The Curriculum Book

Master of Computer Applications (MCA)

2 YEARS PROGRAMME

CHOICE BASED CREDIT BASED SYSTEM

(w.e.f. session 2024-25)

Department of Computer Science & Engineering
Guru Jambheshwar University of Science & Technology,
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Contents

Chapter 1: General Information

1.1. Vision and Mission of the Department of Computer Science and Engineering

1.1.1 Vision

The vision of the Department of Computer Science and Engineering is to become a centre of excellence for education in Computer Science and Engineering, Information Technology and Computer Applications. We visualize ourselves as an agency to nurture young minds to be the future leaders in the field of higher education, research and development, and information technology industry. Our aim is to bring out creators and innovators who will work towards the overall well-being of the society.

1.1.2. Mission

- Imparting state-of-the-art knowledge in Computer Science and Engineering, Information Technology and Computer Applications.
- Ensuring that our students graduate with a sound theoretical basis and wide-ranging practical experience.
- Fostering linkages between the Department and, public and private sectors, traversing research establishments as well as Information Technology industry.
- Promoting ethical research of high quality.
- Adopting the best pedagogical methods in order to maximize knowledge transfer.
- Inculcating a culture of free and open discussions in the Department.
- Engaging students in evolving original ideas and applying them to solve complex engineering and application problems.
- Inspiring a zest into students for lifelong learning.
- Infusing scientific temper, enthusiasm, professionalism, team spirit and leadership qualities in students.
- Sensitizing students to look for environmentally sustainable engineering and computing solutions.
- Upholding democratic values and an environment of equal opportunity for everyone.

1.2. MCA: Programme Educational Objectives (PEOs)

The Programme Educational Objectives of the MCA Programme are:

PEO1. To prepare responsible professionals to be successfully employed and excel in Computer Science Application and Information Technology sectors, and Academic Institutions, who will be able to apply the principles of mathematics, computing science and project management to develop and deploy solutions for real world problems.

PEO2. To equip students for identifying, formulating, analysing, evaluating and designing complex computing applications by doing a systematic and in-depth research in the related problem domains, using modern tools and communicating effectively among the various stakeholders.

PEO3. To motivate students to go for higher studies and research with a positive attitude towards lifelong learning.

PEO4. To groom the independent professionals/entrepreneurs with leadership qualities, team spirit and deep ethical, cultural and societal concerns who can move up in their professional career or start their own ventures.

1.3. MCA Programme Outcomes (POs)

PO1. **Foundation Knowledge:** Apply Knowledge of mathematics, programming logic and coding fundamentals for solution architecture and problem solving.

PO2. **Problem analysis:** Identify, review, formulate and analyse problems primarily focusing on customer requirements using critical thinking frameworks.

PO3. **Development of solutions:** Design, develop and investigate problems with an innovative approach for solutions incorporating ESG/SDG goals.

PO4. **Modern tool usage:** Select, adapt and apply modern computational tools such as development of algorithms with an understanding of the limitations including human biases.

PO5. **Individual and team work:** Function and communicate effectively as an individual or a team leader in diverse and multidisciplinary groups. Use methodologies such as agile.

PO6. **Project management and finance:** Use the principles of project management such as scheduling, work breakdown structure and be conversant with the principles of Finance for profitable project management.

PO7. **Ethics:** Commit to professional ethics in managing software projects with financial aspects. Learn to use new technologies for cyber security and insulate customers from malware.

PO8. **Life-long learning:** Change management skills and the ability to learn, keep up with contemporary technologies and ways of working.

Chapter 2: Bridge Courses

Bridge Course(s) for MCA 2-Year Programme

(For students having non-IT background only)

Course No.	Course	C L T P	Max. Marks	Exams (Internal)
MCA-BC-01	MCA Bridge Course – I	3 3 - -	100	3 Hours
MCA-BC-02	MCA Bridge Course – II	3 3 - -	100	3 Hours
	Total		200	

Note:

1. Both courses are qualifying in nature. However, no student will be awarded MCA degree without qualifying them.
2. Duration – Three/Four weeks
3. The examination/evaluation for the bridge course is internal.
4. Both bridge courses shall be completed by the student(s) as prescribed by the Department/University. MCA degree shall not be awarded unless the students successfully complete the bridge course(s). Bridge course(s) examination will be conducted by the Department/University. The student has to secure 40% marks in examination in order to pass the bridge course(s). The respective University Teaching Department/Affiliated College(s) shall arrange for the contact sessions for completing the bridge course(s). The University/ Affiliated College(s) shall not charge any additional fee for the conduct of bridge course(s). However, the contact classes for bridge course(s) shall count towards teaching workload.

MCA-BC-01
MCA Bridge Course I

L - T - P **Max. Marks- 100**
3 – 0 – 0 **Credits – 3**
Exams(I): 3 Hours

Note: - Total 09 Questions are to be set by the examiner. First question will be compulsory consisting of 5 short (each 4 marks) questions covering entire syllabus uniformly. In addition, 8 more questions will be set unit wise comprising 2 questions from each unit of the given syllabus. A candidate is required to attempt five questions in all, selecting one question from each Unit - Including the compulsory question.

Course Objectives: The main objective of the course is to bridge the gap between courses studied by the students having non-IT background. The students taking this bridge course shall be taught in fundamental concepts of computers and C programming language.

After doing the bridge course the students will be able to:

Course Outcomes

After successful completion of this bridge course, the students will be able to:

CO1. **Define** the terminology regarding C language, Computer Networks and Operating Systems (LOTS: Level 1: Remember)
CO2. **Describe** C language constructs and basics of operating system, data communications and networks and operating systems. (LOTS: Level 2: Understand)
CO3. **Apply** C language constructs to solve programming problems. (LOTS: Level 3: Apply)
CO4. **Analyse** C programmes for syntax and semantic errors. (HOTS: Level 4: Analyse)

Course Content

Unit-I

Elements of C language: C character set, identifiers & keywords, data types: declaration & definition.
Operators: Arithmetic relational, logical, bitwise, unary, assignment and conditional operators & their hierarchy & associativity, Data input/output.

Unit-II

Control statements: Sequencing, Selection: if and switch statement; iteration, repetition: for, while, and do-while loop; break, continue, goto statement.
Functions in C language: Definition, prototype, passing parameters, recursion, Data structure: arrays, structures, union, string, data files.

Unit-III

Computer Software: introduction, relationship between hardware and software, types of software, planning the computer program: purpose of program planning, algorithm, flowcharts, decision tables, pseudo codes, application software packages.
Data Communications and Computer Networks: Introduction, data transmission modes, data transmission speed, transmission media, digital and analog transmission, the internet, multimedia.

Unit-IV

Operating System, types of Operating System; process, process states, major components of an OS - file system, scheduler, and device drivers. Basic tasks of an OS-file management, memory management, process management, handling input and output and controlling peripheral devices such as disk drives and printers.

References:

1. Kernighan B.W., Ritchie D. M., *The C Programming Language,* Second Edition, PHI, 2001.
2. Gottfried Byron, *Programming With C (Schaum's Outlines),* Fourth Edition, McGraw Hill Education, 2018.
3. Kanetkar Y. P., *Exploring C,* Second Edition, BPB Publications, 2004.
4. Kanetkar Y. P., *Let us C,* Nineteenth Edition, BPB Publications, 2022.
5. Venugopal K. R., Prasad S.R., *Programming With C,* First Edition, McGraw Hill Education, 2014.
6. Sinha P., Sinha P. K., *Computer Fundamentals,* Eighth Edition, BPB Publications, 2021.

List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1.	**Define** the terminology regarding C language, Computer Networks and Operating Systems. (LOTS: Level 1: Remember)	3	1	-	-	-	-	-	-
CO2.	**Describe** C language constructs and basics of operating system, data communications and networks and operating systems. (LOTS: Level 2: Understand)	3	2	1	-	-	-	-	-
CO3.	**Apply** C language constructs to solve programming problems. (LOTS: Level 3: Apply)	2	3	2	2	-	-	-	-
CO4.	**Analyse** C programmes for syntax and semantic errors. (HOTS: Level 4: Analyse)	1	3	3	3	1	-	-	-
	Level of Attainments	-	-	-	-	-	-	-	-

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-BC-02
MCA Bridge Course II

L - T - P **Max. Marks- 100**
3 – 0 – 0 **Credits – 3**
Exams(I): 3 Hours

Note: - Total 09 Questions are to be set by the examiner. First question will be compulsory consisting of 5 short (each 4 marks) questions covering entire syllabus uniformly. In addition, 8 more questions will be set unit wise comprising 2 questions from each unit of the given syllabus. A candidate is required to attempt five questions in all selecting one question from each Unit - Including the compulsory question.

Course Objectives: The main objective of the course is to bridge the gap between courses studied by the students having non-IT background. The students taking this bridge course shall be taught topics in C++ programming language, digital electronics and Computer organization.

Course Outcomes:

After successful completion of this bridge course, the students will be able to:

CO1. **State** the basic concepts of digital electronics, computer organisation and object orientated programming. (LOTS: Level1: Remember)
CO2. **Discuss** the fundamentals of digital electronics, computer organisation and object oriented programming. (LOTS: Level2: Understand)
CO3. **Solve** problems regarding digital electronics, computer organisation and object oriented programming. (LOTS: Level3: Apply)
CO4. **Design** object oriented programming programs for simple problems. (HOTS: Level6: Create)

Unit-I

Object oriented concept: Data abstraction, encapsulation, classes and objects modularity, hierarchy, typing, concurrency, object-oriented methodology: advantages and disadvantages of OO methodologies. aggregation, generalization and inheritance, abstract class, meta data, object diagram.

Unit-II

C++ Programming: Data types, expression and control statements, arrays, string and string related library functions, structures vs classes, static data and member function, constant parameters and destruction, dynamic objects, constructors and destructors, operator overloading, function overloading, abstract class.

Unit-III

Digital Fundamentals: Information representation - number systems, codes, binary arithmetic operations; number systems - non positional number system, positional number system, number system conversion, fractional number conversion; computer codes - BCD code, EBCDIC code, ASCII code, Boolean algebra, Boolean functions, truth table, simplification of Boolean functions, digital logic gates.

Unit-IV

Computer Organisation: Combinational logic - adders, subtractors, encoder, decoder, multiplexer, demultiplexer and comparators; processor organisation - machine instructions, instruction cycles, instruction formats and addressing modes.

References:

1. Stroustrup, B., *The C++ programming language*, Addison –Wesley1993.
2. Balaguruswami E., *Object Oriented Programming in C++*, Tata McGraw, 2013.
3. Rumbaugh. J.et. al., *Object Oriented Modeling and Design*, Prentice Hall of India, 1998.
4. Pradeep K. Sinha & Priti Sinha, Computer Fundamentals, BPB Publications, 2004.
5. Rajaraman V, *Fundamentals of Computers*, 4th Edition, 2017.
6. Mano. M. Morris Digital Logic & Computer systems Design, Prentice Hall of India Pvt. Ltd., 2000.

List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1.	**State** the basic concepts of digital electronics, computer organisation and object orientated programming. (LOTS: Level1: Remember)	3	1	-	-	-	-	-	-
CO2.	**Discuss** the fundamentals of digital electronics, computer organisation and object oriented programming. (HOTS: Level2: Understand)	3	2	1	1	-	-	-	-
CO3.	**Solve** problems regarding digital electronics, computer organisation and object-oriented programming. (HOTS: Level3: Apply)	3	2	2	2	1	-	1	1
CO4.	**Design** object-oriented programming programs for simple problems. (HOTS: Level6: Create)	2	3	3	2	2	-	2	2
	Level of Attainments	-	-	-	-	-	-	-	-

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

Chapter 3: Scheme of Examination (MCA)

2.1. General course structure and credit distribution in various components of the curriculum

2.1.1 Definition of a Credit

Type of Teaching Learning Activity	No. of credits
1 Hour Lecture (L) per week	1 credit
1 Hour Tutorial (T) per week	1 credit
2 Hours Practical (Lab) per week	1 credit

2.1.2. Credits for Different Curriculum Components of MCA Programme

Distribution of Credits		
Sr. No.	**Category**	**Total Credit**
1	**Professional Basic Courses (Theory)** Database Management System, Web Designing Java Programming, Software Engineering Data Structures and Algorithms, Computer System Architecture Discrete Mathematics and Optimization, Advanced Operating Systems, Theory of Computation, Mobile Application Development	30
2	**Professional Basic Courses (Lab.)** Database Management System Lab. Web Designing Lab. Java Programming Lab. Data Structures and Algorithm Lab. Android Programming Lab.	10
3	**Professional Core Networking, Cloud Computing and IoT Courses (Theory)** Computer Networks and Internet Protocols Cyber Security IoT and Cloud Computing	9
4	**Professional Core Networking, Cloud Computing and IoT Courses (Lab.)** IoT and Cloud Computing Lab.	2
5	**Professional Core Data Analytics and Designing Intelligent Systems (Theory)** Python Programming, Artificial Intelligence Machine Learning, Data Analytics	12
6	**Professional Data Analytics and Designing Intelligent Systems (Lab.)** Python Programming Lab. Artificial Intelligence Lab. Machine Learning Lab. Data Analytics Lab.	8
	Professional Elective 1 Professional Elective II	6
7	Industrial Internship and Projects	2+6=8
Total Credits		85

2.2 Semester-wise Scheme of Examination for Master of Computer Applications (MCA)-Two-Year Programme under CBCS Scheme (w.e.f. Academic Session 2023-2024)

MCA SEMESTER-I

Course Code	Course Title	Credit	Int.	Ext.	Total
MCA-11	Database Management System	3	30	70	100
MCA-12	Web Designing	3	30	70	100
MCA-13	Java Programming	3	30	70	100
MCA-14	Software Engineering	3	30	70	100
MCA-15	Computer Networks and Internet Protocols	3	30	70	100
MCA-16	Database Management System Lab.	2	50	50	100
MCA-17	Web Designing Lab.	2	50	50	100
MCA-18	Java Programming Lab.	2	50	50	100
Total		**21**	**300**	**500**	**800**

MCA SEMESTER–II

Course No.	Course Title	Credit	Int.	Ext.	Total
MCA-21	Data Structures and Algorithms	3	30	70	100
MCA-22	Python Programming	3	30	70	100
MCA-23	Artificial Intelligence	3	30	70	100
MCA-24	Computer System Architecture	3	30	70	100
MCA-25	Discrete Mathematics and Optimization	3	30	70	100
MCA-26	Data Structures and Algorithms Lab.	2	50	50	100
MCA-27	Python Programming Lab.	2	50	50	100
MCA-28	Artificial Intelligence Lab.	2	50	50	100
Total		**21**	**300**	**500**	**800**
Students will go for four to six weeks Industrial training at the end of second semester. The Industrial Internship evaluation will be done in third semester.					

MCA SEMESTER-III

Course No.	Course Title	Credit	Int.	Ext.	Total
MCA-31	Machine Learning	3	30	70	100
MCA-32	Advanced Operating Systems	3	30	70	100
MCA-33	Data Analytics	3	30	70	100
MCA-34	Cyber Security	3	30	70	100
MCA-35	Theory of Computation	3	30	70	100
MCA-36	Machine Learning Lab.	2	50	50	100
MCA-37	Data Analytics Lab.	2	50	50	100
MCA-38	Industrial Training	2	100	---	100
Total		**21**	**350**	**450**	**800**

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MCA SEMESTER-IV

Course No.	Course Title	Credit	Int.	Ext.	Total
MCA-41	IoT and Cloud Computing	3	30	70	100
MCA-42	Mobile Application Development	3	30	70	100
MCA-43	Elective – I	3	30	70	100
MCA-44	Elective – II	3	30	70	100
MCA-45	IoT and Cloud Computing Lab.	2	50	50	100
MCA-46	Android Programming Lab.	2	50	50	100
MCA-47	Project Work	6	50	50	100
Total		**22**	**270**	**430**	**700**

MCA-43 Elective – I List of Courses

MCA-43(i) Big Data Analytics
MCA-43(ii) Software Project Management
MCA-43(iii) Digital Image Processing
MCA-43(iv) High Speed Networks
MCA-43(v) Any MOOC Course with the permission of Chairperson from the list approved by department.

MCA-44 Elective –III List of Courses

MCA-44(i) Soft Computing
MCA-44(ii) Compiler Design
MCA-44(iii) Data Mining Techniques
MCA-44(iv) Computer Graphics
MCA-44(iv) Any MOOC Course with the permission of chairperson from the list approved by department.

Total Programme Credits
MCA 2–Year under CBCS
w.e.f. Academic Session 2023-2024

Semester	Max. Marks	Credits
I	800	21
II	800	21
III	800	21
IV	700	22
Programme Total	**3100**	**85**

Note: -

1. Two Bridge courses (qualifying in nature) of duration 3-4 weeks will be offered to students of non-IT background during the first year. No student will be awarded MCA degree without qualifying the bridge courses.

2. Evaluation of Industrial Training is done by two members internal committee constituted by the Chairperson of the Department.

3. Students can opt for MOOCS through SWAYAM/NPTEL as elective courses as per the university guidelines.

Chapter 4: Detailed Syllabi (MCA)

MCA-11 Database Management System

General Course Information

Course Code: MCA-11 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Prerequisite: Knowledge of basic computing

About the Course:

This course covers fundamental principles and practical aspects of managing data in an organized manner. Students learn about database system architecture, data modeling, normalization, SQL, and concurrency control techniques. The course will empowers them to design and administer efficient database systems.

Course Outcomes: By the end of the course students will be able to:

CO1. **Define** fundamental elements of Database Management System. (LOTS: Level 1: Remember)
CO2. **Discuss** principles of relational Database design and modelling. (LOTS: Level 2: Understand)
CO3. **Apply** DBMS concepts and tools to solve real world problems. (LOTS: Level 3: Apply)
CO4. **Contrast** various DBMS solutions for any given problem. (HOTS: Level 4: Analyse)
CO5. **Design** database systems using ER modelling and normalization for any given problem. (HOTS: Level 6: Create)

Course Content

Unit-I

Overview: Overview of File Systems and Database Systems, Characteristics of the Data Base Approach, Database users, Advantages and Disadvantages of a DBMS, Responsibility of Database Administrator.
Data Base Systems Concepts and Architecture: DBMS architecture and various views of Data, Data Independence, Database languages, Data Models: Relational Database Model, Hierarchical Data Model, Network Data Model, Schemas and Instances.

Unit-II

E-R Model: Entity Types, Attributes & Keys, Relationships, Roles and Structural Constraints, E-R Diagrams, Reduction of an E-R Diagram to Tables. Relational Model and Query Language: Overview of Relational Database, Key Integrity Constraints, Relational Algebra, Relational Calculus, SQL fundamentals, Basic Operators, Missing information and NULL values, Advanced SQL features

Unit-III

Relational Database Design: Overview of normalization, Database Anomalies, Candidate and Super Key, Functional Dependencies, Integrity Constraints, Decomposition, Normal forms: First, Second, Third Normal, Boyce Codd, Normal Form, Multi-valued Functional Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Denormalization.

Unit-IV

Concurrency Control Techniques: Overview of database Transactions, Transaction states, ACID properties of a Transaction, Transaction Recovery, Concurrency Control, Locking Techniques, Time-stamp ordering, Multi-version Techniques, Deadlock, Recovery Techniques in centralized DBMS.
DDBMS Design: Replication and Fragmentation Techniques.

Text and Reference Books:

1. Elmasri, R., and Navathe, S. B., *Fundamentals of Database Systems*, Addison Wesley, Seventh Edition, 2015.
2. Silberschatz, A., Korth, H. F., and Sudarshan, S., *Database System Concepts*, McGraw Hill, 2019.
3. Pannerselvam R., *Database Management Systems*, PHI Learning, Second Edition 2011.
4. Desai, B. C., *An Introduction to Database System*, Galgotia Publication, 2010.
5. Leon, A., and Leon, M., *Database Management Systems*, Vikas Publishing, First Edition, 2009.
6. Mata-Toledo, R., Cushman, P., Sahoo, D., *Database Management Systems*, Schaums' Outline series, TMH, 2007.

List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1.	**Define** fundamental elements of Database Management System. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2.	**Discuss** principles of relational Database design and modelling. (LOTS: Level 2: Understand)	3	2	-	-	-	-	-	-
CO3.	**Apply** DBMS concepts and tools to solve real world problems. (LOTS: Level 3: Apply)	3	2	1	3	-	-	-	-
CO4.	**Contrast** various DBMS solutions for any given problem. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	1	-
CO5.	**Design** database systems using ER modelling and normalization for any given problem. (HOTS: Level 6: Create)	3	-	2	2	-	1	1	1
	Level of Attainments								

*Attainment Levels:
- None
1: Low, 2: Medium, 3: High

MCA-12 Web Designing

General Course Information

Course Code: MCA-12 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Prerequisite: Basic computer skills

About the Course:

This course covers information architecture, dynamic HTML, client-side and server-side programming, and advanced topics like Java Server Pages, Active Server Pages, and XML. Students will learn the principles and techniques for creating effective and interactive websites, including design, navigation, and programming elements.

Course Outcomes: By the end of the course students will be able to:

CO1. **Outline** Web Designing terminologies and processes. (LOTS: Level 1: Remember)
CO2. **Discuss** Web Designing methodologies and tools. (LOTS: Level 2: Understand)
CO3. **Apply** web designing techniques and tools for designing websites. (LOTS: Level 3: Apply)
CO4. **Compare** the various techniques for web designing. (HOTS: Level 4: Analyse)
CO5. **Evaluate** the various web designing strategies. (HOTS: Level 5: Evaluate)
CO6. **Design** Web Pages using state-of-the-art techniques and tools. (HOTS: Level 6: Create)

Course Content

Unit - I

Information Architecture The Role of Information Architect, Collaboration and Communication, Organizing information, Organizational challenges, Organizing Web Sites and Intranets, Creating Cohesive Organization Systems, Designing Navigation Systems, Types of navigation Systems, Integrated Navigation Elements, Remote Navigation Elements, Designing Elegant Navigation Systems, Designing the Search Interface, Indexing the Right Stuff, Grouping Content, Conceptual Design; High-Level Architecture Blueprints, Architectural Page Mockups, Design Sketches.

Unit - II

Dynamic HTML and Web Designing HTML Basic Concepts, Good Web Design, Process of Web Publishing, Phases of Web Site development, Structure of HTML documents, HTML Elements - Core attributes, absolute and relative links, ordered and unordered lists, Linking Basics, Linking in HTML, Images and Anchors, Anchor Attributes, Image Maps, Semantic Linking Meta Information, Image Preliminaries, , Images as Buttons, Introduction to Layout: Backgrounds, Colors and Text, Fonts, Layout with Tables, Advanced Layout : Frames and layers, HTML and other media types, FORMS, Forms Control, New and emerging Form Elements.

Separating style from structure with style sheets: Internal style specifications within HTML, External linked style specification using CSS, page and site design considerations, Positioning with Style sheets.

Unit - III

Client side programming: Introduction to the JavaScript syntax, the JavaScript object model, Event handling, Output in JavaScript, Forms handling, miscellaneous topics such as cookies, hidden fields, and images; Applications.
Server side programming: Introduction to Server Side Technologies CGI / ASP / JSP, Programming languages for server Side Scripting, Configuring the server to support CGI, applications; Input/ output operations on the WWW, Forms processing, (using PERL/VBSCRIPT/JavaSCRIPT)

Unit - IV

Java Server Pages and Active Server Pages: Basics, Integrating Script, JSP/ASP Objects and Components, configuring and troubleshooting,: Request and response objects, Retrieving the contents of a an HTML form, Retrieving a Query String, Cookies, Creating and Reading Cookies. Using application Objects and Events.
Overview of advance features of XML, XML Relationship between HTML, SGML, and XML, The future of XML.

T**ext and Reference Books:**

1. Thomas A Powell, HTML-*The Complete Reference*, Tata McGraw Hill, Fifth Edition, 2017
2. Scott Guelich, Shishir Gundavaram, Gunther Birzniek; *CGI Programming with Perl* 2/e. O'Reilly, 2000.
3. Doug Tidwell, James Snell, Pavel Kulchenko*; Programming Web Services with SOAP*, O'Reilly, First Edition, December 2001.
4. Pardi, *XML in Action*, Web Technology, PHI.1999.
5. Yong, *XML Step by Step* , PHI, Second Edition, 2002.
6. Aaron Weiss, Rebecca Taply, Kim Daniels, Stuven Mulder, Jeff Kaneshki, *Web Authoring Desk Reference*, Techmedia Publications, 1997.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Outline** Web Designing terminologies and processes. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Discuss** Web Designing methodologies and tools. (LOTS: Level 2: Understand)	2	2	-	2	-	-	-	-
CO3. **Apply** web designing techniques and tools for designing websites. (LOTS: Level 3: Apply)	3	2	1	3	-	-	1	-
CO4. **Compare** the various techniques for web designing. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	2	-
CO5. **Evaluate** the various web designing strategies. (HOTS: Level 5: Evaluate)	-	3	1	2	-	-	2	-
CO6. **Design** Web Pages using state-of-the-art techniques and tools. (HOTS: Level 6: Create)	3	-	2	3	-	1	2	2
Level of Attainments								

*Attainment Levels:
- None
1: Low, 2: Medium, 3: High

MCA-13 Java Programming

General Course Information

Course Code: MCA-13 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisites: Basic knowledge of Object Oriented programming

About the Course:

Java is a general-purpose, concurrent, class-based, object-oriented computer programming language that is specifically designed to have as few implementation dependencies as possible. The aim of this course is to provide the students basic knowledge about object-oriented development and in-depth knowledge about syntax and programming techniques in Java. The course is very comprehensive and covers all the important Java concepts, e.g., Java basics, Object-Oriented Programming, Multithreading, File handling, Exception handling and more.

Course Outcomes: By the end of the course students will be able to:

CO1. **List** object oriented characteristics peculiar to JAVA programming. (LOTS: Level 1: Remember)
CO2. **Describe** object-oriented principles and paradigms implemented by Java programming language. (LOTS: Level 2: Understand)
CO3. **Apply** object-oriented principles for solving problems using JAVA. (LOTS: Level 3: Apply)
CO4. **Identify** classes, interfaces methods, hierarchy in the classes for a given programming problem in JAVA. (HOTS: Level 4: Analyse)
CO5. **Design** Graphical User Interface applications and Web based applications in Java by importing applet, AWT and SWING packages. (HOTS: Level 6: Create)

Course Content

Unit-I

Overview, Control and Looping Structure: Objective Oriented Technology, Introduction to Java Programming, Difference between C++ and Java, Abstraction, Encapsulation, Polymorphism, Inheritance, Data Types and Operators, Java Run-Time Environment, Running Java Application, Java Programming Editors, Control Statements- if, if-else, if-else-if ladder, switch-case statement, Looping Statements – for, while, do while.

Unit-II

Inheritance, Polymorphism and Multithreading: Visibility controls, class and methods in Java, constructors, Final keyword, Array- Single and Multidimensional, String, Vector, Inheritance and its types, Abstract Class, Interfaces and their implementation, Interface Inheritance, Polymorphism – Overloading and Overriding, Multiple inheritance in Java, Packages, Creating user-defined packages, Multithreading concept in Java.

Unit-III

Exceptions and File Handling: Exceptions in Java, try, catch and finally block, Handling user-defined errors, Study of various Exception Classes, Input and Output Streams: Streams Concept, Byte Stream Classes – FileInputStream, FileOutputStream, Character Streams Classes – FileReader, FileWriter, String TokenizerClass, Handling Primitive Data Types.

Unit-IV

GUI Programming:AWT and SWING Components – Creating a Frame, using Labels, TextFiled, Buttons, ComboBox, CheckBox, Radio Button, JOptionPane, Events and Its Types in Java, Mouse Events, Key Events, Other Events with Frame and Controls, Listeners, Creating Menus and Submenus.

Text and Reference Books:

1. E. Balagurusawamy, *Programming with Java A Primer*, McGraw Hill Education Pvt. Limited, Fifth Edition, July 2014.
2. Herbert Schildt, *The Complete Reference Java*, Tata McGraw Hill Education India, Seventh Edition, 2017.
3. Mughal K. A., Rasmussen R. W., *A Programmer's Guide to Java Certification*, Addison – Wesley, Second Edition, 2008.
4. Paul Deitel and Harvey Deital, *Java – How to Program*, Pearson Education, Eleventh Edition, 2017.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **List** object-oriented characteristics peculiar to JAVA programming. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Describe** object-oriented principles and paradigms implemented by Java programming language. (LOTS: Level 2: Understand)	3	2	-	2	-	-	-	-
CO3. **Apply** object-oriented principles for solving problems using JAVA. (LOTS: Level 3: Apply)	3	3	1	3	-	-	-	-
CO4. **Identify** classes, interfaces methods, hierarchy in the classes for a given programming problem in JAVA. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	2	-
CO5. **Design** Graphical User Interface applications and Web based applications in Java by importing applet, AWT and SWING packages. (HOTS: Level 6: Create)	3	-	2	3	-	2	2	2
Attainment Levels of COs								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-14 Software Engineering

General Course Information

Course Code: MCA-14 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Prerequisite: Basic Programming Skills and Innovative assessment.

About the Course:

This course of Software Engineering will help the learners to understand the systematic approach of all software development phases, i.e., from initial stage to final stage of software systems. Learners will gain knowledge about the various processes used in software industry for the development of software product. The learners will delve into testing methods and tools for creating good test cases to improve the overall quality of software.

Course Outcomes: By the end of the course students will be able to:

CO1. **Define** the terminology and concepts related to software engineering and the stages of Software Development Life Cycle. (LOTS: Level 1: Remember)
CO2. **Demonstrate** the selection of Software Process Models as per the requirements and to assess the various processes of requirement analysis for software engineering problems. (LOTS: Level 2: Understand)
CO3. **Apply** the software requirement analysis and design process to model the system as per the requirements (LOTS: Level 3: Apply)
CO4. **Investigate** software development processes and testing techniques for software engineering problems. (HOTS: Level 4: Evaluate)
CO5. **Judge** software quality based on software quality metrics. (HOTS: Level 5: Evaluate)

Course Content

Unit-I

Introduction to Software Engineering: Evolution of Software Engineering, Software Crisis, Types of Software Products, Software Development Life Cycle Phases. Validation and Verification, Software Characteristics, Software Engineering Paradigms: Classical Waterfall Model, Iterative Waterfall Model, Prototyping Model, Evolutionary Model, Spiral Model, Selection of Life Cycle Model.
Software Project Management: Software Project Management Plan (SPMP), Metrics for Project Size estimation- Lines of Code, Function Point Metric, Software Cost estimation - COCOMO, Project Scheduling, Personnel Planning , Organization and Team Structures, Software Configuration Management (SCM), Software Risks, Software Risk Management.

Unit-II

Software Requirements: Functional and non-functional Requirements, User and interface requirements, Software Requirement Specification (SRS), Requirement Engineering Process.

Problem Analysis: Structured Analysis, Data Flow Diagrams (DFD), Decision Tables, Decision Trees, Data Dictionary, Structured Charts, Object Oriented Analysis, System Models: Context Models, Data Modelling, Behavioural Modelling, Object Models, Structured Models.
Software Design: Software Design Fundamentals, Design Principles, Function-Oriented Software Design, Object Oriented Design.
Characteristics of good user interface, Coding Standards and guidelines, Code Review.

Unit-III

Software Testing: Software Testing Basics, Necessity and Objectives of Testing, Difference between Inspection and Testing, Testing vs. Debugging, Testing Life Cycle, Test Artifacts, Test Plan, Test Case Design, Software Testing Strategies, The V-Model of Software Testing, Levels of Software Testing- Unit Testing, Integration Testing-Top down Integration Testing and Bottom-up Integration Testing, Regression Testing, Smoke Testing, System Testing- Recovery Testing, Security Testing, Stress Testing, Performance Testing, Acceptance Testing- Alpha Testing, Beta Testing, Gamma Testing, Software Test Report (STR), Software Testing Tools, Static and Dynamic Testing tools.
Computer Aided Software Engineering (CASE): CASE Environment, advantages of CASE, CASE support in Software Life Cycle, Characteristics of CASE tools.

Unit-IV

Software Testing Methods: Black Box Testing Methods: Equivalence class partitioning, Boundary-value analysis, Error guessing, graph- based testing methods, White Box Testing Methods: Statement coverage, Condition coverage, Path testing, Data flow testing. Object Oriented Testing, Web Testing, GUI testing.
Software Quality: Software Quality Concepts, ISO 9126 Quality Factors, McCall's Quality Factors, Software Quality Assurance (SQA) Activities, Software Reviews-Walkthroughs, Formal Technical Review (FTR), Defect Amplification Model, ISO 9000 series Quality Standards, Capability Maturity Model (CMM), Software Reliability.

T**ext and Reference Books:**

1. Rajib Mall, *Fundamentals of Software Engineering*, PHI Learning Pvt. Ltd., Fourth Edition, 2014
2. K. K. Aggarwal & Yogesh Singh, *Software Engineering Programs Documentation Operating Procedures*, A New Age International Publishers, Third Edition, 2007.
3. Pankaj Jalote, *An Integrated Approach to Software Engineering*, Narosa Publications, Third Edition, 2007.
4. Roger S. Pressman, *Software Engineering A Practitioner's Approach*, McGraw Hill International Edition, Seventh Edition, 2009.
5. M. G. Limaye, *Software Testing: Principles, Techniques and Tools*, TMH, 2009.
6. Renu Rajani & Pradeep Oak, *Software Testing Effective Methods Tools, and Techniques*, McGraw Hill Education Pvt. Limited, Second Edition, 2018.
7. Nina S. Godbole, *Software Quality Assurance Principles and Practice*, Narosa Publications, Second Edition, 2017.
8. Yogesh Singh, *Software Testing*, Cambridge University Press, 2016.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Define** the terminology and concepts related to software engineering and the stages of Software Development Life Cycle. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Demonstrate** the selection of Software Process Models as per the requirements and to assess the various processes of requirement analysis for software engineering problems. (LOTS: Level 2: Understand)	2	3	-	2	-	-	-	-
CO3. **Apply** the software requirement analysis and design process to model the system as per the requirements (LOTS: Level 3: Apply)	3	3	1	2	-	-	-	-
CO4. **Investigate** software development processes and testing techniques for software engineering problems. (HOTS: Level 4: Evaluate)	-	3	-	3	-	-	2	-
CO5. **Judge** software quality based on software quality metrics. (HOTS: Level 5: Evaluate)	-	3	1	2	-	-	2	-
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-15 Computer Networks and Internet Protocols

General Course Information

Course Code: MCA-15 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Prerequisite: Basic knowledge of Digital and Analog Communication.

About the Course:
This course aims to provide students with an overview of the concepts and fundamentals of data communication and computer networks. The learner is given an opportunity to grasp various algorithms for routing of data, forwarding data and switching the data from hop to hop. Layered Architecture adds value to the subject contents.

Course Outcomes: By the end of the course students will be able to:

CO1. **Recall** various models, topologies and devices of Computer Networks. (LOTS: Level 1: Remember)
CO2. **Explain** the functions of various layers in Network Reference Model. (LOTS: Level 2: Understand)
CO3. **Apply** different network concepts in various network communication protocols. (LOTS: Level 3: Apply)
CO4. **Analyse** performance of various protocols in different scenarios. (HOTS: Level 4: Analyse)
CO5. **Compare and Contrast** various networking solutions for given networking problems. (LOTS: Level 5: Evaluate)

Course Content

Unit-I

Data communication: Components. Network: Uses, Topologies, Network Services, OSI and TCP/IP Reference Models; Network categories: LAN, MAN, WAN; Guided Transmission Media, Wireless Transmission Media, Switching Techniques: Circuit Switching, Packet Switching, Message Switching, Networking Devices: Hubs, Repeaters, Bridges, Modems, Switches, Routers, and Gateways.

Unit-II

Data Link Layer-design issues, Framing & Error Handling: Framing Protocols, Error detection and correction mechanisms; Flow Control Protocols: Stop-and-wait, Sliding Window protocols: Go-back-N and Selective Repeat.
Medium Access sub layer: Channel allocation methods, Multiple Access Communication: Random Access-ALOHA, Slotted-ALOHA, CSMA, CSMA-CD, LAN Standards: Ethernet, Fast Ethernet & Gigabit Ethernet.

Unit-III

Network Layer-Design issues, store and forward packet switching connection less and connection oriented networks, Routing algorithms: optimality principle, shortest path, flooding, Distance Vector Routing, Count to Infinity Problem, Link State Routing, Hierarchical Routing, Congestion control algorithms, admission

control. Internetworking: IPV4 and IPV6, IP Addressing (Classful Addressing, Private IP Addresses, Classless Addressing, Sub-netting).

Unit-IV

Transport Layer: Transport layer Services: Addressing, Multiplexing, Flow control, Buffering. Internet Transport Protocols: UDP& TCP. TCP Segmentation & TCP Connection management.
Application Layer: Introduction to DNS, HTTP, SMTP, Electronic Mail, WWW

Text and Reference Books:

1. Andrew S Tanenbaum, *Computer Networks*, Pearson publications, Fifth Edition, 2010.
2. Forouzan, *Data Communication and networking*, Tata McGraw-Hill, Fifth Edition, 2012.
3. William Stalling, *Data & Computer Communication*, LPE Pearson Education, Eighth edition, 2013.
4. Todd Lammle, *CCNA Study Guide*, Sixth Edition, 2013.
5. *RFCs and Internet Drafts available from Internet Engineering Task Force*.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Recall** various models, topologies and devices of Computer Networks. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Explain** the functions of various layers in Network Reference Model. (LOTS: Level 2: Understand)	3	2	-	2	-	-	-	-
CO3. **Apply** different network concepts in various network communication protocols. (LOTS: Level 3: Apply)	3	2	1	3	-	-	-	-
CO4. **Analyse** performance of various protocols in different scenarios. (HOTS: Level 4: Analyse)	-	3	-	3	-	-	1	-
CO5. **Compare and contrast** various networking solutions for given networking problems. (LOTS: Level 5: Evaluate)	-	3	2	2	-	-	1	-
Level of Attainment								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-16 Database Management System Lab.

General Course Information

Course Code: MCA-16 Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Exposure to a programming language, MS Access.

About the Course:
This lab. course on DBMS involves a rigorous training on Oracle programming. It provides a strong formal

foundation in database concepts, technologies and practices to the students to groom them as well-informed database application developers. The objective of the lab. course is to develop proficiency in the execution of commands of the database design and query using Oracle.

Course Outcomes: By the end of the course students will be able to:

CO1. **Implement** database problems using Oracle DML/DDL commands. (LOTS: Level 3: Apply)
CO2. **Enforce** integrity constraints on a database using a state-of-the-art RDBMS. (LOTS: Level 3: Apply)
CO3. **Analyse** the design of a relational database. (HOTS: Level 4: Analyse)
CO4. **Design** a relational database for a given schema. (HOTS: Level 6: Create)
CO5. **Create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create)
CO6. **Demonstrate** ethical practices, self-learning and team spirit.

List of experiments/assignments:

1. Use oracle software and login with valid userid and password. Explore its GUI and practice some basic commands of it.
2. Three assignments related to creation of database with tables having different fields and data types.
3. Two assignments on the creation of table with different types of constraints.
4. Two assignments on insert, delete and modify records from the tables.
5. Two assignments on modifying the table using the alter command.
6. Two assignments on exploring select statement using various clauses like where, order by, group by, having and aggregate functions.
7. Two assignments on the use of set operations to query the tables.
8. Two assignments on creating joins and views on the tables.
9. One assignment on generating sub-queries.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Implement** database problems using Oracle DML/DDL commands. (LOTS: Level 3: Apply)	3	-	-	3	-	-	-	-
CO2. **Enforce** integrity constraints on a database using a state-of-the-art RDBMS. (LOTS: Level 3: Apply)	3	-	-	3	-	-	2	-
CO3. **Analyse** the design of a relational database. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	-	-
CO4. **Design** a relational database for a given schema. (HOTS: Level 6: Create)	3	-	2	3	-	2	2	2
CO5. **Create** lab assignment record that includes problem definitions, solutions, results and conclusions. (HOTS: Level 6: Create)	-	-	-	-	2	2	-	1
CO6. **Demonstrate** ethical practices, self-learning and team spirit.	-	-	-	-	3	-	3	-
Level of Attainments								

*Attainment Levels:
- None
1: Low, 2: Medium, 3: High

MCA-17 Web Designing Lab.

General Course Information

Course Code: MCA-17 Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

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Pre-requisites: Basic programming skills and knowledge of surfing internet.

About the Course:

This lab. course on web development involves learning web-based programming languages. It incorporates

the development of web pages by structuring information provided for the website design. The objective of the lab course is to equip the students to design web pages using modern web development tools.

Course Outcomes: By the end of the course students will be able to:

CO1. **Implement** object models for website design using modern tools like HTML, XMLand JAVA scripting etc. (LOTS: Level 3: Apply)
CO2. **Analyse** the design of websites. (HOTS: Level 4: Analyse)
CO3. **Test** the design of websites. (HOTS: Level 5: Evaluate)
CO4. **Design** efficient and elegant websites that consider socio-cultural values. (HOTS: Level 6: Create)
CO5. **Create** a written report for website designed. (HOTS: Level 6: Create)
CO6. **Use** ethical practices and socio-cultural values while designing websites. (LOTS: Level 3: Apply)

List of experiments/assignments

1. Create a simple webpage using HTML.
2. Designing of registration form with table and use of hyperlink.
3. Design a page with frames to include Images and Videos.
4. Add a cascading style sheet for designing the web page.
5. Use user defined function to get array of values and sort them in ascending order on webpage
6. Design a dynamic web page with validation of form field using Java Script.
7. Design a catalogue in ASP.
8. Event Handling Validation of registration form.
9. Open a Window from the current window on Mouse Over event.
10. Create a simple application to demonstrate Servlets Request and Response object.
11. Demonstrate Array Objects and Date Object's predefined methods
12. Display calendar for the month and year selected from combo box
13. Create a welcome Cookie (Hit for a page) and display different image and text content each time when the user hit the page.
14. Demonstrate Request and Response object using HTML Form.
15. Database Connection to display all the values in the table.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Implement** object models for website design using modern tools like HTML, XML and JAVA scripting etc. (LOTS: Level 3: Apply)	3	-	-	3	-	-	-	-
CO2. **Analyse** the design of websites. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	-	-
CO3. **Test** the design of websites. (HOTS: Level 5: Evaluate)	-	2	-	2	-	-	2	-
CO4. **Design** efficient and elegant websites that consider socio-cultural values. (HOTS: Level 6: Create)	3	-	3	3	-	2	3	2
CO5. **Create** a written report for website designed. (HOTS: Level 6: Create)	-	-	-	-	2	2	-	1
CO6. **Use** ethical practices values while designing websites. (LOTS: Level 3: Apply)	-	-	-	-	2	-	3	-
Level of Attainments								

*Attainment Levels:
- None
1: Low, 2: Medium, 3: High

MCA-18 Java Programming Lab.

General Course Information

Course Code: MCA-18 Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Knowledge of Object-Oriented Concepts and programming.

About the Course:

This Java course will provide a strong understanding of basic Java programming elements and data abstraction using problem representation and the object-oriented framework. The objective of the lab. course is to inculcate proficiency to design and develop market-based software applications.

Course Outcomes: By the end of the course students will be able to:

CO1. **Implement** Java programs using object oriented concepts for problem solving. (LOTS: Level 3: Apply)
CO2. **Detect** syntax and logical errors in java programs (HOTS: Level 4: Analyse)
CO3. **Apply** exception handling for making robust JAVA code. (HOTS: Level 3: Apply)
CO4. **Design** java applications using File I/O and GUI. (HOTS: Level 6: Create)
CO5. **Create** lab record of the solutions of assignments that includes problem definitions, solutions and conclusions. (HOTS: Level 6: Create)
CO6. **Demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of experiments/assignments:

1. Use eclipse or NetBeans platform and acquaint with the various menus, create a test project, add a test class and run it to see how you can use auto suggestions and auto fill functionalities. Try code formatter and code refactoring like renaming variables, methods and classes. Try debug step by step with a small program of about 10 to 15 lines which contains at least one if else condition and a for loop.
2. Two assignments illustrating class, objects, methods, arrays and various data types in java.
3. Two assignments on the use of control, looping statements and user defined functions.
4. One assignment illustrating the implementation of various forms of inheritance.
5. One assignment on method overloading.
6. One assignment on polymorphism and method overriding.
7. One assignment on implementing exception handling.
8. One assignment to illustrate interfaces in java.
9. One assignment to create package in java.
10. One assignment to design of multithreaded programs in java.
11. One new assignment on event handling.
12. Two assignments related to java applets.
13. One assignment to design a GUI application.
14. One assignment to access and update data from a database using JDBC.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Implement** Java programs using object-oriented concepts for problem solving. (LOTS: Level 3: Apply)	3	2	-	3	-	-	-	-
CO2. **Detect** syntax and logical errors in java programs (HOTS: Level 4: Analyse)	-	3	-	2	-	-	-	-
CO3. **Apply** exception handling for making robust JAVA code. (HOTS: Level 3: Apply)	3	-	-	3	-	-	1	-
CO4. **Design** java applications using File I/O and GUI. (HOTS: Level 6: Create)	3	-	2	3	-	2	2	2
CO5. **Create** lab record of the solutions of assignments that includes problem definitions, solutions and conclusions. (HOTS: Level 6: Create)	-	-	-	-	2	2	-	1
CO6. **Demonstrate** ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)	-	-	-	-	3	-	3	-
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-21 Data Structures and Algorithms

General Course Information:

Course Code: MCA-21 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Prerequisite: Elementary Programming skills in C, C++ etc.

About the Course

Data Structure and Algorithms is a core and an essential course for every graduate in Computer Science and Engineering. This course introduces data structures like arrays, linked lists, trees and graphs etc. and various operations to be implemented on these data structures for solving real world problems. It includes various sorting and searching algorithms as well. Further, it incorporates complexity analysis of algorithms implemented on various data structures.

Course Outcomes: By the end of the course students will be able to:

CO1. **Describe** various types of data structures and operations that can be implemented on these data structures. (LOTS: Level 1: Remember)
CO2. **Demonstrate** the use of various data structures and their related operations. (LOTS: Level 2: Understand)
CO3. **Apply** data structure to solve computational problems. (LOTS: Level 3: Apply)
CO4. **Compare** the suitability of alternative data structures and prescribed operations for various computational situations. (HOTS: Level 4: Analyse)
CO5. **Defend** solutions with respect to effective storage of data and efficiency of the required operations for solving real world problems. (HOTS: Level 5: Evaluate)

Course Content

Unit-I

Data Structures Basics: Structure and Problem Solving, Data Structures and Their Types, Data structure operations, Abstract Data Types.
Linear lists: Arrays and linked lists: memory representations, implementing operations like traversing, searching, inserting and deleting etc., types of arrays and linked lists, Applications of arrays and linked lists.

Unit-II

Stack and Queue: Introduction, sequential and linked implementations, Operations and representative applications, Circular queues, De-queue, Priority Queues, Applications of Queues.
Application of stacks: Infix to postfix Transformation, Evaluating Arithmetic Expressions.
Trees: Binary Trees, terminology, representation and traversals- pre, post & in-order traversals. Binary Search Trees implementation and operations.

Unit-III

Heapsort - Heaps, Maintaining the heap property, Building a heap, heapsort algorithm
Advanced tree data structures such as Height Balanced or AVL trees, Multiway Trees or B Trees, red and black trees, splay trees.
Graphs: Graph definitions and related terminology, memory representations for graphs and associated algorithms for searching, inserting and deleting nodes and related algorithms, Graph traversals and applications (DFS, BFS). Shortest path algorithms: Dijkstra's and Warshall's algorithms.

Unit-IV

Sequential and Binary search, Sorting algorithms: Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort, Internal and external sorting and stable sorting techniques.
Hash Tables - Direct-address tables, Hash tables, Hash functions, Open addressing, Perfect hashing.
Algorithm: Role of Algorithms in Computing, Analyzing and Designing Algorithms, Time- space tradeoffs, asymptotic notations, Standard notations.
Comparison of searching and sorting techniques based on their complexity analysis,

T**ext and Reference Books:**

1. Aho, A. V., Ullman, J. D., and Hopcroft, J. E., *Data Structures and Algorithms*, Addison-Wesley, 1983.
2. LangsamYedidyah, Augenstein J Moshe, Tenenbaum M Aaron, *Data Structures using C and C++*, Third Edition, PHI, 2015.
3. Cormen, T. H., Leiserson, C. E., Rivest, R. L. and Stein, C., *Introduction to Algorithms, MIT Press*, Fourth Edition,2022.
4. Weiss, M. A., *Data Structures and Algorithm Analysis in C++*, Addison-Wesley, 2007.
5. Sahni, S., *Data Structures, Algorithms, and Applications in C++*, WCB/McGraw-Hill, Second Edition, 2004.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Describe** various types of data structures and operations that can be implemented on these data structures. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Demonstrate** the use of various data structures and their related operations. (LOTS: Level 2: Understand)	3	2	-	2	-	-	-	-
CO3. **Apply** data structure to solve computational problems. (LOTS: Level 3: Apply)	3	3	1	3	-	-	-	-
CO4. **Compare** the suitability of alternative data structures and prescribed operations for various computational situations. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	1	-
CO5. **Defend** solutions with respect to effective storage of data and efficiency of the required operations for solving real world problems. (HOTS: Level 5: Evaluate)	-	3	2	-	-	-	2	-
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-22 Python Programming

General Course Information

Course Code: MCA-22 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisite: Exposure to any programming language

About the Course:

Python is a popular open source programming language used for standalone programs as well as scripting applications in a wide variety of domains. It is free, portable, and extremely powerful for data analytics and machine learning applications. This course covers most of the basic concepts for python programming. Some of the contents are advanced that may be useful for data analytics and machine learning purposes.

Course Outcomes: By the end of the course students will be able to:

CO1. **Outline** various basic programming constructs including operators, character sets, basic data types and control statements. (LOTS: level 1: Understand)
CO2. **Explain** Python packages and their functionalities for data analysis. (LOTS: level 2: Understand)
CO3. **Solve** problems using python programming. (LOTS: level 3: Apply)
CO4. **Analyse** the results of data analysis or machine learning programs (HOTS: level 4: Analyse)
CO5. **Evaluate** solutions according to the problem definition. (HOTS: level 5: Evaluate)
CO6. **Develop** database applications in Python. (HOTS: level 6: Create).

Course Content

Unit-I

Introduction to Python, History of Python, Features of Python, Python Identifiers, Python Character Set, Keywords and Indentation, Comments, Command Line Arguments, Assignment Operator, Operators and Expressions, print() Function, input() Function, eval() Function, Python Data Types: int, float, complex, Variables, Mutable vs Immutable variables, Namespaces, Decision Statements: Boolean Type, Boolean Operators, if statement, else statement, Nested Conditionals Statements, Multi-way Decision Statements (else- if statement).

Unit-II

Loop Control Statements: While loop, range() Function, For Loop, Nested Loops, Infinite Loop, Break Statement, Continue Statement, Pass Statement, Introduction to Strings, String Operations: Indexing and Slicing, Lists: Operations on List: Slicing, In-built Functions for Lists, List Processing: Searching and Sorting, Dictionaries: Need of Dictionary, Operations on Directories: Creation, Addition, Retrieving Values, Deletion; Tuples, operations on Tuples, Inbuilt Functions for Tuples, Introduction to Sets, operations onsets.

Python Functions, Inbuilt functions, Main function, User Defined functions, Defining and Calling Function, Parameter Passing, Actual and Formal Parameters, Default Parameters, Global and Local Variables, Recursion, Passing Functions as Data, Lamda Function, Modules, Importing Own Module, Packages.

Unit-III

Operations on File: Reading text files, read functions, read(), readline() and readlines(), writing Text Files, write functions, write() and writelines(),Manipulating file pointer using seek, Appending to Files.
Python Object Oriented: Overview of OOP, Classes and objects, Accessing attributes, Built-in Class Attributes, Methods, Class and Instance Variables, Destroying Objects, Polymorphism, Overlapping and Overloading of Operators, Class Inheritance: super(), Method Overriding, Exception Handling, Try-except-else clause, Python Standard Exceptions, User-Defined Exceptions

Unit-IV

Databases in Python: Create Database Connection, create, insert, read, update and delete Operation, DML and DDL Operation with Databases.
Python for Data Analysis: numpy: Creating arrays, Using arrays and Scalars, Indexing Arrays, Array Transposition, Universal Array Function, Array Processing, Array Input and Output
Pandas: Series, Data Frame, Panel, Index objects, Re-indexing, Iteration, Sorting. Matplotlib: Python for Data Visualization, Visualization Section, Sklearn: loading of dataset, learning and predicting, Model Persistence.

Text and Reference Books:

1. Ashok Namdev Kamthane, *Programming and Problem Solving with Python*, McGraw Hill Education Publication, Second Edition, 2020.
2. John Guttag, *Introduction to Computation and Programming using Python*, Springer, Revised and Expanded version (Referred by MIT), Second Edition, 2016.
3. Lutz, M., *Learning Python: Powerful Object-Oriented Programming.* O'Reilly Media, Inc., 2013.
4. Michael T Goodrich and Robertto. Thamassia, *Micheal S Goldwasser, Data Structures and Algorithms in Python*, Wiley, Fifth Edition, 2016.
5. Y. Daniel Liang, *Introduction to Programming Using Python*, Pearson, 2021.
6. Reema Thareja, *Python Programming Using Problem Solving Approach*, Oxford Publications, 2017.
7. Dr. R. Nageswara Rao, Allen B. Downey, *Core Python Programming, Think Python*, O'Reilly Media, 2017.
8. Kenneth A. Lambert, *The Fundamentals of Python: First Programs*, Cengage Learning, Second Edition, 2018.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Outline** various basic programming constructs including operators, character sets, basic data types and control statements. (LOTS: level 1: Understand)	3	-	-	-	-	-	-	1
CO2. **Explain** Python packages and their functionalities for data analysis. (LOTS: level 2: Understand)	2	2	-	2	-	-	-	-
CO3. **Solve** problems using python programming. (LOTS: level 3: Apply)	3	3	1	3	-	-	-	-
CO4. **Analyse** the results of data analysis or machine learning programs (HOTS: level 4: Analyse)	-	3	1	2	-	-	-	-
CO5. **Evaluate** solutions according to the problem definition. (HOTS: level 5: Evaluate)	-	3	-	-	-	-	1	-
CO6. **Develop** database applications in Python. (HOTS: level 6: Create).	3	-	2	3	-	2	2	2
Level of Attainments								

*Attainment Levels:
- None
1: Low, 2: Medium, 3: High

MCA-23 Artificial Intelligence

General Course Information:

Course Code: MCA-23 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Prerequisite Strong foundation in computer science fundamentals and basics Mathematical skills in the domain of Linear Algebra, Calculus and Statistics .

About the Course:

This Artificial Intelligence course provides a comprehensive overview of AI concepts and techniques covering problem-solving strategies, knowledge representation, reasoning under uncertainty, planning, and natural language processing. Students will gain a deep understanding of AI fundamentals and practical applications in various domains.

Course Outcomes: By the end of the course students will be able to:

CO1. **Outline** various Artificial Intelligence basic concepts and techniques. (LOTS: Level 1: Remember)
CO2. **Illustrate** reasoning under uncertainty. (LOTS: Level 2: Understand)
CO3. **Apply** search and knowledge representation techniques to solve AI problems.(LOTS: Level 3: Apply)
CO4. **Compare** various Artificial Intelligence techniques and algorithms (HOTS: Level 4: Analyse).
CO5. **Combine** various Artificial Intelligence techniques to solve intelligent systems' problems. (HOTS: Level 6: Create)

Course Content

Unit-I

Introduction to AI: Introduction, AI problems, AI Techniques, State Space Search, production systems
Problem Solving Using Search: Blind search techniques - Breadth first search, Depth first search. Heuristic search techniques - Generate and test, Hill Climbing, Best first search, A* Algorithm, AO* Algorithm, Constraint Satisfaction, The Minimax Search Procedure, Adding Alpha-Beta Pruning.

Unit-II

Knowledge Representation: Introduction, Knowledge Representation- Representation and Mappings, Symbolic Logic - Propositional logic, Predicate logic- Representing simple facts in logic, Representing Instances and ISA Relationship, Computable functions and Predicates, Unification, Resolution.
Representing Knowledge Using Rules: Procedural versus Declarative Knowledge, Logic Programming, Forward versus Backward Reasoning, Matching, Control Knowledge.

Unit-III

Reasoning Under Uncertainty: Introduction to Nonmonotonic Reasoning, Probability and Baye's Theorem, Certainty Factors and Rule-based Systems, Bayesian Networks.
Fuzzy logic systems: Introduction, Crisp Set, Fuzzy Sets, Fuzzy Logic Control.

Unit-I

Planning: Introduction, Components of Planning System, Goal Stack Planning, Nonlinear Planning using Constraint Posting, Hierarchical Planning.
Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing.

Text and Reference Books:

1. Elaine Rich, Kevin Knight and Shivashankar B Nair, *Artificial intelligence*, McGraw Hill Education. Third Edition, 2017.
2. Stuart Russel and Peter Norvig, *Artificial intelligence: A modern Approach*, Pearson Education, Third Edition, 2015.
3. Dan W. Patterson, *Introduction to Artificial Intelligence and Expert System*, Pearson Education, 2016.
4. Deepak Khemani, *A first course in Artificial Intelligence*, McGraw Hill Education.Third Edition, 2013.
5. George F. Luger, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, Pearson Education, Sixth Edition, 2021.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Outline** various Artificial Intelligence basic concepts and techniques. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Illustrate** reasoning under uncertainty. (LOTS: Level 2: Understand)	2	3	-	2	-	-	-	-
CO3. **Apply** search and knowledge representation techniques to solve AI problems.(LOTS: Level 3: Apply)	3	3	1	3	-	-	-	-
CO4. **Compare** various Artificial Intelligence techniques and algorithms (HOTS: Level 4: Analyse).	-	3	-	2	-	-	1	-
CO5. **Combine** various Artificial Intelligence techniques to solve intelligent systems' problems. (HOTS: Level 6: Create)	3	-	3	3	-	2	2	2
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-24 Computer System Architecture

General Course Information

Course Code: MCA-24 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisites: Basic Computer System and Digital Electronics

About the Course:

The course delves into the foundational principles of digital systems and computer organization. It covers topics such as logic gates, sequential and combinational logic, CPU architecture, instruction sets, parallelism, memory hierarchy, and I/O techniques. Students will gain a deep understanding of computer architecture, its components, and the principles governing efficient data processing.

Course Outcomes: By the end of the course students will be able to:

CO1. **Outline** the basic terminology and concepts of computer architecture. (LOTS: Level 1: Remember)
CO2. **Explain** the basic components of computing systems and their interfacing. (LOTS: Level 2: Understand)
CO3. **Solve** problems pertaining to architecture of computer systems. (LOTS: Level 3: Apply)
CO4. **Analyse** the functioning of sequential logic elements, such as flip-flops and registers, in terms of their role in data storage and processing within computer systems. (HOTS: Level 4: Analyse)
CO5. **Contrast** different types of memory, their architecture and access methods. (HOTS: Level 5: Evaluate)
CO6. **Design** memory hierarchy systems, considering the principles of locality of reference, and assess the role of cache, main memory, and secondary memory in computer systems . (HOTS: Level 6: Create)

Course Content

Unit-I

Basic Principles: Boolean algebra and Logic gates, Combinational logic blocks (Adders, Subtractors, Multiplexers, Encoders, decoders, de-multiplexers, K-Maps), Sequential logic blocks (Flip-Flops, Registers, Counters); Flynn's classification of computers (SISD, MISD, MIMD); Performance metrics: MIPS, MFLOPS; CPU Architecture types: computer register, (accumulator, register, stack, memory/ register) detailed data path of a typical register based CPU.

Unit-II

Computer Organization: Store program control concept, Instruction codes, timing and control, instruction cycle; type of instructions: memory reference, register reference, I/O reference; Basics of Logic Design, accumulator logic, Control memory; Micro Programmed Control: address sequencing, micro-instruction formats, micro-program sequencer, Implementation of control unit.

Unit-III

Instruction Set Architecture & Parallelism: Instruction set based classification of processors (RISC, CISC, and their comparison); Stack Organization, Instruction Formats; addressing modes: register, immediate, direct, indirect, indexed; Operations in the instruction set: Arithmetic and Logical, Data Transfer, Control Flow; Types of interrupts; Introduction to Parallelism: Goals of parallelism (Exploitation of concurrency, throughput enhancement); Amdahl's law; Instruction level parallelism (pipelining, super scaling –basic features); Processor level parallelism (Multiprocessor systems overview).

Unit-IV

Memory Hierarchy & I/O Techniques: The need for a memory hierarchy (Locality of reference principle, Memory hierarchy in practice: Cache, main memory and secondary memory, Memory parameters: access/cycle time, cost per bit); Main memory (Semiconductor RAM & ROM organization, memory expansion, Static & dynamic memory types); Cache memory (Associative & direct mapped cache organizations; input-output interface, mode of transfer, DMA (Direct memory transfer).

Text and Reference Books:

1. Mano, M. Morris, *Digital Logic and Computer Design*, Prentice Hall of India Pvt. Ltd., Sixth Edition, 2018.
2. M. Morris Mano, *Computer System Architecture*, Prentice Hall of India Pvt. Ltd., Third Edition, 2017.
3. Milles J. Murdocca, Vincent P. Heuring, *Computer Architecture and Organization*, An Integrated Approach, John Wiley& Sons Inc., 2007.
4. William Stallings, *Computer Organization and Architecture*, Tenth Edition Prentice Hall, 2016.
5. Heuring, V. P., Jordan, H.F., *Computer Systems Design and Architecture*, Addison Wesley, Second Edition, 2008.
6. R.P Jain, *Modern Digital Electronics*, Fourth Edition, Tata McGraw Hill, 2009.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Outline** the basic terminology and concepts of computer architecture. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Explain** the basic components of computing systems and their interfacing. (LOTS: Level 2: Understand)	3	2	-	2	-	-	-	-
CO3. **Solve** problems pertaining to architecture of computer systems. (LOTS: Level 3: Apply)	3	3	-	3	-	-	-	-
CO4. **Analyse** the functioning of sequential logic elements, such as flip-flops and registers, in terms of their role in data storage and processing within computer systems. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	1	-
CO5. **Contrast** different types of memory, their architecture and access methods. (HOTS: Level 5: Evaluate)	-	3	-	2	-	-	1	-
CO6. **Design** memory hierarchy systems, considering the principles of locality of reference, and assess the role of cache, main memory, and secondary memory in computer systems . (HOTS: Level 6: Create)	3	-	2	3	-	2	2	2
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-25 Discrete Mathematics and Optimization

General Course Information:

Course Code: MCA-25 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Prerequisite: Basic knowledge of Pre-calculus and Algebra.

About the Course:

The purpose of this course is to understand and use discrete structures that are backbones of computer science. This course is designed to equip the students with set theory, algebraic structures, graph theory and optimisation techniques. On the completion of this course, the students will be able to apply the basic methods of discrete mathematics in computer science applications.

Course Outcomes: By the end of the course students will be able to:

CO1. **Outline** various discrete structures and the related operations. (LOTS: Level 1: Remember)
CO2. **Illustrate** different discrete structures with the help of examples. (LOTS: Level 2: Understand)
CO3. **Apply** appropriate techniques to solve problems related to discrete structures. (LOTS: Level 3: Apply)
CO4. **Justify** the solutions with the help of proofs. (HOTS: Level 5: Evaluate)
CO5. **Synthesise** diverse techniques related to discrete structures and optimization for solving real world problems and profitable solution for industries. (HOTS: Level 6: Create)

Course Content

Unit-1

Set Theory: Introduction to Set Theory, Venn Diagrams, Set Operations, Algebra of Sets, Duality, Finite, Infinite Sets and Counting Principle, Classes of Sets, Power Sets, Partitions, Multi Sets, Relations: Cartesian Product, Representation of Relations, Types of Relation, Equivalence Relations, Functions: Definition, Types of Functions, Composition of Functions, Inverse Function, Posets.

Unit-II

Logic and Propositional Calculus: Introduction, Propositions and Compound Propositions, Basic Logical Operations, Propositions and Truth Tables, Tautologies and Contradictions, Logical Equivalence, Algebra of Propositions, Conditional and Bi-conditional Statements, Algebraic Structures: Group Axioms, Monoid, Semi-Groups, Subgroups, Abelian Group, Cosets, Normal Subgroup, Cyclic Group, Lagrange's Theorem.

Unit-III

Graphs Theory: Introduction to Graphs, Multi Graph, Directed and Undirected Graphs, Subgraphs, Bipartite Graphs, Regular Graphs, Connected Graphs, Homomorphic and Isomorphic Graphs, Cut points and Bridges, Paths and Circuits, Euler Graph, Hamiltonian Graph, Planar Graph, Euler Formula, Weighted Graphs,

Dijkstra's Shortest Path Algorithm for Weighted Graphs, Trees, Spanning Trees, Minimum Spanning Tree (Prim's and Kruskal's Algorithm).

Unit-IV

Introduction to Optimization Techniques, Origin & Development of O.R., Nature & Characteristic features of O.R., Models & Modeling in Operation Research. Methodology of O.R. Linear Programming : Formulation, Graphical solution, standard and matrix forms of linear programming problems, Simplex method and its flow chart, Two phase Simplex method, Degeneracy.

Text and Reference Books:

1. S. Lipschutz and M. Lipson, *Discrete Mathematics*, Tata McGraw Hill, Third Edition, 2017.
2. C. L. Liu, *Elements of Discrete Mathematics*, Tata McGraw Hill, Fourth Edition, 2017.
3. Kenneth H. Rosen, *Discrete Mathematics and its applications*, Seventh Edition, Tata McGraw Hill, 2017.
4. B. Kolman, R. C. Busby and S. C. Ross, *Discrete Mathematical structures*, Sixth Edition, PHI, 2015.
5. J.P. Trembley and R. Manohar, *Discrete Mathematical Structures with Applications to Computer Science*, Tata McGraw Hill – 13th reprint, 2017.
6. Sharma, S.D., *Operations Research, KedarNath and Ram Nath*, Meerut, 2014.
7. Taha, H.A., *Operation Research - An Introduction*, McMillan Publishing Co, New York, Tenth Edition, 2019.
8. Gupta P.K., Hira and D.S., *Operation Research*, Sultan Chand & Sons, New Delhi, 2015.

List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1.	**Outline** various discrete structures and the related operations. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2.	**Illustrate** different discrete structures with the help of examples. (LOTS: Level 2: Understand)	3	2	-	-	-	-	-	-
CO3.	**Apply** appropriate techniques to solve problems related to discrete structures. (LOTS: Level 3: Apply)	3	3	-	2	-	-	-	-
CO4.	**Justify** the solutions with the help of proofs. (HOTS: Level 5: Evaluate)	-	3	-	-	-	-	1	-
CO5.	**Synthesise** diverse techniques related to discrete structures and optimization for solving real world problems and profitable solution for industries. (HOTS: Level 6: Create)	3	-	3	2	-	3	2	2
	Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-26 Data Structures and Algorithms Lab.

General Course Information

Course Code: MCA-26 Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Programming in C/C++ language.

About the Course:

This lab. course involves implementation of basic and advanced data structures and various operations on these data structures. The objective of the lab. course is to train the students to solve the problems related to data structures and choose the appropriate data structure for solving computational problem efficiently.

Course Outcomes: By the end of the lab course a student would be able to:

CO1. **Implement** various data structures and the related operations. (LOTS: Levels 3: Apply)
CO2. **Analyse** space and time complexity of algorithms. (HOTS: Level 4: Analyse)
CO3. **Compare** solutions on the basis of the appropriateness of data structure used and the efficiency of the operations implemented. (HOTS: Level 5: Evaluate)
CO4. **Integrate** knowledge of data structures to solve real world problems related to data structure and algorithms. (HOTS: Level 6: Create)
CO5. **Create** written records for the given assignments with problem definition, design of solution and conclusions. (HOTS: Level 6: Create)
CO6. **Demonstrate** ethical practices while solving problems individually or in groups (LOTS: Level 3: Apply).

List of experiments/assignments

1. Two assignments related to creating and manipulating matrices and linear lists.
2. Two assignments associated with linked list, operations on linked lists and their applications.
3. Two assignments on array and linked implementation of stacks and queues.
4. Two assignments on trees and their applications.
5. Two assignments on graphs and their applications.
6. Two assignments on different searching and sorting methods with their complexity analysis.
7. One assignment on challenging problems on data structures to be given in groups.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Implement** various data structures and the related operations. (LOTS: Levels 3: Apply)	3	-	-	3	-	-	-	-
CO2. **Analyse** space and time complexity of algorithms. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	-	-
CO3. **Compare** solutions on the basis of the appropriateness of data structure used and the efficiency of the operations implemented. (HOTS: Level 5: Evaluate)	-	3	-	2	-	-	1	-
CO4. **Integrate** knowledge of data structures to solve real world problems related to data structure and algorithms. (HOTS: Level 6: Create)	3	-	2	3	-	2	2	1
CO5. **Create** written records for the given assignments with problem definition, design of solution and conclusions. (HOTS: Level 6: Create)	-	-	-	-	2	2	-	-
CO6. **Demonstrate** ethical practices while solving problems individually or in groups (LOTS: Level 3: Apply).	-	-	-	-	3	-	3	-
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-27 Python Programming Lab.

General Course Information

Course Code: MCA-27 Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic programming skills

About the Course:

Python is a scripting programming language known for both its simplicity and wide breadth of applications. For this reason, it is considered one of the best languages for beginners. Used for everything from web development to scientific computing, Python is referred to as a general purpose language by the

programming community. The major objective of Python language is to make the students solve real word problem efficiently using python library.

Course Outcomes: By the end of the course students will be able to:

CO1. **Implement** solutions to the given assignments in Python. (LOTS: Level 3: Apply)
CO2. **Use** various Python packages for solving different programming problems. (LOTS: Level 3: Apply)
CO3. **Devise** solutions for complex problems of data analysis and machine learning. (HOTS: Level 6: Create)
CO4. **Evaluate** the output of data analysis and machine learning models. (HOTS: Level 5: Evaluate)
CO5. **Create** lab records of the solutions for the given assignments. (HOTS: Level 6: Create)
CO6. **Demonstrate** use of ethical practices, self-learning and team spirit.. (LOTS: Level 3: Apply)

List of experiments/assignments

1. Install Python and explore various popular IDE like IDLE, PyCharm, and Anaconda.
2. Assignments to perform various number operations like
    a. Find maximum from a list of numbers
    b. GCD of two number
    c. Square root of a number
    d. Check number is prime or not.
    e. Print first N prime numbers
    f. Remove duplicate numbers from list
    g. Print the Fibonacci series.
3. Assignments to perform various operations on Strings like creation, deletion, concatenation.
4. Create a List L = [10, 20, 30]. Write programs to perform following operations:
    a. Insert new numbers to list L.
    b. Delete numbers from list L.
    c. Sum all numbers in list L.
    d. Sum all prime numbers in list L.
    e. Delete the list L.
5. Create a Dictionary D= {‘Name’: ‘Allen’, ‘Age’: 27, 5:123456}. Write programs to perform following operations:
    a. Insert new entry in D.
    b. Delete an entry from D.
    c. Check whether a key present in D.
    d. Update the value of a key.
    e. Clear dictionary D.
6. Two assignments on Sets to perform various operation like union, intersection, difference etc.
7. Two assignments related to searching operation like linear search, binary search.
8. Three assignments related to sorting like selection sort, bubble sort, insertion sort.
9. Demonstrate the use of dictionary for measuring student marks in five subjects and you have to find the student having maximum and minimum average marks.
10. Two assignment on usage of different available packages like random package to perform
    a. Print N random numbers ranging from 100 to500.
    b. Print 10 random strings whose length between 3 and5.
11. Two assignments on usage of package such as Numpy, Pandas.
12. Implement and demonstrate the functions of a simple calculator.
13. One assignment on implementing object oriented concept such as classes, inheritance, and polymorphism.
14. One assignment on file handling that how data is read and written to a file.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Implement** solutions to the given assignments in Python. (LOTS: Level 3: Apply)	3	-	-	3	-	-	-	-
CO2. **Use** various Python packages for solving different programming problems. (LOTS: Level 3: Apply)	3	-	-	3	-	-	-	-
CO3. **Devise** solutions for complex problems of data analysis and machine learning. (HOTS: Level 6: Create)	3	-	3	3	-	2	2	2
CO4. **Evaluate** the output of data analysis and machine learning models. (HOTS: Level 5: Evaluate)	-	3	-	2	-	-	2	-
CO5. **Create** lab records of the solutions for the given assignments. (HOTS: Level 6: Create)	-	-	-	-	2	2	-	-
CO6. **Demonstrate** use of ethical practices, self-learning and team spirit.. (LOTS: Level 3: Apply)	-	-	-	-	3	-	3	-
Level of Attainments								

*Attainment Levels:
- None
1: Low, 2: Medium, 3: High

MCA-28: Artificial Intelligence Lab.

General Course Information:

Course Code: MCA-28 Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Prerequisite

Basic knowledge of HTML, XML, ASP, JSP and Web Designing.

About the Course:

In this course, the learners will be able to develop expertise related to general purpose problem solving, Representation of knowledge, Reasoning under uncertainty, Planning and Natural Language processing

Course Outcomes: By the end of the course students will be able to:

CO1. **Implement** various Artificial Intelligence algorithms and techniques. (LOTS: Levels 3: Apply)
CO2. **Compare** solutions provided by different AI algorithms for given problems. (HOTS: Level 5: Evaluate)
CO3. **Integrate** knowledge of AI to solve complex computing problems . (HOTS: Level 6: Create)
CO4. **Create** written records for the given assignments with problem definition, design of solution and conclusions. (HOTS: Level 6: Create)
CO5. **Demonstrate** ethical practices while solving problems individually or in groups (LOTS: Level 3: Apply).

List of Experiments:

1. Write a program to implement BFS/DFS Traversal?
2. Write simple facts for the statements and querying it.
3. Write a program for Family-tree.
4. Write Program for Monkey-banana Problem.
5. Write a program to implement Tic-Tac-Toe game.
6. Write programs for computation of recursive functions like factorial Fibonacci numbers, etc.
7. Write program to solve 5-queens problem.
8. Write a Program for water jug problem.
9. Write a program for travelling salesman problem.
10. Write a program to implement all set operations.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1.	**Implement** various Artificial Intelligence algorithms and techniques. (LOTS: Levels 3: Apply)	3	-	-	3	-	-	-	-
CO2.	**Compare** solutions provided by different AI algorithms for given problems. (HOTS: Level 5: Evaluate)	-	3	-	2	-	-	2	-
CO3.	**Integrate** knowledge of AI to solve complex computing problems . (HOTS: Level 6: Create)	3	-	3	3	-	2	2	2
CO4.	**Create** written records for the given assignments with problem definition, design of solution and conclusions. (HOTS: Level 6: Create)	-	-	-	-	2	2	-	-
CO5.	**Demonstrate** ethical practices while solving problems individually or in groups (LOTS: Level 3: Apply)	-	-	-	-	3	-	3	-
	Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-31: Machine Learning

General Course Information:

Course Code: MCA-31 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of Linear algebra, Statistics, Probability and Data handling

About the Course:

Machine learning is the study of computer algorithms that improve their performance through experience. Machine learning draws its conceptual foundation from the fields like artificial intelligence, probability and statistics, computational complexity, cognitive science, biology, and information theory etc. The course introduces some of the key machine learning algorithms and the theory that form the backbone of these algorithms. The examples of such algorithms are classification algorithms for learning patterns from data, clustering algorithms for grouping objects based on similarity, neural network algorithms for pattern recognition, genetic algorithms for searching large and complex search spaces etc.

Course Outcomes: By the end of the course students will be able to:

CO1. **Define** mathematical, statistical and machine learning terminology and concepts. (LOTS: Level 1: Remember)
CO2. **Illustrate** the understanding of supervised and unsupervised machine learning algorithms (LOTS: Level 2: Understand)
CO3. **Apply** machine learning algorithms to solve problems pertaining to discovery of regularities and patterns. (LOTS: Level 3: Apply)
CO4. **Compare** the performance of different machine learning algorithms based on evaluation metrics. (HOTS: Level 4: Analyse)
CO5. **Interpret** the results of machine learning algorithms. (HOTS: Level 5: Evaluate)

Course Content

Unit-1

Introduction: What is machine learning? Types of machine learning, Examples of machine learning applications: learning associations, classifications, regression, unsupervised learning, reinforcement learning.
Unsupervised learning : k-mean clustering, self-organizing feature map (SOM algorithm)
Dimensional Reduction: Principal Component Analysis.

Unit-II

Decision tree: Introduction, decision tree representation, appropriate problem for decision tree learning algorithm, basic decision tree learning algorithm, entropy measures, information gain measures, Example problem for illustrating ID3.
Regression: Linear regression, linear regression examples.

Unit-III

Artificial neural network: Introduction, biological motivation, neural network representation, appropriate problem for neural network learning, perceptron, representation power of perceptron, perceptron training rule, gradient descent and delta rule, multilayer network and backpropagation algorithm, a differentiable threshold unit, the backpropagation algorithm, convergence and local minima, deep learning.

Unit-IV

Bayesian learning: Introduction, Bayes theorem, Naive Bayes classifiers.
Instance based learning-nearest neighbour learning, remarks on k-nearest neighbour algorithm.
Support Vector Machines: optimal separation, kernels, extensions to the support vector machine

Text and Reference Books:

1. Tom M. Mitchell, *Machine Learning*, McGraw-Hill, Indian Edition (First), 2018.
2. Stephen Marsland, *Machine Learning: An Algorithmic Perspective*, Chapman and Hall /CRC, Second Edition, 2014.
3. Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press, Fourth Edition, 2020.
4. Bishop Christopher, *Pattern Recognition and Machine Learning*, Springer Verlag, 2006.
5. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference and Prediction*, Springer, Second Edition, 2009.
6. J. Han, J.Pei and H.Tong, *Data Mining Concepts and Techniques*, Fourth Edition, Elsevier, 2022.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Define** mathematical, statistical and machine learning terminology and concepts. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Illustrate** the understanding of supervised and unsupervised machine learning algorithms (LOTS: Level 2: Understand)	3	2	-	2	-	-	-	-
CO3. **Apply** machine learning algorithms to solve problems pertaining to discovery of regularities and patterns. (LOTS: Level 3: Apply)	3	3	1	3	-	-	-	-
CO4. **Compare** the performance of different machine learning algorithms based on evaluation metrics. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	2	-
CO5. **Interpret** the results of machine learning algorithms. (HOTS: Level 5: Evaluate)	-	3	2	-	-	-	2	-
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-32 Advanced Operating Systems

General Course Information

Course Code: MCA-32 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Prerequisite: Knowledge of basic computing skills and Windows and Linux Operating Systems

About the Course:

The course explores essential concepts in operating systems, covering topics such as system functions, process management, file systems, distributed operating systems, deadlocks, memory management, and case studies of well-known operating systems. Students gain a deep understanding of the structures and functionalities that underpin modern operating systems and their applications.

Course Outcomes: By the end of the course students will be able to:

CO1. **List** various functions, types and architectural characteristics and other related terminology of operating systems. (LOTS: Level 1: Remember)
CO2. **Explain** fundamental and advanced concepts of operating systems. (LOTS: Level 2: Understand)
CO3. **Apply** Apply knowledge of file systems, including file types, access methods, and directory structures, and analyze the issues and challenges in distributed operating systems (LOTS: Level 3: Apply)
CO4. **Analyze** deadlock characterization, methods for handling deadlocks, and memory management techniques, including paging, segmentation, and virtual memory. (HOTS: Level 4: Analyse)
CO5. **Compare** operating systems such as Windows, UNIX, and Linux through case studies, demonstrating critical thinking. (HOTS: Level 6: Evaluate)

Course Content

Unit-1

Introductory Concepts: Operating systems functions and characteristics, Computer system organization, Computer system architecture, Operating system structure, Virtual machines, Protection & security, Operating system services and system calls, Types of Operating systems: Batch operating system, Time-sharing OS, Distributed operating system, Real time systems. Network operating system, Multiprocessor OS, Mobile OS, Real time OS, Cloud OS.

Unit-II

Processes: Process in memory, Process states, PCB, Process scheduling, Inter-process communication.
CPU scheduling: Levels of Scheduling, Scheduling criteria, Scheduling algorithms, Multithreading models. Thrashing.
File Systems: Types of Files and their access methods, File allocation methods, Directory structure.

Unit-III

Distributed OS: Types of distributed operating systems, Network topology, Communication protocols. Issues in Distributed operating systems.
Deadlocks: Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Recovery from deadlock.

Unit-IV

Memory: Basic hardware, Address binding, swapping, logical and physical address space, Contiguous memory allocation, Fragmentation, Paging, TLB, Segmentation.
Virtual memory: Demand paging, Page replacement algorithms.
Case Studies: Comparative study of WINDOW, UNIX & LINUX system.

Text and Reference Books:

1. M. Singhal and Niranjan G. Shivaratri, *Advanced Concepts in Operating Systems*, McGraw-Hill, Indian Edition, 2017
2. A. Silberschatz, Peter B. Galvin and G. Gagne, *Operating System Concepts*, Ninth Edition, 2018.
3. Andrew S. Tanenbaum, Albert S. Woodhull, *Operating System Design and Implementation*, Pearson, Third Edition, 2015.
4. William Stallings, *Operating System: Internal and Design principles*, Pearson, Ninth Edition, 2018.
5. Andrew S. Tanenbaum and Herbert BOS, *Modern Operating System*, Pearson, Fourth Edition, 2015.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **List** various functions, types and architectural characteristics and other related terminology of operating systems. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Explain** fundamental and advanced concepts of operating systems. (LOTS: Level 2: Understand)	3	2	-	2	-	-	-	-
CO3. **Apply** knowledge of file systems, including file types, access methods, and directory structures, and analyze the issues and challenges in distributed operating systems (LOTS: Level 3: Apply)	3	-	-	3	-	-	-	-
CO4. **Analyze** deadlock characterization, methods for handling deadlocks, and memory management techniques, including paging, segmentation, and virtual memory. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	1	-
CO5. **Compare** operating systems such as Windows, UNIX, and Linux through case studies, demonstrating critical thinking. (HOTS: Level 6: Evaluate)	-	3	-	2	-	-	2	-
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-33: Data Analytics

General Course Information:

Course Code: MCA-33 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Prerequisite: Basic programming skills and statistics.

About the Course:

This course covers how to works with vectors metrices, Lists and Dataframes. It also includes the exploratory data analysis, pre-processing of data, effective visualization of data and predictive models and their evaluation.

Course Outcomes: By the end of the course students will be able to:

CO1. **Define** the basic terms related to data analytics (LOTS: Level 1: Remember)
CO2. **Describe** methods used for data manipulation, exploration, visualization, statistical and predictive analysis (LOTS: Level 2: Understanding)
CO3. **Solve** exploratory analysis, descriptive summaries, data visualization and predictive modelling problems. (LOTS: Level 3: Apply)
CO4. **Analyse** the quality of a model fit (HOTS: Level 4: Analyse).
CO5. **Conclude** the findings of predictive modelling (HOTS: Level 5: Evaluate).

Course Content

Unit-1

Data Analytics preliminaries: Scales of measurements and their implementation. Working with vectors, matrices and tabular data (data frames), reading and writing tabular data from and to files. Describing data with statistical summaries (mean, median, mode, variance and standard deviation). Discriminating between sample and population, Quantile-Quantile plot. writing user-defined functions in R/Python.
Manipulating tabular data: Sorting, filtering cases, selecting variables, deriving new variables, grouping and summarizing data. working with packages (dplyr, tidyverse or any equivalent package in Python) for data manipulations and transformations, discovering correlation between attributes.

Unit-II

Exploratory data analysis: Random and normally distributed variables, skewed normal distribution, z-score, detecting outliers in data, handling missing values.
Visualizing data through various plots and charts: Pie chart, bar charts, histogram, frequency polygon, density plots, scatter plots, box & whisker plots, heat maps and contour plots., plotting the above graphs in R/Python, plotting with package- ggplot2 in R or any equivalent package in Python.

Unit-III

Predictive modelling: What is predictive modelling, estimating a function, the trade-off between model accuracy and prediction accuracy and model interpretability, regression versus classification, measuring the quality of fit, The bias and variance trade- off.
Simple and multiple linear regression modelling: Estimating the coefficients, assessing the accuracy of the coefficient estimates, assessing the accuracy of the model. Logistic regression modelling, building regression models in R/Python.

Unit-IV

Classification Modeling: The process of classification, decision tree, bayesian, k-nearest neighbor, support vector machine classification models and their implementation in R/Python. evaluating a classification model: confusion matrix, accuracy, sensitivity, specificity, f-measure, kappa statistics, ROC and area under curve. accuracy and interpretability of classification models.
Evaluating the accuracy of a classifier: Holdout or random sampling methods, cross-validation, bootstrap methods.

T**ext and Reference Books:**

1. J. Han, J.Pei and H.Tong, *Data Mining Concepts and Techniques*,Elsevier, Fourth Edition, 2022.
2. W. N. Venables, D. M. Smith and the R core Team, *An introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics*, version 3.3.2, 2016.
3. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, *An Introduction to Statistical Learning with Applications in R*, Springer, Second Edition, 2021.
4. Hadley Wickham and Garrett Grolemund, *R for Data Science Import, Tidy, Transform and model Data*, O'Reilly, 2017.
5. Roger D. Peng, R Programming for Data Science, Lean Publishing, 2015.
6. David Beazley and Brian K. Jones, *Python Cookbook: Recipes for Mastering Python*, O'Reilly Media, Third Edition, 2013.
7. Andreas C. Muller and Sarah Guido, *Introduction to Machine Learning with Python: A Guide for Data Scientists*, O'Reilly, 2016.
8. Paul Teeter, *R Cookbook*, O'Reilly, 2011.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Define** the basic terms related to data analytics (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Describe** methods used for data manipulation, exploration, visualization, statistical and predictive analysis (LOTS: Level 2: Understanding)	3	2	-	2	-	-	-	-
CO3. **Solve** exploratory analysis, descriptive summaries, data visualization and predictive modelling problems. (LOTS: Level 3: Apply)	3	3	-	3	-	-	-	-
CO4. **Analyse** the quality of a model fit (HOTS: Level 4: Analyse).	-	3	-	2	-	-	1	-
CO5. **Conclude** the findings of predictive modelling (HOTS: Level 5: Evaluate).	-	3	1	-	-	-	2	-
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-34 Cyber Security

General Course Information:

Course Code: MCA-34 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Prerequisite: Computer networks, essentials of computer security

About the Course:

The increase in techniques for unauthorized access into systems has led to variety of cyber- attacks. To mitigate the exploitation of the vulnerabilities leading to these attacks, we need to adopt robust security architecture into our premises. We have to choose between various cyber security technologies. In the current scenario, we require to secure end-to-end devices, networks, networking devices. The objective of this course is to acquaint students to cyber security principles to be followed while working online and offline.

Course Outcomes: By the end of the course students will be able to:

CO1. **Recognize** the terminology and concepts associated with networking and cyber security. (LOTS: Level 1: Remember)
CO2. **Discuss** cyber security fundamentals, principles, ethical issues and protection against cybercrimes. (LOTS: Level 2: Understand)
CO3. **Suggest** appropriate solutions and cyber laws for the cyber security violation activities.(LOTS: Level 3: Apply)
CO4. **Identify** the challenges of cyber security, cyber laws and ethical issues. (HOTS: Level 4: Analyse)
CO5. **Integrate** cyber security frameworks for addressing cyber security violations. (HOTS: Level 6: Create)

Course Content

Unit-1

Cyber Security Fundamentals: Network and Security Concepts: Firewalls, Virtualization, DNS, Radio-Frequency Identification, Attacker Techniques and Motivations: Tunneling Techniques, Fraud Techniques, Threat Infrastructure, Exploitation, Malicious code. Defense and Analysis Techniques.

Unit-II

Ethics in Cyber Security: Privacy, Intellectual property in the cyberspace, Professional ethics, Freedom of speech, Fair user and ethical hacking, Trademarks, Internet fraud, electronic evidence, Forensic technologies, Digital evidence collections. Tools and methods used in cybercrime: Introduction, Password cracking, Keyloggers and spywares, Virus and worms, Phishing and identity theft, Trojan horses and backdoors, Steganography

Unit-III

Cybercrimes and Cyber security: Cybercrime and legal landscape around the world, Cyber laws, The Indian IT Act, Challenges, Digital signatures and Indian IT Act, Amendments to the Indian IT Act, Cybercrime and punishment, Cost of Cybercrimes and IPR Issues, Web threats for organizations, Social computing and associated challenges for organizations.

Unit-IV

Protecting Critical Infrastructures: Critical Infrastructures: Key Assets, Critical Infrastructure Interdependencies, Internet, Social Media and Cyber Attacks on Critical Infrastructures, Cyber Threat Spectrum- Cyberspace Attacks and Weapons, Framework for improving Critical Infrastructure Cyber security.

Text and Reference Books:

1. James Graham, Richard Howard, *Cyber Security Essentials*, CRC Press, Taylor & Francis Group, First Edition, 2011.
2. Thomas A. Johnson, *Cyber-Security Protecting Critical Infrastructures from Cyber Attack and Cyber Warfare*, CRC Press, First Edition, 2015
3. Nina Godhole and Sunit Belapure, *Cyber Security*, Wiley India, 2011.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Recognize** the terminology and concepts associated with networking and cyber security. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Discuss** cyber security fundamentals, principles, ethical issues and protection against cybercrimes. (LOTS: Level 2: Understand)	3	2	-	-	-	-	2	-
CO3. **Suggest** appropriate solutions and cyber laws for the cyber security violation activities.(LOTS: Level 3: Apply)	3	3	-	3	-	-	3	-
CO4. **Identify** the challenges of cyber security, cyber laws and ethical issues. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	2	-
CO5. **Integrate** cyber security frameworks for addressing cyber security violations. (HOTS: Level 6: Create)	3	-	2	3	-	2	3	2
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-35 Theory of Computation

General Course Information

Course Code: MCA-35 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisites: Background in the fundamentals of discrete mathematics.

About the Course:

Formal Languages and Automata theory presents the theoretical aspects of computer science, which lay the foundation of computing science. The course introduces some fundamental concepts in automata theory and formal languages including grammar, finite automaton, regular expression, formal language, pushdown automaton and Turing machine.

Course Outcomes: By the end of the course students will be able to:

CO1. **Define** terminology and concepts related to theory of computation. (LOTS: Level 1: Remember)
CO2. **Illustrate** the understanding of concepts and applications of theory of computation. (LOTS: Level 2: Understand)
CO3. **Apply** the principles of theory of computation to solve computational problems. (LOTS: Level 3: Apply)
CO4. **Compare and contrast** the hierarchy of grammars. (HOTS: Level 4: Analyse)
CO5. **Design** various types of automata for given problems. (HOTS: Level 6: Create)

Course Content

Unit-I

Finite Automata and Regular Expressions: Finite State Systems, Basic Definitions Non-Deterministic finite automata (NDFA), Deterministic finite automata (DFA), Equivalence of DFA and NDFA Finite automata with E- moves, Regular Expressions, Equivalence of finite automata and Regular Expressions, Regular expression conversion and vice versa, Conversion of NFA to DFA by Arden'sMethod.

Unit-II

Introduction to Machines: Concept of basic Machine, Properties and limitations of FSM. Moore and mealy Machines, Equivalence of Moore and Mealy machines.
Properties of Regular Sets: The Pumping Lemma for Regular Sets, Applications of the pumping lemma, Closure properties of regular sets, Myhill-Nerode Theorem and minimization of finite Automata, Minimization Algorithm.

Unit-III

Grammars: Definition, Context free and Context sensitive grammar, Ambiguity regular grammar, Reduced forms, Removal of useless Symbols and unit production, Chomsky Normal Form (CNF), Griebach Normal

Form (GNF).
Pushdown Automata: Introduction to Pushdown Machines, Application of Pushdown Machines

Unit-IV

Turing Machines: Deterministic and Non-Deterministic Turing Machines, Design of T.M, Halting problem of T.M., PCP Problem.
Chomsky Hierarchies: Chomsky hierarchies of grammars, Unrestricted grammars, Context sensitive languages, Relation between languages of classes.
Computability: Basic concepts, Primitive Recursive Functions.

Text and Reference Books:

1. Hopcroaft& O. D. Ullman, R Mothwani, *Introduction to automata theory, language & computations*, AW, Third Edition, October 2013.
2. K. L. P. Mishra & N. Chandrasekaran, *Theory of Computer Sc.(Automata, Languages and computation)*, PHI, Third Edition, January 2006.
3. Peter Linz, *Introduction to formal Languages & Automata*, Jones &Bartlett Publication, Sixth Edition, January 2006.
4. Ramond Greenlaw and H. James Hoover, *Fundamentals of the Theory of Computation- Principles and Practice*, Harcourt India Pvt. Ltd., July 1998.
5. H. R. Lewis & C. H. Papaditriou, *Elements of theory of Computation*, PHC, 1998.
6. John C. Martin, *Introduction to Languages and the Theory of Computation*, T.M.H., Fourth Edition, 2011.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Define** terminology and concepts related to theory of computation. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Illustrate** the understanding of concepts and applications of theory of computation. (LOTS: Level 2: Understand)	3	2	-	-	-	-	-	-
CO3. **Apply** the principles of theory of computation to solve computational problems. (LOTS: Level 3: Apply)	3	3	-	2	-	-	-	-
CO4. **Compare and contrast** the hierarchy of grammars. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	-	-
CO5. **Design** various types of automata for given problems. (HOTS: Level 6: Create)	3	-	2	3	-	-	-	2
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-36 Machine Learning Lab.

General Course Information

Course Code: MCA-36 Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Programming in Java, Python, R and Octave/MATLAB.

About the Course:

In this lab. course, students learn to solve optimization, supervised and unsupervised learning problems using machine learning tools. Students will use machine learning tools available in WEKA, R, Python and Octave etc. The lab experiments involve downloading datasets and applying machine learning techniques on these datasets. The course has a special focus on interpreting and visualizing results of machine learning

algorithms.

Course Outcomes: By the end of the course students will be able to:

CO1. **Implement** machine learning algorithms using modern machine learning tools. (LOTS: Level 3: Apply)
CO2. **Analyse** the trends in datasets using descriptive statistics. (HOTS: Level 4: Analyse)
CO3. **Apply** descriptive and predictive modelling. (LOTS: Level 3: Apply)
CO4. **Compare and contrast** machine learning algorithms for a given problem. (describe datasets using descriptive statistics. (HOTS: Level 5: Evaluate)
CO5. **Create** lab records of assignment by incorporating problem definitions, design of solutions, results and interpretations. (HOTS: Level 6: Create)
CO6. Demonstrate use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)

List of experiments/assignments

1. Install WEKA/R/Python/Octave and learn to use these software packages.
2. Two assignments related to classification algorithms and interpreting the results of these algorithms.
3. Two assignments related to clustering algorithms and interpreting the results of these algorithms.
4. Three assignments on designing neural networks for solving learning problems.
5. Two assignments on ranking or selecting relevant features.
6. Two assignments on linear regression and logistic regression.
7. One assignment to be done in groups.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Implement** machine learning algorithms using modern machine learning tools. (LOTS: Level 3: Apply)	3	-	-	3	-	-	-	-
CO2. **Analyse** the trends in datasets using descriptive statistics. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	-	-
CO3. **Apply** descriptive and predictive modelling. (LOTS: Level 3: Apply)	3	2	-	3	-	-	-	-
CO4. **Compare and contrast** machine learning algorithms for a given problem. (describe datasets using descriptive statistics. (HOTS: Level 5: Evaluate)	-	3	-	2	-	-	2	-
CO5. **Create** lab records of assignment by incorporating problem definitions, design of solutions, results and interpretations. (HOTS: Level 6: Create)	-	-	-	-	2	2	-	-
CO6. **Demonstrate** use of ethical practices, self-learning and team spirit. (LOTS: Level 3: Apply)	-	-	-	-	3	-	3	-
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-37 Data Analytics Lab.

General Course Information

Course Code: MCA-37 Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 2 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Course Assessment Methods (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic programming skills.

About the Course:

The objective of this lab. is to enable students to learn R/Python programming constructs for manipulating, exploring and visualizing data. It involves applying descriptive and inferential statistics. It also covers implementation of advanced data analytics tools for regression, classification and clustering.

Course Outcomes: By the end of the course students will be able to:

CO1. **Apply** pre-processing techniques to real world data. (LOTS: Level 3: Apply)
CO2. **Solve** problems of predictive analytics. (LOTS: Level 3: Apply)
CO3. **Evaluate** the performance of predictive models. (LOTS: Level 5: Evaluate)
CO4. **Design** complete data analytics experiments. (LOTS: Level 6: Create)
CO5. **Create** lab assignment record that includes problem definitions, solutions, results, and conclusions. (HOTS: Level 6: Create).
CO6. **Demonstrate** ethical practices, self-learning and team spirit.

List of experiments/assignments

1. Four Assignments on descriptive statistics
2. Four Assignment on visualizing data
3. Four Assignments on Pre-processing Data
4. Two assignments to solve linear and non-linear regression problems.
5. Two assignments on classification problems.
6. Two assignment on different sampling techniques.

Note:

The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Apply** pre-processing techniques to real world data. (LOTS: Level 3: Apply)	3	-	-	3	-	-	-	-
CO2. **Solve** problems of predictive analytics. (LOTS: Level 3: Apply)	3	2	-	3	-	-	-	-
CO3. **Evaluate** the performance of predictive models. (LOTS: Level 5: Evaluate)	-	3	-	2	-	-	2	-
CO4. **Design** complete data analytics experiments. (LOTS: Level 6: Create)	3	-	2	3	-	2	-	1
CO5. **Create** lab assignment record that includes problem definitions, solutions, results, and conclusions. (HOTS: Level 6: Create).	-	-	-	-	2	2	-	-
CO6. **Demonstrate** ethical practices, self-learning and team spirit.	-	-	-	-	3	-	3	-
Level of Attainments								

*Attainment Levels:
- None
1: Low, 2: Medium, 3: High

MCA-38 Industrial Training

General Course Information

Course Code: MCA-38 Course Credits: 2 Mode: Self learning in industry.	**Course Assessment Methods (100 Marks)** An internal evaluation is done by a faculty member appointed by the Chairperson of the Department. The evaluation is based on the weightage of the following four criteria. 1. Significance of knowledge of the internship domain: 30 % 2. Modern tools usage, skill enhancement and the computing system developed: 30 % 3. Presentation and Report Writing: 25 % 4. Level of ethics followed: 15 %

About the Industrial Training:

The students do training/internship in IT or computing application related industries after the second semester. During the internship they are expected to learn modern tools/software and develop applications that can be completed within 4 to 6 weeks.

Course Outcomes: After doing internship students will be able to:

CO1. **Analyse** the suitability of computing techniques and modern tools for solving problems. (HOTS: Level 4: Analyse)
CO2. **Identify** the strengths and limitations of the work done during industrial training. (HOTS: Level 5: Evaluate)
CO3. **Equip** themselves with modern tools to solve complex computing problem. (LOTS: Level 3: Apply)
CO4. **Build** effective verbal communication skills and team sprits. (LOTS: Level 3: Apply)
CO5. **Interact** with personnel from Industry and follow engineering and societal practices. (LOTS: Level 3: Apply)
CO6. **Follow** ethical and societal practices while doing the training and writing report. (LOTS: Level 3: Apply)
CO7. **Develop** communication skills for preparing technical reports and presentation. (HOTS: Level 6: Create)

List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1.	**Analyse** the suitability of computing techniques and modern tools for solving problems. (HOTS: Level 4: Analyse)	-	3	-	3	-	-	-	-
CO2.	**Identify** the strengths and limitations of the work done during industrial training. (HOTS: Level 5: Evaluate)	-	3	-	-	-	-	2	-
CO3.	**Equip** themselves with modern tools to solve complex computing problem. (LOTS: Level 3: Apply)	3	-	-	3	-	-	-	-
CO4.	**Build** effective verbal communication skills and team sprits. (LOTS: Level 3: Apply)	-	-	-	-	3	1	-	-
CO5.	**Interact** with personnel from Industry and follow engineering and societal practices. (LOTS: Level 3: Apply)	-	-	-	-	3	-	2	-
CO6.	**Follow** ethical and societal practices while doing the training and writing report. (LOTS: Level 3: Apply)	-	-	-	-	-	-	3	-
CO7.	**Develop** communication skills for preparing technical reports and presentation. (HOTS: Level 6: Create)	-	-	-	-	2	3	-	2
	Level of Attainments								

*Attainment Levels:
- None
1: Low, 2: Medium, 3: High

MCA-41 IoT and Cloud Computing

General Course Information

Course Code: MCA-41 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of Computer Network, Distributed System.

About the Course:

The objective of the course is to give students a comprehensive understanding of the vision and impact of IoT, IoT Market perspective, Cloud architectures for cloud computing .

Course Outcomes: By the end of the course students will be able to:

CO1. **Define** concepts related to internet of things and cloud computing. (LOTS: Level 1: Remember)
CO2. **Demonstrate** a deep understanding of IoT and cloud computing fundamentals, including key concepts, components, and technologies. (LOTS: Level 1: Understand)
CO3. **Apply** cloud computing techniques for various applications. (LOTS: Level 3: Apply)
CO4. **Analyse** cloud computing models, architectures, services, IOT devices and solutions. (HOTS: Level 3: Analyse)
CO5. **Develop** cloud and IOT based applications. (HOTS: Level 6: Create)

Course Content

Unit-I

Overview of Cloud Computing: Brief history and evolution - history of cloud computing, evolution of cloud computing, traditional vs. cloud computing, cloud service models (IaaS, PaaS & SaaS), cloud deployment models (public, private, hybrid and community cloud), benefits and challenges of cloud computing, introduction to AWS public cloud vendor, cost optimization in AWS, basics of virtualization, virtualization technologies, server virtualization, VM migration techniques, role of virtualization in cloud computing, introduction to EC2 service of AWS.

Unit-II

Working with Private Cloud: Private cloud definition, characteristics of private cloud, private cloud deployment models, private cloud vendors - CloudStack, OpenStack, Eucalyptus Microsoft, private cloud ± benefits and challenges, private cloud implementation in Amazon EC2 service.

Unit-III

Working with Public Clouds: What is public cloud, why public cloud, when to opt for public cloud, public cloud service models, public cloud players, infrastructure as a service offering, IaaS vendors, PaaS offerings,

PaaS vendors, software as a service, demonstrating public cloud with AWS ± storage and database services, private vs. public cloud ± when to choose.

Unit-IV

IoT Architecture- Introduction, State of the art: Architecture reference model- introduction, reference model and architecture, IoT reference model.

IoT Reference Architecture: 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.

Text and Reference Books:

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, *From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence*, 1st Edition, Academic Press, 2014.
2. Hwang Kai, Fox Geoffrey C, Dongarra Jack G, *Distributed and Cloud Computing, From Parallel Processing to the Internet of Things*, Morgan Kaufmann Publishers, 2011.
3. Rittinghouse John W. and Ransome James F., *Cloud Computing: Implementation, Management, and Security*, CRC Press, 2009.
4. Velte Toby, Velte Anthony, Elsenpeter Robert, *Cloud Computing, A Practical Approach*, TMH, 2013.
5. Vijay Madisetti and Arshdeep Bahga, *Internet of Things (A Hands-on- approach)*, 1st Edition, VPT, 2014.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Define** concepts related to internet of things and cloud computing. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Demonstrate** a deep understanding of IoT and cloud computing fundamentals, including key concepts, components, and technologies. (LOTS: Level 1: Understand)	3	2	-	2	-	-	-	-
CO3. **Apply** cloud computing techniques for various applications. (LOTS: Level 3: Apply)	3	-	1	3	-	-	-	-
CO4. **Analyse** cloud computing models, architectures, services, IOT devices and solutions. (HOTS: Level 3: Analyse)	-	3	-	3	-	-	1	-
CO5. **Develop** cloud and IOT based applications. (HOTS: Level 6: Create)	3	-	2	3	-	2	2	2
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-42 Mobile Application Development

General Course Information

Course Code: MCA-42 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisites: Java Programming and Object-Oriented programming, Knowledge of RDBMS and OLTP.

About the Course:

Mobile Application Development is introduced as a professional elective course for students keeping in view the Employers' requirements. Android Platform forms the basis for developing Mobile Applications since the last decade as compared to IOS Platform for Apple Products. The Environment requires developing User Interface using Buttons, Check-Boxes, Alert Dialog and its kind.

Course Outcomes: By the end of the course students will be able to:

CO1. **State** basics of Android, its Evolution and its Architecture. (LOTS: Level 1: Remember)
CO2. **Demonstrate** the lifecycle of software for Android mobile applications.
CO3. **Prepare** mobile applications on the Android platform. (LOTS: Level 3: Apply)
CO4. **Compare** working with buttons and other widgets for visual environments. (HOTS: Level 4: Analyse)
CO5. **Develop** mobile applications using data storage in SQLite Database. (HOTS: Level 6: Create)

Course content

Unit-I

Mobile OS Architecture: Android, Blackberry OS, Firefox OS, IOS, Window OS, ARM and MIPS processor, Challenges of the mobile platform, Hello Android example, Internal Details, Dalvik VM, Software Stack, Android Core Building Blocks, Android Emulator, Android Manifest.xml, R.java file, Hide Title Bar, Screen Orientation.

Unit-II

UI Widgets: Working with Button, Toast, Custom Toast, Button, Toggle Button, Switch Button, Image Button, CheckBox, Alert Dialog, Spinner, AutoCompleteTextView, RatingBar, DatePicker, TimePicker, ProgressBar, Quick Contact Budge, Analog Clock and Digital Clock, Working with hardware Button, File Download.

Unit-III

Activity, Intent & Fragment: Activity Lifecycle, Activity Example, Implicit Intent, Explicit Intent, Fragment Lifecycle, Fragment Example, Dynamic Fragment.
Android Menu: Option Menu, Context Menu, Popup Menu
Layout Manager: Relative Layout, Linear Layout, Table Layout, Grid Layout.

Unit-IV

Adaptor: Array Adaptor, ArrayList Adaptor, Base Adaptor.
View: GridView, WebView, ScrollView, SearchView, TabHost, DynamicListView, Expanded ListView.
SQLite: SQLite API, SQLite Spinner, SQLite ListView
XML & JSON: XML Parsing SAX, XML Parsing DOM, XML Pull Parser, JSON basics, JSON Parsing.

Text and Reference Books:

1. Redazione Io Programmo, *Android Programming*, 2011.
2. John Horton, *Android Programming for Beginners*, packt publishing, 2015.
3. Jason Wei, *Android Database Programming*, packt publishing, 2012.
4. Mark L Murphy, *AndroidProgrammingTutorials*,3rdEdition, 2010.
5. Bill Phillips et al., *Android Programming - The "Big Nerd Ranch Guide*, 2017.
6. Rick Rogers et al., *Android Application Development: Programming with the Google SDK*, 2009.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **State** basics of Android, its Evolution and its Architecture. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Demonstrate** the lifecycle of software for Android mobile applications.	2	3	-	-	-	-	-	-
CO3. **Prepare** mobile applications on the Android platform. (LOTS: Level 3: Apply)	3	-	1	3	-	-	-	-
CO4. **Compare** working with buttons and other widgets for visual environments. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	-	-
CO5. **Develop** mobile applications using data storage in SQLite Database. (HOTS: Level 6: Create)	3	-	2	3	-	2	2	2
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-43(i) Big Data Analytics

General Course Information

Course Code: MCA-43(i) Elective-I Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of statistics and data mining.

About the Course:

This course aims to provide students with the knowledge of current challenges, methodologies and technologies in processing big data. Emphasis will be placed on the students' understanding of the rationales behind the technologies and the students' ability to analyse big data using professional packages and tools.

Course Outcomes: By the end of the course students will be able to:

CO1. **Recall** the concepts and terminology of big data analytics. (LOTS: Level 1: Remember)
CO2. **Describe** algorithms and techniques for big data analytics. (LOTS: Level 2: Understand)
CO3. **Apply** technical skills and modern tools for descriptive and predicative modelling for big data. LOTS: Level 3: Apply)
CO4. **Judge** different frameworks for big data analytics. (HOTS: Level 4: Analyse)
CO5. **Examine** critically the performance of big data analytics algorithms and techniques. (HOTS: Level 5: Evaluate)
CO6. **Devise** schemes for big data analytics for solving big data problems in efficient manner. (HOTS: Level 6: Create)

Course Content

Unit-I

Introduction: Overviews of Big Data, State of the Practice in Analytics, The Data Scientist, Big Data Analytics in Industry Verticals, Data Analytics Lifecycle Challenges of Conventional Systems, Statistical Concepts: Sampling Distributions, Re-Sampling, Statistical Inference, Prediction Error, Regression Modelling, Multivariate Analysis, Bayesian Modelling.

Unit-II

Mining Data Streams: Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Oneness in a Window, Decaying Window, Real time Analytics, Platform (RTAP) Applications, Case Studies, Real Time Sentiment Analysis, Stock Market Prediction

Unit-III

Frequent Itemset and Clustering: Mining Frequent Itemsets, Market Based Model: Apriori Algorithm, Handling Large Data Sets in Main Memory, Limited Pass Algorithm, Counting Frequent Itemsets in a Stream, **Clustering based Techniques:** Hierarchical, K-Means etc., Clustering High Dimensional Data,

CLIQUE And PROCLUS, Frequent Pattern based Clustering Methods, Clustering in Non-Euclidean Space, Clustering for Streams and Parallelism.

Unit-IV

Frame works and Visualization: Overview of Map Reduce, Hadoop, Hive, MapR, Sharding, No SQL Databases, S3, HADOOP, Distributed File System (HDFS), Visualizations: Visual Data Analysis Techniques, Interaction Technique and Applications.

Text and Reference Books:

1. Michael Berthold, David J. Hand, *Intelligent Data Analysis*, Springer, 2007.
2. A. Rajaraman, J.D. Ullman, *Mining of Massive Datasets*, Cambridge University Press, 2012.
3. Bill Franks, *Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics*, John Wiley & sons, 2012.
4. Glenn J. Myatt, *Making Sense of Data*, John Wiley & Sons, 2007.
5. Pete Warden, *Big Data Glossary*, O'Reilly, 2011.

List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1.	**Recall** the concepts and terminology of big data analytics. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2.	**Describe** algorithms and techniques for big data analytics. (LOTS: Level 2: Understand)	2	2	-	2	-	-	-	-
CO3.	**Apply** technical skills and modern tools for descriptive and predicative modelling for big data. LOTS: Level 3: Apply)	3	3	1	3	-	-	-	-
CO4.	**Judge** different frameworks for big data analytics. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	1	-
CO5.	**Examine** critically the performance of big data analytics algorithms and techniques. (HOTS: Level 5: Evaluate)	-	3	1	-	-	-	2	-
CO6.	**Devise** schemes for big data analytics for solving big data problems in efficient manner. (HOTS: Level 6: Create)	3	-	3	3	-	2	2	2
	Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-43(ii) Software Project Management

General Course Information

Course Code: MCA-43(ii) Elective-I Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisites: Preliminary knowledge of Software Engineering.

About the Course:

The course involves training students in software project management and project planning. It focuses on the need for careful planning, monitoring and control for delivering quality projects in time. Besides this student learn to measure the success of a project in meeting its objectives.

Course Outcomes: By the end of the course students will be able to:

CO1. **Outline** basic concepts related to software project management and planning, project evaluation, risk management and software quality. (LOTS: Level 1: Remember)
CO2. **Demonstrate** the knowledge of software project management concepts. (LOTS: Level 2: Understand)
CO3. **Apply** software project management principles for risk analysis and quality management. (LOTS: Level 3: Apply)
CO4. **Manage** contracts and people as individual as well as in teams for software development. (LOTS: Level 3: Apply)
CO5. **Analyse** software project planning and development strategies. (HOTS: Level 5: Analyse)
CO6. **Evaluate** software development projects. (HOTS: Level 6: Evaluate)

Course Content

Unit-I

Introduction to Software Project Management(SPM): Definition of Software Project, Software Project Vs Other types of projects, activities covered by SPM, categorizing software projects, project as system, management control, Requirement specification, Information and control in organization, project management life cycle.
Stepwise Project Planning: Introduction, selecting a project, identifying project scope and objectives, identifying project infrastructure, analysing project characteristics, identifying the project products and activities, estimate efforts for each activity, identifying activity risk, allocate resources, review/publicize plan.

Unit-II

Project Evaluation and Estimation: Cost-Benefit analysis, cash flow forecasting, cost benefit evaluation techniques, Selection of an appropriate project, choosing technologies, choice of process models, rapid application development, waterfall model, V process model and spiral model, Albrecht function point analysis.

Activity Planning: Objectives of activity planning, project schedule, projects and activities, sequencing and scheduling activities, network planning model.

Unit-III

Risk Management: Introduction, the nature of risk, managing risk, risk identification, risk analysis, reducing the risks, evaluating risks to schedule, calculating z-values**.**
Resource Allocation: Introduction, the nature of resources, identifying resource requirements, scheduling resources, creating critical paths.

Unit-IV

Managing Contracts and People: Introduction, types of contract, stages in contract placement, terms of contract, contract management, acceptance, managing people and organizing teams: Introduction, understanding organization behaviour: a background, selecting the right person for job, instruction in best methods, motivation, working in groups, becoming a team, decision making, leadership, organization structures.
Software Quality: Introduction, the place of software quality in project planning, the importance of software quality, defining software quality, McCall's software quality factors, product versus process quality management, external standards, techniques to enhance software quality.

Text and Reference Books:

1. Bob Hughes and Mike Cotterell , *Software Project Management*, Sixth Edition, TMH, 2018.
2. Walker Royce, *Software Project Management*, , Addison Wesley, 1998.
3. Pankaj Jalote , *Software Project Management in Practice*, Pearson, 2002.
4. Ramesh, *Managing Global Software Projects*, TMH, 2005.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Outline** basic concepts related to software project management and planning, project evaluation, risk management and software quality. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Demonstrate** the knowledge of software project management concepts. (LOTS: Level 2: Understand)	2	2	-	-	-	-	-	-
CO3. **Apply** software project management principles for risk analysis and quality management. (LOTS: Level 3: Apply)	3	-	-	-	-	2	2	-
CO4. **Manage** contracts and people as individual as well as in teams for software development. (LOTS: Level 3: Apply)	-	-	-	-	3	3	-	-
CO5. **Analyse** software project planning and development strategies. (HOTS: Level 5: Analyse)	-	3	-	-	-	2	-	-
CO6. **Evaluate** software development projects. (HOTS: Level 6: Evaluate)	-	3	-	-	-	2	2	-
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-43(iii) Digital Image Processing

General Course Information

Course Code: MCA-43(iii) Elective-I Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisites: knowledge of basic linear algebra, basic probability theory, basic programming techniques and Fourier Transforms.

About the Course:

Digital Image Processing provides a theoretical foundation of digital image processing concepts. This course delivers mathematical foundation for digital manipulation of images, image acquisition, pre-processing, enhancement, segmentation and compression. Students learn algorithms that perform basic image processing operations (e.g., histogram processing, noise removal and image enhancement and restoration). Algorithms for image analysis (e.g., image compression, image segmentation and image representation) are explained.

Course Outcomes: By the end of the course students will be able to:

CO1. **State** concepts related to image acquisition and processing. (LOTS: Level 1: Remember)
CO2. **Illustrate** the principles and methods in image processing. (LOTS: Level 2: Understand)
CO3. **Apply** mathematical functions for digital manipulation of images such as image acquisition, pre-processing, segmentation, compression and representation. (LOTS: Level 3: Apply)
CO4. **Compare** various image processing techniques. (HOTS: Level 4: Analyse)
CO5. **Assess** the various image processing techniques for a given problem. (HOTS: Level 5: Evaluate)
CO6. **Design** and implement algorithms for digital image processing operations such as histogram equalization, filtering, enhancement, restoration and denoising, segmentation, compression. (HOTS: Level 6: Create)

Course Content

Unit-I

Introduction and fundamental to digital image processing: What is digital image processing, Origin of digital image processing, Examples that use digital image processing, Fundamental steps in digital image processing, Components of digital image processing system, Image sensing and acquisition, Image sampling, Quantization and representation, Basic relationship between pixels.
Image enhancement in spatial domain and frequency domain: Background, Basic gray level transformation, Histogram processing, Basics of spatial filtering, Smoothing and sharpening spatial and the frequency domain filters.

Unit-II

Image Restoration: Image degradation/restoration Process, Noise models, Restoration in presence of noise,

inverse filtering, Minimum mean square filtering, Geometric mean filter, Geometric transformations. Color **Image Processing:** Color fundamentals, Color models, Basics of full color image processing, Color transformations.

Unit-III

Image Compression: Fundamentals, Image compression models, Error free compression, Lossy compression. **Image Segmentation:** Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region based segmentation.

Unit-IV

Representation, Description and Recognition: Representation-chain codes, polygonal approximation and skeletons, Boundary descriptors-simple descriptors, shape numbers, Regional descriptors- simple, topological descriptors.
Recognition: Pattern and Pattern classes.

Text and Reference Books:

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Pearson Education, Ed, 2001.
2. Anil K. Jain, *Fundamentals of Digital Image Processing*, Pearson Education, PHI, 2001.
3. Tinku Acharya and Ajoy K. Ray, *Image Processing-Principles and Applications*, John Wiley & Sons, Inc., 2005.
4. Chanda and D. Dutta Majumdar, *Digital Image Processing and Analysis*, PHI, 2003.
5. Milan Sonka, Vaclav Hlavac, Roger Boyle, *Image Processing, Analysis and Machine Vision*, 2nd edition, PWS Publishing Company, Thomson Learning, 1999.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **State** concepts related to image acquisition and processing. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Illustrate** the principles and methods in image processing. (LOTS: Level 2: Understand)	2	2	-	2	-	-	-	-
CO3. **Apply** mathematical functions for digital manipulation of images such as image acquisition, pre-processing, segmentation, compression and representation. (LOTS: Level 3: Apply)	3	3	-	3	-	-	-	-
CO4. **Compare** various image processing techniques. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	-	-
CO5. **Assess** the various image processing techniques for a given problem. (HOTS: Level 5: Evaluate)	-	3	-	-	-	-	1	-
CO6. **Design** and implement algorithms for digital image processing operations such as histogram equalization, filtering, enhancement, restoration and denoising, segmentation, compression. (HOTS: Level 6: Create)	3	-	2	3	-	2	-	2
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-43(iv) High Speed Networks

General Course Information

Course Code: MCA-43(iv) Elective-1 Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisites: Knowledge of computer networks

About the course:

High Speed Network is a professional core course based around Network Architectures, protocols used across the layers, techniques used in communication and modes of data transfer. The course deals with creating High Speed Networks for any organization/institute with its various phases/life cycles.

Course Outcomes: By the end of the course students will be able to:

CO1. **Outline** different high speed network technologies. (LOTS: Level 1: Remember)
CO2. **Explain** working of different wired / wireless technologies suitable for LAN and WAN communication. (LOTS: Level 2: Understand)
CO3. **Use** high speed network technologies to provide solutions for creating efficient networks. (LOTS: Level 3: Apply)
CO4. **Compare** different high-speed technologies in different scenarios / situations. (HOTS: Level 4: Analyse)
CO5. **Recognize** the evolving trends and emerging technologies in high-speed networks, staying updated with industry developments and adapting to changing network requirements. (HOTS: Level 5: Evaluate)

Course Content

Unit-I

Gigabit Ethernet: Overview of fast Ethernet, Gigabit Ethernet – overview, specifications, layered protocol architecture, frame format, network design using Gigabit Ethernet, applications, 10GB Ethernet – overview, layered protocol architecture, frame format.
Fiber Channel: Fiber channel – overview, topologies, ports, layered protocol architecture, frame structure, class of service.

UNIT-II

Frame Relay: Protocol architecture and frame format.
ISDN & B-ISDN: Channels, interfaces, addressing, protocol architecture, services.
ATM: Virtual circuits, cell switching, reference model, traffic management.

Unit-III

Wireless Networks: Existing and emerging standards, Wireless LAN (802.11), Broadband Wireless (802.16), Bluetooth (802.15) their layered protocol architecture and security. Mobile Networks – GSM, CDMA.

Unit-IV

Internet Layer: IPV4 and IPV6, IP addressing, IP classes, CIDR.
Transport Layer: UDP/TCP protocols & architecture, TCP connection management.
Application Layer: DNS, E-Mail, Voice over IP.

Text and Reference Books:

1. Jochen Schiller, *Mobile Communication*, Pearson, Second Edition, 2009.
2. Andrew S Tanenbaum, Nick Feamster, David J. Wetherall, *Computer Networks*, Pearson, Sixth Edition, 2022.
3. William CY Lee, *Mobile Communication Engineering: Theory and Applications*, McGrawHill, Second Edition, July 2017.

List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1.	**Outline** different high speed network technologies. (LOTS: Level 1: Remember)	3	-	-		-	-	-	1
CO2.	**Explain** working of different wired / wireless technologies suitable for LAN and WAN communication. (LOTS: Level 2: Understand)	2	2	-	2	-	-	-	-
CO3.	**Use** high speed network technologies to provide solutions for creating efficient networks. (LOTS: Level 3: Apply)	3	3	-	3	-	-	-	-
CO4.	**Compare** different high-speed technologies in different scenarios / situations. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	-	-
CO5.	**Recognize** the evolving trends and emerging technologies in high-speed networks, staying updated with industry developments and adapting to changing network requirements. (HOTS: Level 5: Evaluate)	-	-	-	-	-	-	-	3
	Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-44(i) Soft Computing

General Course Information

Course Code: MCA-44(i) Elective-II Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Prerequisites: Basic knowledge of Probability Theory, Set Theory and, Data Structure and Computer Algorithms.

About the Course:

We need to learn soft computing techniques to make intelligent machines that possess human like abilities to reason, learn and handle the uncertainty and vagueness often inherent in real world problems. Unlike conventional computing, soft computing techniques are tolerant of imprecision, uncertainty and approximations, and provide low cost, robust and tractable solutions to the complex real-world problems where conventional methods fail to do so. This introductory course on soft computing is going to cover Genetic Algorithms, Artificial Neural Networks and Fuzzy Logic.

Course Outcomes: By the end of the course students will be able to:

CO1. **Define** the terminology and concepts related to soft computing techniques. (LOTS: Level 1: Remember)
CO2. **Discuss** soft computing techniques including genetic algorithms, fuzzy systems and neural networks. (LOTS: Level 2: Understand)
CO3. **Solve** problems related to Genetic algorithms, Fuzzy logic and Neural Networks. (LOTS: Level 3: Apply)
CO4. **Analyse** the design of Genetic Algorithms, Neural Networks and Fuzzy Systems. (HOTS: Level 4: Analyse)
CO5. **Justify** the design of a soft computing algorithm for a given problem. (HOTS: Level 5: Evaluate)
CO6. **Design** Genetic Algorithms and Neural Networks to solve optimization and pattern recognition problems. (HOTS: Level 6: Create)

Course Content

Unit-I

Introduction to Soft Computing and related definitions: Defining soft computing, Differentiating the situations for application of hard and soft computing; Working of a simple Genetic Algorithm: Representation/Encoding Schemes, initializing a GA population, evaluation function, genetic operators, Function optimization using GA.
Study of parameters of genetic algorithms and its performance, sampling and selection mechanisms. Scaling of GA population.

Unit-II

Designing Genetic Algorithms for different applications: Different types encoding schemes, role of fitness function, different types of genetic operators, Designing GAs for numerical optimization, knapsack problem and travelling salesperson and other similar problems.

Unit-III

Fuzzysets:Basicterminologyanddefinitions,OperationsonFuzzysets,MFformulationsandparameterisation, MFs of one and two dimensions, Derivatives of parameterised MFs, Fuzzy numbers, Extension principle and fuzzy relations, Operations on Fuzzy relations, Linguistic variables, Fuzzy If-Then Rules, Compositional rule of inference.

Unit-IV

Neural networks: Basic terminology and definitions, Model of an artificial neuron, Sigmoid function, Neural Network Architectures, Rosenblatt's Perceptron, Fixed increment perceptron learning algorithm for a classification problem, Examples of learning of AND/OR gate by perceptron, XOR problem. Back Propagation Neural Networks: Architecture of a backpropagation network, Model for multi-layer perceptron, Back propagation learning, Delta or gradient descent learning rule and effect of learning rate, Back propagation learning algorithm.

Text and Reference Books:

1. David. E. Goldberg, *Genetic Algorithms in Search, Optimization and machine learning*, Addison Wesley, 1999.
2. Zbigniew Michalewicz, *Genetic algorithms + Data Structures = Evolution Programs*, Springers-Verlag, 1999.
3. M. Mitchell, *An Introduction to Genetic Algorithms*, Prentice-Hall, 1998.
4. S. Rajasekaran & G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications*, PHI, 2003.
5. S. N. Sivanandam & S. N. Deepa, Principles of Soft Computing, Wiley - India, 2007.
6. J-S. R. Jang, C.-T. Sun, E. Mizutani, *Neuro-Fuzzy and Soft Computing*, PHI, 1997.
7. Simon O. Haykin, *Neural Networks, A Comprehensive Foundation*, PHI, 1994.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Define** the terminology and concepts related to soft computing techniques. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Discuss** soft computing techniques including genetic algorithms, fuzzy systems and neural networks. (LOTS: Level 2: Understand)	2	2	-	2	-	-	-	-
CO3. **Solve** problems related to Genetic algorithms, Fuzzy logic and Neural Networks. (LOTS: Level 3: Apply)	3	3	1	3	-	-	-	-
CO4. **Analyse** the design of Genetic Algorithms, Neural Networks and Fuzzy Systems. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	1	-
CO5. **Justify** the design of a soft computing algorithm for a given problem. (HOTS: Level 5: Evaluate)	-	3	1	-	-	-	2	-
CO6. **Design** Genetic Algorithms and Neural Networks to solve optimization and pattern recognition problems. (HOTS: Level 6: Create)	3	-	3	3	-	2	2	2
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-44(ii) Compiler Design

General Course Information

Course Code: MCA-44(ii) Elective-II Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Prerequisites: Knowledge of Discrete mathematic, Theory of computation and Computer algorithms.

About the Course:

Compilers have become part and parcel of today's computer systems. These are responsible for making the user's computing requirements, specified as a piece of program, understandable to the underlying machine. These tools work as interface between the entities of two different domains – the human being and the machine. Compiler design covers basic translation mechanism and, error detection and recovery. It also includes lexical, syntax, and semantic analysis as front end, and code generation and optimization as back-end.

Course Outcomes: By the end of the course students will be able to:

CO1. **State** principles of compiler design. (LOTS: Level 1: Remember)
CO2. **Illustrate** the essential phases for automatically converting source code into target code. (LOTS: Level 2: Understand)
CO3. **Apply** lexical analysis, syntax analysis and code optimization techniques for solving problems. (LOTS: Level 3: Apply)
CO4. **Analyse** a parse tree and a given BNF grammar. (LOTS: Level 4: Analyse)
CO5. **Compare and contrast** syntax-oriented translation schemes (HOTS: Level 5: Evaluate)
CO6. **Design** a lexical analyser from the specification of a language's lexical rules. (HOTS: Level 6: Create)

Course Content

Unit-I

Introduction To Compilers: Compilers and translators, need of translators, structure of compiler its different phases, Compiler construction tools.
Lexical Analysis: Role of lexical analyzer, design of lexical analyzer, regular expressions, Specification and recognition of tokens, input buffering, A language specifying lexical analyzer. Finite automata, conversion from regular expression to finite automata, and vice versa, minimizing number of states of DFA, Implementation of lexical analyzer.

Unit-II

Syntax Analysis: Role of parsers, context free grammars, definition of parsing. Parsing Technique: Shift-reduce parsing, operator precedence parsing, top down parsing, predictive parsing.

Unit-III

LR parsers, SLR, LALR and Canonical LR parser. Syntax Directed Translations: Syntax directed definition, construction of syntax trees, syntax directed translation scheme and implementation of syntax directed translation, three address code, quadruples and triples.

Unit-IV

Symbol Table & Error Detection and Recovery: Symbol tables, its contents and data structure for symbol tables; trees, arrays, linked lists, hash tables. Errors, lexical phase error, syntactic phase error, semantic error. Code Optimization & Code Generation: Code generation, forms of objects code, machine dependent code, optimization, register allocation for temporary and user defined variables.

Text and Reference Books:

1. Alfread V. AHO, Ravi Sethi and J.D. Ullman, *Compilers Principle, Techniques and Tools*, Addison Wesley, 2007.
2. Tremblay and Sorenson, *Theory and practice of compiler writing*, McGraw Hill, 1985.
3. Dhamdare, *System software*, MGH, 1986.
4. Alfred V. Aho, Jeffrey D. Ullman, *Principles of Compiler Design*, Narosa Publication, 2002.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **State** principles of compiler design. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Illustrate** the essential phases for automatically converting source code into target code. (LOTS: Level 2: Understand)	3	2	-	2	-	-	-	-
CO3. **Apply** lexical analysis, syntax analysis and code optimization techniques for solving problems. (LOTS: Level 3: Apply)	3	3	-	3	-	-	-	-
CO4. **Analyse** a parse tree and a given BNF grammar. (LOTS: Level 4: Analyse)	-	3	-	2	-	-	-	-
CO5. **Compare and contrast** syntax-oriented translation schemes (HOTS: Level 5: Evaluate)	-	3	-	2	-	-	-	-
CO6. **Design** a lexical analyser from the specification of a language's lexical rules. (HOTS: Level 6: Create)	3	-	2	3	-	1	-	1
Level of Attainments								

*Attainment Levels:
- None
1: Low, 2: Medium, 3: High

MCA-44(iii) Data Mining Techniques

General Course Information

Course Code: MCA-44(iii) Elective-II Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisites: Knowledge of database systems, elementary knowledge of statistics and probability.

About the Course:

Data is growing exponentially day by day. There is a need to process and analyse the data to extract knowledge from it, so that one can use that knowledge for decision making. This course provides introductory concepts of data mining and data warehousing. The course will be taught with a database as well as machine learning perspectives. The objective of the course is to provide a comprehensive understanding of data prep-processing, data mining tasks and evaluation of results obtained out of data mining processes.

Course Outcomes: By the end of the course students will be able to:

CO1. **Outline** various types of data mining and data warehouse concepts and techniques. (LOTS: Level 1: Remember)
CO2. **Explain** characteristics, architecture of a data warehouse, OLAP operations and data mining tasks. (LOTS: Level 2: Understand)
CO3. **Apply** various pre-processing and data mining techniques for extracting valuable information from data. (LOTS: Level 3: Apply)
CO4. **Evaluate** the descriptive and predictive data mining models. (HOTS: Level 5: Evaluate)
CO5. **Plan** a data mining process for discovering knowledge from real-world databases. (HOTS: Level 6: Create)

Course Content

Unit-I

Introduction to Data Mining: Kind of data to be mined, Data Mining Functionalities, Technologies used in Data Mining, Applications of data Mining, Major Issues in Data Mining.
Data Pre-Processing: Need for preprocessing, Data Objects and Attribute types, Statistical description of data, Data Visualization, Measuring similarity and dissimilarity of data, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization.

Unit-II

Data Warehouse: Introduction, Data Warehouse and Database Systems, Data Warehouse Architecture, Data Warehouse Models, Data Cube and OLAP, Multidimensional data Model, Concept Hierarchies, OLAP operations, Data Warehouse Implementation

Unit-III

Mining Associations and Correlations: Mining Frequent Patterns, Associations and Correlations, Frequent

Itemset Mining using Apriori Algorithm, Generating Association Rules from Frequent Itemsets. Improving efficiency of Apriori, Pattern Growth Approach for Mining Frequent Itemsets, Pattern evaluation Methods.
Advanced Pattern Mining: Pattern Mining in Multilevel and Multidimensional Space, Constraint-Based Frequent Pattern Mining.

Unit-IV

Classification: Introduction, Classification using Decision Tree Induction, Bayesian Classification Methods, Rule Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy. Classification by Backpropagation, Support Vector Machines and Lazy Learners.
Cluster Analysis: Introduction, Basic Clustering Methods, Partitioning Methods, Hierarchical Methods, Evaluation of Clustering.

Text and Reference Books:

1. Jiawei Han, Micheline Kamber and Jian Pei, *Data Mining Concepts and Techniques*, Morgan Kaufmann Publishers, Third Edition, July 2011.
2. Alex Berson, Stephen J. Smith, *Data Warehousing, Data Mining & OLAP*, Tata McGraw Hill, 2004.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, *Introduction to Data Mining*, Pearson Education, 2014.
4. K. P. Soman, Shyam Diwakar and V. Ajay, *Insight into Data Mining Theory and Practice*, Easter Economy Edition, Prentice Hall of India, 2009.
5. G. K. Gupta, *Introduction to Data Mining with Case Studies*, Prentice Hall of India, 2006.
6. Daniel T. Larose, *Data Mining Methods and Models*, Wiley, 2006.
7. W. H. Inman, *Building the Data Warehouse*, Wiley India, 2005.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Outline** various types of data mining and data warehouse concepts and techniques. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Explain** characteristics, architecture of a data warehouse, OLAP operations and data mining tasks. (LOTS: Level 2: Understand)	2	2	-	2	-	-	-	-
CO3. **Apply** various pre-processing and data mining techniques for extracting valuable information from data. (LOTS: Level 3: Apply)	3	3	-	3	-	-	-	-
CO4. **Evaluate** the descriptive and predictive data mining models. (HOTS: Level 5: Evaluate)	-	3	-	2	-	-	2	-
CO5. **Plan** a data mining process for discovering knowledge from real-world databases. (HOTS: Level 6: Create)	3	-	2	3	-	2	1	2
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-44(iv) Computer Graphics

General Course Information

Course Code: MCA-44(iv) Elective II Course Credits: 3 Type: Professional Core Contact Hours: 3 hours/week Mode: Lectures (L) Exam Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor examinations each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. The syllabus is divided into four units. For the end semester examination, nine questions are to be set by the examiner. Question number one is compulsory and contains seven short answer questions covering entire syllabus. Rest eight questions are set by giving two questions from each unit of the syllabus. A candidate is required to attempt any four questions selecting at least one from each of the four units. All questions carry equal marks.

Pre-requisites: Basic mathematical concepts and computer algorithms.

About the Course:

The course delves into graphic techniques, algorithms, and imaging models. Students learn to create 2-D and 3-D objects, apply clipping and transformation techniques, and compare various graphics algorithms. This course equips students to design user-friendly interfaces and grasp the fundamental concepts of computer graphics.

Course Outcomes: By the end of the course students will be able to:

CO1. **State** basic concepts related to graphics. (LOTS: Level 1: Remember)
CO2. **Describe** the principles of creating graphical objects and graphical user interface applications. (LOTS: Level 2: Understand)
CO3. **Apply** different clipping and transformations techniques for diverse geometric objects. (LOTS: Level 3: Apply)
CO4. **Compare** different graphics algorithms for geometric objects. (HOTS: Level 4: Analyse)
CO5. **Design** and represent curves and surfaces using parametric methods such as Bezier and B-Spline curves, and interpolation techniques. (HOTS: Level 6: Create)

Course Content

Unit-I

Introduction to Computer Graphics: What is Computer Graphics, Computer Graphics Applications, Computer Graphics Hardware and software, Two dimensional Graphics Primitives: Points and Lines, Line drawing algorithms: DDA, Bresenham's; Circle drawing algorithms: Using polar coordinates, Bresenham's circle drawing, mid-point circle drawing algorithm; Filled area algorithms: Scan-line: Polygon filling algorithm, boundary filled algorithm.

Unit-II

Two/Three Dimensional Viewing: The2-Dviewing pipeline, windows, viewports, window to view port mapping; Clipping: point, clipping line (algorithms):- 4 bit code algorithm, Sutherland-cohen algorithm, parametric line clipping algorithm (Cyrus Beck). Polygon clipping algorithm: Sutherland-Hodgeman polygon clipping algorithm.
Two dimensional transformations: transformations, translation, scaling, rotation, reflection, composite transformation.
Three dimensional transformations: Three-dimensional graphics concept, Matrix representation of 3-D

Transformations, Composition of 3-D transformation.

Unit-III

Viewing in 3D: Projections, types of projections, the mathematics of planner geometric projections, coordinate systems.
Hidden surface removal: Introduction to hidden surface removal, Z- buffer algorithm, scanline algorithm, area sub-division algorithm.

Unit-IV

Representing Curves and Surfaces: Parametric representation of curves: Bezier curves, B-Spline curves. Parametric representation of surfaces; Interpolation method.
Illumination, shading, image manipulation: Illumination models, shading models for polygons, shadows, transparency. What is an image? Filtering, image processing, geometric transformation of images.

Text and reference books:

1. James D. Foley, Andeies van Dam, Stevan K. Feiner and JohbF. Hughes, *Computer Graphics Principles and Practices*, AddisionWesley,Third Edition, 2019.
2. Pradeep K Bhatia, *Computer Graphics*, I K International Pub, New Delhi,Third Edition, 2013.
3. Donald Hearn and M. Pauline Baker, *Computer Graphics*, PHI, Second Edition, 1999.
4. David F. Rogers, *Procedural Elements for Computer Graphics*, T.M.H, Second Edition, July 2017.
5. Alan Watt, *Fundamentals of 3Dimensional Computer Graphics*, AddisionWesley, Third Edition, 2000.
6. Corrign John, *Computer Graphics: Secrets and Solutions*, BPB, 1994.
7. Pilania&Mahendra, *Graphics, GUI, Games & Multimedia Projects in C*, Standard Pub., 2002.
8. N. Krishanmurthy, *Introduction to Computer Graphics*, T.M.H, 2002.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **State** basic concepts related to graphics. (LOTS: Level 1: Remember)	3	-	-	-	-	-	-	1
CO2. **Describe** the principles of creating graphical objects and graphical user interface applications. (LOTS: Level 2: Understand)	2	2	-	2	-	-	-	-
CO3. **Apply** different clipping and transformations techniques for diverse geometric objects. (LOTS: Level 3: Apply)	3	3	-	3	-	-	-	-
CO4. **Compare** different graphics algorithms for geometric objects. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	-	-
CO5. **Design** and represent curves and surfaces using parametric methods such as Bezier and B-Spline curves, and interpolation techniques. (HOTS: Level 6: Create)	3	-	2	3	-	1	-	2
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-45 IoT and Cloud Computing Lab.

General Course Information

Course Code: MCA-45 Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic programming skills.

About the Course:

This course in IoT and Cloud Computing equips students with the skills to apply cloud and IoT frameworks effectively. They learn to analyze cloud setups, design workflows, and maintain ethical practices. Through experiments and assignments, students gain hands-on experience with various Amazon Web Services, databases, and IoT protocols, enhancing their ability to address real-world problems in these domains.

Course Outcomes: By the end of the course students will be able to:

CO1. **Apply** cloud computing and IoT frameworks to address the problems in respective domains (LOTS: Level 3:Apply)
CO2. **Analyse** the cloud computing setup with its vulnerabilities and applications using different architectures. (HOTS: Level 4:Analyse)
CO3. **Design** different workflows according to requirements and apply map reduce programming model. (HOTS: Level 6:Create)
CO4. **Create** lab record for assignments that includes problem definitions, design of solutions and conclusions. (HOTS: Level 6:Create)
CO5. **Demonstrate** use of ethical practices, self-learning and team spirit.

List of experiments/assignments:

1. Amazon Simple Storage Service (Amazon S3) and Amazon Glacier Storage
2. Amazon Elastic Compute Cloud (Amazon EC2) and Amazon Elastic Block Store
3. Amazon Virtual Private Cloud (Amazon VPC)
4. Elastic Load Balancing, Amazon CloudWatch, and Auto Scaling
5. AWS Identity and Access Management (IAM)
6. Databases and AWS
7. SQS, SWF, and SNS
8. Domain Name System (DNS) and Amazon Route 53
9. Amazon ElastiCache
10. Additional Key Services
11. Security on AWS
12. MQTT, REST/HTTP, CoAP, MySQL, apache for handling HTTP Requests, PHP & MySQL for data processing, MongoDB object type database
13. HTML, CSS & jQuery for UI designing, JSON lib for data processing, security & privacy during development, Working with arduino and intel galileo boards/Rsapberry Pi

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Apply** cloud computing and IoT frameworks to address the problems in respective domains (LOTS: Level 3:Apply)	3	-	-	3	-	-	-	-
CO2. **Analyse** the cloud computing setup with its vulnerabilities and applications using different architectures. (HOTS: Level 4:Analyse)	-	3	-	2	-	-	2	-
CO3. **Design** different workflows according to requirements and apply map reduce programming model. (HOTS: Level 6:Create)	3	-	3	3	-	2	-	2
CO4. **Create** lab record for assignments that includes problem definitions, design of solutions and conclusions. (HOTS: Level 6:Create)	-	-	-	-	2	2	-	-
CO5. **Demonstrate** use of ethical practices, self-learning and team spirit.	-	-	-	-	3	-	3	-
Level of Attainments								

*Attainment Levels:

- None

1: Low, 2: Medium, 3: High

MCA-46 Android Programming Lab.

General Course Information

Course Code: MCA-46 Course Credits: 2 Type: Professional Core Lab. Course Contact Hours: 4 hours/week Mode: Lab practice and assignments	**Course Assessment Methods:** **Total Marks: 100 (internal: 50; external:50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the laboratory course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. For implementing the spirit of continuous evaluation, the course coordinators will maintain the experiment-wise record of the performance of students for the laboratory courses as a part of their lab course file. The course coordinator/Internal Examiners/External Examiners will maintain and submit the bifurcation of marks obtained by the students in internal as well as external evaluations in the prescribed proformas to the respective departments in addition to submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the course outcomes of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Java Programming and Object-oriented programming, knowledge of XML, JSON and database concepts.

About the Course:

This lab. course on Android Programming helps students to learn how to develop android apps.

Course Outcomes: By the end of the course students will be able to:

CO1. **Apply** Android programming concepts for calling, display, creation and validation. (LOTS: Level 3: Apply)
CO2. **Compare** the visual effects generated by Android and visual studio frameworks. (HOTS: Level 4: Analyse)
CO3. **Generate** solutions for content providers and permissive models. (HOTS: Level 6: Create)
CO4. **Design** applications for Android Programming by using Android Studio framework. (HOTS: Level 6: Create)
CO5. **Create** lab record of the solutions for assignment. (HOTS: Level 6: Create)
CO6. **Demonstrate** ethical practices, independent enquiry and self-learning to solve unseen problems. (LOTS: Level 3: Apply)

List of experiments/assignments:

1. Setting up development environment, Dalvik Virtual Machine & .apk file extension, Fundamentals: a. Basic Building blocks - Activities, Services, Broadcast Receivers & Content providers b. UI Components – Views& notifications c. Components for communication -Intents & Intent Filters, AndroidAPI levels (versions & version names).
2. Emulator-Android Virtual Device, Launching emulator, Editing emulator settings, Emulator shortcuts, Logcat usage, Introduction to DDMS, Second App: - (switching between activities) Develop an app for demonstrating the communication between Intents.
3. Design a Basic of UI structure, Form widgets, Text Fields, Layouts, [dip, dp, sip, sp] versus px, Menu, Option menu, Context menu, Sub menu, menu from xml, menu via code.
4. Implementation of Intents (in detail), Explicit Intents, Implicit intents with Examples
5. Styles & Themes, styles.xml, drawable resources for shapes, gradients (selectors), style attribute in layout file, Applying themes via code and manifest file.
6. SQLite Programming, SQLite Open Helper, SQLite Database, Cursor, Reading and updating Contacts, Reading bookmarks.
7. Notifications, Broadcast Receivers, Services and notifications, Toast, Alarms.

Note:
The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Apply** Android programming concepts for calling, display, creation and validation. (LOTS: Level 3: Apply)	3	-	-	3	-	-	-	-
CO2. **Compare** the visual effects generated by Android and visual studio frameworks. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	-	-
CO3. **Generate** solutions for content providers and permissive models. (HOTS: Level 6: Create)	3	-	3	3	-	2	-	-
CO4. **Design** applications for Android Programming by using Android Studio framework. (HOTS: Level 6: Create)	3	-	3	3	-	2	-	2
CO5. **Create** lab record of the solutions for assignment. (HOTS: Level 6: Create)	-	-	-	-	2	2	-	-
CO6. **Demonstrate** ethical practices, independent enquiry and self-learning to solve unseen problems. (LOTS: Level 3: Apply)	-	-	-	-	3	-	3	2
Level of Attainments								

*Attainment Levels:
- None
1: Low, 2: Medium, 3: High

MCA-47 PROJECT WORK

General Course Information

Course Code: MCA-47 Course Credits: 6 Mode: Self learning under the guidance of a faculty member.	**Course Assessment Methods (internal: 30; external: 70)** Evaluation is done by the internal examiner (project guide) and external examiner appointed by Controller of Examination. The criteria for evaluation are given below. 1. Review of literature related to problem domain: 15% 2. Significance and originality of the solution presented: 15% 3. Application of software engineering principles and project management: 15% 4. Significance and Scope of results: 20% 5. Organization and presentation of major project report: 20% 6. Level of Ethics and societal issues covered: 15%

About the Project Work:

The project work is an opening to apply computing concepts, principles and techniques in a real life scenario. It provides opportunity to every student to address computing application problems of contemporary importance in an original and innovative way. A student learn to review the existing solutions for the chosen tentative problem and arrive at the exact problem statement and methodology. A student explores the modern tools to address the problem. Writing project report offers an opportunity to organise the ideas and results in an effective manner. Overall, the project work inspires project planning and lifelong learning.

Course Outcomes: After doing Project students will be able to:

CO1. **Review** critically the existing solutions and methodologies for similar problems. (HOTS: Level 4: Analyse)
CO2. **Devise** original and innovative solutions to complex computing problems using modern tools. (HOTS: Level 6: Create)
CO3. **Justify** the outcomes of the project work. (HOTS: Level 5: Evaluate)
CO4. **Apply** the principles of project management while carrying out the project work. (LOTS: Level 3: Apply)
CO5. **Organize** and communicate (written and oral) ideas effectively. (HOTS: Level 6: Create)
CO6. **Develop** solutions that meet ethical, societal and legal considerations. (HOTS: Level 6: Create)

Note:
Students start working on their project work in the beginning of fourth semester. Students do the background research for identifying appropriate problems, methodology and tools for their respective project works. Students can carry out projects in groups of two. In case of a group project, the size of the problem should be significant, and members of the group must specify their individual contribution. They are required to complete their project work by the end of the 4^{th} semester. They prepare the final project reports according to the format provided. The guidelines for preparing and evaluating project report are given in Chapter 8.

List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1. **Review** critically the existing solutions and methodologies for similar problems. (HOTS: Level 4: Analyse)	-	3	-	2	-	-	-	2
CO2. **Devise** original and innovative solutions to complex computing problems using modern tools. (HOTS: Level 6: Create)	3	-	3	3	-	3	-	2
CO3. **Justify** the outcomes of the project work. (HOTS: Level 5: Evaluate)	-	3	-	-	-	-	2	-
CO4. **Apply** the principles of project management while carrying out the project work. (LOTS: Level 3: Apply)	-	-	-	-	-	3	-	-
CO5. **Organize** and communicate (written and oral) ideas effectively. (HOTS: Level 6: Create)	-	-	-	-	3	-	-	3
CO6. **Develop** solutions that meet ethical, societal and legal considerations. (HOTS: Level 6: Create)	-	-	3	-	-	-	3	-
Level of Attainments								

*Attainment Levels:
- None
1: Low, 2: Medium, 3: High

Chapter 5: Guidelines for Assessment of Theory Courses

5.1 Assessment tools for theory courses

The overall direct and indirect tools of assessment for theory courses are given below.

Assessment Tools for Theory Courses		
Direct Tools		
Sr No.	**Description of the tool**	**COs Covered**
1	Minor Examination I	At least first Three Levels of COs (Remember, Understand, Apply)
2	Minor Examination II	At least first Four Levels of COs (Remember, Understand, Apply, Analyse)
3	Assignment I	Last Three Levels of COs (Analyse, Evaluate, Create)
4	Assignment II	Last Three Levels of COs (Analyse, Evaluate and Create)
6	Attendance/Level of Participation in Class	Learning Curve and Communication
7.	Final Examination	Possibly Covering all levels of COs
Indirect Tools		
1.	End-Semester Survey	Covering all levels of COs
2.	Exit Survey	Covering all POs

5.2 Guidelines for internal evaluation

1. All the teachers are required to set questions for sessional/minor examinations according to the COs. The level of COs must be mentioned against each question.
2. The two sessional/minor examinations together must cover at least first four levels of COs.
3. It is compulsory to give two assignments during the semester pertaining to the last three levels of COs.
4. The sessional/minor examination answer sheets must be evaluated as per the COs.
5. All the teachers are required to maintain the internal evaluation record according the COs.
6. All the teachers are required to submit the internal evaluation record along with the CO attainment levels.
7. The respective proformas for making sessional/ minor question papers, maintaining CO-wise evaluation record of the course and submitting the CO attainment levels are given next in this chapter.

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Detailed Direct Tools for Internal Assessment

<table>
<tr><td>Sessional 1</td><td>The sessional exams must contain four questions.
<table>
<tr><td>Question No.</td><td>Question No. 1</td><td>Question No. 2</td><td>Question No. 3</td><td>Question No. 4</td></tr>
<tr><td>Levels of Bloom’s Taxonomy</td><td>First level: Remember</td><td>Second level: Understand</td><td>Third Level: Apply</td><td>Any of these levels (3, 4, 5) Apply, Analyse, Evaluate</td></tr>
<tr><td>Marks Distribution</td><td>4</td><td>4</td><td>6</td><td>6</td></tr>
</table></td></tr>
<tr><td>Sessional 2</td><td>
<table>
<tr><td>No. of Questions</td><td>Question No. 1</td><td>Question No. 2</td><td>Question No. 3</td><td>Question No. 4</td></tr>
<tr><td>Levels of Bloom’s Taxonomy</td><td>First level: Remember</td><td>Second level: Understand</td><td>Third Level: Apply</td><td>Last three levels: (4, 5, 6) Analyse, Evaluate, Create</td></tr>
<tr><td>Marks Distribution</td><td>4</td><td>4</td><td>6</td><td>6</td></tr>
</table></td></tr>
<tr><td>Assignment 1</td><td>Must be assessed for the last three levels.
20</td></tr>
<tr><td>Assignment 2</td><td>Must assesses for the last three levels.
20</td></tr>
<tr><td>Industrial Training</td><td>Based on the last four levels</td></tr>
<tr><td>Major Project</td><td>Based on the last four levels</td></tr>
</table>

Note:

1. The internal assessment will be submitted out of 30 marks. (20 marks for minors and 10 for class performance and attendance)
2. The teachers have liberty to modify distribution of marks across all COs provided they must give at least equal weightage to LOTS and HOTS level COs. The COs pertaining to LOTS should not dominate the evaluation process.
3. The teachers can assign marks for assignments at their liberty for computing COs’ attainment levels.

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Record of CO-wise Internal Assessment

Name of the Programme:	Semester:
Nomenclature of the Course:	Course Code:

Details of Students		Sessional I					Sessional II					Assign I	Assign II	Overall Attainment				
Roll. No.	**Name**	**Q1 CO1 4**	**Q2 CO2 4**	**Q3 CO3 6**	**Q4 CO4 6**	**- CO5**	**Q1 CO1 4**	**Q2 CO2 4**	**Q3 CO3 6**	**Q4 CO4 6**	**- CO5**	**CO4+ CO5 20**	**CO4+CO5 20**	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
101	-	3	3	4	4	-	4	3	5	4	-	12	16	7/8 0.85	6/8 0.80	9/12 0.79	24/28 0.63	16/20 0.80
102	-													-	-	-	-	-
103	-													-	-	-	-	-
104	-													-	-	-	-	-
% student getting morethan 55 % marks														0.82	0.78	0.72	0.65	0.60
Attainment Levels														**3**	**3**	**3**	**2**	**1**

Name of the Course Coordinator	**Signature of the Course Coordinator**

Max marks for COs: CO1:8; CO2: 8; CO3=12; CO4=28; CO5=38. (Teacher is at liberty to assign marks to the assignments. The proportion marks to HOTs should not be less than LOTs)

Criteria for Computing Attainment Level

Attainment Level - (None): Below 60% of students score more than 55% marks out of the maximum relevant marks.

Attainment Level 1 (low): 60% of students score more than 55% marks out of the maximum relevant marks.

Attainment Level 2 (Medium): 70% of students score more than 55% marks out of the maximum relevant marks.

Attainment Level 3 (high): 80% of students score more than 55% marks out of the maximum relevant.

Sample Overall Attainment Level of COs for Data Structures and Algorithms Course	
List of Course Outcomes	**Level of attainment**
CO1. list or describe types of data structures and operations that can be implemented on these data structures.	**3**
CO2. Demonstrate the use of various data structure and their related operations	**3**
CO3. Apply appropriate data structures with respect to effective storage of data and efficiency of the required operations on data for solving real world problems.	**3**
CO4. Analyse the time complexity of searching and algorithms.	**2**
CO5. formulate data structures and prescribe operations for given real world situations.	**1**

Chapter 6: Guidelines Internal and external Assessment of Lab. Courses

6.1 Assessment Tools for Lab. Courses

The assessment tools for evaluating lab. courses are given below.

Assessment Tools for Lab. Courses		
Direct Tools		
Sr No.	**Description of the tool**	**COs Covered**
1	Assignments	10 to 15 assignments based on the last four levels of COs (Apply, Analyse, Evaluate, Create)
2.	Group Assignment (s)	Last three levels of COs (Analyse, Evaluate, Create)
3.	Internal Examinations (Two minor lab. assessments) (Implementing a problem, lab. record, VIVA-VOCE, use of ethical practices, self-learning and group spirit.	Last four levels of COs (Apply, Analyse, Evaluate, Create)
4.	External Examination (Implementing a problem, lab. record, VIVA-VOCE, use of ethical practices	Last four levels of COs (Apply, Analyse, Evaluate, Create)
Indirect Tools		
1.	End-Semester Survey	Covering all levels of COs
2.	Exit Survey	Covering all POs

6.2. Guidelines for internal and external evaluation of lab. courses:

1. The internal assessment will be submitted out of 30 marks. (20 marks for internal lab. Practical examinations and 10 for class performance and attendance)
2. The internal evaluation will be done by the course coordinator by conducting internal lab. practical examinations.
3. The internal lab practical examinations are to be conducted strictly on the pattern of external practical examination.
4. The evaluation must be done to measure the attainment level of COs.
5. The proforma for break-up of marks for internal and external lab. course evaluations are given on next page.

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Internal/External Lab. Course Evaluation Proforma

Name of the Programme:
Semester:
Nomenclature of the Course:
Course Code:
Type of lab. Assessment (Minor Lab Assessment1/ Minor Lab Assessment2/External)

SR. No.	Roll. No.	Quality of solutions devised and implemented	(VIVA-VOCE) based on lab. from CO2 to CO4			Class Performance and Quality of Lab. Record.	Ethical practices followed, Self-Learning and Team Spirit	Total
		CO1 (15)	CO2 (5)	CO3 (5)	CO4 (5)	CO5 (15)	CO6 (5)	50
1								
2								
3								
.								
.								

Total No. of Students	Present:	Absent
Name of the Course Coordinator/ Internal Examiner	Signature of the Course Coordinator/ Internal Examiner	
Name of External Examiner (If Applicable)	Signature of External Examiner (If Applicable)	

Chapter7: Evaluating Training Report

7.1 Evaluation of Industrial Training/Internship

It is mandatory for all the students to go for industrial training/internship after second semester. The students internship work is evaluated as per the criteria given in the evaluation proforma given below.

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Name of the Programme:_____

Credits: 2

Semester:_____

Total Marks: 100

Session:_____

Evaluation of Industrial Training (MCA-38)					
SR. No.	Roll. No.	Significance and knowledge of the internship domain (VIVA-VOCE) CO1+CO2+CO4 (30)	Modern tools usage, skill enhancement and the computing system developed CO3 (30)	Quality of Report Writing CO6 (25)	Level of ethics followed CO7 (15)
1					
2					
3					
.					
.					

Name of the examiner: Signature of the Examiner: Date: Signature of Chairperson	Total Candidates: No. of Candidates Present: No. of Candidates Absent:

7.2 Guidelines for Preparing Industrial Training (MCA-38) Report

All the students are required to follow these guidelines for preparing their industrial training report.

7.2.1 General Guidelines

The industrial training report must include a declaration by the student that he/she has followed ethical practices while doing the industrial training/internship. Any violation of ethical practices will lead to rejection of the industrial training/internship report. For instance, a plagiarized report or a readymade report purchased from market will be rejected straight away.

7.2.2 Formatting Instructions

The formatting instructions are given in Table below.

Formatting Instructions		
Sr. No.	Item	Formatting
1.	No. of pages	Minimum 20 and maximum 40
2.	Paper size	A4
3.	Font Type	Times New Roman
4.	Normal text size	12
5.	Page numbering	Place: Centre Bottom Type: Front material in Roman numbers
6.	Margins	Left margin: 3.75 cms (1.5 inch) Right, bottom, top= 2.5 cms (1 inch)
7.	References/Bibliography	IEEE format
8.	Binding	soft binding of good quality

7.2.3 Contents of the Industrial Training Report

The contents of the industrial training report should be organised as described below.

1. Declaration that the students has carried out his work on his own. It is his/her original creation, not plagiarised from any other source and due credit has been given to the source material used in the industrial training report through references and citations.
2. Acknowledgement
3. List of figures
4. List of Tables
5. List of Abbreviations
6. Contents

Contents in the Body of the industrial training report

The report must be written in English. The ideas must be organised in a clear and concise fashion.

S. No	Content	Tentative No. of pages
1.	Profile of the Company	At most 2 pages
2.	Introduction	2-4 pages
3.	Description of skills learned	4-6 pages
4.	Application developed (if any) based on skills learnt	10-18 pages
5.	Scope of the training/ application developed	1 paragraph

The industrial training/internship report should no way exceed 40 pages and should be submitted in soft binding of good quality.

7.2.4. Format of the title page

The format of the title page is given is given on next page.

TITLE OF THE INDUSTRIAL TRAINING REPORT

(Write in Times New Roman, 16-point size, Bold and Centred and Uppercase font)

Training report submitted to
Guru Jambheshwar University of Science and Technology, Hisar
for the partial award of the degree

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 4 lines gap with 12 font size from the title of the project)

of

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 1 lines gap with 12 font size from the text above in three lines)

Master of Computer Applications

(Write in Times New Roman, 14-point size, Bold, Centred style after "***of***" after 1 line gap with 12 font size)

By

(Write in Times New Roman 12-point size, Bold, Italics, and Centred style after the name of the degree with 1 line gap with 12 font size)

Your Name

(Enrolment Number)

(Write in Times New Roman, 14-point size font, Bold, Centred style after1 line gap with 12 font from "***By***")

Department of Computer Science & Engineering
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE AND TECHNOLOGY, HISAR

Month, Year

(Write in Times New Roman, 14-point size font, Bold, Centred style, after 2 lines gap from logo)

7.2.5 Declaration to be submitted for training report

DECLARATION

I, *Your Name*, *Your Roll No*., certify that the work contained in this industrial training report is original and has been carried by me in the --------- (*company name*) ---------. This work has not been submitted to any other institute for the award of any degree and I have followed the ethical practices and other guidelines provided by the Department of Computer Science and Engineering in preparing the industrial training report.

Signature

Name of Student

Registration Number

Department of Computer Science and Engineering

Guru Jambheshwar University of Science and Technology, Hisar

Chapter 8: Evaluating Project Report

8.1 Guidelines for preparing Project Work Report

All the students are required to follow these guidelines for preparing their final project report.

8.1.1 General Guidelines:

1. The report must include a declaration by the student that he/she has followed ethical practices while doing the project work. Any violation of ethical practices will lead to rejection of the report. For instance, a plagiarized report or a readymade report purchased from market will be rejected straight away.
2. The project report must include a similarity index report generated by Turnitin software. The similarity index must be less than 10 %.
3. Project works carried out in groups of two students must include the individual contribution of the students.
4. The report must be submitted to the internal guide in soft binding at least 10 days before the final examination so that he/she can suggest changes before the report is presented to external examiner.

8.1.2 Formatting Instructions

The formatting instructions are given in Table below.

Formatting Instructions		
Sr. No.	Item	Formatting
1.	Front Cover	Dark Green and contents in golden ink
2.	No. of pages	Minimum 40 and maximum 70 excluding front material
3.	Paper size	A4
4.	Font Type	Times New Roman
5.	Chapter Heading Font	16
6.	Font of Sections and Subsections	14 and 12 in bold style
7.	Numbering style for sections and subsections; Do not use more than three levels.	2., 2.1 and 2.1.1
8.	Normal text size	12
9.	Figures and Tables must be numbered chapter-wise. Table headings on the top of the tables and Figure heading at the bottoms of the figures.	For example for chapter 2, Figures should be numbered as Fig. 2.1, Fig. 2.2 etc. and Tables as Table 2.1 and Table 2,2 etc.
10.	Page numbering	Place: Centre Bottom Type: Front material in Roman numbers

		Body of the report: in Arabic numerals. Pagination must start with first page of the first chapter and continue throughout the end of the report.
11.	Margins	Left margin: 3.75 cms (1.5 inch) Right, bottom, top= 2.5 cms (1 inch)
12	References/Bibliography	IEEE format
13	Binding	Hard binding of good quality

8.1.3 Contents of the Project Report

The content of the report should be organised as described below.

1. The first page in the report should be same as the cover page.
2. Declaration that the students has carried out his work on his own. It is his/her original creation, not plagiarised from any other source and due credit has been given to the source material used in the report through references and citations.
3. Similarity Index Report
4. Acknowledgement
5. List of figures
6. List of Tables
7. List of Abbreviations
8. Contents
   Abstract (in not more than 250 words)
   This answers the question what have you done? How have you done and brief indication about the results.
9. Body of the Report
   The report must be written in English. The ideas must be organised in a clear and concise fashion. Chapters must be tentatively organised as below.

   Chapter 1. Introduction
   This includes introduction to relevant area of project, problem formulation objectives of the project, and structure of the project report.
   Chapter 2. Background Details and Literature Review
   Chapter 3. Design or Framework of the project work
   Methodology, Data Flow Diagrams, Entity Modelling etc.
   Chapter 4. Discussion, comparison and Analysis of Results
   Chapter 5. Conclusion and Future Scope
   This includes relevance and scope of the project work, and its extensions.
   References/Bibliography
10. Appendices

8.1.4 Declaration to be Submitted

The format of declaration to be included in the project report is given on next page.

8.1.5 Format of the Title Page

The format of the title page for the Project Work is given on the next to next page

DECLARATION

I, *Your Name, Your Registration No.*, certify that the work contained in this project report entitled "……..." is original and has been carried by me under the guidance of my supervisor. This work has not been submitted to any other institute for the award of any degree or diploma. I have followed the academic integrity and ethical practices, and other guidelines provided by the Department of Computer Science and Engineering while doing the project. Whenever I have used materials (data, theoretical analysis, figures, and text) from other sources, I have given due credit to them by citing them in the text of the report and giving their details in the references. Further, I have taken permission from the copyright owners of the sources, wherever necessary.

Signature
Name of the Student
Registration Number
Department of Computer Science and Engineering
Guru Jambheshwar University of Science and Technology, Hisar

Signature
Name of the Supervisor
Designation
Department of Computer Science and Engineering
Guru Jambheshwar University of Science and Technology, Hisar

Similarity Index Certificate

It is certified that I Mr./Ms. ……S/o (D/o) …….……

Registration no. …….has carried out this project work on the topic **"……"**. The project report has been checked by the TURNITIN Software. The similarity index is ……..% and it below the accepted norms of the university. The project report may be considered for the award of the degree.

The following is permitted to be excluded while checking similarity index using TURNITIN:

i. Published research papers/articles (if any) based on the project work where the student is an author.
ii. All the quoted work reproduced with all necessary permission and/or attribution.
iii. The front page, all certificates, declarations, Table of Contents, List of Figures, List of Tables, List of Abbreviations and references.
iv. All generic terms, laws, standard symbols and equations.
v. Common knowledge/definitions or coincidental terms up to 14 consecutive words.

Signature

Name of the student

Registration Number

TITLE OF THE PROJECT REPORT

(Write in Times New Roman, 16-point size, Bold and Centred and Uppercase font)

Project report submitted to
Guru Jambheshwar University of Science and Technology, Hisar
for the partial award of the degree

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after 4 lines gap with 12 font size from the title of the project)

of

(Write in Times New Roman, 12-point size font, Bold, Italics and Centred style after two lines gaps with 12 fontsize from the text above in three lines)

Master of Computer Applications

(Write in Times New Roman, 14-point size, Bold, Centred style after "***of***" after 2 line gaps with 12 font size)

by

(Write in Times New Roman 12-point size, Bold, Italics, and Centred style after the name of the degree with 2 lines gap with 12)

Your Name **Supervisor Name**

(Enrolment Number) **Designation**

(Write in Times New Roman, 14-point size font, Bold, Centred style after 2 lines gap with 12 font from "***by***")

Department of Computer Science &Engineering
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE AND TECHNOLOGY, HISAR

Month, Year

Chapter 9: Indirect Assessment Tools: End Semester and Exit Survey Samples

Sample Theory Course Feedback Form (MCA)

Department of Computer Science and Engineering

GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY

HISAR-125001

MCA: End Semester Feedback Form (Course: Data Analytics- MCA-33)

Instructions: This is anonymous survey. You may prefer not to give your personal details. Kindly give response to the following questions as per your own opinion. Your feedback will help in improving this course.

General Information

1. Name of the student (Optional)

2. Registration No. (Optional)

3. Admission year: (Enter Academic Session, i.e., 2022-2023) *

4. Name of the Course: *

5. Course code *

6. Current Semester *

Course Feedback

Please give your responses being objective and honest.

---

1. The suitability of the contents of this course as per the state-of-art requirements. *

   Mark only one oval.

   - ◯ Not Suitable (1)
   - ◯ Good (2)
   - ◯ Very Good (3)
   - ◯ Excellent (4)

2. The coverage and depth of knowledge provided as per the syllabus of the course. *

   Mark only one oval.

   - ◯ Poor (1)
   - ◯ Good (2)
   - ◯ Very Good (3)
   - ◯ Excellent (4)

3. The effectiveness of the teaching methods and usage of multi-media aids during thecourse.

   Mark only one oval.

   - ◯ Poor (1)
   - ◯ Good (2)
   - ◯ Very Good (3)
   - ◯ Excellent (4)

4. The amount and suitability of the study material provided. *

Mark only one oval.

- Poor (1)
- Good (2)
- Very Good (3)
- Excellent (4)

5. The scope of open discussions during and after the class. *

Mark only one oval.

- Poor (1)
- Good (2)
- Very Good (3)
- Excellent (4)

6. State your level of comfort with basic vocabulary of data analytics. (CO1) *

Mark only one oval.

- None
- Weak
- Moderate
- High

7. State your level of proficiency at describing methods used for data manipulation, exploration, visualisation, statistical and predictive analysis. (CO2)

Mark only one oval.

- None
- Weak
- Moderate
- High

8. State your confidence level for solving problems pertaining to data manipulation, exploration, visualisation and statistical and predictive analysis. (CO3)

Mark only one oval.

- None
- Weak
- Moderate
- High

9. Comment on your ability to analyse the quality of a predictive model. (CO4) *

Mark only one oval.

- None
- Weak
- Moderate
- High

10. State your capability in concluding the findings of a predictive models? (CO5) *

Mark only one oval.

- None
- Weak
- Moderate
- High

11. State your level of awareness of the course objectives and outcomes of the dataanalytics course.

Mark only one oval.

- None
- Weak
- Moderate
- High

12. Select the degree to which the course outcomes are met. *

Mark only one oval.

- None
- Weak
- Moderate
- High

13. State the level of opportunities provided to enhance independent thinking to solve unfamiliar/unforeseen problems.

Mark only one oval.

- None
- Weak
- Moderate
- High

14. Your overall judgement about the level relevance of the course towards achieving youobjectives as a professional.

Mark only one oval.

- None
- Weak
- Moderate
- High

15. Kindly give two suggestions for improving the content or delivery of this course.

16.

for filling the survey form

Sample Lab. Course Feedback Form (MCA)

Department of Computer Science and Engineering

GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR-125001

MCA: End Semester Feedback Form (Course: Data Analytics Lab.-MCA-38)

Instructions: This is anonymous survey. You may prefer not to fill in your personal details. Kindly give response to the following questions as per your own opinion. Your feedback will help in improving this course.

General Information

1. Name of the student (optional)

2. Registration No. (optional)

3. Admission year: (Enter Academic Session, i.e., 2022-2023) *

4. Name of the Course: *

5. Course code *

6. Current Semester *

Feedback for the Lab course

(Please fill in the responses being objective and honest.)

1. State the level of suitability and depth of the assignments for the course as per the state-of-art requirements.

   Mark only one oval.

   - None Low
   - Moderate
   - High
   -

2. State the level of effectiveness of the support (Hardware, Software and Human Resourc provided for the lab course.

   Mark only one oval.

   - None Low
   - Moderate
   - High
   -

3. The level of individual help during implementing the assignments in lab. *

   Mark only one oval.

   - None Low
   - Moderate
   - High
   -

4. State your level of confidence in carrying out data manipulation and data pre-processing tasks? (CO1)

   Mark only one oval.

- None Low
- Moderate
- High
-

5. State the level of proficiency with which you can handle the predictive analytics problems. (CO2)

   Mark only one oval.

   - None Low
   - Moderate
   - High
   -

6. Comment on your ability to evaluate the performance of predictive models. (CO3) *

   Mark only one oval.

   - None Low
   - Moderate
   - High
   -

7. State your level of comfort in designing complete experiments for predictive modellingtasks and interpreting the outcomes for given problems. (CO4)

   Mark only one oval.

   - None Low
   - Moderate
   - High
   -

8. At what level the data analytics lab course has enhanced your ability to create lab recorfor the given assignments in an original and elegant and manner? (CO5)

   Mark only one oval.

   - None Low
   - Moderate
   - High
   -

9. State your level of awareness of the ethical practices while solving your assignmentsand working in lab. (CO6)

Mark only one oval.

- None Low
- Moderate
- High
-

10. Comment on the your level of skill attained of using data analytics tools. *

Mark only one oval.

- None Low
- Moderate
- High
-

11. The opportunities provided for finding solutions to the problems that requires critical thinking/analysis and creative advances.

Mark only one oval.

- None Low
- Moderate
- High
-

12. State the adequacy of the lab. course providing opportunity for enhancing problemsolving and self-learning aptitude.

Mark only one oval.

- None Low
- Moderate
- High
-

13. Whether the lab course provides opportunity for discussions in groups/teams? *

Mark only one oval.

- None Low
- Moderate
- High
-

14. The opportunities provided to enhance independent thinking to solve unfamiliar/unforeseen problems.

Mark only one oval.

- None Low
- Moderate
- High
-

15. Your level of awareness of the course objectives and outcomes of this course. *

Mark only one oval.

- None Low
- Moderate
- High
-

16. The degree to which the course outcomes are met *

Mark only one oval.

- None Low
- Moderate
- High
-

Kindly give two suggestions for improving the content or delivery of this lab course.

1. _____

_____

_____

_____

2.

for filling the survey form

Programme Exit Feedback Form (MCA)

Department of Computer Science and Engineering

GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR-125001

Instructions: This is anonymous survey. You may prefer not to fill in your personal details. Kindlygive response to the following questions as per your own opinion. Your feedback will help in improving this course.

This survey will be conducted at the end of the programme by MCA Programme Coordinator.

---

1. Roll/Regn. Number (Optional)

_____

2. Name (Optional)

_____

3. Email Address (Optional)

_____

SECTION – 1

4. Why did you take admission in MCA Programme ? *

Check all that apply.

- [ ] The programme offers the state of the art courses.
- [ ] The programme has the qualified human resources and good infrastructure.
- [ ] I heard good things about this programme from family and friends.
- [ ] The post-graduates get good jobs after doing programme.
- [ ] The fees structure was affordable.
- [ ] Any other

5. Do you think that your undergraduate academic preparations were sufficient to succeed in this course?

Mark only one oval.

- ◯ Yes
- ◯ No

6. Are you aware of the Outcomes and Educational Objectives of MCA Programme? *

Mark only one oval.

- Yes
- No

7. Does the Programme prepare you adequately for taking up doctoral research or a research job?

Mark only one oval.

- Yes
- No

8. Does the Programme prepare you to take up a professional trainer/teaching job? *

Mark only one oval.

- Yes
- No

9. Does the Programme prepare you to work as a professional in IT and its related industries?

Mark only one oval.

- Yes
- No

10. Does the Programme prepare you to qualify national or state level examinations in your domain, i.e., GATE, NET/JRF, HTET etc.?

Mark only one oval.

- Yes
- No

11. Have you cleared NET/JRF or any other examination? Please specify *

_____

12. What are your career goals? *

Mark only one oval.

- Working as a professional in IT industry Pursuing PhD
- To do a research job
- Teaching in a college or university Any
- other

13. State to what extent the POs are achieved? *

Mark only one oval.

- None Low
- Moderate
- High

14. Are you satisfied with MCA Programme?

If yes, State reasons

_____

_____

If not, suggest things you would like to change/improve for the MCA Programme?

_____

_____

15. Any Additional Comments

_____

_____

Thanks a Lot for filling up the survey form

SECTION - 2

Feedback on POs

This section is about the theoretical and practical knowledge, and other related skills acquired during MCA programme towards achieving POs.

---

1. State your ability to apply the knowledge acquired through variety of courses to conceptualise and address computing problems.

   Mark only one oval.

   - None Weak
   - Moderate
   - High

2. State your level of confidence to identify, formulate, computing problems and, review research literature to solve the problems in an effective manner.

   Mark only one oval.

   - None Weak
   - Moderate
   - High

3. State your ability to design solutions with appropriate considerations to public health an safety, the cultural, societal and environmental considerations.

   Mark only one oval.

   - None Weak
   - Moderate
   - High

4. At what level of confidence you can use research based knowledge, research methods to design experiments and interpret experimental results?

   Mark only one oval.

   - None Weak
   - Moderate
   - High

5. State your proficiency to select and apply modern tools to address complex computing tasks.

   Mark only one oval.

   - None Weak
   - Moderate
   - High

6. State your competence to comprehend the ethics including cyber regulations and professional conduct.

Mark only one oval.

- None Weak
- Moderate
- High

7. To what extent MCA programme enhances your lifelong learning aptitude? *

Mark only one oval.

- None Weak
- Moderate
- High

8. At what level you can apply project management skills to solve computing problems as per the requirements and in a given time frame?

Mark only one oval.

- None Weak
- Moderate
- High

9. State the level of opportunities you got to enhance your verbal and written communication skills (Communication with team members and society at large, preparing and presenting technical reports).

Mark only one oval.

- None Weak
- Moderate
- High

10. State your comprehension about the social, environmental, health safety and cultural issues in local and global context as a professional.

Mark only one oval.

- None Weak
- Moderate
- High

11. State your potential to work independently or as a member of a team. *

Mark only one oval.

None Weak
Moderate
High

12. State the level of adeptness achieved to go for innovation and entrepreneurship. *

Mark only one oval.

None Weak
Moderate
High

for filling the survey form