Pt. Ravishankar Shukla University
Raipur

CURRICULUM & SYLLABI

(Based on CBCS & LOCF)

M. C. A.
[Master of Computer Applications]

Semester System

Session: 2024-26 & onwards

Approved by:	Board of Studies	Academic Council
Date:	10 May 2024	

Master of Computer Applications (MCA)

Master of Computer Applications (MCA) is a two-years professional post-graduate program designed to meet the shortage of qualified professionals in the Computer Application areas. This program helps students wanting to delve deeper into the world of Computer Applications by studying the core concepts of computer science and learning modern programming languages and technologies. The program is a blend of both theoretical and practical knowledge. **MCA** endows students' an opportunity to work with tools meant to develop better and faster applications. Technological issues require specialised solutions and **MCA course** provides hands-on training and skills to address to complex issues arising in the domains such as operating systems, computer languages and system administration. Students learn about the advanced applications of computer hardware and software and its applications in various fields such as operating systems, web technology and computer languages such as .NET, Java, HTML, C++, RDBMS etc.

Program Outcomes:

Upon successful completion of the Master of Computer Applications program, students will be able to:

PO-1	**Knowledge:** Demonstrate a deep understanding of advanced computing concepts, theories, and techniques in various subfields of Computer.
PO-2	**Critical Thinking and Reasoning:** Exhibit advanced critical thinking skills by analyzing and evaluating by theories, practical and projects, and by making reasoned judgments about complex computing problems.
PO-3	**Problem Solving:** Formulate abstract computing problems and derive solutions using logical reasoning and programming.
PO-4	**Advanced Analytical and Computational Skills:** Possess advanced skills in system analysis and computation, including proficiency in using software, programming languages, and computational tools for simulations and data analysis.
PO-5	**Effective Communication**: Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions
PO-6	**Social/ Interdisciplinary Interaction**: Integrate programming concepts and Techniques into interdisciplinary contexts, collaborating effectively with professionals from other fields to address complex problems.
PO-7	**Self-directed and Life-long Learning**: Recognize the importance of ongoing professional development and lifelong learning in the rapidly evolving field of computer applications, and will exhibit the ability to continue learning independently or in formal educational settings.
PO-8	**Effective Citizenship**: **Leadership and Innovation:** Lead and innovate in various computer applications, contributing to advancements in the field and applying computer applications insights to emerging challenges.
PO-9	**Ethics**: Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practice.
PO-10	**Further Education or Employment:** Engage for further academic pursuits, including Ph.D.. Get employment in academia, research institutions, industry, government, and other public sectors.
PO-11	**Global Perspective**: Recognize the global nature of Computer Applications and its impact.

PROGRAMME SPECIFIC OUTCOMES (PSOs): At the end of the program, the student will be able to:

PSO1	Understand the nature of Computer Applications and explore the concepts in further details.
PSO2	Apply the knowledge of Computer concepts in interdisciplinary fields and draw the inferences by finding appropriate solutions.
PSO3	Pursue research in challenging areas of Computer Applications/Computer Science & IT
PSO4	Employ confidently the knowledge of Computer software and tools for treating the complex problems and scientific investigations.
PSO5	Qualify national level tests like NET/GATE etc.

Master of Computer Applications (MCA)

Specification of Course	Semester	No. of Courses	Credits
Core	I-IV	25	84
Elective	II-III	04	16
Total		29	100
Additional Courses (Qualifying in nature, for Student admitted in School of Studies only)			
Generic Elective	II-III	02	06
Skill Enhancement (Value Added Courses)	II, III	02	04

SCHEME OF TEACHING AND EXAMINATIONS 2024-26

MASTER OF COMPUTER APPLICATIONS (2 Years)

FIRST SEMESTER

Subject Code	SUBJECTS	Teaching Load Per Week			Credit *	Examination Marks							
						Max. Marks				Min. Marks			
		L	T	P		Th	Ses	Pr	Total	Th	Ses	Pr	Total
MCA101	Object Oriented Programming With 'C++'	3	1	-	4	100	25	-	125	40	15	-	55
MCA102	RDBMS (SQL/PL-SQL)	3	1	-	4	100	25	-	125	40	15	-	55
MCA103	Operating System with Case Study of Linux	3	1	-	4	100	25	-	125	40	15	-	55
MCA104	Computer System Architecture	3	1	-	4	100	25	-	125	40	15	-	55
MCA105	Software Engineering	3	1	-	4	100	25	-	125	40	15	-	55
MCA106	Lab-I : Programming in C++	-	-	2x2	2	-	50	100	150	-	30	50	80
MCA107	Lab-II : Programming in SQL/PL-SQL	-	-	2x2	2	-	50	50	100	-	30	25	55
MCA108	Lab-III : Programming in Linux	-	-	2x2	2	-	50	50	100	-	30	25	55
MCA109	Soft Skills	-	-	2x2	2	-	25	-	25	-	15	-	15
	TOTAL	15	5	16	28	500	300	200	**1000**	200	180	100	**480**

SECOND SEMESTER

Subject Code	SUBJECTS	Teaching Load Per Week			Credit *	Examination Marks							
						Max. Marks				Min. Marks			
		L	T	P		Th	Ses	Pr	Total	Th	Ses	Pr	Total
MCA201	JAVA Programming	3	1	-	4	100	25	-	125	40	15	-	55
MCA202	Data Structure and Algorithms	3	1	-	4	100	25	-	125	40	15	-	55
MCA203	Advanced Computer Architecture	3	1	-	4	100	25	-	125	40	15	-	55
MCA204	Elective – I	3	1	-	4	100	25	-	125	40	15	-	55
MCA205	Elective – II	3	1	-	4	100	25	-	125	40	15	-	55
MCA206	Lab-IV : Programming in JAVA	-	-	2x2	2	-	50	100	150	-	30	50	80
MCA207	Lab-V : Programming based on MCA202	-	-	2x2	2	-	50	50	100	-	30	25	55
MCA208	Lab-VI : Programming Based on MCA204	-	-	2x2	2	-	50	50	100	-	30	25	55
MCA209	GD/PI based on Indian Knowledge System	-	-	2x2	2	-	25	-	25	-	15	-	15
	TOTAL	15	5	16	28	500	300	200	**1000**	200	180	100	**480**

* **L+T+(P/2)**

S. No	Elective -I	Elective -II
I.	Programming in Python	Internet of Things
II.	Programming in PHP	Mobile Computing
III.	R Language	Theory of Computations
IV.	-	MOOC

THIRD SEMESTER

Subject Code	SUBJECTS	Teaching Load Per Week			Credit *	Examination Marks							
						Max. Marks				Min. Marks			
		L	T	P		Th	Ses	Pr	Total	Th	Ses	Pr	Total
MCA301	.Net Technology	3	1	-	4	100	25	-	125	40	15	-	55
MCA302	Computer Network & Data Communication	3	1	-	4	100	25	-	125	40	15	-	55
MCA303	Artificial Intelligence	3	1	-	4	100	25	-	125	40	15	-	55
MCA304	Elective – III	3	1	-	4	100	25	-	125	40	15	-	55
MCA305	Elective – IV	3	1	-	4	100	25	-	125	40	15	-	55
MCA306	Lab-VII : Programming in .Net Technology	-	-	2x2	2	-	50	100	150	-	30	50	80
MCA307	Lab-VIII: Networking	-	-	2x2	2	-	50	50	100	-	30	25	55
MCA308	Lab-IX : Mini Project	-	-	2x2	2	-	50	50	100	-	30	25	55
MCA309	Internship	-	-	2x2	2	-	25	-	25	-	15	-	15
	TOTAL	15	5	16	28	500	300	200	**1000**	200	180	100	**480**

Note – Student should join Summer Internship of 4 to 6 weeks, after Second Semester Examination.

S. No	Elective –III	Elective -IV
I.	Compiler Design	Big Data Analytics
II.	Cyber Security	Cloud Computing
III.	Digital Image Processing	Soft Computing
IV.	MOOC	MOOC

FOURTH SEMESTER

Subject Code	SUBJECTS	Teaching Load Per Week			Credit *	Examination Marks							
						Max. Marks				Min. Marks			
		L	T	P		Sessional Marks of Project Work	Project Viva-Voce	Pr	Total	Sessional Marks of Project Work	Project Viva-Voce	Pr	Total
MCA401	Internship: System Development Project & Implementation / Research Project (Dissertation)	-	-	32	16	200	200	-	400	120	100	-	220
MCA402	MOOC	Non Credit but mandatory course											
	TOTAL	-	-	32	16	200	200	-	400	120	100	-	220

* **L+T+(P/2)**
* **The work done by the students should be enough to justify the duration of project as 5 to 6 months.**
* **The certificate of Company/institute must specify the duration of at least five months.**
* **Students having undergoing Project will have to send the confirmation letter from the company/institute within 15 days of joining. This letter will have to consist of the information regarding Company/institute name, Guide Name, Project Title, Project Starting Date etc.**
* **Students undergoing Project work should send a Progress Report after competition of two months to the department.**
* **The student will have to deliver Seminar and will have to submit two copies of Project Reports after completion of Project Work.**
* **Preferably, independent work should be carried out by each student.**
* **Participating in Workshops, Conferences and Seminars or publishing Research Papers will be given weightage in the Research Project.**
* **Students should register for any one MOOC course from SWAYAM/NPTEL/RSU LMS under the guidance of a mentor and a certificate of completion must be submitted to the mentor.**

Note:

- In place of Elective Course of II and III semester, Student can choose paper(s) from **any one MOOC course from SWAYAM/NPTEL/RSU LMS** subject to the following conditions:
  a. The chosen paper from **any one MOOC course from SWAYAM/NPTEL/RSU LMS** will be other than the papers offered in the current course structure.
  b. The paper will be of PG level with a minimum of 10 weeks' duration of 4 credits and 100 marks.
  c. The list of courses on SWAYAM keeps changing; the departmental committee will finalize the list of MOOC courses for each semester.
  d. The paper(s) may be chosen from **any one MOOC course from SWAYAM/NPTEL/RSU LMS** on the recommendation of Head of the Department.
- The candidates who have joined the PG Program in School of Studies (University Teaching Department), shall undergo Generic Elective Courses (only qualifying in nature) offered by other departments/SoS in Semester II and Semester III.
- The candidates who have joined the PG Program in School of Studies in Computer Science & IT Studies (University Teaching Department), shall undergo Skill Enhancement Course/Value Added Course (only qualifying in nature) in Semester II and Semester III.

Generic Elective Courses: (Offered to PG students of other Departments/SoS only)

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
II	CS-CBCS-01	Essential of Information Technology	T	3	3	25	75	100
III	CS-CBCS-02	Computer Networking & HTML	T	3	3	25	75	100

Skill Enhancement/Value Added Courses: (Offered to the PG students of SoS in Computer Science & IT)

Semester	Course Code	Course Title	Course Type (T/P)	Hrs/ Week	Credits	Marks		
						CIA	ESE	Total
II	CS-VAC-01	Introduction to Digital Marketing	T	2	2	25	75	100
III	CS-VAC-02	Green Computing	T	2	2	25	75	100

Program Articulation Matrix:

Following matrix depicts the correlation between all the courses of the program and Program Outcomes

Course Code	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
MCA101	√	√	√	√	√	√	√	×	√	√	√	√	√	√	×	√
MCA102	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MCA103	√	√	√	√	√	×	√	√	×	√	√	√	×	√	×	√
MCA104	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MCA105	√	√	√	√	√	√	√	×	×	√	√	√	√	√	×	×
MCA106	√	√	√	√	√	√	√	×	×	√	√	√	√	√	×	√
MCA107	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MCA108	√	√	√	√	√	×	√	√	×	√	√	√	×	√	×	×
MCA109	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	×
MCA201	√	√	√	√	√	√	√	×	×	√	√	√	√	√	×	×
MCA202	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	×
MCA203	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MCA204-I	×	√	×	√	√	√	√	×	√	×	×	×	×	×	√	×
MCA204-II	×	√	×	√	√	√	√	×	√	×	×	×	×	×	√	×
MCA204-III	×	√	×	√	√	√	√	×	√	×	×	×	×	×	√	×
MCA205-I	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	×
MCA205-II	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	×
MCA205-III	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	×
MCA206	√	√	√	√	×	√	√	√	√	√	√	√	√	√	√	√
MCA207	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
MCA208	√	√	√	×	√	×	√	√	√	√	√	√	√	√	×	×
MCA209	√	√	√	√	√	√	√	√	√	√	√	√	√	×	√	×
MCA301	√	√	√	×	√	×	√	√	×	√	√	√	√	√	×	×
MCA302	√	√	√	×	√	√	√	√	×	√	√	√	√	√	×	√
MCA303	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MCA304-I	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MCA304-II	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MCA304-III	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	√
MCA305-I	×	√	×	√	√	√	√	×	√	×	×	×	×	×	√	×
MCA305-II	×	√	×	√	√	√	√	×	√	×	×	×	×	×	√	×
MCA305-III	×	√	×	√	√	√	√	×	√	×	×	×	×	×	√	×
MCA306	√	√	√	√	√	√	√	√	×	√	√	√	√	√	×	×
MCA307	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	×
MCA308	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
MCA309	√	√	√	×	√	×	√	√	×	√	√	√	√	√	×	×
MCA401	×	√	×	√	×	√	√	√	√	√	√	√	√	√	√	√
No. of courses mapping the PO/PSO	27	30	27	25	28	24	30	24	11	28	28	28	26	27	9	14

MCA Semester-I

Program	Subject	Year	Semester
MCA	MCA	1	I
Course Code	Course Title		Course Type
MCA101	Object Oriented Programming with C++		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0
Maximum Marks	Sessional		Theory
125	25		100

Learning Objective (LO):

The course aims to equip students with a deep understanding of oop concepts,particularly in programming theory, and skill them to apply this knowledge to solve programming problems.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the basic terminology used in computer programming and will be able to design programs involving decision structures, loops and functions.	An
2	Understand the dynamics of memory by the use of pointers, understand different data structures and create/update basic data files.	U
3	Understand the basic concepts of inheritance by which they can achieve the code reusability.	U
4	Create file and can also perform specific operations in existing files.	Ap
5	a) Analyze a simple programming problem specification. b) Design a high-level (programming language independent) solution to the problem using functional abstraction and general imperative programming language constructs.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	2	-
CO2	3	2	3	1	1	1	3	-	1	-	-	1	3	-	-	3
CO3	3	3	1	1	1	1	1	-	-	2	-	3	2	-	1	2
CO4	1	3	3	1	1	2	3	1	1	2	1	2	2	-	-	-
CO5	3	3	3	1	3	-	2	-	-	2	2	3	2	3	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

MCA101

Object Oriented Programming with C++

Unit No.	Topics	No. of Hours	CO No.
I	**Overview of OOP:** The Object Oriented paradigm, Basic concepts of OOP, Benefits of OOP, Object oriented languages, Application of OOP **Overview of C++:** History of C++, **Data Types:** Built-in data types, User-defined data types, Derived data types. **Constants and Variables:** symbolic constants, Dynamic initialization of variable, Reference variable. Operators in C++.**Control Structures:** if-else, nested if-else, while, do-while, for, break, continue, switch, goto statement.	10	1
II	**Structures:** A Simple structure, defining a structure variable, Accessing structures member, Enumeration data type. **Function:** Function Declaration, Calling Function, Function Definition, **Passing Arguments to function:** Passing Constant, Passing Value, Reference Argument, Structure as argument, Default Argument. **Returning values from function:** return statement, Returning structure variable, Return by reference. Overloaded Functions, Inline Functions and Templates.	10	2
III	Object and Class, Defining the class and its member, Making an outside function inline, nesting of member function, array as class member, structure and classes. **Memory allocation:** memory allocation for objects, new and delete operator, static data member, static member functions, object as function argument. **Constructor & Destructor:** Null and default constructor. Parameterized constructor, Constructor with default argument, copy constructor, class destructors, **Inheritance:** Introduction to inheritance, Types of inheritance, function overriding, Constructor in Derived class. **Access specifiers:** public, private, protected.	10	3
IV	**Pointers:** Introduction, & and * operator, pointer to object, this pointer, pointer to derived class. **Dynamic polymorphism:** Virtual function, Pure Virtual Function, Abstract class. **Static Polymorphism:** Operator keyword, overloading unary operator (++ (pre increment and post increment),--) using operator function, overloading binary operators (+,-,==,>=,<=, +=,<,>,[]), Friend function, Friend class, overloading binary operators using friend function.	10	4
V	**File and Stream:** C++ Stream class, unformatted I/O operations, formatted console I/O, manipulators, opening and closing a file, detecting eof, file modes, get(), put(),reading and writing a class object, Updating a file random access.	10	5

RECOMMENDED BOOKS:

1. **C++: The Complete Reference,** *Herbert Schildt,* Tata McGraw-Hill
2. **Object Oriented Programming with C++,** *E. Balagurusamy,* Tata McGraw-Hill
3. **The C++ Programming Language,** *BjarneStroustrup,* Addison-Wesley.
4. **Object Oriented Programming in C++,***RobertLafore,* Galgotia Publications.
5. **Introduction to Object Oriented Programming,** *K V Witt,* Galgotia Publications.
6. **Object Oriented Programming,** *G Blaschek,* Springer Verlag
7. **Object Data Management ,** *RCattel,* Addison Wesley.

MCA Semester-I

Program	Subject	Year	Semester
MCA	MCA	1	I
Course Code	Course Title		Course Type
MCA102	RDBMS (SQL/PL-SQL)		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0
Maximum Marks	Sessional		Theory
125	25		100

Learning Objective (LO):

The course objective is to make students learn a understanding of DBMS concepts specifically SQL Concepts and PL- SQL programming.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Design a database based on the given requirements.	**Ap**
2	Make Database oriented application with knowledge of subject provided to them.	**Ap**
3	Get the knowledge about Standard Query Language statements, PL/SQL, Query processing and optimization.	**U**
4	Apply normalization techniques on given database.	**Ap**
5	RDBMS are the basic building blocks of data warehousing, mining, Big Data Analytics, cloud computing etc.	**U**

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	Pos											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	3	2	2	1	2	1	-	2	2	3	1	2	-	1
CO2	3	1	3	2	3	2	2	1	-	2	1	1	1	2	2	3
CO3	2	3	3	2	2	1	1	-	-	3	2	3	1	2	-	2
CO4	3	2	3	3	2	3	2	1	-	2	1	2	2	2	1	2
CO5	1	3	3	1	2	1	2	1	-	2	2	3	1	2	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

MCA102

RDBMS (SQL/PL-SQL)

Unit No.	Topics	No. of Hours	CO No.
I	**Overview of Database Management:** Data, Information and knowledge, Importance of database oriented approach to data management; data independence, database administration roles, DBMS architecture, different kinds of DBMS users, importance of data dictionary, contents of data dictionary, types of database languages. Data models: network, hierarchical, relational. Introduction to distributed databases, Client/Server databases, Object-oriented databases.	10	1
II	**ER Model & Relational Algebra:** Entity - Relationship model as a tool for conceptual design- entities, attributes and relationships. ER diagrams; Concept of keys; Case studies of ER modeling Generalization; specialization and aggregation. Converting an ER model into relational Schema.**Relational Algebra:** select, project, cross product, different types of joins; set operations, Tuple relational calculus, Domain relational calculus.	10	2
III	**Normalization:** Introduction, Pitfalls in database design, Anomalies, Decomposition, Functional dependencies, Join dependencies, Normal forms (1NF, 2NF, 3NF). Boyce-Codd Normal form, Multi-Valued Dependencies, 4NF, 5NF. Denormalization. Protecting the Data Base - Integrity, Security and Recovery. Domain Constraints, Referential Integrity, Assertion, Security & Authorization in SQL.	10	3
IV	**SQL and Relational Database Design:** Introduction to SQL constructs (SELECT...FROM, WHERE... GROUP BY... HAVING... ORDERBY....), CREATE, INSERT, DELETE, UPDATE, ALTER, LIKE, DROP, VIEW definition and use, Temporary tables, Nested queries, and correlated nested queries, Integrity constraints: Not null, unique, check, primary key, foreign key, references. Transaction control commands –grant, privileges, commit, Rollback, Savepoint.	10	4
V	**PL/SQL** Introduction to PL/SQL variables – literals – data types – advantages of PL/SQL; Control statements : if ; iterative control – loop, while, for, goto ; exit when; Cursors : Types –implicit, explicit – parameterized cursors – cursor attributes; Exceptions: Types – internal , user-defined , handling exceptions – raise statement; Triggers. Sub programs: Functions - procedures - in, out, inout parameters; purity functions - packages - package specification -advantages of packages.	10	5

BOOKS RECOMMENDED:

1. **Database System Concept**: *A. Silberschatz , H.F. Korth and S. Sudarshan*, TMH
2. **Fundamentals of Database Systems**: *Elmasri&Nawathe*, Pearson Education
3. **An Introduction to Database Systems**: *C. J. Date*, AWL Publishing Company
4. **SQL, PL/SQL**: *Ivan Bayross*, BPB Publication
5. **An Introduction to database systems**: *Bipin Desai*, Galgotia Publication.
6. **Database Management System**: *A. K. Majumdar&P.Bhattacharya*, TMH

MCA Semester-I

Program	Subject	Year	Semester
MCA	MCA	1	I
Course Code	Course Title		Course Type
MCA103	Operating System with Case Study of Linux		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0
Maximum Marks	Sessional		Theory
125	25		100

Learning Objective (LO):

The course learning objective is to develop an understanding of Operating System Concepts for relating the other subjects with the functions of OS.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Come to know the basics of how does operating system work.	U
2	Know about how process starts their execution and how it completes.	U
3	Inculcate knowledge of basic functions of operating system like memory management, disk scheduling etc.	U
4	Develop critical thinking to manage processes and learn managing hardware and software both.	U
5	Develop internal knowledge of system handling.	U

CL: Cognitive Levels
Cognitive Level: **R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; B-Evaluate; **C**-Create.

CO-PO/PSO Mapping for the course:

PO / CO	Pos											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	1	3	3	1	2	-	2	1	-	2	2	1	-	2	-	3
CO2	3	3	3	-	3	-	2	1	-	2	2	3	-	1	-	1
CO3	2	3	2	1	2	-	2	1	-	2	2	3	-	2	-	-
CO4	3	3	3	1	1	-	2	1	-	2	2	2	-	2	-	-
CO5	3	3	1	2	2	-	2	1	-	2	2	3	-	1	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

MCA103

Operating System with Case Study of Linux

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction:** Defining operating system, History and Evolution of operating system, Dual mode operation in operating system . **Basic Concepts**: batch processing, spooling, multiprogramming, multiprocessor system, time sharing, real time systems, Functions and Goals of operating system, Operating system as resource manager, Operating system as an abstract machine. . **Distributed systems:** Introduction& Features, Types of distributed OS.	10	1
II	**Process Management :** Process concept, Process Control Block, **Process State**: State Transition Diagram, **Scheduling Queues**: Queuing Diagram, Types of schedulers-context switching and dispatcher, various types of CPU scheduling algorithms and their evaluation, multilevel queues and multilevel feedback queues, Thread life cycle, multithreading.	10	2
III	**IPC and Dead Locks : Inter Process Communication**: competing and co-operating processes, Introduction to concurrent processing, Precedence graphs, Critical section problem, Semaphore concept, Study of classical process synchronization problems: Producer–Consumer, Dining Philosophers. **Deadlocks**: The dead lock problem, dead lock definition, **Deadlock Characterization**: necessary condition, resource allocation graph, **Deadlocks handling**: Deadlock prevention, Deadlock avoidance, Banker's algorithm, Deadlock detection, Recovery from Deadlock	10	3
IV	**Memory Management :** Preliminaries of memory management, Contiguous memory allocation, partitioned allocation MFT, fragmentation, MVT, partition allocation policies, compaction, Non-Contiguous memory allocation, Paging, Structure of page table, Segmentation, **Virtual Memory**: Concepts, demand paging, Swapping, **Page replacement policies**: FIFO, Optimal, LRU, MRU, Thrashing. **Secondary Storage**: Hierarchy, physical characteristics, evaluation of disk access time and data transfer rate, **Scheduling algorithms**: FCFS, SCAN etc.	10	4
V	**File and Device Management: File concept**: file types, file directory maintenance, File sharing, Basic file system structure, access methods-sequential and direct access, free space management contiguous, linked allocation and indexed allocation and their performances. **Protection and Security**: principle of protection, domain structure, access matrix, access control, the security problems	10	5

BOOKS RECOMMENDED:

1. **Operating System Concepts**, *Abraham Silberschatz, Peter B. Galvin and Greg Gagne,* Wiley India
2. **Modern Operating System**, *Andrew .S. Tanenbaum,* PHI
3. **Operating System Concepts**, *James L. Peterson and Abraham Silberschatz,* Addison-Wesley
4. **Operating System Concepts & Design**, *Milan Milenkovic,* MGH
5. **An Introduction to Operating Systems**, *Harvey M. Dietel,* Addison Wesley

MCA Semester-I

Program	Subject	Year	Semester
MCA	MCA	1	I
Course Code	Course Title		Course Type
MCA104	Computer System Architecture		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0
Maximum Marks	Sessional		Theory
125	25		100

Learning Objective (LO):

The course develops an understanding of Computer architecture and its detailed working. It inculcates the cognition of circuit design of internal parts of computers and its electronics basics.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Develops an intuitive knowledge of circuitry design of electronic components.	U
2	Be familiar with system hardware component.	U
3	Understand the overall internal architecture of computer in detail and also the digital representation of data in a computer system.	U
4	Understand the general concepts in digital logic design, including logic elements and their use in combinational and sequential logic circuit design.	U
5	Understand computer arithmetic formulate and solve problems, understand the performance requirements of systems.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	3	2	-	1	2	1	-	2	-	3	2	2	-	3
CO2	3	3	3	2	2	1	2	1	-	2	2	3	1	2	-	3
CO3	3	2	-	2	2	1	2	1	-	2	2	3	1	2	2	1
CO4	1	3	3	2	1	1	2	1	-	1	2	2	1	1	-	3
CO5	3	3	3	2	2	1	2	1	-	2	2	3	1	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

MCA104

Computer System Architecture

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I Representation of Information and H/w component:** Number system (decimal, BCD, octal, hexadecimal) and conversions, r and r-1's complement, Fixed and Floating point representation, Binary codes: Excess-3, ASCII, EBCDIC, Error detection codes. Boolean Algebra, Map simplification K-Map, Logic Gates, **Combinational Circuit:** Half and Full Adder, Decoder and Multiplexer; **Sequential Circuit:** Flip-Flop (SR, D, JK, Master-Slave, T), 4 bit Register, Register with parallel load, Shift register, Binary ripple Counter, Binary synchronous counter.	10	1
II	**UNIT – II Register transfer language and micro operations** Register Transfer Language (RTL), Concepts of bus, Bus and Memory transfers, **Micro-operation:** Arithmetic, Logic and Shift micro operation, Instruction code, Computer registers, Computer instructions, Timing and control, Instruction Cycle and Interrupt Cycle, Memory reference instructions, Input-output and interrupt, Design of basic computer.	10	2
III	**UNIT – III Programming Computers and CPU** Machine Language, Assembly Language, Assembler, Program Loops, Input /Output, Programming, General register organization, Stack organization, Instruction format, Addressing modes, Data transfer and manipulation language, Micro-programmed and Hardwired control, RISC Vs. CISC, **Pipelining in CPU design:**, Parallel Processing ,Arithmetic and RISC pipelining.	10	3
IV	**UNIT – IV Computer Arithmetic and I/O Techniques:** Addition, Subtraction, Division and Multiplication Algorithm, Input-Output Interface, asynchronous data transfer; **Modes of transfer:** Programmed I/O, Interrupt Mechanism, Direct Memory Access (DMA), I/O Processor.	10	4
V	**UNIT – V Memory Organization** **Memory hierarchy:** Static and Dynamic RAM, ROM; Building large memory using chips, Associative memory: associative mapping, direct mapping, set associative mapping; cache memory organization, virtual memory.	10	5

BOOKS RECOMMENDED:

1. **Computer System Architecture**, *Morris Mano*, PHI
2. **Computer Organization and Architecture**, *William Stalling*, PHI
3. **Computer organization and Architecture**, *J.P.Hayes*, TMH
4. **Digital Computer Logic Design**, *Morris Mano*, PHI
5. **Fundamentals of Microprocessors,** *B. Ram*
6. **Computer System Architecture and organization**, *Dr.M. Usha,T. S. Shrikant*,Wiley publication.
7. **Digital Computer Electronics,** *Malvino.*
8. **Structured Computer Organization,** *Andrew M. Tanenbanm*, PHI
9. **Modern Digital Electronics,** *R.P.Jain*, Tata McGrawHill

MCA Semester-I

Program	Subject	Year	Semester
MCA	MCA	1	I
Course Code	**Course Title**		**Course Type**
MCA105	Software Engineering		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

Objective of this course is to develop a skill to analysis the software requirement and students will be able to know about SDLC and how that phases can be used for designing and implementation of softwares.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Have a fair idea about the importance of using software engineering principles in real life projects and also be able to pick an appropriate software development model for developing systems.	Ap
2	Prepare software requirement sheet for a real life project, keeping in mind the properties of an SRS document.	Ap
3	Use mathematical models for calculating the size, cost and duration of real life projects.	U
4	Test the developed system using different testing techniques.	An
5	Design applicable solutions in one or more application domains using software engineering approaches that integrate ethical, social, legal and economic concerns.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	1	2	-	-	2	2	3	1	1	-	-
CO2	2	3	3	2	1	1	2	-	-	2	2	3	1	1	-	1
CO3	3	1	3	2	3	2	-	1	-	1	2	-	2	1	-	2
CO4	1	3	3	2	2	1	2	-	1	2	-	3	1	2	3	-
CO5	3	3	-	2	2	1	2	-	3	2	2	3	1	1	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA105
Software Engineering

Unit No.	Topics	No. of Hours	CO No.
I	**Software Engineering Fundamentals:** Introduction to Software Engineering; Software Engineering Principles(Layers); Software Process – Process Framework, Umbrella Activities, Process Adaptation; Software Crisis; Process Models-Waterfall Model, Prototype Model, Incremental Model, Spiral Model, RAD Model; Agile Process.	10	1
II	**Software Analysis and Design:** Requirement Engineering; Analysis Model-Data Flow Diagram, Data Dictionary, E-R Diagram, Decision Table; Software Requirements Specification(SRS), Structure of SRS; Pseudo code; Software Design; Design Process; Design Concepts-Abstraction, Partitioning, Modularity, Information Hiding, Refinement, Refactoring; Function Oriented Design; Object Oriented Design; Cohesion and Coupling.	10	2
III	**Software Quality and Case Tools:** Software Metrics, Categories of Metrics, Function Point Metric; Software Quality; McCall's Quality Factors; Software Maturity Model-CMM,CMMI; Software Quality Assurance; ISO Standards-9000, 9001 and 9126; Software Reliability; Case Tools and its Scope; Case Objectives; Architecture of Case Tools; Case Classification.	10	3
IV	**Coding and Testing:** Programming Style; Structured Programming; Coding Standard; Internal Documentation; Software Testing-Verification and Validation; Alpha and Beta Testing; Levels of Testing-Unit, Integration and System Testing; Testing Techniques- White Box, Black Box; Cyclomatic Complexity; Test Plan; Debugging-Debugging Process, Debugging Strategies(Approaches).	10	4
V	**Software Maintenance and Project Management:** Risk Management – Software Risk, Risk Identification; Introduction to Software Maintenance, Categories of Maintenance; Belady and Lehman Model; Boehm Model; Project Management Concept – People, Product, Process, Project; Software Team; Software Project Planning; Software Project Estimation; Cost Estimation Model(COCOMO, COCOMO II, Putnam-SLIM, Walston and Felix); Software Reengineering.	10	5

RECOMENDED BOOKS:

1. **Software Engineering: A Practitioner's Approach**, *Roger S. Pressman*, TMH
2. **An Integrated approach to Software Engineering**, *PankajJalote*, Narosa Publications
3. **Software Engineering**, *Bharat Bhushan Agarwal*.

MCA Semester-I

Program	Subject	Year	Semester
MCA	MCA	1	I
Course Code	Course Title		Course Type
MCA106	Lab-I : Programming in C++		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	0	0	4
Maximum Marks	Sessional		Practical
150	50		100

Learning Objective (LO):

The learning objective of the course is implement concepts of OOP by developing programs in lab to solve real world programming issues.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the basic terminology used in computer programming and will be able to design programs involving decision structures, loops and functions.	Ap
2	Understand the dynamics of memory by the use of pointers, understand different data structures and create/update basic data files.	Ap
3	Understand the basic concepts of inheritance by which they can achieve the code reusability.	Ap
4	Understanding the file handling concept they can easily create file and can also perform specific operations in existing files.	Ap
5	a) Analyze a simple programming problem specification. b) Design a high-level (programming language independent) solution to the problem using functional abstraction and general imperative programming language constructs.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	3	1	1	-	2	1	-	2	2	3	-	2	-	3
CO2	3	2	3	-	2	-	2	1	-	1	2	2	1	1	1	-
CO3	3	3	3	1	2	3	-	1	2	2	2	3	-	2	-	-
CO4	1	3	3	1	2	-	2	2	-	2	1	3	-	1	1	-
CO5	3	3	3	1	2	-	1	1	1	2	2	3	-	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA106
Lab-I : Programming in C++

Unit No.	Topics	No. of Hours	CO No.
I	**Programs Related to Language Fundamental**	10	1
II	**Programs Related to Structure & Function**	10	2
III	**Programs Related to Object Classes and Inheritance**	10	3
IV	**Programs Related to Pointers, Virtual Function and Operator Overload**	10	4
V	**Programs Related to File & Stream File and Stream:**	10	5

Books Recommended:

1. **Object Oriented Programming with C++** : *E. Balagurusamy*, The McGraw-Hill
2. **The C++ Programming Language**: *Bjarne Stroustrup*, Addision Wasley.
3. **Object Oriented Programming in C++**: *Robert Lafore*, Galgotia Publications.
4. **Introduction to Object Oriented Programming**: *K V Witt*, Galgotia Publications.
5. **Object Oriented Programming**: *G Blaschek*, Springer Verlag
6. **Object Data Management**: *R Cattel*, Addison Wasley.

MCA Semester-I

Program	Subject	Year	Semester
MCA	MCA	1	I
Course Code	Course Title		Course Type
MCA107	Lab-II : Programming in SQL/PL-SQL		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	0	0	4

Maximum Marks	Sessional	Practical
100	50	50

Learning Objective (LO):

The learning objective of the course is know how Database is managed by developing SQL queries and PL- SQL triggers etc.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Da database based on the given requirements.	**Ap**
2	Make Database oriented application with knowledge of subject provided to them.	**Ap**
3	Get the knowledge about Standard Query Language statements, PL/SQL, Query processing and optimization.	**Ap**
4	Apply normalization techniques on given database.	**Ap**
5	RDBMS are the basic building blocks of data warehousing, mining, Big Data Analytics, cloud computing etc.	**Ap**

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	2	3	2	1	1	1	1	-	2	2	3	-	2	-	3
CO2	3	2	3	1	2	-	2	1	-	2	2	3	-	2	-	1
CO3	3	2	3	1	2	1	3	-	1	2	2	3	2	3	1	-
CO4	3	2	3	1	2	-	2	1	-	2	1	2	-	2	-	1
CO5	3	3	3	1	2	-	1	2	-	1	2	3	-	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA107
Lab-II : Programming in SQL/PL-SQL

Unit No.	Topics	No. of Hours	CO No.
I	Introduction to SQL constructs (SELECT...FROM, WHERE... GROUP BY... HAVING... ORDERBY....), CREATE, INSERT, DELETE, UPDATE, ALTER, LIKE, DROP, VIEW definition and use, Temporary tables,	10	1
II	Nested queries, and correlated nested queries, Integrity constraints: Not null, unique, check, primary key, foreign key, references	10	2
III	. Transaction control commands –grant, privileges, commit, Rollback, Savepoint. Introduction to PL/SQL variables – literals – data types – advantages of PL/SQL; Control statements : if ; iterative control – loop, while, for, goto ; exit when;	10	3
IV	Cursors : Types –implicit, explicit – parameterized cursors – cursor attributes; Exceptions: Types – internal , user-defined , handling exceptions – raise statement; Triggers; PL/SQL tables and records: Declaring PL/SQL tables - referring PL/SQL tables, inserting and fetching rows using PL/SQL table, deleting rows; records - declaration of records - deleting records;	10	4
V	Sub programs: Functions -procedures - in, out, inout parameters; purity functions - packages - package specification -advantages of packages - private and public items - cursors in packages.	10	5

MCA Semester-I

Program	Subject	Year	Semester
MCA	MCA	1	I
Course Code	Course Title		Course Type
MCA108	Lab-III : Programming in Linux		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	0	0	4
Maximum Marks	Sessional		Practical
100	50		100

Learning Objective (LO):

The aim of this course is to make students proficient in Linux environment, commands and shell programming.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn about the basic linux commands.	**Ap**
2	Introduced to the various command line editors provided by typical linux flavours such as vim, nano etc.	**Ap**
3	Learn the basics of shell programming using the bash shell.	**Ap**
4	Learn control structures of shell programming such as branching and looping statements.	**Ap**
5	Learn to write functions in bash script	**Ap**

CL: Cognitive Levels: Cognitive Level: **R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; B-Evaluate; **C**-Create.

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	1	3	3	1	1	1	2	1	-	2	2	3	-	2	-	3
CO2	2	3	3	1	2	1	2	1	-	2	2	3	-	2	-	1
CO3	3	3	2	1	1	1	2	1	-	-	2	2	2	1	1	1
CO4	3	3	1	2	2	1	2	1	2	-	2	3	-	2	-	-
CO5	3	3	2	2	2	1	2	1	-	2	2	3	-	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

MCA108

Lab-III : Programming in Linux

Unit No.	Topics	No. of Hours	CO No.
I	Basic Linux Commands	10	1
II	Command line editors	10	2
III	Shell programming Fundamentals	10	3
IV	Control Statements	10	4
V	Functions	10	5

MCA Semester-I

Program	Subject	Year	Semester
MCA	MCA	1	I
Course Code	**Course Title**		**Course Type**
MCA109	Soft Skills		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	0	0	4
Maximum Marks	**Sessional**		-
25	25		00

Learning Objective (LO):

The course aims is to develop presentation skills and communication skills in students.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Develop good personality.	Ap
2	Develop good managerial skill	Ap
3	Develop good communication skill	Ap
4	Face an interview with more confidence.	Ap
5	Have a better holistic perspective about their careers.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	2	2	2	-	2	1	-	2	1	3	-	2	-	3
CO2	1	3	3	1	2	-	2	1	-	2	3	1	1	1	1	1
CO3	2	3	3	3	2	-	2	1	-	3	2	3	-	2	2	-
CO4	1	3	3	1	3	1	1	1	1	2	2	3	-	2	-	-
CO5	3	2	3	1	2	-	2	1	-	2	2	3	-	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

MCA109
Soft Skills

Unit No.	Topics	No. of Hours	CO No.
I	Personality Development	50	1
II	Managerial Skill		2
III	Mock Interview		3
IV	Communication Skill		4
V	Interpersonal Skill		5

MCA Semester-2

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	Course Title		Course Type
MCA201	JAVA Programming		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

The objective of this course is to make the students learn and apply high level object oriented programming "java" and develop problem solving skills along with programming skills.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand fundamentals structure and model of Java programming language.	**U**
2	Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.	**U**
3	Relate and solve the real problem.	**An**
4	Understand the basic principles of creating Java applications with graphical user interface (GUI).	**U**
5	Write a computer program to solve specified problems as well as make Business and research applications.	**Ap**

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	1	3	2	2	3	2	-	-	3	3	3	3	3	1	-
CO2	3	1	3	2	2	1	2	-	1	2	1	3	1	-	1	3
CO3	2	1	2	2	2	-	2	-	-	3	2	-	2	2	1	2
CO4	3	3	3	2	2	1	1	1	-	3	1	1	3	2	-	-
CO5	3	3	2	2	2	1	2	-	-	3	2	3	3	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA201
JAVA Programming

Unit No.	Topics	No. of Hours	CO No.
I	**An overview of Java:** Object Oriented Programming, Features of Java, Java Virtual Machine, Java Environment: Java Development Kit, Java Standard Library, Data Types, **Variables:** Declaring a variable, Dynamic Initialization, The scope and life time of variable, Type conversion and Casting: Narrowing and Widening Conversions, Numeric Promotions, Type Conversion Contexts; **Operators**: Arithmetic Operators, Relational Operators, Logical Operators, Bit wise Operators, Conditional Operators, new operator, [ ] and instance of operator. **Control Statements:** Java's Selection statement, Iteration Statement, Jump Statement. **Arrays**: Declaring Array variables, constructing an Array, Initializing an Array, Multidimensional Arrays, Anonymous Arrays.	10	1
II	**Introducing Classes:** Class Fundamentals, Declaring Object, Assigning Object Reference Variables, Defining **Methods**: method overloading and overriding, Using objects as parameter, Constructors, Garbage collection, finalize () method. **Inheritance**: Inheritance basic, method overloading, object reference this and super, Chaining constructor using this () and super (), Member accessibility modifier: public, protected, default accessibility of member, private protected, private, **Package:** Define package, CLASSPATH, importing package, Interface: Define an interface, implementing interface, extending interface, variable in interface, **Overview of nested class:** Top level nested class and interface, Non static inner class, Local class, Anonymous class.	10	2
III	**Exception Handling:** Exception types, Uncaught Exception, Using try and catch, multiple catch, nested try block, throw, throws, and finally. **Multithreading:** Creating Thread, Thread Priority, Synchronization, Thread Scheduler, Running & Yielding, Sleeping & Waking Up, Waiting & Notifying, Suspending & Resuming; miscellaneous methods in thread class.	10	3
IV	**Fundamental Library Classes of Java and Input / Output** Object class, String class, String Buffer class, Wrapper class, Math class, Collection: Collection interface, List interface, Set interface sorted interface, Array List class, Liked List class, Tree Set, Comparator, Vector, Stack. **I/O Classes and Interfaces:** File, Buffer Stream, Character Stream, and Random Access for files, Object Sterilization.	10	4
V	**Event Handling:** Overview of Event Handling, Event Hierarchy, The Delegation Event Model, Event Classes, KeyEventClass, Sources of Events, Event Listener Interfaces, Using the Delegation Event Model, Event Adapters. **GUI Programming:** Introduction to Swing, History, Features, Components and Containers, Swing Packages, Painting, Swing Component Classes: JLabel, JTextField, Swing Buttons, JTabbedPane, JScrollBar,JList, JComboBox, Trees, JTable, Swing Menus:< Main Menu, PopUp Menu, ToolBar. **JDBC:** Introduction to JDBC, JDBC Drivers Type, Connection, JDBC URLs, Driver Manager, Statement – Creating, Executing, Closing, Result Set – Data Types and Conversions. Prepared Statement, Callable Statement, Mapping SQL and Java Types.	10	5

BOOKS RECOMMENDED:

1. **Java: The Complete Reference,** *HerbertSchildt,* Oracle Press.
2. **Core Java: Volume-I & Volume 2,** *Cay S. Horstmann& Gary Cornell,* PEARSON
3. **Programming with Java,** *E. Balagurusamy,* McGraw Hill Education
4. **Core Java**, *R.NageshwaraRao,* Dreamtech Press

MCA Semester-2

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	**Course Title**		**Course Type**
MCA202	Data Structure and Algorithms		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

Objective of this course is to make student think about real time data storage and its structure. After completion of this course student will be able to understand and write coding in efficient manner.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Design the appropriate data structures and algorithms for solving real world problems and enables them to gain knowledge in practical applications of data structures.	Ap
2	Choose efficient data structures and apply them to solve problems and analyze the efficiency of programs based on time complexity.	An
3	Create better design of computer applications.	An
4	Gain the reasoning ability to implement these concept in development of live commercial applications	Ap
5	Understand about memory representation of different data structures.(U)	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	3	1	3	1	2	-	1	3	2	2	2	2	2	-
CO2	2	3	3	1	3	3	1	1	1	3	1	3	3	2	1	3
CO3	1	1	3	2	2	1	2	-	1	3	3	3	3	2	1	2
CO4	1	2	3	2	2	1	2	-	-	2	3	3	3	2	-	-
CO5	3	2	3	2	2	1	2	-	-	1	2	3	3	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA202
Data Structure and Algorithms

Unit No.	Topics	No. of Hours	CO No.
I	**UNIT – I Array and Linked Lists** **Algorithm**: Concept of Algorithm, definition, characteristics of algorithm, algorithmic notation, analysis of algorithm, rate of growth, time, Basic time and space analysis of an algorithm, Asymtotic notation. **Data Structure**: Definition, Types of Data Structure, Data Structure operation. **Array**: Linear Array, Representations of Array in Memory, Traversing, Insertion and Deletion in Linear Array, Multidimensional Array. **Linked list**: Representation of linked lists in memory, Traversing a linked list, Searching a linked list, Memory Allocation, Insertion into a linked List, Deletion from a Linked List, Header Linked List, Two- Way Linked Lists, Circular Linked List.	10	1
II	**UNIT – II Stack and Queues** Stacks Definition, concepts, operation and application of Stacks, Recursion and Polish notations, Quick sort, tower of Hanoi, Queue, Priority Queue: definition concepts, operation and application of Queue, circular queue and Dequeue.Linked representation of stack and queue.	10	2
III	**UNIT – III Trees and their Representations:** Terminologies related to trees, Binary Tree, complete binary tree, almost complete binary tree; Tree Traversals-preorder, in order and post order traversals, their recursive and non-recursive implementations, Expression tree-evaluation, Linked representations of binary tree, operations. Header nodes; threads, Binary Search Tree: searching, Inserting and deleting in BST, Heap; Path Lengths; Huffman's Algorithms. Basic idea of AVL Tree.	10	3
IV	**UNIT – IV Graphs:** Related definitions; Graph representations- adjacency matrix, adjacency list, adjacency multi-list; Traversal schemes - depth first search, breadth first search; Minimum spanning tree; Shortest path algorithm; Kruskal and Dijkstra's algorithms.	10	4
V	**UNIT – V Searching, Hashing and Sorting:** Searching : Linear Search, Binary Search, Searching and data modification Hashing-Basics, methods, collision, resolution of collision, chaining; Internal Sorting, External sorting - Bubble Sort, Insertion Sort, Selection Sort, Merge sort, Radix sort, heap sort.	10	5

BOOKS RECOMMENDED:

1. **Data Structures and Program Design in C**, *Kruse R.L*, PHI.
2. **Data Structures using C and C++**, *Tanenbaum*, PHI.
3. **Fundamental of Data Structures**, *Horowitz and Sahani*, Galgotia Publishers.
4. **Data Structures**, Schaum Series.
5. **Data Structures**, *Bhagat Singh*.
6. **Data Structures**,*Trembley and Sorenson*.

MCA Semester-2

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	Course Title		Course Type
MCA203	Advanced Computer Architecture		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

Students will develop a cognitive understanding of parallel processing and hardware architecture of CPU for its implementation.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the basic principles of Parallel Computing.	U
2	Understand the concepts of Multiprocessors, Multicomputer, Pipelining etc.	U
3	Become more employable in the area of HPC	U
4	Pursue research in Computer Architecture and HPC.	E
5	Apply HPC in various fileds	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	Pos											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	2	3	2	2	1	2	-	-	3	3	3	3	2	-	-
CO2	2	1	1	2	2	2	2	1	3	3	3	3	3	2	-	3
CO3	1	3	2	2	2	2	2	2	1	2	2	2	2	2	2	2
CO4	1	1	2	2	2	1	2	3	-	3	3	3	3	2	2	3
CO5	3	3	3	2	3	1	2	-	-	3	2	3	3	2	1	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA203
Advanced Computer Architecture

Unit No.	Topics	No. of Hours	CO No.
I	Introduction - Feng's and Flynn's classification scheme – SISD, SIMD, MISD, MIMD, Multiprocessor and Multicomputer, UMA, NUMA, COMA, NORMA, memory models, parallel computer and its type. Applications of Parallel Computers. Cache Coherence Protocols – Snoopy and Directory Protocols.	10	1
II	System Interconnect Architecture – Static and Dynamic, Hypercube Interconnection network, multistage interconnection networks-architecture and routing, design consideration, throughput delay, bandwidth. Architecture and routing of 3 stage and 4 stage Banyan Network. Routing and Addition in Hypercube Interconnection network. Performance Metrics and Benchmarks.	10	2
III	Principle of pipelining-overlapped parallelism, Linear and non-linear pipelining, reservation table, calculation of MAL.Types of Instruction Pipeline. Arithmetic pipeline designs example –Floating point adder, pipelined multiplier.	10	3
IV	Advanced processor Technology – RISC, CISC, VLIW architectures, Hazard detection and resolution, functional organization of instruction in IBM 360/91. Numerical Problems based on CPI, IPC and MIPS.	10	4
V	Exploring parallelism in program - Parallel Algorithm for Matrix addition and subtraction. Bitonic sort, sorting on linear array processors or odd even sort, PRAM algorithm for addition of numbers or Parallel Reduction. Bernstein's condition, ISO efficiency concept.	10	5

BOOKS RECOMMENDED:

1 **Computer Architecture & Parallel Processing**, *Kai Hwang and F.A. Briggs*, McGraw Hill.
2 **Advanced Computer Architecture**, *Kai Hwang*, McGraw Hill.
3 **Parallel Computing**, *M.R. Bhujade*, New Age Publication.
4 **Parallel Computing Theory and Practice**, *Michael J. Quinn*, Tata McGraw Hill

MCA Semester-2

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	**Course Title**		**Course Type**
MCA204-I	Programming in Python		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

The course aims to equip students with a deep understanding of advanced Programming in python. Which helps students to understand real world AI application and data mining concepts.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand why Python is a useful scripting language for developers and learn how to design and program Python applications.	U
2	Learn how to use lists, tuples, dictionaries, indexing and slicing to access data in Python programs.	U
3	Define the structure and components, how to write loops, decision statements, functions and pass arguments of a Python program.	U
4	Learn about graphical programing in Python programs.	U
5	Learn how to build and package Python modules for reusability.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	1	2	3	3	1	3	2	-	-	3	3	2	1	1	2	-
CO2	2	3	3	3	1	3	2	-	-	3	3	2	2	2	1	3
CO3	3	3	3	2	2	3	2	-	1	1	1	1	3	2	-	2
CO4	3	3	3	1	2	3	2	1	-	3	3	3	3	2	-	-
CO5	3	3	3	1	2	2	-	2	-	3	2	3	3	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA204-I
Programming in Python

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction to Python Programming**: What is a Program, Formal and Natural Languages, Why use Python, Uses of python, Strengths & Drawbacks, The Python Interpreter, Running Python, The IDLE User Interface, The Interactive Prompt, Script Mode, Dynamic Typing , Debugging. Types, Operators, Expressions & Statements: Values and Types, Assignment Statement, Variable Names, Expressions & Statements, Order of Operations, String Operations, Comments.	10	1
II	**Conditionals:** Boolean Expressions, Logical operators, Conditional & Alternative Execution, Chained and Nested Conditions. Iterations: Reassignment, Updating Variables, The "for" and "while" statements, break. Strings: String is a sequence, len, Traversal with a for loop, String Slices, Searching, Looping and Counting, String Methods, the "in" operator, String Comparison.	10	2
III	**Lists:** List is a Sequence, Traversing and other Operations, List Slices, List Methods, Map Filter and Reduce, Deleting Elements, Lists and Strings, Objects and Values, Aliasing, List Arguments. Dictionaries: A Mapping and as a Collection of Counters, Looping and Dictionaries, Reverse Lookup, Dictionaries and Lists, Memos, Global Variables. Tuples: Tuple Assignments, Tuples as Return Values, Variable Length Argument Tuples, Lists and Tuples, Dictionaries and Tuples, Sequence of Sequences.	10	3
IV	**Functions**: Function Calls, Math Functions, Composition, Adding New Functions, Definitions & Uses, Flow of Execution, Parameters and Arguments, Why Functions, Stack Diagrams, Void and Fruitful Functions, Return Values, Incremental Development, Composition, Boolean Functions, Checking Types. Recursion: Stack Diagram for Recursive Functions, Infinite Recursion, Taking Input from Keyboard, More Recursion. Catching Exceptions	10	4
V	**Files:** Files & Persistence, Reading and Writing, Filenames and Paths. Object-Oriented Programming: Programmer defined Types, Attributes, Instances as Return Values, Classes and Functions, Classes and Methods, Inheritance and Polymorphism. **Graphics programming**: Drawing with turtle graphics, using turtle module, moving the turtle with any direction, moving turtle to any location, the color, bgcolor, circle and speed method of turtle, drawing with colors, drawing basic shapes using iterations.	10	5

BOOKS RECOMMENDED:

1. **Learning Python** 5th Edition, *Mark Lutz*, O'Reilly Publications
2. **Core Python Programming**, *R. NageshwaraRao*, Dreamtech Publications
3. **Think Python** 2nd Edition, *Allen B. Downey*, O'Reilly Publications
4. **Beginning Python: Using Python 2.6 and Python 3.1**, *James Payne*, Wiley
5. **Python Essentials Reference**, 4th Edition, *David M. Beazley*, Addison – Wesley
6. **Practical Programming: An Introduction to Computer Science Using Python 3**, *Paul Gries et al.*, Pragmatic Programmers

MCA Semester-2

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	**Course Title**		**Course Type**
MCA204-II	Programming in PHP		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

The objective of this course is to make the students learn and understand high level server-side programming language PHP which develops programming skills in students.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Design and develop dynamic, database-driven web applications using PHP.	U
2	Understand the concepts like Arrays, Strings and write Functions in PHP.	U
3	Learn Object Oriented PHP.	U
4	Learn Server and Client-side validations in PHP.	Ap
5	Learn about Stateful and Stateless Programming and mage states.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	-
CO2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
CO3	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	2
CO4	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	-
CO5	3	3	3	1	2	1	2	-	-	3	2	3	3	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA204-II
Programming in PHP

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction to Web Development**: Introduction to web applications, Client Side Vs Server Side Scripting **Web Servers**: Local Servers and Remote Servers, Internet Information Server(IIS),Personal Web Server(PWS) Static website vs Dynamic website development, Introduction to PHP Framework, Basic PHP syntax, Data types in PHP, Variables, Constants, operators and Expressions, printing data on PHP page, Control statements: if, switch case, for, while, do while.	10	1
II	**Arrays**: Initialization of an array, Types of Arrays, Array Functions, **String**: Formatting String for Presentation and Storage, Joining and Splitting String, Comparing String, Matching and replace Substring, patterns, basic regular expressions, String Functions. **Functions**: Defining and Calling Functions, Passing by Value and passing by references, Inbuilt Functions.	10	2
III	**Object Oriented Programming in PHP**: Object oriented concepts, Define a class and objects, Class attributes, Object properties ,Object methods ,constructors and destructors ,Class constants , Static method ,Inheritance ,Abstract classes ,Exception Handling ,Final keyword, Implementing Interface	10	3
IV	**Working With Forms**: Forms controls properties, methods and events, retrieving form data with $_POST, $_GET and $_REQUEST arrays, Super global variables, Super global array, importing user input, accessing user input, Combine HTML and PHP code, Using hidden fields, Redirecting the user, File upload and scripts, Validation-Server-side validation, Client-side validation (Java script) **Working with Database MYSQL**: Steps for PHP and MYSQL Connection, Creating Tables, Inserting, deleting and updating data to a table, displaying returned data on Web pages, Finding the number of rows from table.	10	4
V	**State Management**: Cookies: Setting time in a cookie with PHP, Deleting a cookie, Query String: Working with the query string Session: Starting a session, Registering Session variables, working with session variables, destroying session, passing session Ids, encoding and decoding session variables.	10	5

BOOKS RECOMMENDED:

- PHP: The Complete Reference, Steven Holzner. McGraw Hill
- Professional PHP 5-Ed, Lecky
- Thompson, HeowEide - Goodman, Steven D. ,Nowicki Wrox
- Programming PHP ,Rasmuslerdorf, Kevin Tatroe,Oreilly
- Learning php, mysql, javascript and css,Robin Nixon ,OreillyHill.

MCA Semester-2

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	**Course Title**		**Course Type**
MCA204-III	R Language		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

The objective of this course is to make the students learn and understand high level Database and data analysis language R which develops programming skills in students.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn Fundamentals of R.	U
2	Covers how to use different functions in R, how to read data into R, accessing R packages, writing R functions, debugging, and organizing data using R functions.	Ap
3	Cover the Basics of statistical data analysis with examples.	U
4	Give an idea to collect, compile and visualize data using statistical functions.	Ap
5	Understands the loading, retrieval techniques of data.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	Pos											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	-
CO2	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	3
CO3	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	2
CO4	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	-
CO5	3	3	3	1	2	1	2	-	-	3	2	3	3	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA204-III
R Language

Unit No.	Topics	No. of Hours	CO No.
I	Introduction to R:What is R? – Why R? – Advantages of R over Other Programming Languages - R Studio: R command Prompt, R script file, comments – Handling Packages in R: Installing a R Package, Few commands to get started: installed.packages(), packageDescription(), help(), find.package(), library() - Input and Output – Entering Data from keyboard – Printing fewer digits or more digits – Special Values functions : NA, Inf and –inf.	10	1
II	R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame – R - Variables: Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables - R Operators: Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators - R Decision Making: if statement, if – else statement, if – else if statement, switch statement – R Loops: repeat loop, while loop, for loop - Loop control statement: break statement, next statement.	10	2
III	R-Function : function definition, Built in functions: mean(), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, calling a function without an argument, calling a function with argument values - R-Strings – Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower() - R Vectors – Sequence vector, rep function, vector access, vector names, vector math, vector recycling, vector element sorting - R List - Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging Lists, Converting List to Vector - R Matrices – Accessing Elements of a Matrix, Matrix Computations: Addition, subtraction, Multiplication and Division- R Arrays: Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculation Across Array Elements - R Factors –creating factors, generating factor levels gl().	10	3
IV	Data Frames –Create Data Frame, Data Frame Access, Understanding Data in Data Frames: dim(), nrow(), ncol(), str(), Summary(), names(), head(), tail(), edit() functions - Extract Data from Data Frame, Expand Data Frame: Add Column, Add Row - Joining columns and rows in a Data frame rbind() and cbind() – Merging Data frames merge() – Melting and Casting data melt(), cast(). Loading and handling Data in R: Getting and Setting the Working Directory – getwd(), setwd(), dir() - R-CSV Files - Input as a CSV file, Reading a CSV File, Analyzing the CSV File: summary(), min(), max(), range(), mean(), median(), apply() - Writing into a CSV File – R -Excel File – Reading the Excel file.	10	4
V	Descriptive Statistics: Data Range, Frequencies, Mode, Mean and Median: Mean Applying Trim Option, Applying NA Option, Median - Mode - Standard Deviation – Correlation - Spotting Problems in Data with Visualization: visually Checking Distributions for a single Variable - R – Pie Charts: Pie Chart title and Colors – Slice Percentages and Chart Legend, 3D Pie Chart – R Histograms – Density Plot - R – Bar Charts: Bar Chart Labels, Title and Colors.	10	5

BOOKS RECOMMENDED:

1. Sandip Rakshit, R Programming for Beginners, McGraw Hill Education (India), 2017, ISBN : 978-93-5260-455-5.
2. Seema Acharya, Data Analytics using R, McGrawHill Education (India), 2018, ISBN: 978-93-5260-524-8.
3. Andrie de Vries, Joris Meys, R for Dummies A Wiley Brand, 2nd Edition, John Wiley and Sons, Inc, 2015, ISBN: 978-1-119-05580-8

MCA Semester-2

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	Course Title		Course Type
MCA205-I	Internet of Things		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0
Maximum Marks	Sessional		Theory
125	25		100

Learning Objective (LO):

Students will be able understand how to connect and control physical devices through the internet to gather and gather and exchange data. It involves learning about sensors, connectivity, data analysis, and the integration of devices to create smart and interconnected systems.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Describe what IoT is and how it works today and recognise the factors that contributed to the emergence of IoT.	An
2	Design and program IoT devices and use real IoT protocols for communication.	Ap
3	Secure the elements of an IoT device.	Ap
4	Design an IoT device to work with a Cloud Computing infrastructure.	Ap
5	Transfer IoT data to the cloud and in between cloud providers.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	-
CO2	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	3
CO3	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	2
CO4	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	-
CO5	3	3	3	1	2	1	2	-	-	3	2	3	3	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA205-I
Internet of Things

Unit No.	Topics	No. of Hours	CO No.
I	**OVERVIEW:** IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management	10	1
II	**REFERENCE ARCHITECTURE:** **IoT Architecture** – State of the Art – Introduction, State of the art, Reference Model and architecture, **IoT reference Model** – IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **Real-World Design Constraints** – Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control.	10	2
III	**IOT DATA LINK LAYER & NETWORK LAYER PROTOCOLS:** PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP	10	3
IV	**TRANSPORT & SESSION LAYER PROTOCOLS:** **Transport Layer** Transmission Control Protocol (TCP), Multipath Transmission Control Protocol (MPTCP), User Datagram Protocol (UDP), Datagram Congestion Control Protocol (DCCP) , Stream Control Transmission Protocol (SCTP),Transport Layer Security (TLS), Datagram Transport Layer Security (DTLS)) **Session Layer**- Hyper Text Transfer Protocol (HTTP), Constrained Application Protocol (CoAP), Extensible Messaging and Presence Protocol (XMPP), Advanced Message Queuing Protocol (AMQP), Message Queue Telemetry Transport (MQTT)	10	4
V	**SERVICE LAYER PROTOCOLS & SECURITY:** **Service Layer** – oneM2M, European Telecommunications Standards Institute (ETSI) M2M (Machine-to-Machine), OMA, BBF – Security in IoT Protocols – MAC 802.15.4, 6LoWPAN, Routing Protocol for Low-Power and Lossy Networks (RPL), Application Layer	10	5

RECOMMENDED BOOKS:

1. **From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence**, *Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle,* Academic Press, 2014
2. **Learning Internet of Things**, *Peter Waher,* PACKT publishing
3. **Architecting the Internet of Things**, *Bernd Scholz-Reiter, Florian Michahelles,* Springer
4. **Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications**, *Daniel Minoli,* Willy Publications
5. **Internet of Things (A Hands-onApproach)**, *Vijay Madisetti and ArshdeepBahga,* VPT, 2014.

MCA Semester-2

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	**Course Title**		**Course Type**
MCA205-II	Mobile Computing		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Mobile Communication course will develop and understanding among student how communication technology. They will also develop an insight view for networking technologies and devices.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the cellular concepts and infrastructure such as frequency reuse.	U
2	Understand the concept of Satellite systems.	U
3	Hand off and how interference between mobiles and base stations affects the capacity of cellular systems.	U
4	Identify the technical aspects of wireless and mobile communications along with the knowledge about the wireless LAN, PAN, MANET and its routing protocol.	An
5	Research in wireless communication.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	-
CO2	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	3
CO3	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	2
CO4	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	-
CO5	3	3	3	1	2	1	2	-	-	3	2	3	3	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlatio

Detailed Syllabus:
MCA205-II
Mobile Computing

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction** Introduction to Mobile Communication, Evolution of modern Mobile wireless communication systems, Applications of mobile communication, Requirements of Mobile communication, satellite systems and Applications, Satellite classification, characteristics of satellite systems, Some open research topics in mobile communication	10	1
II	**Mobile Communication Systems** Introduction, Cellular Structure, Cell Cluster, Frequency Reuse, Co-channel and Adjacent Channel Interference, Enhancement of system capacity, Channel Assignment schemes in Cellular network. Cellular System Infrastructure: Registration, Handoff Parameters and Underlying support, Roaming Support Using System Backbone.	10	2
III	**Mobile IP and Mobility Management** Mobile IP, Mobile Node, Corresponding Node, Home Network, Foreign Network, Home Agent, Foreign Agent, Care-of Address, Mobile IP Operations: Agent Discovery, Agent Solicitation, Tunneling. **Mobility management in wireless**: Networks, Handoff Techniques, Handoff detection and Assignment, Types of Handoff, channel Reservation for Handoff calls.	10	3
IV	**Wireless LANs and PANs** Introduction to IEEE 802.11, WLAN transmission technology, Spread Spectrum Technology, Frequency Hopping Spread Spectrum Technique, Direct Sequence Spread Spectrum Technique, WLAN System Architecture, IEEE 802.11 Logical Architecture, CSMA/CA, Home RF, Hiper LAN, Bluetooth , Advantages and disadvantages of Wireless LAN.	10	4
V	**Mobile Adhoc Network** Introduction to Mobile Adhoc Network (MANET), Characteristics of MANET, Applications of MANET, Routing, Need for Routing, Routing Classification, Table-Driven Routing Protocol – Destination Sequenced Distance Vector Routing Protocol, Cluster-Head Gateway Switch Routing. Source initiated On-demand Routing- Adhoc On Demand Distance Vector Routing, Dynamic Source Routing, Hybrib Protocol – Zone Routing Protocol.	10	5

RECOMMENDED BOOKS:

1. **Mobile Communication**: *Jochen H. Schiller,* Pearson Education Publication
2. **Introduction to Wireless and Mobile Systems**: *D.P. Agrawal, Qing-An Zing,* Vikas Publishing House.
3. **Wireless Communication and Networks**: *ItiSaha Misra,* McGraw Hill education.
4. **Wireless and mobile Communication**: *T.G. Palanivelu, R. Nakkeeran,* PHI Publication.
5. **Mobile Commerce**: *Karabi Bandyopadhyay,* PHI Publication.

MCA Semester-2

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	Course Title		Course Type
MCA205-III	Theory of Computations		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0
Maximum Marks	Sessional		Theory
125	25		100

Learning Objective (LO):

Student will learn mathematical relation of computing model. It helps to design and enhance new computing model and its operation.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Be able to construct finite state machines and the equivalent regular expressions.	Ap
2	Be able to prove the equivalence of languages described by finite state machines and regular expressions.	U
3	Be able to construct pushdown automata and the equivalent context free grammars.	Ap
4	Be able to prove the equivalence of languages described by pushdown automata and context free grammars. Be able to construct Turing machines and Post machines	Ap
5	Be able to understand undecidability.	R

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	-
CO2	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	3
CO3	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	2
CO4	3	3	3	1	2	1	2	-	-	3	3	3	3	2	-	-
CO5	3	3	3	1	2	1	2	-	-	3	2	3	3	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA205-III
Theory of Computations

Unit No.	Topics	No. of Hours	CO No.
I	Alphabet, String and language, Finite state Machines, finite automata with Є-moves, Conversion of NDFA to DFA, Removal of Є-transition from NDFA, Two way finite automata, finite automata with output, Mealy & Moore machines, Applications of finite automata, minimization of finite automata.	10	1
II	Chomsky classification of Languages, Regular Expression and Language, Properties of Regular languages, Pumping lemma for regular sets, Closure properties of regular sets, Decision algorithms for Regular sets, Myhill-Nerode theorem.	10	2
III	Context free grammars and their properties, derivation tree, simplifying CFG, ambiguity in CFG, Chomsky Normal form, Greibach Normal form, Pumping lemma for CFL, Closure properties of CFL.	10	3
IV	Pushdown automata: Informal description, Definition, Determinism and Non determinism in PDA, Equivalence of PDA's and CFL's. Two way PDA, Concept of Linear Bounded Automata, context sensitive grammars and their equivalence, Turning machine construction, determinism and non-determinism in TM, Multi tape, multi-track TM.	10	4
V	Decidability, Universal turning machine and decidable problem, recursive function theory, Recursively enumerable sets, recursive sets, partial recursive sets, Church's hypothesis, post correspondence problem, Russell's paradox.	10	5

Books Recommended:

- **Theory of Computer Science, Automata Languages & computation**, *K.L.P. Mishra, N. Chandrashekharan*, PHI.
- **Introduction to Automata Theory Language and Computation**, *John E. HopcraftandJeffary D. Ullman*, Narosa Publication house.
- **Introduction to Formal Languages, Automata Theory and Computation**, *Kamala Krithivasan and Rama. R*,Pearson.
- **Introduction to Automata Theory Languages and Computation**, *John E. Hopcraft, Jeffary, D. Ullman and Rajeev Motwani.*

MCA Semester-II

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	**Course Title**		**Course Type**
MCA206	Lab-IV : Programming in JAVA		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	0	0	4
Maximum Marks	**Sessional**		**Practical**
150	50		100

Learning Objective (LO):

The students will learn to apply the concepts learned in the corresponding theory subject.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Program related to fundamental structure and model of Java programming language.	**Ap**
2	Program related to object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.	**Ap**
3	Program related to Exception Handling and Multi-threading.	**Ap**
4	Program related to Java applications with graphical user interface (GUI).	**Ap**
5	Program related to Databases.	**Ap**

CL: Cognitive Levels
Cognitive Level: **R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; B-Evaluate; **C**-Create.

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	3
CO2	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	1
CO3	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	-
CO4	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	-
CO5	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA206
Lab-IV : Programming in JAVA

Unit No.	Topics	No. of Hours	CO No.
I	Programs related to fundamental structure and model of Java programming language.	10	1
II	Programs related to object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.	10	2
III	Programs related to Exception Handling and Multi-threading.	10	3
IV	Programs related to Java applications with graphical user interface (GUI).	10	4
V	Programs related to Databases.	10	5

MCA Semester-II

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	Course Title		Course Type
MCA207	Lab-V : Programming based on MCA202		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	0	0	4
Maximum Marks	Sessional		Practical
100	50		50

Learning Objective (LO):

This course aims to student to learn how memory uses data structures for efficient management of memory for better programming.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Students will be able to design the appropriate data structures and algorithms for solving real world problems and enables them to gain knowledge in practical applications of data structures.	Ap
2	Choose efficient data structures and apply them to solve problems and analyze the efficiency of programs based on time complexity.	Ap
3	Student gets analytical ability to create better design of computer applications.	Ap
4	Gain the reasoning ability to implement these concept in development of live commercial applications	Ap
5	Understand about memory representation of different data structures.(U)	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	3
CO2	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	1
CO3	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	-
CO4	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	-
CO5	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA207
Lab-V : Programming based on MCA202

Unit No.	Topics	No. of Hours	CO No.
I	Programs Related to Array and Linked Lists	10	1
II	Programs Related to Stack and Queues	10	2
III	Programs Related to Trees	10	3
IV	Programs related to Searching algorithms	10	4
V	Programs related to Sorting algorithms	10	5

Books Recommended:

- **Fundamental of Data Structures**, *Horowitz and Sahani*, Galgotia Publishers.
- **Data Structures and Program Design in C**, *Kruse R.L*, PHI.
- **Data Structures using C and C++,** *Tanenbaum,* PHI.
- **Data Structures**, Schaum Series.
- **Data Structures**, *Bhagat Singh.*
- **Data Structures** - *Trembley and Sorenson.*

MCA Semester-II

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	**Course Title**		**Course Type**
MCA208	Lab-VI : Programming Based on MCA204		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	0	0	4
Maximum Marks	**Sessional**		**Practical**
100	50		50

Learning Objective (LO):

The course aims to equip students with a deep understanding of advanced Programming in python. Which helps students to understand real world AI application and data mining concepts.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand why Python is a useful scripting language for developers and learn how to design and program Python applications.	Ap
2	Learn how to use lists, tuples, dictionaries, indexing and slicing to access data in Python programs.	Ap
3	Define the structure and components, how to write loops, decision statements, functions and pass arguments of a Python program.	Ap
4	Learn about graphical programing in Python programs.	Ap
5	Learn how to build and package Python modules for reusability.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	3
CO2	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	1
CO3	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	-
CO4	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	-
CO5	3	3	3	1	2	-	2	1	-	2	2	3	-	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

MCA208

Lab-VI : Programming Based on MCA204

Elective - I(I. Programming in Python)

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction to Python Programming**	10	1
II	**Conditionals**	10	2
III	**Lists, Dictionaries, Tuples**	10	3
IV	**Functions, Recursion**	10	4
V	**Files, Graphics programming**	10	5

Elective - I(II. Programming in PHP)

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction to Web Development, Web Servers, Control statements**	10	1
II	**Arrays, String, Functions**	10	2
III	**Object Oriented Programming in PHP**	10	3
IV	**Working With Forms, Working with Database MYSQL**	10	4
V	**State Management**	10	5

Elective - I(III. R Language)

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction to R**	10	1
II	**R Data Types, R Operators, R Decision Making, R Loops**	10	2
III	**R-Function, R-Strings, R Vectors, R List, R Matrices, R Arrays**	10	3
IV	**Data Frames, Loading and handling Data in R**	10	4
V	**Descriptive Statistics, Visualization**	10	5

MCA Semester-II

Program	Subject	Year	Semester
MCA	MCA	1	2
Course Code	**Course Title**		**Course Type**
MCA209	GD/PI Based on Indian Knowledge System		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	0	0	4
Maximum Marks	**Sessional**		-
25	25		00

Learning Objective (LO):

The objective of the course is to develop public speaking skills, team work, communication in group among students.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Achieve confidence in public speaking.	Ap
2	Know how to behave in group.	Ap
3	Observe how to work with team.	An
4	Be better equipped to resolve conflicts.	Ap
5	Be able to express themselves in a professional and diplomatic manner.	Ap

CL: Cognitive Levels Cognitive Level: **R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; B-Evaluate; **C**-Create.

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	2	1	1	3	1	-	-	-	3	1	-	-	-
CO5	3	3	3	2	1	1	3	-	-	-	-	3	2	-	-	3

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

MCA209 (GD/PI Based on Indian Knowledge System)

Unit No.	Topics	No. of Hours	CO No.
I	Group Discussion	50	1
II	Debate		2
III	Extempore		3
IV	Presentation		4
V	Leadership		5

MCA Semester-3

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	**Course Title**		**Course Type**
MCA301	.Net Technology		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

The course aims to develop programming skills based on .NET frame work. Programming skills leads student to have critical thinking for solving any technical issues using softwares.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand .NET Framework and describe some of the major enhancements to the new version of Visual Basic.	U
2	Describe the basic structure of a Visual Basic.NET project and use main features of the integrated development environment (IDE).	U
3	Understand the OOP and Exception handling in .NET	U
4	Create applications using Microsoft Windows Forms and also ADO .NET	Ap
5	Design web applications using ASP.NET	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	2	1	2	1	1	3	3	1	3	2	1	-
CO2	2	2	3	1	2	1	2	1	1	3	2	2	3	2	1	3
CO3	3	1	3	1	2	1	2	-	1	2	3	3	3	2	1	2
CO4	3	3	3	1	2	1	2	-	2	3	3	3	3	2	1	-
CO5	3	3	1	1	2	1	2	2	2	3	2	3	3	2	1	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA301
.Net Technology

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction to the .NET framework:** Overview of .net framework, Managed Execution process, CLR, .Net Framework class library, common language specification, Common Type System, JIT Compilation, MSIL, Assemblies, metadata, Garbage collection. Windows form: Working with Visual Studio IDE, creating a .NET solution, MDI application.	10	1
II	**Programming with .NET Framework** Components and controls, Data types, variables, Constant, Enumerations, Declaring Enumeration, Type conversions, Operators, Control Structures: conditional statements, loops, Arrays: creating array in vb.net, Dynamic arrays, Multi-dimensional arrays, Jagged Array, The Array class, Method of Array Class, Functions: defining Function, Function returning a value, Recursive function, Param Arrays, Passing Array as Function Arguments, Defining Sub procedures,' Passing Parameters by Value and by reference.	10	2
III	**OOPS and Exception Handling** Types, structures:Declare a structures, structures variable, structures and array, structures and objects, structures and procedures, structures within structures. classes : class Definition,Member fnctions and Encapsulation,Constructor and Destructors, Parameterized Constructor, Shared Members of vb.net Class, Inheritance: Base and Derived Classes, Base Class Initialization, MyBase, Interfaces:creating interfaces, using multiple interfaces, using the MustInherit keyword(creating abstract classes), using MustOverride, MustOverridable, and NotOverridable, Polymorphism, Inheritance based polymorphism, Interface based polymorphism. Exception Handling: Try catch statement, Exception classes in .Net Framework, Handling Exceptions, Creating User define Exceptions.	10	3
IV	**Building .NET Framework Applications** Introduction to ASP .NET, Differentiate classic ASP and ASP .NET, Asp.net- Life Cycle, , Asp.net state management, Web application, Web forms, Controls in web forms, Events in Web form, Form validations – Client side, Server side.	10	4
V	**Database Programming in .NET** ADO .NET Architecture, .NET data provider, dataset components, ADO. NET Adapter and Dataset, ADO.Net Dataview and Datagrid view, creating database applications using Window forms and web forms (Database connectivity through ADO .NET), Introduction to.web services.	10	5

BOOKS RECOMMENDED:

1. **MSDN online – by Microsoft**
2. **Visual Basic .NET Complete** - BPB Publications, New Delhi.
3. **The Complete Reference VB .NET**, *Jeffery R. Shapiro*, Tata McGraw Hill.
4. **Professional VB .NET 2003**, *Bill Evjen & others*, Wiley India (P) Ltd.

MCA Semester-3

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	**Course Title**		**Course Type**
MCA302	Computer Network & Data Communication		Core
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

The course aims to develop understanding about security in network communication. It introduces the real time threats and its causes so that student will be able to do secure programming.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Develop basic understanding of computer network.	U
2	Understand basic concepts of bandwidth, data communication etc.	U
3	Understand ideas about cyber security and networking technologies.	U
4	Be more employable.	Ap
5	Be open up new areas in the field of research and development in the area of computer networking.	An

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	1	3	1	2	1	2	-	2	3	3	3	2	2	2	-
CO2	3	2	3	1	2	1	2	-	2	3	3	3	3	2	1	3
CO3	3	3	3	1	2	1	2	-	1	3	3	3	2	2	1	2
CO4	3	3	3	1	2	1	2	2	-	3	3	3	3	2	1	-
CO5	3	3	3	1	2	1	2	1	-	3	2	3	3	2	1	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA302
Computer Network & Data Communication

Unit No.	Topics	No. of Hours	CO No.
I	Introduction to Computer Networking: The Concept of Networking, Data Communication, Required network elements, The role of Standards Organization. Line Configuration, Various Topologies, Transmission Mode, Categories of Networks- LAN, MAN, WAN. The benefits of a Computer Networks. The OSI and TCP/IP Reference Model: The Concept of Layered Architecture, Design Issues for the Layers. Interfaces and services, Detailed Functions of the Layers. Comparison between OSI and TCP/IP Reference model.	10	1
II	Transmission of Digital Data: Bandwidth, Nyquist and Shannon's theorems for maximum data rate of a channel. Transmission media- Co-axial, UTP, Fiber optic and wireless. Analog and digital data Transmission- Serial and Parallel transmission. Modulation Techniques – AM, FM, PM. ADSL Modem. Multiplexing and Switching: The Concept of Multiplexing- FDM, TDM, WDM, CDM. The Concept of Switching- Circuiting, Message switching, Packet switching. Virtual Circuit and Datagram.	10	2
III	**Data Link Layer :** Line Discipline, Flow Control- stop and wait, sliding window, Go back N, Selective Repeat. Error Detection and Correction – Parity, CRC, Hamming Code. ALOHA, Slotted ALOHA, CSMA/CD, HDLC. IEEE standards for LAN's and MAN's – Ethernet, DQDB The concept of ICMP, ARP, RARP, SNMP, SMTP, MIME, POP3 Protocols.	10	3
IV	**Network Layer and Transport Layer:** IP Addressing, Classes of IP Addresses, Subnet Mask. IPv4 and IPv6 Header Formats. Routing algorithms - Distance Vector, Link State. TCP Header Format, UDP Header Format. Congestion Control Algorithms – Leaky Bucket and Token Bucket. Internetwork, Networking Devices – Repeater, Bridge, Router, Gateway, Switch, Hub	10	4
V	**Comparative study of Networking Technologies:** X.25, Frame Relay, Cell Relay - ATM, ATM Cell, ATM Switch – Multistage Switch. Banyan Network. DSL, ADSL, SONET, SMDS. Network Security: The Importance of Security in Networking. Confidentiality, Authentication, Integrity, Non Repudiation. Traditional Cryptography - Data Encryption Standards, RSA algorithm. Deffie Hellman Algorithm. Virus, Worm, Trojan Horse, DoS, Spoofing, Phishing.	10	5

BOOKS RECOMMENDED:

- Computer Networks - A. S. Tanenbaum
- Data Communication and Networking - B. A. Forouzan

MCA Semester-3

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	**Course Title**		**Course Type**
MCA303	Artificial Intelligence		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Students will learn about the basics of various AI concepts such as problem solving, logic, reasoning, learning and various algorithm related to these concepts.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Have ability to define the heuristics and apply them for solving complex problem with understanding of different heuristic based search techniques.	An
2	Have understanding of different knowledge structure and inference mechanism with ability to apply them in intelligent solutions of complex problem.	An
3	Understand the existence of uncertainty in problem solving and how mathematical /statistical models are used to overcome these problems.	An
4	Understand planning system and different types of planning required for problem solving process	U
5	Understand expert system and their various field.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	2	2	-	-	3	3	3	3	2	1	-
CO2	3	3	3	2	2	2	2	-	-	3	3	3	3	2	1	3
CO3	3	3	3	2	2	2	2	-	-	3	3	3	3	2	1	2
CO4	3	3	3	2	2	2	2	-	-	3	3	3	3	2	1	-
CO5	3	3	3	2	2	2	2	-	-	3	2	3	3	2	1	1

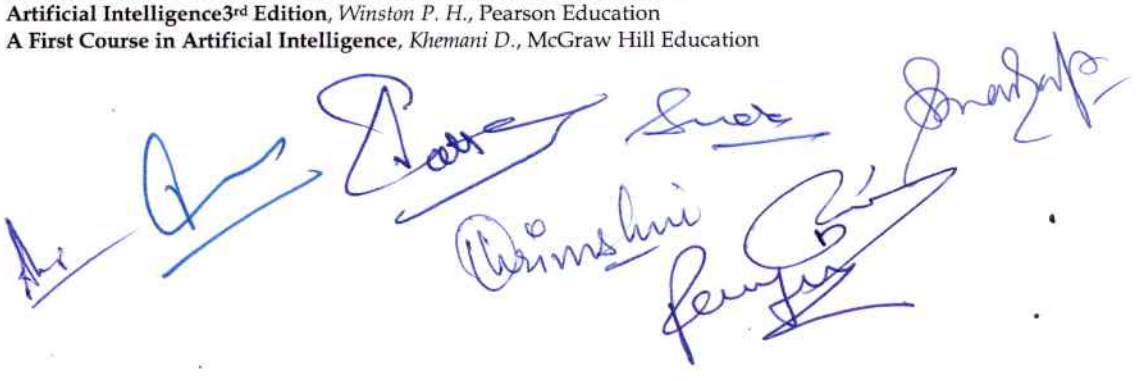
"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA303
Artificial Intelligence

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction to AI:** Foundations of AI, Philosophy and History; AI problems, AI technique; The Turing Test. **Intelligent Agents:** Agents and Environments, the Concept of Rationality, the Nature of Environments and the Structure of Agents. **Problem solving & State Space Search:** General problem solving: defining problems as State Space Search, Problem Characteristics; Production Systems & their characteristics.	10	1
II	**Exhaustive Searches:** Generate and Test, Breadth First Search, Depth First Search and DFID **Heuristic Search Techniques:** Branch and Bound technique; Best first search; A* algorithm; Problem Reduction AND/OR Graphs and AO* algorithm. **Local Searches & Optimizations:** Hill climbing and its variants. **Constraint Satisfaction Problems:** Definition; Constraint Propagation and Backtracking. **Game Playing:** Mini-Max Search Procedure; Alpha-Beta Cutoffs; Additional Refinements.	10	2
III	**Knowledge Representation:** Types of Knowledge; Knowledge Representation Issues; **Logic:** First order Predicate Logic; Representation of facts in FOL; Inference in FOL; Resolution Principle, Clausal Form and Unification; **Inference Mechanisms:** Forward and Backward Chaining; **Slot and Filler Structures:** Semantic Networks; Frame Systems and value inheritance; Conceptual Dependency; Scripts	10	3
IV	**Reasoning under Uncertainty:** Non-monotonic Reasoning, Logics for Non-monotonic Reasoning, Default Reasoning, Minimalistic Reasoning, Implementation Issues, Truth Maintenance Systems; Probabilistic Reasoning and Uncertainty; Statistical Reasoning; Probability Theory; Bayes Theorem and Bayesian networks; Certainty Factor; Dempster-Shafer Theory. **Planning:** Overview; The Blocks Word; Component of a Planning System: Goal Stack Planning; Nonlinear Planning	10	4
V	**Expert Systems:** Introduction, Characteristics, History and Applications of expert systems; Expert System Shells; Rule Based Systems Architectures, Non Production System Architectures; Knowledge Acquisition and Validation; Case Studies: MYCIN & DENDRAL. **Learning:** Rote learning; Learning by Taking Advise; Induction; Explanation based learning; Discovery; Analogy.	10	5

BOOKS RECOMMENDED:

1. **Artificial Intelligence 3rd Edition**, *Rich E., Knight K. and Nair S. B.*, McGraw Hill Education
2. **Artificial Intelligence: A Modern Approach 3rd Edition**, *Russell S. J. and Norvig P.*, Pearson Education
3. **Introduction to Artificial Intelligence and Expert Systems**, *Patterson D. W.*, PHI
4. **Principles Of Artificial Intelligence**, *Nilson N. J.*, Narosa Publications
5. **Artificial Intelligence3rd Edition**, *Winston P. H.*, Pearson Education
6. **A First Course in Artificial Intelligence**, *Khemani D.*, McGraw Hill Education



MCA Semester-3

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	Course Title		Course Type
MCA304-I	Compiler Design		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0
Maximum Marks	Sessional		Theory
125	25		100

Learning Objective (LO):

Compiler design course aims to make students understand that how high level language is translated into low level languages. It also develops an insight for deep analysis of code optimization for the fast execution of the programming code.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Know about various phases of compiler design.	U
2	Be aware of the function and complexity of modern compilers.	A
3	Be aware of generation of intermediate code.	A
4	Have a concrete view on the theoretical and practical aspects of compiler design.	U
5	Able to apply ideas and techniques discussed to various software design.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	2	3	1	2	1	2	1	-	3	3	3	3	2	1	-
CO2	2	2	3	1	2	1	2	1	-	3	3	3	3	2	2	3
CO3	1	2	3	1	2	1	2	1	-	3	3	3	3	2	2	2
CO4	2	2	3	1	2	1	2	1	-	3	3	3	3	2	2	-
CO5	2	3	3	1	2	1	2	1	-	3	2	3	3	2	2	1

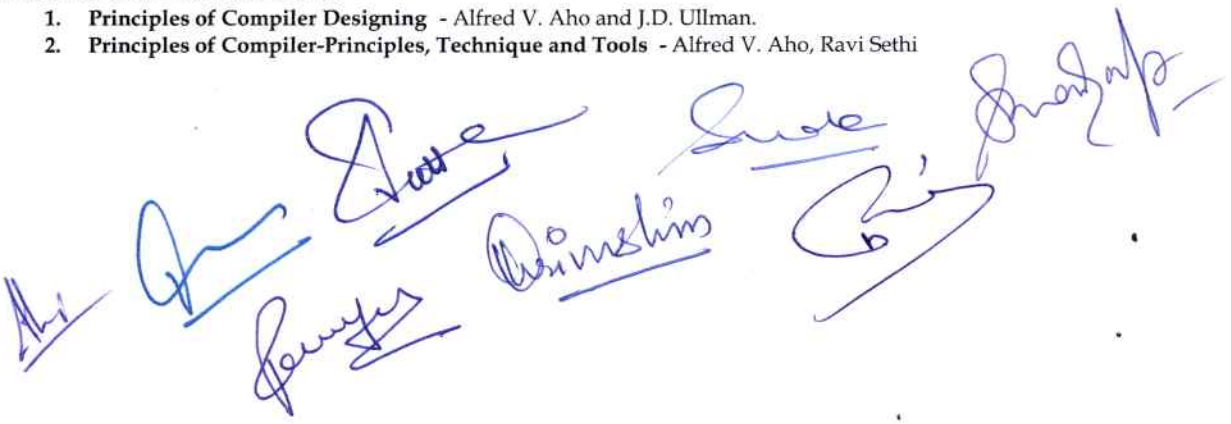
"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA304-I
Compiler Design

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction to Compiling and one pass compiler:** Compilers & translators, Phases of compilers, Compiler writing tools, Bootstrapping; overview of one pass compiler. **Finite Automata and Lexical Analysis:**Role of Lexical Analyzer; specification of tokens, Recognition of tokens, Regular expression, Finite automata, from regular expression to finite automata, DFA and NFA, Implementation of lexical analyzer; tools for lexical analyzer -LEX.	10	1
II	**Syntax analysis & Parsing Technique:** Context free grammars; Bottom up parsing, Shift reduce parsing, Operator Precedence parsing, Top down parsing, elimination of left recursion; recursive descent parsing, Predictive parsing. **Automatic Construction of Efficient parsers:** LR parser, construction of SLR and canonical LR parser table, Using ambiguous grammar, An automatic parser the generator, YACC, Using YACC with ambiguous grammar, creating YACC lexical analyzer with LEX, Error recovery in YACC.	10	2
III	**Syntax Directed Translation:** Syntax directed schema, Construction of syntax tree, Translation with top down parser. **Run Time Environment:** Source Language issues, Storage organization and allocation strategies, Parameter passing, Implementation of block-structured language.	10	3
IV	**Intermediate Code Generation:** Intermediate languages; Postfix notation, Three-address code, Quadruples and triples, Translation of assignment statements, Boolean expression, and Procedure call. **Error Detection & recover:** Lexical & syntactic phase error, semantics error.	10	4
V	**Code Optimization:** Optimization of basic block, Loop optimization global data flow analysis, Loop in variant computation. **Code Generation:** Issue and design of code generator, the target machine, a simple code generator.	10	5

BOOKS RECOMMENDED:

1. **Principles of Compiler Designing** - Alfred V. Aho and J.D. Ullman.
2. **Principles of Compiler-Principles, Technique and Tools** - Alfred V. Aho, Ravi Sethi



MCA Semester-3

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	**Course Title**		**Course Type**
MCA304-II	Cyber Security		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	**T**	**P**
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

The course aims to develop understanding about security in computer systems and network communications. It introduces the real time threats and its causes so that student will be able to do secure programming and make various types of computer systems more safe and secure.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Able to acknowledge about the cybercrime, cyber criminal, and intellectual property rights. Protection and resilience of Critical Information Infrastructure.	U
2	Enable effective prevention, investigation and prosecution of cybercrime and enhancement of law enforcement capabilities through appropriate legislative intervention.	U
3	Learn basics about computer, Network and Data Security, threats to any network and data security.	U
4	Know how to secure any network, computer and data in it, security goals to secure any network.	U
5	Learn internal details of security mechanism so that they could adopt it in their programming.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	1	2	2	2	3	3	3	3	2	1	1
CO2	3	3	3	2	2	1	2	2	2	3	3	3	3	2	1	3
CO3	3	3	3	2	2	1	2	2	2	3	3	3	3	2	1	2
CO4	3	3	3	2	2	1	2	2	2	3	3	3	3	2	1	1
CO5	3	3	3	2	2	1	2	2	2	3	2	3	3	2	1	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA304-II
Cyber Security

Unit No.	Topics	No. of Hours	CO No.
I	**INTRODUCTION** Computer Security Concepts, The Challenges of Computer Security, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanism, A model for network Security, **Symmetric Encryption Principal:** Cryptography, Cryptanalysis, Feistel Cipher Structure, DES, Random and Pseudorandom Numbers, Symmetric Block Modes of Operation (ECB, CBC, CFB, CTR).	10	1
II	**PUBLIC KEY CRYPTOGRAPHY** Approaches to Message Authentication, **Hash Functions**: Hash Functions Requirement, Security of Hash Functions, The SHA Secure Hash Function, **Public Key Cryptography:** Public –Key Encryption Structure, Applications for Public Key Cryptosystem, RSA, Attacks on RSA, OAEP.	10	2
III	**MESSAGE INTEGRITY AND MESSAGE AUTHENTICATION** **Message Integrity:** Document and Finger Printing, Message and Message Digest, Cryptographic Hash Function Criteria Random Oracle Model, Birthday Problems and Summery of solutions, **Message Authentication:** Modification Detection 'Code, Message Authentication Code, Introduction of HMAC & CMAC, **Digital Signature:** Comparison, Process, Services, Attacks on Digital Signature.	10	3
IV	**MALICIOUS SOFTWARE** **Intruders:** Intruder Behavior Patterns, Intrusion Techniques, Intrusion Detection by Audit Records, Statistical Intrusion Detection, Distributed Intrusion Detection, Honeypot Types of Malicious Software, Nature of Viruses, Virus Classification, Antivirus Approaches, Worms and its Propagation model, DDoS Attack.	10	4
V	**FIREWALL & SECURITY TOOLS** **Firewall:** Need & Characteristics of Firewall, Types of Firewall, Firewall Basing, Firewall Location and Configuration, Introduction to Kali Linux ,Tools Available in Kali Linux and Its Usage. WireShark Packet Analyzer and Its Features. Cyber Security Policy, Domain of Cyber Security Policies.	10	5

RECOMMENDED BOOKS:

1. **Network Security Essentials**, *William Stallings*, PEARSON
2. **Cryptography and Network Security**, *William Stallings*, PHI.
3. **Cryptography and Network Security**, *AtulKahate*, Tata McGraw Hill
4. **Cryptography and Network Security**, *B.A. FOROUZAN*, TMH
5. **Cyber Security policy Guidebook**, *Jennifer Jason Paul, Marcus Jeffery Joseph*. Wiley Publication,2012.
6. **Network Security: The Complete Reference**, Robertra Bragg, Tata McGraw Hill.
7. **Cyber Security Essentials**, *James Graham, Richard Ryan*, CRC press

MCA Semester-3

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	**Course Title**		**Course Type**
MCA304-III	Digital Image Processing		Elective
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
4	3	1	0
Maximum Marks	**Sessional**		**Theory**
125	25		100

Learning Objective (LO):

Digital Image Processing is a course used to inculcate skills like creativity, analysis of the images, finding conclusions, enhancing picture quality etc.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Review the fundamental concepts of a digital image processing system and analyze images in the frequency domain using various transforms.	An
2	Evaluate the techniques for image enhancement and image restoration and categorize various compression techniques.	E
3	To increase the employability.	C
4	Interpret Image compression standards, image segmentation and representation techniques.	E
5	Know about the application area and use of image processing in different research area mostly in image diagnosis, medical.	An

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	3	1	2	1	2	2	-	3	3	3	3	2	-	-
CO2	3	2	3	1	2	1	2	2	-	3	3	3	3	2	2	3
CO3	3	3	2	1	2	1	2	2	1	3	3	3	2	3	2	2
CO4	3	3	3	3	2	1	2	2	2	3	3	3	3	2	-	-
CO5	3	3	3	1	3	1	2	-	2	3	2	3	3	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA304-III
Digital Image Processing

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction:** Digital Image Fundamentals Origins of Digital Image Processing, examples, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sensing and acquisition Basic Concepts in Sampling and Quantization, Representing Digital Images, Zooming and Shrinking Digital Images, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.	10	1
II	**Image Enhancement Spatial Domain**: Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters, Combining Spatial Enhancement Methods; **Frequency Domain**: Background, Image Enhancement in the Frequency Domain, Introduction to the Fourier Transform and the Frequency, Domain, Smoothing Frequency-Domain Filters, Sharpening Frequency Domain Filters, Homomorphic Filtering	10	2
III	**Image Restoration** A Model of the Image degradation/Restoration process, Noise Models, Restoration in the Presence of Noise Only–Spatial Filtering, Periodic Noise Reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.	10	3
IV	**Image Compression:** Fundamentals, Image Compression Models, Error-Free Compression, Lossy Compression, Image Compression Standards. **Morphological Image Processing**: Dilation and Erosion, Opening and Closing, Hit-or-Miss Transformations,Some Morphological Algorithms.	10	4
V	**Segmentation** Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation. **Representation and Description:** Representation, Boundary Description and Regional Descriptor.	10	5

RECOMMENDED BOOKS:

1. **Digital Image Processing**, *Rafel C Gonzalez and Richard E. Woods*, PHI 2nd Edition
2. **Computer Vision and Image Processing**, *Scott.E.Umbaugh*, Prentice Hall

MCA Semester-3

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	Course Title		Course Type
MCA305-I	Big Data Analytics		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0
Maximum Marks	Sessional		Theory
125	25		100

Learning Objective (LO):

Student will learn concepts of BigData, MongoDB, Spark, Zookeeper, etc and it also develops how Bigdata is maintained and managed.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand the building blocks of Big Data.	U
2	Articulate the programming aspects of cloud computing (map Reduce etc). Also get the knowledge about the big data programming languages apache, pig, hive and spark.	Ap
3	Understand the specialized aspects of big data with the help of different big data applications.	U
4	Represent the analytical aspects of Big Data along with the knowledge of big data database such as mongodb and nosql.	An
5	Know the recent research trends related to Hadoop File System, MapReduce and Google File.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	3	2	2	1	-	3	3	3	3	2	1	2
CO2	3	3	3	1	3	1	2	1	-	3	3	3	3	2	2	3
CO3	3	3	3	3	2	1	2	1	2	3	3	3	3	2	2	2
CO4	3	2	3	2	2	1	2	-	1	3	3	3	3	2	-	1
CO5	2	3	3	1	2	1	2	-	1	3	2	3	3	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA305-I
Big Data Analytics

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction Concept of Big Data** Big Data- Define Data, Web Data, Classification of Data- Structured, Semi-Structured, and Unstructured. Big Data Definitions, Challenges of Conventional system, Why We Need Big Data, Difference between Big Data and Small Data, Importance of Big Data.Big Data Characteristics (4V's Volume, Velocity, Variety, and Veracity), Big Data Types, Big Data Handling Techniques. Scalability and Parallel Processing, Designing Data Architecture, Data Sources , Quality, Pre- Processing and Storing, Data Storage and Analysis, Big Data Analytics Application, Big Data Challenges and Future Scope.	10	1
II	**HADOOP AND HADOOP ARCHITECTURE** Introduction, Apache Hadoop and its Ecosystem, Hadoop Core Component, Features of Hadoop, The Hadoop Distributed File System: HDFS data Storage, Hadoop Physical Organization, HDFS Commands, MapReduce Framework, MapReduce Programming Model, MapReduce Map task, Reduce Task and MapReduceExecution, Hadoop YARN, Hadoop2 Execution Model, Hadoop Ecosystem Tools, Hadoop Ecosystem.	10	2
III	**NoSQL Big Data Management, Mongo DB** NoSQL: Introduction, NoSQL Data Store, NoSQL Data Architecture patterns, NoSQL to Manage Big Data, Shared-Nothing Architecture for Big Data Tasks, Advantages of NoSQL, Application of NoSQL in Industry. Data Base for the Modern Web: Introduction to MongoDB, features of MongoDB, Data Types, Mongo DB Query Language and Database Command.	10	3
IV	**Hive and Pig:** Hive: Introduction, Characteristics, Hive Architecture and Installation, Comparison with Traditional Database (RDBMS), Hive Data type and File Formats, Hive Data Model, Hive Integration and Workflow Steps, Hive Built-in Functions, HiveQL. Pig: Apache Pig, Application of Apache Pig, Feature, Pig Architecture, Pig- Grunt Shell, Installing Pig, Pig Latin Data Model, Pig Latin and Developing Pig Latin Scripts: Apache Pig Execution, Commands.	10	4
V	**Spark** SPARK: Introduction to Data Analysis with Spark, Downloading Spark and Getting Started, Programming with RDDs, Machine Learning with MLlib, Introduction to Analytics, Information Reporting, Data Visualization, Data Stream Concepts and Management, Stream Computing Aspects, Frequent Itemsets, Spark Streaming, Spark GraphX Platform.	10	5

RECOMMENDED BOOKS:

1. **Big Data Analytics**, *Raj Kamal and PreetiSaxena*, McGrawHill Education
2. **Big Data: Black Book**, *DT Educational Services*, Dreamtech Press
3. **Big Data Analytics**,*SeemaAcharya&ShubhashiniChellappan*, Wiley India
4. **Big Data Analytics**,*M. Vijayalakshmi&RadhaShankarmani*, Wiley India

MCA Semester-3

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	Course Title		Course Type
MCA305-II	Cloud Computing		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

Student will learn the concepts of cloud computing and develops analytical skills and critical thinking for better programming.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Perform cloud oriented analysis.	Ap
2	Model cloud candidate derived from existing business documentation.	Ap
3	Design the composition of a cloud services.	Ap
4	Design application services for technology abstraction.	Ap
5	Appreciate the cloud computing paradigm, recognize its various forms and able to implement some cloud computing features	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	2	2	2	2	-	1	3	3	3	3	2	2	1
CO2	3	3	3	2	2	2	2	-	2	3	3	3	3	2	-	3
CO3	3	3	3	2	2	2	2	2	-	3	3	3	3	2	-	2
CO4	3	2	3	1	2	2	2	2	-	3	3	3	3	2	-	1
CO5	2	3	3	1	2	2	2	1	-	3	2	3	3	2	2	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA305-II
Cloud Computing

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction:** Cloud Computing: Vision, Definition, Reference Model, Characteristics, Benefits and Challenges, Historical Developments, Cloud Computing Environments, Cloud Platforms and Technologies; The Evolution of Cloud Computing: Parallel Computing vs. Distributed Computing, Elements of Parallel Computing, Elements of Distributed Computing, Technologies for Distributed Computing, Introduction of Grid Computing.	10	1
II	**Virtualization:** Introduction, Characteristics, Taxonomy of Virtualization, Levels of Virtualization, Structure and Mechanism of Virtualization, Virtualization and Cloud Computing, Advantages and Disadvantages, Virtualization Technology Examples: Xen, VMware, Microsoft Hyper-V.	10	2
III	**Cloud Computing Architecture:** Service Oriented Architecture, Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), Data Storage as a Service (DSaaS). Types of Clouds; Economics of the Cloud and Open Challenges; **Security and Organizational aspects**: Host Security and Data Security.	10	3
IV	**Migration to the Cloud:** Adoption and use of Cloud by Businesses (Small and Enterprise), Pace of Adoption, Benefits and Phases of Adoption, Cloud Service Provider's Capabilities and Liabilities, Success factors and Issues. **Migrating Applications**: Key Aspects, Migration Techniques, Phases of Migration. **Service Level Agreement (SLA)**: Aspects and Requirements, Availability and Outages, Credit Calculations, SLA Samples.	10	4
V	**Industry Platforms:** Amazon Web Services, Google AppEngine, Microsoft Azure; **Cloud Applications**: Scientific Applications, Business and Consumer Applications; Advanced Topics: Energy Efficiency in Clouds, Market Based Management, Federated Clouds / InterCloud, Third Party Cloud Services.	10	5

RECOMMENDED BOOKS:

1. **Mastering Cloud Computing**, *RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi*, McGraw Hill Education
2. **Cloud Computing: Black Book**, *KailashJayaswal et al.*,Kogent Learning Solutions, Dreamtech Press
3. **Cloud Computing: Principals and Paradigms**, *RajkumarBuyya et al.*, Wiley India
4. **Cloud Computing: Concepts, Technology & Architecture**, *Erl*, Pearson Education India
5. **Cloud Computing Bible**, *Barrie Sosinsky*, O'Reilly Media
6. **Cloud Computing: A Practical Approach**, *Toby Velte, Anthony Vote and Robert Elsenpeter*, McGraw Hill
7. **Cloud Application Architectures: Building Applications and Infrastructures in the Cloud**, *George Reese*, O'Reilly Media.

1. **Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance**, *Tim MathermSubraKumaraswamy and ShahedLatif*, O'Reilly Media.

MCA Semester-3

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	Course Title		Course Type
MCA305-III	Soft Computing		Elective
Credit	Hours Per Week (L-T-P)		
	L	T	P
4	3	1	0

Maximum Marks	Sessional	Theory
125	25	100

Learning Objective (LO):

Student will be able to apply various computational techniques such as fuzzy logic, neural network, genetic algorithms and probabilistic reasoning. These techniques are used to solve complex problems that may involve uncertainty, imprecision, or incomplete information.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand Artificial Neural Network concept with the help of Biological Neural Network.	U
2	Implement algorithms to train ANN by using learning algorithms.	Ap
3	Test fuzzy set operations and binary relations.	An
4	Understand Genetic algorithms.(CL)	U
5	Understand programming in MATLAB.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	2	1	2	2	2	3	3	3	3	2	2	1
CO2	3	3	3	1	2	1	2	2	2	3	3	3	3	2	2	3
CO3	3	3	3	1	2	1	2	2	2	3	3	3	3	2	2	2
CO4	3	3	3	1	2	1	2	2	2	3	3	3	3	2	2	1
CO5	3	3	3	1	2	1	2	2	2	3	2	3	3	2	2	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA305-III
Soft Computing

Unit No.	Topics	No. of Hours	CO No.
I	**Introduction to Fuzzy Logic System** Fuzzy Sets Operation Of Fuzzy Sets, Properties Of Fuzzy Sets, Fuzzy Relations, Fuzzy Arithmetic, Membership Functions, Fuzzy To Crisp Conversion. Fuzzy Logic, Fuzzy Rule Based Systems, Fuzzy Decision Making, Fuzzy Database, Fuzzy Intelligent System.	10	1
II	**Introduction to Artificial Neural Networks** Introduction to Artificial Neural Network, Artificial Neuron, Classification of Artificial NeuralNetwork, Architecture of a Artificial Neural Network, Activation Function, Training an Artificial Neural Network, Application of Artificial Neural Network.	10	2
III	**Perceptron and Associative Memories** Amari General Learning Rule, HEBB Learning Rule, ADLINE, Perceptron Layer Network, Associative memory: Auto associative Memory, Bi-directional memory, Back-propagation Network: Architecture, Training Algorithm Application of Back-propagation algorithm	10	3
IV	**Evolutionary Computing** Introduction, overview of evolutionary computing, Genetic algorithms and optimization, The schema theorem: the fundamental theorem of genetic algorithms, Genetic algorithm operators, Integration of genetic algorithms with neural networks, Integration of genetic algorithms with fuzzy logic, Known issues in GAs.	10	4
V	**Soft Computing Tools** Introduction to MATLAB, Features, Matrix Operations, Curve Plotting, Toolbox Introduction, Introduction to Simulink.	10	5

RECOMMENDED BOOKS:

1. **Soft Computing**, SarojKaushik, TMH Publications.
2. **Fuzzy systems and Fuzzy Logic**, *Klir and Uuna*, PHI Publications.
3. **Introduction to Artificial Neural Networks**, *S. N. Sivanandam and M. Paulraj*, Vikas publication.
4. **Soft Computing and Intelligent systems Design**, *Fakhreddine O. Karry and Clarence de Silva*
5. **Neural Network Design**, *Hagan & Demuth*, Vikas Pub. Comp.
6. **Fundamentals of Artificial Neural Networks**, *M.A.Hassaoun*.
7. **Fuzzy sets, uncertainty and information,** *George J. Kir, & TA Folger*.
8. **Fuzzy sets, Decision making and Expert system**, *HJ Zimmerman*, Kluwer, Boston.
9. **Fuzzy set theory and its applications**, *H. J. Zimmerman*, Kluwer, Boston.

MCA Semester-III

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	**Course Title**		**Course Type**
MCA306	Lab-VII : Programming in .Net Technology		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
2	0	0	4

Maximum Marks	Sessional	Practical
150	50	100

Learning Objective (LO):

Students are going to be able to understand client-server programming paradigm in network based web application.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn about .NET framework.	Ap
2	Learn about control structures and functions	Ap
3	Learn about OOPs concepts and how to do OO Programming.	Ap
4	Understand website designing and its concepts.	Ap
5	Learn client-server paradigm.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	2	2	2	1	1	2	2	3	-	2	-	3
CO2	3	3	3	1	2	2	2	1	1	2	2	3	-	2	-	1
CO3	3	3	3	1	2	2	2	1	1	2	2	3	-	2	-	-
CO4	3	3	3	1	2	2	2	1	1	2	2	3	-	2	-	-
CO5	3	3	3	1	2	2	2	1	1	2	2	3	-	2	-	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA306
Lab-VII : Programming in .Net Technology

Unit No.	Topics	No. of Hours	CO No.
I	**Programs to explain following concepts**: Data types, variables, Constant, **Control Structures**: conditional statements, loops, **Arrays:** creating array in vb.net, Dynamic arrays.	10	1
II	**Programs on Functions:** defining Function, Function returning a value, Recursive function, Param Arrays, Passing Array as Function Arguments,	10	2
III	**Programs Related to following concepts:** MustInherit keyword, using MustOverride, MustOverridable, **Exception Handling.**	10	3
IV	**Programs Related to following concepts:** classes : class Member Constructor and Destructors, Parameterized Constructor, Shared Members of vb.net Class, **Inheritance**: Base and Derived Classes, Base Class Initialization.	10	4
V	**Programs related to** Asp.net- Life Cycle, , Asp.net state management, Web application, Web forms, Controls in web forms, Events in Web form.	10	5

MCA Semester-III

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	Course Title		Course Type
MCA307	Lab-VIII: Networking		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	0	0	4
Maximum Marks	Sessional		Practical
100	50		50

Learning Objective (LO):

This course will help students understand and apply the concepts learned in the corresponding theory subject which will promote deeper understanding and practical skills which are necessary for employability.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understanding of computer network.	Ap
2	Know basic concepts of bandwidth, data communication etc.	Ap
3	Understand the ideas about cyber security and networking technologies.	Ap
4	Be more employable.	Ap
5	Be open up new areas in the field of research and development in the area of computer networking.(C)	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	1	2	1	2	1	1	2	2	3	2	2	2	3
CO2	3	3	3	1	2	1	2	1	1	2	2	3	2	2	2	1
CO3	3	3	3	1	2	1	2	1	1	2	2	3	2	2	2	1
CO4	3	3	3	1	2	1	2	1	1	2	2	3	2	2	2	1
CO5	3	3	3	1	2	1	2	1	1	2	2	3	2	2	1	1

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA307
Lab-VIII: Networking

Unit No.	Topics	No. of Hours	CO No.
I	Basic Network Commands	10	1
II	Crimping of LAN Cable	10	2
III	Network Simulation in Cisco Packet Tracer	10	3
IV	Server Installation	10	4
V	Server Configuration	10	5

MCA Semester-III

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	Course Title		Course Type
MCA308	Lab-IX : Mini Project		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	0	0	4
Maximum Marks	Sessional		Practical
100	50		50

Learning Objective (LO):

Objective of minor project is to make student capable of implementing learnt programming concepts into practical by creating small software by applying SDLC concepts.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Enhance coding skills.	Ap
2	Enable to analyze system.	Ap
3	Create small software using programming language.	Ap
4	Design backend and front end parts of software and make them communicate with each other.	Ap
5	Do requirement analysis and design and develop an application that fulfills those requirements.	Ap

CL: Cognitive Levels

Cognitive Level: **R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; B-Evaluate; **C**-Create.

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO5	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

MCA Semester-III

Program	Subject	Year	Semester
MCA	MCA	2	I
Course Code	Course Title		Course Type
MCA309	Internship		Core
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	0	0	4
Maximum Marks	Sessional		-
25	25		00

Learning Objective (LO):

Students will be able to polish their communication skill and presentation skills.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Learn how to make presentation PPT.	U
2	Learn how to present effectively.	U
3	Becomes confident for their knowledge expression.	Ap
4	Improve their public speaking skills.	Ap
5	Learn novel topics and develop a more holistic perspective.	Ap

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO5	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:
MCA309 (Internship)

Unit No.	Topics	No. of Hours	CO No.
I	Internship	50	1
II	Internship Seminar		2
III	Internship Report		3
IV	Internship Presentation		4
V	Internship Viva		5

MCA Semester-IV

Program	Subject	Year	Semester
MCA	MCA	2	2
Course Code	**Course Title**		**Course Type**
MCA401	Internship: System Development Project & Implementation / Research Project (Dissertation)		Core
Credit	**Hours Per Week (L-T-P)**		
	L	T	P
16	0	0	32
Maximum Marks	**Sessional**		**Project**
400	200		200

Learning Objective (LO):

To make students skilled and employable for industry requirement and to make them understand latest knowledge in their domain.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Develop software for organizations..	C
2	Analyze and design a system	C
3	Relate their knowledge and its implementation.	C
4	Find practical exposure to industry.	C
5	Understand current trends in technology.	U

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	POs											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	3	3	3	-	1	-	3	1	-	-	-	3	1	-	-	-
CO2	3	3	3	1	1	1	3	-	-	-	-	3	2	-	-	3
CO3	3	3	3	1	1	1	3	-	-	2	-	3	2	-	-	2
CO4	3	3	3	1	1	2	3	1	-	2	1	3	2	-	-	-
CO5	3	3	3	1	1	-	2	-	-	2	2	3	2	3	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

MCA

Skill Enhancement/Value Added Courses

Program	Subject	Year	Semester
MCA	MCA	1	II
Course Code	Course Title		Course Type
CS-VAC-01	Introduction to Digital Marketing		Skill Enhancement
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	0	0

Maximum Marks	Sessional	Theory
100	25	75

Learning Objective (LO):

To understand the basic Concepts of Digital marketing and the road map for successful Digital marketing strategies.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Understand and describe about fundamentals of digital marketing.	**Ap**
2	Describe the development of digital marketing in India.	**Ap**
3	Understand and explain the terminology and jargons used in the fields of digital marketing.	**U**
4	Understand about various aspects of advertising in relation to digital marketing.	**Ap**
5	Describe financial technology and current developments in the field.	**U**

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	Pos											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	3	2	2	1	2	1	-	2	2	3	1	2	-	1
CO2	3	1	3	2	3	2	2	1	-	2	1	1	1	2	2	3
CO3	2	3	3	2	2	1	1	-	-	3	2	3	1	2	-	2
CO4	3	2	3	3	2	3	2	1	-	2	1	2	2	2	1	2
CO5	1	3	3	1	2	1	2	1	-	2	2	3	1	2	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

MCA-(Skill Enhancement/Value Added Courses)

Introduction to Digital Marketing

Unit No.	Topics	No. of Hours	CO No.
I	Fundamentals of Digital marketing & Its Significance, Traditional marketing Vs Digital Marketing, Evolution of Digital Marketing, Digital Marketing Landscape, Key Drivers, Digital Consumer & Communities, Gen Y & Netizen's expectation & influence wrt Digital Marketing.	6	1
II	The Digital users in India, Digital marketing Strategy- Consumer Decision journey, POEM Framework, Segmenting & Customizing messages, Digital advertising Market in India, Skills in Digital Marketing, Digital marketing Plan	6	2
III	Terminology used in Digital Marketing, PPC and online marketing through social media, Social Media Marketing, SEO techniques, Keyword advertising, Google web-master and analytics overview, Affiliate Marketing, Email Marketing, Mobile Marketing	6	3
IV	Display adverting, Buying Models, different type of ad tools, Display advertising terminology, types of display ads, different ad formats, Ad placement techniques, Important ad terminology, Programmatic Digital Advertising.	6	4
V	**Fin-Tech**: Introduction to Fin-Tech, History & Development of Fin-Tech, Advantages of Fin-Tech, Applications of Fin-Tech, Fin-Tech in Banking, Digital Payments, Crypto-currencies, Fin-Tech in Digital Marketing.	6	5

BOOKS RECOMMENDED:

1. Digital Marketing –Kamat and Kamat-Himalaya
2. Marketing Strategies for Engaging the Digital Generation, D. Ryan,
3. Digital Marketing, V. Ahuja, Oxford University Press
4. Digital Marketing, S.Gupta, McGraw-Hill
5. Quick win Digital Marketing, H. Annmarie , A. Joanna, Paperback edition

MCA

Skill Enhancement/Value Added Courses

Program	Subject	Year	Semester
MCA	MCA	1	III
Course Code	Course Title		Course Type
CS-VAC-02	Green Computing		Skill Enhancement
Credit	Hours Per Week (L-T-P)		
	L	T	P
2	2	0	0
Maximum Marks	Sessional		Theory
100	25		75

Learning Objective (LO):

- The course objective is to learn the fundamentals of Green Computing and to analyze the Green computing Grid Framework. To understand the issues related with Green compliance and study and develop various case studies.

Course Outcomes (CO):

CO No.	Expected Course Outcomes At the end of the course, the students will be able to :	CL
1	Acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.	**Ap**
2	Enhance the skill in energy saving practices in their use of hardware.	**Ap**
3	Understand the issues related with Green compliance.	**U**
4	Evaluate technology tools that can reduce paper waste and carbon footprint by the stakeholders.	**Ap**
5	Understand the ways to minimize equipment disposal requirements.	**U**

CL: Cognitive Levels (**R**-Remember; **U**-Understanding; **Ap**-Apply; **An**-Analyze; **E**-Evaluate; **C**-Create).

CO-PO/PSO Mapping for the course:

PO / CO	Pos											PSO				
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5
CO1	2	3	3	2	2	1	2	1	-	2	2	3	1	2	-	1
CO2	3	1	3	2	3	2	2	1	-	2	1	1	1	2	2	3
CO3	2	3	3	2	2	1	1	-	-	3	2	3	1	2	-	2
CO4	3	2	3	3	2	3	2	1	-	2	1	2	2	2	1	2
CO5	1	3	3	1	2	1	2	1	-	2	2	3	1	2	-	-

"3" – Strong; "2" – Moderate; "1"- Low; "-" No Correlation

Detailed Syllabus:

MCA-(Skill Enhancement/Value Added Courses)

Green Computing

Unit No.	Topics	No. of Hours	CO No.
I	**Green Fundamentals**: Introduction, Green Computing: Benefits And Important, Growth Statistics Of Internet Usages, Formal Approach To Green Computing: Green Design, Green Manufacturing, Green Management, Green Purchasing, Green Use, Green Disposal And Recycle. Environmentally Sound Practices For Computing, Green Computing Standardizations And Compliances.	6	1
II	**GREEN ASSETS AND MODELING** : Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models.	6	2
III	**GRID FRAMEWORK** :Virtualization of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center – Green Grid framework.	6	3
IV	**GREEN COMPLIANCE** :Socio-cultural aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, and Audits – Emergent Carbon Issues: Technologies and Future.	6	4
V	**CASE STUDIES:** The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.	6	5

BOOKS RECOMMENDED:

TEXT BOOKS: 1. Bhuvan Unhelkar, —Green IT Strategies and Applications-Using Environmental Intelligence‖, CRC Press, June 2014.

1. Woody Leonhard, Katherine Murray, —Green Home computing for dummies‖, August 2012.
2. **REFERENCES**

1. Alin Gales, Michael Schaefer, Mike Ebbers, —Green Data Center: steps for the Journey‖, Shroff/IBM rebook, 2011.
2. John Lamb, —The Greening of IT‖, Pearson Education, 2009.
3. Jason Harris, —Green Computing and Green IT- Best Practices on regulations & industry‖, Lulu.com, 2008
4. Carl speshocky, —Empowering Green Initiatives with IT‖, John Wiley & Sons, 2010.
5. Wu Chun Feng (editor), —Green computing: Large Scale energy efficiency‖, CRC Press

Detailed Syllabus:

MCA-(Skill Enhancement/Value Added Courses)

Green Computing

Unit No.	Topics	No. of Hours	CO No.
I	**Green Fundamentals**: Introduction, Green Computing: Benefits And Important, Growth Statistics Of Internet Usages, Formal Approach To Green Computing: Green Design, Green Manufacturing, Green Management, Green Purchasing, Green Use, Green Disposal And Recycle. Environmentally Sound Practices For Computing, Green Computing Standardizations And Compliances.	6	1
II	**GREEN ASSETS AND MODELING** : Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models.	6	2
III	**GRID FRAMEWORK** :Virtualization of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center – Green Grid framework.	6	3
IV	**GREEN COMPLIANCE** :Socio-cultural aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, and Audits – Emergent Carbon Issues: Technologies and Future.	6	4
V	**CASE STUDIES:** The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.	6	5

BOOKS RECOMMENDED:

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2. John Lamb, —The Greening of IT‖, Pearson Education, 2009.
3. Jason Harris, —Green Computing and Green IT- Best Practices on regulations & industry‖, Lulu.com, 2008
4. Carl speshocky, —Empowering Green Initiatives with IT‖, John Wiley & Sons, 2010.
5. Wu Chun Feng (editor), —Green computing: Large Scale energy efficiency‖, CRC Press