** **Credit:02**
Subject Title	**ELECTIVE II** **BIG DATA ANALYTICS LAB**

COURSE OBJECTIVES:
1. Optimize business decisions and create competitive advantage with Big Data analytics.
2. Imparting the architectural concepts of Hadoop and introducing map reduce paradigm.
3. Introducing Java concepts required for developing map reduce programs.
4. Derive business benefit from unstructured data.
5. Introduce programming tools PIG & HIVE in Hadoop echo system.
6. Developing Big Data applications for streaming data using Apache Spark.

COURSE OUTCOMES:
1. Preparing for data summarization, query, and analysis.
2. Applying data modelling techniques to large data sets.
3. Creating applications for Big Data analytics.
4. Building a complete business data analytic solution.

SAMPLE EXERCISES:

1. (i)Perform setting up and Installing Hadoop in its two operating modes:

   - Pseudo distributed,

   - Fully distributed.

   (ii) Use web based tools to monitor your Hadoop setup.

2. (i) Implement the following file management tasks in Hadoop:

   - Adding files and directories

   - Retrieving files

   - Deleting files

   ii) Benchmark and stress test an Apache Hadoop cluster

3. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
   - Find the number of occurrences of each word appearing in the input file(s)

   - Performing a MapReduce Job for word search count (look for specific keywords in a file)

4. Stop word elimination problem:
   - Input:
     - A large textual file containing one sentence per line
     - A small file containing a set of stop words (One stop word per line)
   - Output:
     - A textual file containing the same sentences of the large input file without the words appearing in the small file.

5. Write a Map Reduce program that mines weather data. Weather sensors collecting

data every hour at many locations across the globe gather large volume of log data, which is a good candidate for analysis with MapReduce, since it is semi structured and record-oriented.

- Find average, max and min temperature for each year in NCDC data set?

- Filter the readings of a set based on value of the measurement, Output the line of input files associated with a temperature value greater than 30.0 and store it in a separate file.

6. Purchases.txt Dataset
   - Instead of breaking the sales down by store, give us a sales breakdown by product category across all of our stores
     - What is the value of total sales for the following categories?
     - Toys
     - Consumer Electronics
   - Find the monetary value for the highest individual sale for each separate store
     - What are the values for the following stores?
     - Reno
     - Toledo
     - Chandler
   - Find the total sales value across all the stores, and the total number of sales.

7. Install and Run Pig then write Pig Latin scripts to sort, group, join, project, and filter your data.

8. Write a Pig Latin scripts for finding TF-IDF value for book dataset (A corpus of eBooks available at: Project Gutenberg)

9. Install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

10. Install, Deploy & configure Apache Spark Cluster. Run apache spark applications using Scala.

11. Data analytics using Apache Spark on Amazon food dataset, find all the pairs of items frequently reviewed together.

   - Write a single Spark application that:
     - Transposes the original Amazon food dataset, obtaining a PairRDD of the type:
     - <user_id> → <list of the product_ids reviewed by user_id>
     - Counts the frequencies of all the pairs of products reviewed together;
     - Writes on the output folder all the pairs of products that appear more than once and their frequencies. The pairs of products must be sorted by frequency.

Branch: MCA	Semester-III
Subject Code:3204	**Practical: 04** **Credit: 02**
Subject Title	Machine Learning LAB

COURSE OBJECTIVES:
1. Understand the features of machine learning to apply on real world problems.
2. To extract patterns from data
3. To design and implement various machine learning algorithms and techniques using standard datasets.

COURSE OUTCOMES:
After completion of course, students would be able to:
1. Effectively use the various machine learning tools.
2. Understand and implement the procedures for machine learning algorithms.
3. Design Python programs for various machine learning algorithms.
4. Apply appropriate datasets to the Machine Learning algorithms.
5. Analyze the graphical outcomes of learning algorithms with specific datasets.

SAMPLE EXERCISES:
1. Introduction to Machine Leaning Tools.
2. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
3. 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.
4. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.
5. Write a program to implement k-Nearest Neighbor algorithm to classify a standard data set. Print both correct and wrong predictions.
6. 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.
7. Develop machine learning method for classifying i) the incoming mails. ii) how people rate the movies, books, etc.
8. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

Branch: MCA	SEMESTER-III
Subject Code: 3205	**Practical: 02** **Credit: 01**
Subject Title	**Research Paper III- Presentation / Publication** **(Content: Technical communication for Research** **Paper Writing, Rubrics for evaluation)**

The conference paper written during **SEMESTER** - II has to be presented in the form of either a poster or as an oral presentation in conferences (International /Nation /State/ Regional/ Inter-collegiate level) and a certificate of the same should be obtain by the students and submitted in the department.

The conferences presentation should be done during their **SEMESTER** - III only.

Evaluation will be done on the basis of Rubrics by the team of department faculties.

Branch: MCA	SEMESTER-IV
Subject Code: 4101	Credit: 16
Subject Title	Project

Objectives:

To give the first-hand experience of analysis, design, implementation and documentation of relevant projects. Analysis of the existing system, Investigating alternatives, Design of a computer-based system Documentation, User training.

Branch: MCA	SEMESTER-IV
Subject Code: 4102	Credit: 04
Subject Title	SWAYAM based MOOC Subject

Objectives:

To encourage students to self –learn, a course of interest to the students in Computer Science and Application, that must be completed in form of certification from Swayam. The Department will Approve the list of MOOC course at the beginning of the semester IV. The students will be required to submit the certificate and give a University External Exam of 100 marks.