ST. JOSEPH'S COLLEGE (AUTONOMOUS), DEVAGIRI, KOZHIKODE

Re-accredited with A++ Grade

Affiliated to the University of Calicut

Proposed Programme Structure and Syllabus of

Master of Computer Applications

EFFECTIVE FROM 2025-26 ACADEMIC YEAR ONWARDS

(CBCSS PG Regulations 2019)

REGULATIONS FOR THE DEGREE OF MASTER OF COMPUTER APPLICATIONS

EFFECTIVE FROM 2025 ADMISSION

1. PROGRAMME DURATION

Duration of the MCA Programme shall be 2 years spread over 4 semesters. Each semester shall have at least 18 weeks. The maximum duration permissible for completing the programme is fixed as 4 years.

2. PROGRAMME OUTCOMES

At the end of the program the student will be able to:

- **PO-1**: Apply the knowledge of mathematics, statistics, and computer science to the solution of complex problems.
- **PO-2:** Identify, formulate, review research literature, and analyze problems reaching validated conclusions.
- **PO-3:** Design solutions for difficult problems and design software that meet the specified needs with appropriate consideration for the society.
- **PO-4:** Use research-based knowledge and methods to conduct investigations on complex problems and provide valid conclusions.
- **PO-5:** Create and apply appropriate techniques for requirement collection, development and testing using tools.
- **PO-6:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
- **PO-7:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO-8:** Apply knowledge and understanding of the engineering and management principles to one's own work.
- **PO-9:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

- **PO-10:** Unify the students to take up a career in the highly competitive IT industry with research and development skills acquired through minor and major projects. •
- **PO-11:** Equip students with comprehensive knowledge and understanding of advanced theoretical fundamentals in computer science as well as contemporary key research issues in specialized areas of computer science.

3. SELECTION AND ELIGIBILITY FOR ADMISSION

Candidates for admission to the MCA degree course shall be required to have passed a Bachelor's Degree in any discipline of three-year duration with Mathematics (this does not include Business Mathematics or Business Statistics) as one of the subjects or BCA under University of Calicut or any other University/ Institution, recognized by this University as equivalent thereto with at least 50% marks or equivalent grade. 5% of relaxation in the marks will be allowed in the case of Candidates, belonging to socially and educationally backward classes. Candidates belonging to scheduled caste and scheduled tribe need only a pass in the qualifying examination. Candidates have to qualify the entrance examination conducted by the St. Joseph's College (Autonomous), Devagiri. They shall also satisfy the conditions regarding age and physical fitness as prescribed by the University of Calicut.

4. PROGRAMME STRUCTURE

4.1 SUBJECTS OF STUDY

The subjects of study, both theory, practical and project, shall be in accordance with the prescribed scheme and syllabi.

4.2 ATTENDANCE

A candidate shall be permitted to appear for the end-semester examinations only if he/she satisfies the following requirements:

a. He/she maintains not less than 80% attendance in the total number of working hours in each semester, all subjects of study in the semester put together.
b. His/her conduct and Progress must be satisfactory.

It shall be open to the Vice Chancellor to grant condonation of shortage of attendance up to 10% on the recommendation of the Head of the institution in accordance with the

following norms. Shortage shall not be condoned more than twice during the entire programme. Candidates who are not eligible for condonation of shortage of attendance shall repeat the semester.

4.2.1 Duty Leave

Students are eligible for duty leave if they perform certain kinds of duties like representing the college in sports and games, etc. On recommendation from concerned faculty members, Head of Institution/Head of MCA Department shall sanction duty leave for the period of absence. The maximum limit of duty leave that can be granted to a student during a semester is 10% of the number of working hours in that semester.

Application for duty leave should be submitted to the Head of the Institution/Head of MCA Department preferably before the duty is performed or within ten working days after returning from duty. If duty leave is sanctioned, the student shall meet the faculty members handling classes for him/her in that semester (within 2 weeks after returning from duty) and request them to mark duty leave granted in the record of attendance.

4.2.2. Registration for each Semester

Every candidate should register for all subjects of the end-semester examinations of each semester. A candidate who does not register will not be permitted to attend the end-semester examinations; he/she shall not be permitted to attend the next semester.

A candidate shall be eligible to register for any higher semester, if he/she has satisfactorily completed the course of study and registered for the examination of the immediate previous semester. He/she should register for the semester at the start of the semester before the stipulated date. University will notify the starting and closing dates for each semester.

4.3 CREDIT SYSTEM

Each subject shall have a certain number of credits assigned to it depending upon the academic load and the nature and importance of the subject. The credit associated with each subject will be shown in the prescribed scheme and syllabi. Each course shall have an integer number of credits, which reflects its weightage.

4.4 GRADING

The university shall award the letter grade to students based on the marks secured by them in both internal assessment and end-semester examinations taken together in the subjects registered. Each letter grade indicates a qualitative assessment of the student's performance and is associated with a specified number of grade points. The grading system along with the grade points for each grade, applicable to passed candidates is shown below. All passed candidate will be allotted a grade S, A, B, C or D according to the total marks scored by him/her.

If a candidate does not pass a subject as per the conditions given in Section (3.7), he/she will be assigned an Unsatisfactory grade 'U' irrespective of his/her total marks. If a student does not pass a subject in two attempts, the maximum grade he/she can get is 'D' when he/she passes the subject in any subsequent examination, whatever be the marks scored by him/her.

A student is considered to have completed a subject successfully and earned the credits if he/she secures a letter grade other than 'U' in that course. Letter grade 'U' has zero grade point and the candidate has to write the examination again to improve the grade. A student's performance is measured by the number of credits that he/she has earned and by the cumulative grade point average (CGPA) maintained by him/her.10. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA).

DETAILS OF GRADING SCHEME

Range of % of Marks	Grade Points	Letter Grade
90-100	10	S
80-89	9	A
70-79	8	B
60-69	7	C
50-59	6	D
0-49	0	U

Pass minimum for external examination: 40%

Pass minimum for a course: 50%

a) A Semester Grade Point Average (SGPA) shall be computed for all the students for each semester, as follows:

$$SGPA = \frac{(C_1 G_1 + C_2 G_2 + C_3 G_3 + \ldots + C_n G_n)}{(C_1 + C_2 + C_3 + \ldots + C_n)}$$

where, n is the number of subjects registered during the semester, Ci is the number of credits allotted to i^{th} subject as per the scheme, and Gi is the grade points corresponding to the grade awarded to the student for the subject.

b) A Cumulative Grade Point Average (CGPA) shall be computed for all the students at the end of each semester by taking into consideration their performance in the present and the past semesters as follows:

$$CGPA = \frac{(C_1 G_1 + C_2 G_2 + C_3 G_3 + \ldots + C_m G_m)}{(C_1 + C_2 + C_3 + \ldots + C_m)}$$

Where m is the number of courses registered up to that semester, Ci is the number of credits allotted to i^{th} subject as per the scheme, and Gi is the grade points corresponding to the grade awarded to the student for the subject. An up-to-date assessment of overall performance of a student is obtained by calculating CGPA. CGPA is weighted average of the grade points obtained in all the subjects registered by the students since he entered the MCA Programme.

c) Both the SGPA and CGPA shall be rounded off to the second place of decimal and recorded as such for ease of presentation. Whenever the CGPAs are to be used for the purpose of determining the merit ranking in a group of students, only the rounded off value shall be made use of.

4.5 ELECTIVES

All students shall choose three elective subjects, one in the second and two in the third semesters from a set of elective subjects prescribed in the syllabus and offered by the institution. There should be at least 25% students of the class for an elective subject to be offered.

However, any student having a CGPA of not less than 7.0 shall be permitted to select an elective of his/her choice and register under a faculty, subject to the permission from

the faculty and Head of Department. The student will have to study this subject on his /her own (self-study mode) or the classes of this subject shall be taken during off-hours.

New electives may be introduced according to the needs of emerging fields in technology. The name of the elective and its syllabus should be approved by the university before the subject is offered as an elective.

4.6 PATTERN OF QUESTIONS FOR END-SEMESTER EXAMINATIONS OF THEORY SUBJECTS

The question papers of end-semester examinations of theory subjects shall be able to perform achievement testing of the students in an effective manner. The question paper shall be prepared in accordance with the following guidelines:

a. Should contain seven full questions of 20 marks each
b. Each question should have minimum two subdivisions
c. At least one question from each module and not more than two questions from any module
d. Covering all sections of the course syllabus
e. Unambiguous and free from any defects/errors
f. Emphasizing knowledge testing, problem solving & quantitative methods
g. Containing adequate data/other information on the problems assigned
h. Having clear and complete instructions to the candidates.
i. Duration of end-semester examinations will be 3 hours and the maximum mark is100.

4.7 MINIMUM FOR PASS

A candidate who secures not less than 40% marks in a subject at the end-semester examinations and not less than 50% (75 marks out of 150) of the total marks assigned to the subject, shall be declared to have passed the examination in that subject.

The total marks assigned to a subject in the above calculations are the sum of maximum marks assigned to the end-semester examination (ie, 100 marks) and maximum internal assessment marks of that subject (ie, 50 marks). Candidates will be assigned grades according to the marks scored.

4.7.1. Term Paper, Project Evaluation and Viva Voce

For Term Paper (2^{nd} semester) and Project and Viva Voce (in 4^{th}semester), the minimum for a pass shall be 50%of the total marks assigned to the respective examinations.

A student who does not secure this pass marks in a subject will have to repeat the respective subject. If a candidate has passed all examinations of MCA Programme (at the time of publication of results of fourth semester) except project and Viva-Voce in the fourth semester, a re- examination for the Project and Viva-Voce should be conducted within one month after the publication of results. Each candidate should apply for this "Save a Semester" examination within one week after the publication of fourth semester results.

4.8 ASSESSMENT OF STUDENTS

Assessment of students for each subject will be done by internal continuous assessment and end semester examinations. Internal assessment shall be conducted throughout the semester. It shall be based on internal examinations, assignments (such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises, etc.) as decided by the faculty handling the course, and other measures like regularity in the class. Assignments of every semester shall preferably be submitted in Assignment Book, which is a bound book similar to laboratory record.

There shall be End Semester Examination at the end of each semester. Practical examinations shall be conducted by the College at the end of each semester. There will be one internal and one external examiner for the conduct of End Semester Practical examination. Project Work / Dissertation shall be evaluated at the end of the programme only. There shall be both Internal and External evaluation for the Project Work. There shall be one end-semester examination of 3 hours duration for each theory course and practical course.

(a) Assessment in Theory Subjects

The marks allotted for internal continuous assessment and end-semester university examinations shall be 50 marks and 100 marks respectively with a maximum of 150 marks for each theory subject. The weightage to award internal continuous assessment marks should be as follows:

Sl. No	Components for Continuous Assessment	Marks (Max. Mark-50)
1	Test Paper (Average of minimum two test papers)	30
2	Assignments/Seminar/ GD/Quiz/Homework/ Problem Solving/ literature Survey/ Software Exercises	15
3	Regularity	5

Assignments (minimum two) such as homework, problem solving, group discussions, quiz, literature survey, seminar, term-project, software exercises etc. Full credit for regularity in the class can be given only if the candidate has secured minimum 90% attendance in the subject. Award of marks for attendance should be as follows:

Percentage of Attendance	Marks
90 and above	5
85 to 89.9	4
80 to 84.9	3
75 to 79.9	2
Below 75	1

(b) Assessment in Practical Subjects

Practical examinations and Term Paper can be conducted internally with internal continuous assessment with 50 marks. Head of the institution/Department shall appoint two examiners for each practical subject in order to conduct end-semester examinations for practical subjects. Award of marks in the practical subjects should be as follows:

Internal Assessment for Practical Exam	Max. Marks (50)
Regularity	10
Evaluation in the lab and Rough Record	10
End-semester Test	15
Viva	5
Fair Record	10

No candidate will be permitted to attend the end-semester test unless he/she produces a certified record of the laboratory.

(c) Assessment in Mini Project

A mini-project should be done in the 3rd Semester by the students based on concepts they have already learnt in the previous semesters of the MCA Programme.

Objectives of the mini project:

Working on Mini project is to get used to the larger project, which will be handled in the 4th Semester. The project work constitutes an important component of the MCA Programme of the University and it is to be carried out with due care and should be executed

with seriousness by the students. The objective of this mini project is to help the student develop the ability to apply theoretical and practical tools/techniques to solve real life problems related to industry, academic institutions and research laboratories.

Guidelines:

Students are expected to devote about 1-2 months in planning, analyzing, designing and implementing the project. The initiation of a project should be with the project proposal that is to be treated as an assignment.

Mini-project evaluation:

The evaluation of the mini-project will be based on the project reports submitted by the student, a presentation and a demonstration.

Components for Project Evaluation (Internal examiner)	Max. Marks
First evaluation	15
Second Evaluation	15
Report	10
Viva Voce	10
Total Marks	**50**

(d) Project Evaluation and Viva Voce.

The student is expected to work on a chosen topic, under the guidance of a supervisor approved by the department, for a period of four full months. The evaluation of project and viva voce will be conducted at the end with 350 marks with the following distribution:

Sl.No	Components for Project Evaluation	Max. Marks
1	First evaluation after one month of commencement of Project(Internal examiner will evaluate this)	100
2	Second Evaluation before completion of Project (Internal examiner will evaluate this)	100
3	Thesis Evaluation and Viva Voce (External Examiner will evaluate this)	125
4	Viva Voce (Internal Examiner)	25
	Total Marks	**350**

An Evaluation Committee consisting of two faculty members appointed by the University will evaluate the project. Guide will be the Internal Examiner.

4.9 IMPROVEMENT

Candidates shall not be allowed to improve the grade already obtained. However, cancellation and reappearance will be permitted. Revaluation for each paper is also permitted.

5. EXAMINATION MONITORING CELL

Head of each institution/Department should formulate an Examination Monitoring Cell at the department level for supervising all examinations, especially the internal examinations. This cell, with a senior staff member as Convener, shall consist of minimum three members (one shall be a lady). A clerical staff having computer skills shall also be assigned for the examination monitoring cell. The collective responsibilities of the examination monitoring cell are:

a. Schedule all end-semester practical examinations as per the programme calendar.
b. Officiate as the examination squad to keep a vigil on all end-semester examinations. If any malpractices are found /reported by invigilators, inform them to the Head of Institution along with a report about the incident. The Head of Institution shall forward all such complaints to the University.
c. Schedule all examinations conducted as part of internal assessment of students.
d. To receive any complaint from students regarding issues like out-of-syllabus questions, printing mistakes, etc. of end-semester examinations of theory and practical subjects. The cell shall investigate these complaints and if necessary forward it to university with specific comments.
e. To receive any complaints from students regarding internal examinations, inquire about such incidents, and give a report to the Head of Institution/Department for necessary action.
f. In general, to function as an extended wing of the office of the Controller of Examinations of the University, at institution level.

To conduct all the theory examinations, a Chief Superintendent and an Assistant Chief

Superintendent should be appointed by the Head of Institution. At least two external Additional Chief Superintendents should also be appointed by the University as Observers for conducting theory examinations in all affiliated Institutions.

6. CLASS COMMITTEE

Head of the institution shall take necessary steps to form a class committee for each class at the start of classes of each semester. This class committee shall be in existence for the concerned semester.

The class committee shall consist of the Head of Department, Staff Advisor of the class, a senior faculty member of the department, and three student representatives (one of them should be a girl). There should be at least two meetings of the class committee every semester; it shall be the responsibility of the Head of Department to convene these meetings. The decisions of the Class Committee shall be recorded in a register for further reference. Each class committee will communicate its recommendations to the Head of Institution. The responsibilities of the class committee are:

a) To review periodically the progress and conduct of students in the class.

b) To discuss any problems concerning any subjects in the concerned semester.

c) To identify weaker students of the class and suggest remedial measures.

d) Discuss any other issue related to the students of the class.

7. ELIGIBILITY FOR THE DEGREE

No candidate shall be eligible for the MCA degree unless he/she has undergone the prescribed course of study for a period of not less than two academic years in an institution affiliated to the University of Calicut and has passed all subjects as per the prescribed syllabus.

8. PROCEDURE FOR COMPLETING THE COURSE

a. A candidate shall be required to complete the course and pass all the examinations within a period of 4 years after joining the course.
b. A candidate shall not be allowed to improve the marks already obtained.

c. However, cancellation and reappearance along with the regular examination will be permitted.

9. CLASSIFICATION OF SUCCESSFUL CANDIDATES

a. A candidate who qualifies for the degree, passing all the subjects of the four semesters, in 2 academic years after the commencement of this course of study and secures not less than a CGPA of 8.00 of all the semesters shall be declared to have passed the MCA degree examination in **Distinction**.

b. A candidate who qualifies for the degree, passing all the subjects of the four semesters within 2 academic years after the commencement of his course of study and secures not less than a CGPA of 6.5 of all the semesters shall be declared to have passed the MCA degree examination in **First Class.**

c. All other candidates who qualify for the degree passing all the subjects of the four semesters and not covered as per Sections 8 (a) and (b) and CGPA not less than 6.5 shall be declared to have passed the MCA examination in **Second class**.

10. GRIEVANCE CELL

Each college should set up a Grievance Cell with at least four faculty members to look into grievances of the students, if any.

11. ANTI-RAGGING CELL

The Head of Institution shall take necessary steps to constitute an anti-ragging committee and squad at the commencement of each academic year. The committee and the squad shall take effective steps as specified by the Honorable Supreme Court of India, to prevent ragging.

12. COLLEGE TRANSFER

A candidate shall not be eligible for college transfer and inter university transfer (Notwithstanding all that has been stated above, the University has the right to modify any of the above regulations from time to time as per University rules.)

BRIDGE COURSE

1. INTRODUCTION

A pass in BCA/ Bachelor Degree in Computer Science/IT/Engineering or equivalent degree recognized by the University of Calicut are eligible for direct entry to the Programme. Other students who have passed B.Sc./ B.Com /B.A or equivalent degree with Mathematics at Graduation Level recognized by University of Calicut have to undergo an additional bridge course as per the norms of the Calicut University.

The bridge program comprises 40 hours teaching and learning activities. It consists of two theory papers. This course shall be conducted during the first semester of the MCA Programme without affecting the actual workload of the semester. The course shall be offered in the department/college at which the candidates enroll for the MCA program. The mode of conduct of the course is completely under the strict control of the department/college at which the MCA Programme is offered. Total forty (40) hours of teaching and learning activities shall be completed before the notification of 1st semester examination by the College. The department/College has to complete the course by conducting classes and evaluation of the students before the commencement of the Ist semester MCA examination. All those students who successfully complete the bridge course shall be given a completion certificate by the department/College.

2. CONDUCT OF CLASSES

Department/College council shall schedule regular classes (may be online class – preferably MOOC) and complete the forty (40) hours programme before the 1st semester MCA end semester examination notification by the College. The classes shall be conducted either in the weekend mode or regular working day without affecting the actual regular teaching and learning activities of the 1st semester MCA curriculum.

3. DURATION OF THE PROGRAM

The course shall comprise two (02) theory papers. Candidates have to appear for examinations for all the papers at the end of the program conducted by the Department/College at which the candidate has registered for the MCA program. The details of subjects and corresponding examination details are mentioned in the curriculum.

4. CONDUCT OF EXAMINATION

At the end of the course, the department/college has to conduct the examinations on each theory paper with two (02) hours duration and complete the evaluation process of all those papers within two (02) weeks. The pattern of question papers and evaluation criteria for passing examinations are specified in the regulation.

5. PATTERN OF QUESTION PAPER FOR THEORY PAPERS

Question Type	Number of Questions	No. of Questions to be answered	Marks/ question	Max.Marks
Essay	7	5	5 × 10= 50	50

6. QUESTION PAPER PREPARATION

The faculty in-charge of each course shall prepare three (03) unique set of question papers on the subject she/he taught. Faculty should give utmost care in preparing the question paper. After preparing the question paper, faculty-in-charge shall submit these question papers to the Head of the department in sealed cover. The Head of the department shall then constitute a question paper scrutiny committee composed of the Head of the department and two more senior faculty members other than faculty-in charge of any course in Bridge program for scrutinizing the question papers submitted by the faculty-in-charge and finalize the question papers for the examinations.

7. PAPER EVALUATION

The Head of the department shall constitute a Board of Examiners (BoE) by including all the faculties in the department (minimum three faculties) with the Head of the department as the chairman. The BoE prepares the scheme and criteria for the evaluation of the answer books of the students in the Bridge course and the evaluation shall be completed within two weeks after the examinations of the Bridge Program. Only a single valuation is enough.

8. FINALIZING THE RESULTS OF BRIDGE PROGRAM

The BoE shall conduct a pass board meeting soon after completing the evaluation of the answer books and related tabulation works. The students who receive (40%) marks in each subject shall be placed as successful completion of the program. All the documents including

the tabulation registers regarding the conduct of the examinations shall be kept in the department and the same shall be produced to CoE as and when needed/requested.

9. SUPPLEMENTARY CHANCE

A candidate who fails to secure minimum marks (40%) for a pass in a course will be permitted to write the same examination one more time after three months of the completion of the program. The students who do not complete the bridge program within one year shall not be registered for 2nd semester MCA end semester examination conducted by the College and no further promotion shall be allowed for subsequent semesters too.

10. SCHEME AND CURRICULUM FOR BRIDGE PROGRAM

Subject Code	Subject	Instructional Hour/Week (30 Hours/paper)			Marks	Credit
		L	P	Total		
BR01	Mathematical Foundations	25	--	25	50	0
BR02	Research Methodology	15	--	15	50	0

BR01 MATHEMATICAL FOUNDATIONS

Course Outcomes

CO1	Understand the basics of number systems and logic operators
CO2	Understand Boolean algebra and Logic circuits
CO3	Apply K-Map to simplify Boolean functions.
CO4	Explain sets and operations on sets.
CO5	Solve Linear Equations using Matrices.

UNIT I

Number systems: Decimal numbers, binary numbers, decimal-to-binary conversion-Binary arithmetic-1's and 2's complements-signed numbers- Octal numbers- Hexadecimal Numbers- BCD numbers- Digital codes. Binary digit-Logic Level- Basic logic operators- Basic logic functions.

UNIT II

Boolean Algebra and Logic circuits- fundamental concepts of Boolean Algebra, postulates, Principle of duality, theorems of Boolean Algebra, Boolean functions, minimization, canonical forms.

UNIT III

Logic Gates- AND, OR, NOT, NAND, NOR, XOR and XNOR, logic circuits, converting expression to logic circuit, universal NAND and NOR gates, Exclusive OR, Design of Combinational circuits (Half Adder, Subtractor and Full Adder)

UNIT IV

Measures of Central Tendency: Mean, Median, Mode. Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Variance, Standard Deviation, Coefficient of Variation.

UNIT V

Matrices and determinants: matrix, types of matrices, operations on matrices, Determinants- properties of determinants-inverse of a matrix- Rank of a Matrix, Trace of a Matrix. Solving Linear Equations using Matrices.

References:

1. Thomas L Flyod-Digital Fundamentals, Pearson International Edition (9th Edition), Prentice Hall. (I and II Units)
2. Balachandra Rao, C K Shantha – "Numerical Methods – with Programs in BASIC, FORTRAN, Pascal and C++". University Press
3. Babu Ram –"Numerical Methods", Pearson
4. M.K. Jain, S.R.K. Iyengar, R.K. Jain – Numerical Methods (Problems and Solutions), New Age International Publishers

BR02 RESEARCH METHODOLOGY

Course Outcomes

CO1	Understand the essence of research and the necessity of defining a research problem.
CO2	Apply research methods and methodologies including research design, data collection, data analysis, and interpretation.
CO3	Create scientific reports according to specified standards.

UNIT I

Defining research problem: Selecting the problem- Necessity of defining the problem- Techniques involved in defining a problem-Ethics in Research.

UNIT II

Principles of experimental design- Working with Literature: Importance- finding literature- Using your resources- Managing the literature-Keep track of references- Using the literature- Literature review- On-line Searching: Database-SCI Finder- Scopus- ScienceDirect-Searching research articles- Citation Index -Impact Factor -H-index.

UNIT III

Measurement of Scaling: Quantitative-Qualitative, Classification of Measure scales- Data Collection- Data Preparation.

UNIT IV

Scientific Writing: Significance- Steps- Layout- Types- Mechanics and Precautions- Paper writing for international journals- Writing scientific report.

UNIT V

Report Writing: Latex: Introduction-Text-Tables- Figures- Equations- Citations-Referencing and Templates (IEEE style).

References:

1. C. R. Kothari, Research Methodology Methods and Techniques,4th Edition, New Age International Publishers, 2019.

2. Zina O'Leary, The Essential Guide of Doing Research, 3rdEdition, SAGE Publications Ltd, 2017. with C", Cengage Learning ISBN:9788131503140.
3. J. W. Creswell, Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 4th Edition, SAGE Publications, 2014.
4. Kumar, Research Methodology: A Step by Step Guide for Beginners, 4th Edition, SAGE Publications Ltd, 2014

MASTER OF COMPUTER APPLICATIONS

EFFECTIVE FROM 2025 ADMISSION ONWARDS

PROGRAMME STRUCTURE

SEMESTER-I

NO	Subject Code	Subject Title	Instructional Hrs/week			Marks			Credit
			L	P	T	E.E	C.E	Total	
1	MCA 25 101	Programming in C & Data Structures	3	2	1	100	50	150	4
2	MCA 25 102	Computer Organization and Design	3	0	1	100	50	150	3
3	MCA 25 103	Advanced Database Technologies	3	1	1	100	50	150	3
4	MCA 25 104	Python Programming	3	1	1	100	50	150	3
5	MCA 25 105	Full Stack Development	3	0	1	100	50	150	3
6	MCA 25106 (P)	Practical 1- Full Stack Development	0	5	1	-	50	50	3
Total			**15**	**9**	**6**	**500**	**300**	**800**	**19**

SEMESTER-II

NO	Subject Code	Subject Title	Instructional Hrs/week			Marks			Credit
			L	P	T	E.E	C.E	Total	
1	MCA 25 201	Software Engineering	3	1	1	100	50	150	3
2	MCA 25 202	Applied Statistics Using R	3	1	1	100	50	150	3
3	MCA 25 203	Operating Systems	3	1	1	100	50	150	3
4	MCA 25 204	Computational Intelligence	3	1	1	100	50	150	4
5	MCA 25 205	Advanced Java Programming	3	0	1	100	50	150	3
6	MCA 25 206 (P)	Practical II-Java & R Lab	0	4	1	-	50	50	2
7	MCA 25 207 (T)	Term Paper	0		1	-	50	50	1
Total			**15**	**8**	**7**	**500**	**350**	**850**	**19**

SEMESTER-III

NO	Subject Code	Subject Title	Instructional Hrs/week			Marks			Credit
			L	P	T	E.E	C.E	Total	
1	MCA 25 301	Cloud Computing	4	1	1	100	50	150	4
2	MCA 25 302	Machine Learning	3	1	1	100	50	150	3
3	MCA 25 303	Data Communication & Cryptography	3	1	1	100	50	150	3
4	MCA 25 304	Elective I	3	0	1	100	50	150	3
5	MCA 25 305	Elective II	3	0	1	100	50	150	3
6	MCA 25 306 (P)	Mini Project	0	5	1	-	50	50	3
Total			**16**	**8**	**6**	**500**	**300**	**800**	**19**

SEMESTER-IV

NO	Subject Code	Subject Title	Instructional Hrs/week			Marks			Credit
			L	P	T	E.E	C.E	Total	
1	MCA 25 401	Industry Project and Viva Voce	-	25	-	125	225	350	15
Total				**25**		**125**	**225**	**350**	**15**

List of Elective Courses for (Semester III-MCA 25 304)	
MCA 25 304A	Big Data Technologies
MCA 25 304B	Digital Image Processing
MCA 25 304C	Advanced Computer Graphics
MCA 25 304D	Internet of Things
MCA 25 304E	Neural Network & Deep Learning
List of Elective Courses for (Semester III-MCA 25 305)	
MCA 25 305A	Data Mining

MCA 25 305B	Advanced Python Programming
MCA 25 305C	Mobile Application Development
MCA 25 305D	Block Chain
MCA 25 305E	Theory of Computation

* L- Lecture Hours, P- Practical Hours, T- Tutorial, E.E External Evaluation, I.E- Internal Evaluation.

SEMESTER-I

MCA 25 101 PROGRAMMING IN C & DATA STRUCTURES

Course Outcomes

CO1	Understand different features of C language.
CO2	Analyse real life problem statements to enhance problem solving skills
CO3	Apply the features of C language to develop applications targeting the industry needs.
CO4	Design code involving applications arrays, structures, Pointer,stacks, queues, trees, and graphs
CO5	Understand various techniques for searching, sorting, and hashing
CO6	Implement an appropriate data structure to solve real-world problems

UNIT I

C Control Structures- Tokens in C, data types and keywords - Decision control structures -Loop control structure. Functions and Pointers- Functions - Library functions - Function definitions - Prototype -Scope - Storage classes -Call by value - Pointers variable - Definition and initialization - Pointer operators - Calling function by reference - const qualifier with pointers - sizeof operator - Pointer arithmetic - Pointers to functions - Recursion - Recursion and stack.

UNIT II

Arrays and Strings- Arrays - Definition - Initialization - 2D arrays - Memory map of 2D arrays - Pointers and 2D arrays - Passing Arrays to functions -Strings - Characters - Character handling library - String I/O -Pointers and strings. Structures, Union, Enum- Structure definitions - Initializing structures - Accessing structure members - Array of structures - Pointers to structures - Using structures with functions - Self referential structures - typedef –Unions, enums

UNIT III

Linked List- Concept of Singly Linked List, Operations on Linked List, Inserting and Removing Nodes from a List, Array Implementation of Lists, Doubly Linked List.

Stacks- Definition and Example, Primitive Operations, Stack as an ADT,

Implementation of Stacks as An Array and Linked List, Operations on Stacks, Arithmetic Expression, Converting an Expression from Infix to Postfix. Queues - Definition And examples Of Queues, Queues as An Abstract Data Type, Queues Stored as a Linked List, Circular Queue, Implementation of Queues as An Array and Linked List, Operations on Queues, Priority Queue & Dequeue.

Lab Exercises:

1. Implement Linked List and its Operations.
2. Application of Stack (convert an infix expression to the postfix form)
3. Queue Operations using Linked List

UNIT IV

Searching - Linear Search, Binary Search, Hashing: hash tables, hash functions, collision resolution-separate chaining, open addressing-linear probing, quadratic probing, double hashing – Pattern matching: Naïve/KMP. Sorting: Bubble Sort, Insertion Sort, Selection Sort, Merge and Quicksort along with time complexity

Lab Exercises:

1. Implementation of Linear and Binary Search
2. Implementation of Quick / Merge Sort

UNIT V

Trees- Definition of Trees, Basic Terminology of Trees, Binary Tree, Binary Tree Representation as An Array & Linked List, Binary Tree Traversal: In-Order, Pre-Order, Post-Order - Threaded Binary Tree, Height Balanced Tree, B-Trees, Binary Search Trees, Construction of BST Operations- Searching, Insertion and Deletion, AVL Trees, Height of an AVL Tree, Operations – Insertion, Deletion and Searching. Graphs: Basic Terminology of Graphs, Implementation of Graphs as An Array & Linked List, Operation on Graphs, Graphs Traversals: Breadth First Search, Depth First Search.

Lab Exercises:

1. Implementation of Tree Traversal
2. Construction of BST and operations
3. Implementation of Graph Traversal

References:

1. P. J. Deitel, H. M. Deitel, C: How to Program, Pearson Prentice Hall, 9th Edition, 2021.
2. Byron Gottfried, Programming with C, McGraw Hill, 4thEdition, 2018.
3. Herbert Schildt, The Complete Reference C, Mc Graw Hill, 4thEdition, 2000.
4. Brian W. Kernighan, Dennis M. Ritchie, The C Programming Language, Pearson, 2nd Edition, 2012.
5. Gilberg, F Richard & Forouzan, A Behrouz, Data Structures: A Pseudocode approach with C,Cengage. 2nd Edition, 2008.
6. Peter Brass, Advanced Data Structures, Cambridge University Press.
7. Horowitz Sahni Anderson-Freed, Fundamental of Data Structures in C, Universities Press, Reprint, 2008.
8. Yashavant Kanetkar , Data Structures Through C, BPB Publications, 2019.

MCA 25 102 COMPUTER ORGANIZATION AND DESIGN

Course Outcomes

CO1	Understand and analyze computer architecture and organization, computer arithmetic, and CPU design
CO2	Compare the design issues in terms of speed, technology, cost and performance
CO3	Identify the performance of various classes of Memories, build large memories using small memories for better performance and analyze arithmetic for ALU implementation

UNIT I

Basics Of Digital Electronics: Multiplexers and Demultiplexers, Decoder and Encoder, Registers., shift registers, Introduction to combinational circuit, introduction to sequential circuits, Register Transfer and Micro Operations: Register Transfer Language and Register Transfer, Bus and Memory Transfer Logic, Micro Operations, Shift Micro Operations, Design of arithmetic logic unit, arithmetic microoperations.

UNIT II

Data representation: signed number representation, fixed and floating point representations, character representation. Computer Arithmetic - integer addition and subtraction, ripple carry adder, carry look-ahead adder. Multiplication - shift-and-add, Booth Multiplier, carry save multiplier. Division - non-restoring and restoring techniques, floating point arithmetic.

UNIT III

Fundamental concepts – Execution of a complete instruction –Multiple bus organization – Hardwired control – Micro programmed control -Basic concepts – Data hazards – Instruction hazards –Influence on Instruction sets – Data path and control consideration –Superscalar operation.

UNIT IV

Memory Hierarchy and Processor Vs Memory Speed–Semiconductor RAMs – ROMs – Speed – size and cost – Cache Memories – Performance consideration – Virtual memory- Memory Management requirements – Secondary storage.

UNIT V

Introduction to Parallel Processing: Pipelining, Characteristics of multiprocessors, Interconnection Structures, parallel processing. Latest technology and trends in computer architecture: multi-core processor, next generation processor architecture, microarchitecture, latest processor for smartphone or tablet and desktop. Multiprocessors: Categorization of multiprocessors (SISD, MIMD, SIMD, SPMD), Introduction to GPU.

References:

1. Computer Organization – Carl Hamacher, Zvonks Vranesic,SafeaZaky, Vth Edition, McGraw Hill, 2011.
2. Computer Systems Architecture – M.Moris Mano, IIIrd Edition,Pearson/PHI,2017
3. Computer Organization and Architecture – William StallingsSixth Edition, Pearson/PHI,2016.
4. Structured Computer Organization – Andrew S. Tanenbaum, 4thEdition PHI/Pearson, 2006.
5. Computer Architecture a quantitative approach, John L. Hennessyand David A. Patterson, Fourth Edition Elsevier, 3RD Edition 2012.

MCA 25 103: ADVANCED DATABASE TECHNOLOGIES

Course Outcomes

CO1	Understand the basic concepts of database systems, transactions, and related database facilities like concurrency control, data object locking, and protocols.
CO2	Analyze the database requirements and develop the logical design of the database.
CO3	Develop NoSQL database applications using storing, accessing, and querying.

UNIT I

Using High-Level Conceptual Data Models for Database Design - Entity Types, Entity Sets, Attributes, and Keys - Relationship Types, Relationship Sets, Roles, and Structural Constraints - Weak Entity Types - ER Diagrams, Naming Conventions, and Design Issues - Relationship Types of Degree Higher than Two - Enhanced Entity Relationship Model - Relational Database Design by ER- and EER-to-Relational Mapping

UNIT II

Design Guidelines for Relation Schemas - Functional Dependencies - Normal Forms Based on Primary Keys - Second and Third Normal Forms - Boyce-Codd Normal Form - Multivalued Dependency and Fourth Normal Form - Join Dependencies and Fifth Normal Form - - File Organization - Organization of Records in Files - Ordered Indices - B+ Tree Index Files - Static Hashing - Bitmap Indices

UNIT III

Transaction - Introduction to transaction processing- transaction and system concept- Desirable properties of transaction- Transaction support in SQL- concurrency control techniques – Two phase Locking techniques for concurrency- Concurrency Control Based on Timestamp Ordering. Recovery Concepts. Distributed databases: Distributed Database concepts- Types - Data Fragmentation- Replication- Allocation Techniques. Overview of Transaction Management - Overview of Concurrency Control and Recovery.

UNIT IV

Definition and Introduction-Sorted Ordered Column-Oriented Stores- Key/Value Stores. Interacting with NoSQL, NoSQL Storage Architecture: Working with Column-Oriented

Databases-HBase Distributed Storage Architecture, NoSQL Stores: Accessing Data from Column-Oriented Databases Like HBase-Querying Redis Data Stores- Querying in Neo4J.

UNIT V

DDL commands, DML commands, TCL commands, NoSQL CRUD operations, NoSQL aggregate functions, Data manipulation using CASSANDRA.

References:

1. Elmasri & Navathe, Fundamentals of Database Systems, Addison-Wesley, 7th Edition, 2021.
2. Shashank Tiwari, Professional NoSQL, Wrox Press, Wiley, 2021,
3. Korth F. Henry and Silberschatz Abraham, Database System Concepts, McGraw Hill, 6th Edition, 2010.
4. O'neil Patric, O'neil Elizabeth, Database Principles, Programming and Performance, Argon Kaufmann Publishers, 2nd Edition, 2002.
5. Ramakrishnan and Gehrke, Database Management System, McGraw-Hill, 3rd Edition, 2003.

MCA 25 104 PYTHON PROGRAMMING

Course Outcomes

CO1	Understand and apply Python Data structures
CO2	Demonstrate Object Oriented Concepts in Python
CO3	Apply NumPy, Pandas and Matplotlib libraries for solving real time problems
CO4	Design an application with database operations

UNIT I

Underlying mechanism of Module Execution- Sequences, Mapping and Sets- Dictionaries- Functions - Lists and Mutability - Custom and built-in modules.

UNIT II

Classes: Classes and Instances-Inheritance—Polymorphism- Abstract Classes-Exceptional Handling- Regular Expressions using “re” module.

UNIT III

Computation on NumPy-Aggregations-Computation on Arrays-Comparisons, Masks and Boolean Arrays-Fancy Indexing-Sorting Arrays-Structured Data: NumPy’s Structured Array. Introduction to Pandas Objects-Data Indexing and Selection-Operating on Data in Pandas-Handling Missing Data-Hierarchical Indexing.

UNIT IV

Basic functions of Matplotlib-Simple Line Plot, Scatter Plot, Bar Plot, Stem Plot, Histogram, Pie Chart, Violin Plot. Introduction-Web framework-creating model to add database service-Django administration application.

UNIT V

Database Programming- Basic Database Operations and SQL, Databases and Python, The Python DB-API, Connection Objects Databases and Python: Adapters Examples of Using Database Adapters, A Database Adapter Example Application.

References:

1. Wesely J.Chun, Core Python Application Programming, Prentice Hall, 3rd Edition, 2019
2. Python Tutorial, Guido Rossum, CreateSpace Independent Publishing Platform, 2018
3. Python Programming Fundamentals, Kent D. Lee, Springer Publications, 2nd Edition, 2015
4. Programming Python, Mark Lutz, O'Reily Media Inc., 2019.
5. Programming with Python, T. R. Padmanabhan, Springer Publications, 2019.
6. Murach's Python Programming (2nd Edition), Joel Murach, Michael Urban, Mike Murach & Associates, Incorporated, 2021

MCA 25 105 FULL STACK DEVELOPMENT

Course Outcomes

CO1	Understand the concepts to create responsive web pages using HTML, XML and CSS
CO2	Familiarization with Client -Side Scripting using JavaScript
CO3	Understanding and building interactive web pages using React JS.
CO4	Understand Node.JS and equip learners with a comprehensive understanding of NodeJS and its functionalities.

UNIT I

Overview of Web Technologies and HTML5- Internet - Client/Server model -Web Search Engine- Web Crawling- Web Indexing- Search Engine Optimization and Limitations- Web Services– Collective Intelligence – Mobile Web –Features of Web3.0- HTML vs HTML5- Exploring Editors and Browsers Supported by HTML5- New Elements- HTML5 Semantics- Canvas- HTML Media. Git- commit- rollback- remote repository- GitHub- merge conflict- CSS specificity rule- Pseudo selectors- media queries- flexbox- responsive web design- transition- Bootstrap 5 responsive grid- Components (Navbar, tables, heroes, carousel, modal etc.,) - font awesome icons.

UNIT II

XML-Documents and Vocabularies -Versions and Declaration -Namespaces JavaScript and XML: Ajax-DOM based XMLprocessing Event-Transforming XML Documents - Selecting XML-Data:XPATH - Template based Transformations: XSLT – Displaying XML Documents in Browsers - Evolution of AJAX - Web Applications with AJAX - AJAX Framework.

UNIT III

Client-Side Scripting- JavaScript Implementation - Use Javascript to interact with some of the new HTML5 APIs -Create and modify Javascript objects- JSForms - Events and Event handling-Async await-JS Navigator-JS Cookies - Introduction to JSON-JSON vs XML-JSON Objects-fetch API .

UNIT IV

React JS- Package Manager (NPM) - ES6- Introduction to React.js - CreateReact App & React file structure - JSX and Components -passing and de-structuring props - React Hooks - Axios - Images and Forms -Conditional Rendering - Routes - Redux.

UNIT V

Node JS and MYSQL- Introduction to Node.js - Express JS - Node mailer - NODE JSWITH MYSQL - Introduction to MySQL - Performing basic database operation(DML) (Insert, Delete, Update, Select)-PreparedStatement- Uploading Image or File to MySQL- Retrieve Image or File from MySQL - bcrypt hashing

References:

1. HTML 5 Black Book (Covers CSS3, JavaScript, XML,XHTML, JAX, PHP, jQuery), DT Editorial Services, DreamtechPress, 2nd Edition, 2016.
2. Modern Full-Stack Development: Using TypeScript, React,Node.js, Webpack, and Docker, Frank Zammetti, APRES, 1stEdition, 2020
3. Chris Northwood, The Full Stack Developer: Your EssentialGuide to the Everyday Skills Expected of a Modern Full Stack WebDeveloper, Apress Publications, 1st Edition, 2018.
4. Laura Lemay, Rafe Colburn & Jennifer Kyrnin, MasteringHTML, CSS & Javascript Web Publishing, BPB Publications, 1stEdition, 2016.
   Web Resources:
5. www.w3cschools.com
6. https://fullstackopen.com/en/part1/introduction_to_react

MCA 25 106(P) - Practical I: FULL STACK DEVELOPMENT

Course Outcomes

CO1	Apply JavaScript, HTML5 and CSS3 effectively to create interactive and dynamic websites
CO2	Design websites using appropriate security principles, focusing specifically on the vulnerabilities inherent in common web implementations
CO3	Create modern web applications using MERN

1. Identify a domain of your choice, list out ten entities in the domain. For each entity, identify minimum 10 attributes and assign the data type for each attribute with proper justification.
2. Develop static pages for a given scenario using HTML
3. Demonstrate Geolocation and Canvas using HTML5
4. Write an XML file and validate the file using XSD
5. Demonstrate XSL with XSD
6. Write a JavaScript program to demonstrate Form Validation and Event Handling
7. Implement web application using AJAX with JSON
8. Demonstrate to fetch the information from an XML file (or)JSON with AJAX
9. Create a web application using React Js with Forms.
10. Develop SPA (Single Page Application) with React JS
11. Implement CRUD Operation using React JS.
12. Demonstrate Node.js file system module.
13. Implement CRUD operation with MySQL using Node.JS

SEMESTER-II

MCA 25 201 SOFTWARE ENGINEERING

Course Outcomes

CO1	Understanding life cycle models and applying best model
CO2	Describe the requirements by understanding and analyzing the problem
CO3	Making designs according to the requirement specification
CO4	Apply suitable testing for the software
CO5	Develop, implement and test a software product which is reliable economically and functionally.

UNIT I

Introduction -what is software Engineering-why it is needed? -importance of software engineering-- Software lifecycle – The Software process- Software Process Models - Predictive and Adaptive based Methodologies: Waterfall model, Iterative Models, Incremental Models, RAD Principles-Agile view of process- XP Model, ASD, DSDM, Scrum Framework – About Scrum, Scrum Process- Sprint planning, Product Backlog- Burndown chart. – CASE tools.

UNIT II

Software Requirements and Specification: Functional and Non-Functional Requirements, User and System Requirements, Requirements Gathering, Prototyping Approach, Requirements Engineering process: Feasibility study, Elicitation and Analysis, requirements Validation, Requirements Management, SRS. Formal System Specification. System Models: Context oriented Models, Flow Oriented Models, Data Oriented Models – Object Oriented Models. Design Process and Design Strategies: Design by Template and Design Reuse, The Design Pattern, Software Architectural Design: About Software Architecture, Architectural Styles, Architectural Design, Modular decomposition and Domain Specific Architectures.

UNIT III

Object Oriented Design- Objects and Classes- objects-module-cohesion-coupling Functional Independence. Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Deployment Diagrams – Data Flow Diagrams. Reusability, portability vs interoperability- Design with reuse concepts, Component-Level Design: About the Component, Designing Class-Based Components. Component based development- User Interface Design-Design Principles-Interface Evaluation. –COTS.

UNIT IV

Software Quality and Software Testing- Software quality concepts and attributes- Software Quality Assurance- SQA Activities-Software Reviews-Software Inspections- Verification and Validation-Clean Room Approach Testing: Testing Strategies, Different types and Levels of Testing, Black Box and White Box testing, testing object Oriented applications, Testing Web applications. - Software Maintenance and evolutions- Software Re-engineering. Software Configuration Management & Release Management.

UNIT V

Software Project Management-Planning and Scheduling, Staffing and Group working, People Capability Maturity Model, Process and Product Quality, Process measurement, Process CMM, Software Costing and Pricing, Cost Estimation Techniques, COCOMO Emerging Trends in Software Engineering: Continuous Integration (CI) ,Software Engineering Methodologies for Mobile and CloudEnvironments.

References:

1. Ian Sommerville, Software Engineering, 7/e, Pearson Education Asia.
2. Pressman R. S., Software Engineering, 5/e, McGraw Hill.
3. Mall R., Fundamentals of Software Engineering, Prentice Hall of India.
4. Behferooz A. & Hudson F.J., Software Engineering Fundamentals, Oxford University Press.
5. Jalote P., An Integrated Approach to Software Engineering, Narosa.

MCA 25 202 - APPLIED STATISTICS USING R

Course Outcomes

CO1	Understand the applied statistics and probability concepts from a computational perspective.
CO2	Creating knowledge on statistics and probability to learn courses like machine learning and deep learning
CO3	Apply the implementation of statistical concepts with R Programming.

UNIT I

Introduction to R: Basic calculation - Getting Help - Installing Packages - Data and programming: Data Types, Data Structures, programming Basics

UNIT II

Descriptive Statistics: Introduction to Statistics and Data, Types of Data -Quantitative Data, Qualitative Data, Data, Multivariate Data etc. Features of Data distributions - Center, Spread, Shape, Symmetry, Skewness and Kurtosis, Stem and Leaf Diagrams, Frequency Distributions and Histogram, Measures of Center - Mean, Median, Mode, Measures of Spread - Range, Variance, Standard Deviation, Interquartile range, Measures of Relative Position: Quartiles, Percentiles. Plotting - Histogram, Bar plot, Box plot, Scatter Plot, Pie chart.

UNIT III

Inferential Statistics: Hypothesis Tests in R - One sample t-Test Review and example, Two sample t-Test Review - and example - Simulation, Simple Linear Regression - Modeling, Least square approach, The lm function - Maximum likelihood Estimation (MLE) Approach, Simulating SLR, Analysis of Variance - One-Way ANOVA, Two-Way ANOVA.

UNIT IV

Probability: Sample Spaces - Events - Model Assignments - Properties of Probability - Counting Methods - Conditional probability - Independent Events - Bayes' Rule - Random Variables.

UNIT V

CASE STUDY: Healthcare - Finance - Digital Marketing- Environment-Sports

References:

1. Applied Statistics with R, David Dalpiaz, 2021. 2.
2. Introduction to Probability and Statistics Using R, G. JayKerns, Lulu.com, 2016.
3. An introduction to statistical data analysis using R, Basic Operations, Graphics and Modelling using R, Christoph Scherber
4. Applied Statistics with R- A Practical Guide for the LifeSciences, Justin C. Touchon, Oxford university press, 2021.

MCA 25 203 OPERATING SYSTEMS

Course Outcomes

CO1	Comprehend the fundamentals concepts and building blocks of Operating Systems
CO2	Understand the concepts of processes, threads, files, inter-process communication and memory management
CO3	Appreciate the concepts of processes, threads, files, inter-process communication and memory management

UNIT I

Fundamentals and Process Management: Concepts - Operating System Definition – Operating System operations – Kernel Data Structures - Operating System Services - System Calls - Linkers and Loaders – Process Management – Concepts - Process Concept – Kernel Level Data Structures for Process Management - Operations on Process IPC Basics – IPC in Shared-Memory Systems – IPC in Message-Passing Systems – Examples of IPC Systems – Pipe, FIFO, Message Queue.

UNIT II

File Management: File-System Interface - File Concept – File Operations - Kernel Level Data Structures for File Management - Operations on Files. File-System Implementation – File System Structure - File System Operations - Directory Allocation - Allocation Methods – Free Space Management – Kernel Level Data Structures for handing open files.

UNIT III

Threads and Synchronization: Multi-Threading – Overview – Multi-Threading Models – Thread Libraries. Thread Synchronization – Critical Section – Synchronization Objects

UNIT IV

Memory Management: Main Memory – Conceptual background – Contiguous Memory Allocation – Paging – Swapping. Virtual Memory – Background – Demand Paging – Page Replacement – Thrashing.

UNIT V

Process Related commands – Debugging Commands – process synchronization - shell scripting – file related commands – system calls.

References:

1. Abraham Silberschatz, P.B. Galvin, G. Gagne, Operating System Concepts, Wiley, 10th Edition, 2018.
2. Andrew S Tanenbaum & Herbert Bos, Modern Operating Systems, Pearson, 4th Edition, 2014
3. Digital Computer Fundamentals, Floyd, Thomas L, Pearson International, 11th Edition, 2015

MCA 25 204 COMPUTATIONAL INTELLIGENCE

Course Outcomes

CO1	Understand basic principles, models, and algorithms of AI
CO2	Identify problems where artificial intelligence techniques are applicable.
CO3	Conceptualize various knowledge representation techniques.
CO4	Analyze the problem-solving methods and algorithms related to search, reasoning, game playing and machine learning.
CO5	Apply selected basic AI techniques; judge applicability of more advanced techniques.

UNIT I

Introduction - Artificial Intelligence - problems, scope and applications, problem space and search - production system- characteristics - the predicate calculus, inference rules, structures and strategies for state space search, strategies for space search, using state space to represent reasoning with the predicate calculus.

UNIT II

Heuristics Search: control and implementation of state space search, generate and test, hill climbing, Best– first search, problem reduction, constraint satisfaction, means-ends analysis, heuristic in games, complexity issues.

UNIT III

Knowledge representation issues, representation and mappings, representing simple facts in logic, representing instances and ISA relationships, computable functions and predicates, resolution, natural deduction, knowledge representation using rules, logic programming, forward versus backward reasoning, symbolic reasoning under uncertainty- nonmonotonic reasoning, depth first search, breadth first search.

UNIT IV

Knowledge and Reasoning: Logical Agents, First-order Logic, Inference in First-Order Logic, Knowledge Representation Planning: Planning, Planning and Acting in the Real World-

Uncertain Knowledge: Uncertainty, Probabilistic reasoning, Making simple decisions. Learning: Learning from Observations, Knowledge in learning, Statistical learning Methods, Reinforcement Learning.

UNIT V

Game playing – the Minimax search procedure, adding Alpha-beta cutoffs, additional refinement, iterative deepening, planning system and its components, understanding, understanding as constraint satisfaction. Slot and filler structures: semantic nets, frames, conceptual dependency, scripts. Definition and characteristics of expert systems, representing and using domain knowledge, expert system shells-Knowledge engineering, knowledge acquisition, expert system life cycle & expert system tools, MYCIN & DENDRAL examples of expert systems.

References:

1. Elaine Rich, Kevin Knight and Shivshankar B. Nair, Artificial Intelligence, 3rd Edition, Tata – McGraw Hill, New Delhi, ISBN:0070087709.
2. V S Janakiraman, K Sarukesi and P Gopalakrishnan, Foundations of Artificial Intelligence and Expert System, Macmillan India Limited, ISBN:0333926250.
3. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, ISBN:0136042597.
4. G. F. Luger and W.A Stubblefield, Artificial Intelligence – Structures and Strategies for Complex Problem Solving, Addison-Wesley, 6th Edition, ISBN:9780321545893.
5. P. H. Winston, Artificial Intelligence, Addison-Wesley, 3rd Edition, ISBN:0201533774.
6. Nils J. Nilsson, Artificial Intelligence, A New Synthesis , 1st Edition, Morgan Kaufmann Publishers, Inc.

MCA 25 205 ADVANCED JAVA PROGRAMMING

Course Outcomes

CO1	Understanding and applying the principles of object-oriented programming in the construction of robust, maintainable programs.
CO2	Analyze the various societal and environmental problems critically to develop solutions using the features of programming language.
CO3	Develop sustainable and innovative solutions for real-time problems.

UNIT I

Introduction to Object Oriented Programming (OOP): Object-Oriented Programming (OOP) Principles- Class Fundamentals - Declaring Objects - Introducing Methods - Overloading methods – Constructors - Parameterized Constructors - this Keyword. Garbage Collection - the finalize () Method - Introducing Access Control - Understanding static - Introducing nested and inner classes - String class - String Buffer Class - Command Line Arguments.

UNIT II

Inheritance in Java: Inheritance Basics - Multilevel Hierarchy- Using super - Method overriding - Dynamic Method Dispatch- Abstract keyword- Using final with inheritance - The Object Class. Interfaces and Packages: Inheritance in java with Interfaces – Defining Interfaces - Implementing Interfaces - Extending Interfaces- Creating Packages - CLASSPATH variable - Access protection - Importing Packages - Interfaces in a Package.
Multithreading Java: Thread Model - Life cycle of a Thread - Java Thread Priorities - Runnable interface and Thread Class- Thread Synchronization – Inter Thread Communication.

UNIT III

Generics: Generics Concept - General Form of a Generic Class – Bounded Types – Generic Class Hierarchy - Generic Interfaces – Restrictions in Generics. Lambda Expression: Introduction to Lambda expression- Block Lambda Expressions - Generic Functional Interfaces - Passing lambda expressions as arguments - Lambda expressions and exceptions- Lambda expressions and variable capture. The Collections Framework: The Collections Overview – Collection Interface – List Interface – Set Interface – SortedSet Interface – Queue

Interface - ArrayList Class – LinkedList Class – HashSet Class – Using an Iterator – The For Each Statement. Working with maps – The map interfaces, the map classes. Comparators- the collection algorithms.

UNIT IV

Introduction to JDBC- Connecting to the database- Basic JDBC Operations – Essential JDBC Classes – JDBC Drivers – JDBC-ODBC Bridge – Connecting to a database with driver manager – JDBC database URL. JAVA BEANS: Java beans - Advantages of Beans – Introspection- Bound and Constrained Properties – Persistence – Customizers - The JavaBeans API. JAVA SWING: Swing Basics – Components and Containers – JLabel and ImageIcons- JTextField – Swing Buttons – JTabbedPane – JScrollPane – JList – JComboBox – JTable – Swing Menus.

UNIT V

JAVA SERVLETS: Servlets Basics – Life Cycle of a Servlet –A Simple Servlet - The Servlet API – Servlet Interfaces – Generic Servlet Class- HttpServletRequest Interface – HttpServletResponse. JSP: The JSP development model – component of jsp page – Page directive – Action – scriptlet – JSP expression, JSP Syntax and semantics, JSP in XML.

References:

1. Schildt Herbert, Java : The Complete Reference, Tata McGraw- Hill, 11 th Edition,2019
2. The complete reference JSP 2.0, Tata McGraw- Hill, 2nd Edition, Phil Hanna
3. Cay S Horstmann, Core Java Volume 1 Fundamentals, Prentice Hall, 11th Edition, 2018.

MCA 25 206(P) - Practical II: Java & R Programming Lab

Course Outcomes

CO1	Apply object oriented concepts in Java Programming
CO2	Create dynamic web applications using Java Programming
CO3	Apply R data structures to perform basic calculations and data manipulation.
CO4	Effectively communicate results, including data visualizations, statistical summaries, and interpretations.

Java Lab

1. Implement the concept of class, data members, member functions and access specifiers.
2. Implement the concept of function overloading & Constructor overloading.
3. Implement String and StringBuffer classes.
4. Implement the concept of inheritance, super, abstract and final keywords.
5. Implement the concept of package and interface.
6. Implement the concept of multithreading.
7. Implement the concept of JDBC.
8. Implement the concept of JAVA beans.
9. Implement the concept of JAVA swing.
10. Implement the concept of JAVA servlets.

R Programming

1. Perform basic calculations using R data structures (Vector, Matrices, List, Data Frames)
2. Calculate descriptive statistics.
3. Visualize Data using plots (Bar, histogram, pie, scatter, Box)
4. Build a simple linear regression model.
5. Perform a one-way analysis of variance.

MCA 25 207 (T) - Term Paper

Course Outcomes

CO1	Apply critical thinking skills.
CO2	Apply foundational research skills to address a research question.
CO3	Demonstrate capacity to improve student achievement, engagement and retention
CO4	Demonstrate capacity to lead and manage change through collaboration with others.
CO5	Innovate, experiment and analyze research findings and familiarize the process of scientific publishing.

Course Outline

The student is expected to do an extensive literature survey and analysis in an area related to computer science, chosen by him/her, under the supervision of a faculty member from the department. The student has to choose an area for his/her work after due consultation and approval from the guide. The study should preferably result in a critical review of the present works/design ideas/designs/algorithms/theoretical contributions in the form of theorems and proofs/new methods of proof/new techniques or heuristics with analytical studies/implementations and analysis of results.

The student should give a seminar on his/her work, during the semester, and submit a technical report. Technical reports should be prepared in TEX in IEEE conference style format.

Course Delivery Mode

Students are given a choice to opt for the supervisor according to his/her area of interest. The Department Council will finally decide and distribute the students among the faculty members by accommodating the choice and interest of the students, as far as possible. The faculty in charge must give proper directions and guidance to the students in carrying out the literature review effectively and systematically.

Course Evaluation

Component	Marks
Publication of the Review Paper in a UGC Listed, Peer Reviewed or other peer reviewed refereed Journals	20% (Maximum mark be given to UGC listed Journal and mark be reduced in other cases)
Quality of the Technical Report	40%
Quality and Effectiveness of the Report Presentation	40%

Students have to obtain only minimum pass requirements in this Audit Course.

Reference:

Articles from ACM/IEEE/INFLIBNET Journals/Conference Proceedings and/or equivalent documents, standard textbooks and web-based material, approved by the supervisor.

SEMESTER-III

MCA 25 301 -CLOUD COMPUTING

Course Outcomes

CO1	Adapt the fundamental concepts in cloud computing
CO2	Describe the basics of cloud infrastructure management
CO3	Understand the technical capabilities and business benefits of cloud computing
CO4	Utilize cloud for workflow execution
CO5	Analyze Data privacy and Security issues in cloud

UNIT I

Introduction to Cloud Computing: Roots of Cloud Computing – Layers and Types of Cloud - Features of a cloud-Infrastructure Management- Infrastructure as a Service Providers- Platform as a Service Providers- Challenges and Risks. Broad Approaches to Migrating into the Cloud - Seven Step Model of Migration into a Cloud.

UNIT II

The Evolution of SaaS-The Challenges of SaaS Paradigm- Approaching the SaaS Integration Enigma-New Integration Scenarios- The Integration Methodologies- SaaS Integration Products, Platforms and Services- B2Bi Services -. Background of Enterprise cloud computing paradigm- Issues for Enterprise Applications on the Cloud- Transition Challenges- Enterprise Cloud Technology and Market Evolution- Business drivers toward a marketplace for Enterprise cloud computing- The Cloud Supply Chain.

UNIT III

The Anatomy of Cloud Infrastructure- Distributed Management of Virtual Infrastructures- Scheduling Techniques for Advance Reservation of Capacity- RVWS Design - Cluster as a Service: The Logical Design-Cloud Storage : from LANs TO WANs- Technologies for Data Security in Cloud Computing.

UNIT IV

Workflow Management Systems and Clouds - Architecture of Workflow Management Systems – Utilizing Clouds for Workflow Execution- A Classification of Scientific Applications and Services in the Cloud- SAGA based Scientific Applications that Utilize Clouds. Map Reduce Programming Model- Major Map Reduce Implementations for the Cloud- Map Reduce Impacts and Research Directions. A Model for Federated Cloud Computing - Traditional Approaches to SLO Management- Types of SLA -Life Cycle of SLA - SLA Management in Cloud- Automated Policy based Management.

UNIT V

Grid and Cloud- HPC in the Cloud: Performance related Issues - Data Security in the Cloud- The Current State of Data Security in the Cloud- Homo Sapiens and Digital Information- Risk- Identity- The Cloud, Digital Identity and Data Security - Content Level Security :Pros and Cons- Legal Issues in Cloud Computing - Data Privacy and Security Issues- Cloud Contracting models- Case Studies : Aneka and Comet Cloud.

References:

1. Rajkumar Buyya, James Broberg, and Andrzej Goscinski, “Cloud Computing - Principles and Paradigms”, 2011, Addison-wily, 1st Ed.
2. GeorgeReese,“Book for ReferenceCloud Application Architectures, Shroff /O'Reilly,2009.
3. Toby Velte, Robert Elsenpeter and Anthony Velte, “Cloud Computing, A Practical Approach”, TMH., 1st Ed.2009
4. George Reese, “Cloud Application Architectures”, 1st Edition, Shroff/O'Reilly, Ravi Nair and Jim Smith, “Virtual Machines: Versatile Platforms for Systems and Processes”, 1st Edition, Elsevier Science / MorganKaufmann

MCA 25 302 MACHINE LEARNING

Course Outcomes

CO1	Formulate machine learning problems corresponding to different applications
CO2	Understand the arrangement of machine learning algorithms along with their strengths and weaknesses
CO3	Understand the basic theory underlying machine learning
CO4	Apply machine learning algorithms to solve problems of moderate complexity.
CO5	Understand the issues raised by the current research papers and analyze the research finding reported

UNIT I

Introduction to Machine Learning: Concept of learning task, inductive learning and the concepts of hypothesis space, introduction to different types of machine learning approaches, examples of machine learning applications, different types of learning; supervised learning, unsupervised learning, reinforcement learning. Setting up your machine learning platform; training, validation and testing, over-fitting and under- fitting, different types of error calculation.

UNIT II

Supervised Learning: Introduction, learning a class from example, learning multiple classes, model selection and generalization, linear regression and feature selection, Bayesian and Decision Tree learning; classification tree and regression tree, multivariate methods for learning; multivariate classification and regression.

UNIT III

Unsupervised Learning: Introduction, clustering; mixture densities, k-means clustering, expectation maximization algorithm, mixture latent variable models, Latent Dirichlet Allocation, Spectraland hierarchical clustering, Dimensionality reduction; principal component allocation, linear discriminant analysis, canonical correlation analysis.

UNIT IV

Introduction to Artificial Neural Network: Understanding brain, perceptron, Multi-Layer perceptron as universal approximator, general architecture of artificial neural network, feed forward and back- propagation, different linear and nonlinear activation functions for binary and multi class classification.

UNIT V

Introduction to Deep Learning: Fundamentals of deep learning, Deep Feedforward Networks, Regularization for Deep Learning, Optimization for Training Deep Models, Introduction to Convolutional Networks, Sequence Modeling using Recurrent Nets, overview of LSTM, fundamentals of Generative adversarial network.

References:

1. Ethem Alpaydin, Introduction to Machine Learning- 3rdEdition,PHI.
2. Tom M. Mitchell, Machine Learning, McGraw-Hill, 1stEd.
3. Ian Goodfellow and Yoshua Bengioand Aaron Courville, Deep Learning (Adaptive Computation and Machine Learning), MIT Press, 2016.
4. Kuntal Ganguly, Learning Generative Adversarial Networks, PacktPublishing,2017

MCA 25 303 DATA COMMUNICATION & CRYPTOGRAPHY

Course Outcomes

CO1	Follow Network Architecture and its functionality.
CO2	Evaluate network protocols for data transmission in various types of networks.
CO3	Understand symmetric and asymmetric cryptography
CO4	Acquire background on hash functions, authentication protocols
CO5	Explain the working principle of Algorithms in Cryptography.

UNIT I

Data Communications - Data Transmission: Concepts and Terminology - Analog and Digital Data Transmission - Transmission Impairments - Transmission Media - Guided Transmission Media - Wireless Transmission - Signal Encoding Techniques - Digital Data - Digital Signals - Digital Data - Analog Signals - Analog Data - Digital Signals - Analog Data - Analog Signals.

UNIT II

Digital Data Communication Techniques- Asynchronous and Synchronous Transmission - Types of Errors - Error Detection - Error Correction - Line Configurations - Multiplexing: Frequency - Division Multiplexing - Synchronous Time-Division Multiplexing - Statistical Time-Division Multiplexing - Asymmetric Digital Subscriber Line - Circuit Switching Networks - Circuit Switching Concepts - Packet-Switching Principles

UNIT III

Congestion Control in Data Networks - Congestion Control - Traffic Management - Congestion Control in Packet - Switching Networks - High-Speed LANs: The Emergence of High-Speed LANs - Ethernet - Wireless LANs: IEEE 802.11 Architecture and Services - Internetwork Protocols - Internetwork Protocols: Internet Protocol - IPv6 - Transport Protocols: Connection-Oriented Transport Protocol Mechanisms – TCP - TCP Congestion Control - UDP.

UNIT IV

Introduction to Cryptography and Data Security - Stream Ciphers - Block Cipher - The Data Encryption Standard (DES) and Alternatives - The Advanced Encryption Standard (AES) - Introduction to Public-Key Cryptography - The RSA Cryptosystem - Public-Key Cryptosystems Based on the Discrete Logarithm Problem - Elliptic Curve Cryptosystems.

UNIT V

Digital Signatures - The Digital Signature Algorithm (DSA) - Hash Functions - Message Authentication Codes (MACs) - Principles of Message Authentication Codes - MACs from Hash Functions: HMAC - Key Establishment.

References:

1. Forouzan, Behrouz A., “Data Communications and Networking”, Tata McGrawHill publishing Company Limited, 5th Edition, 2013.
2. AtulKahate, “Cryptography and Network Security”, Tata McGraw-Hills, 2010.
3. Stallings William, “Data and Computer Communications”, PHI, 9th Edition, 2011.
4. Bart Preneel, “Understanding Cryptography”, Springer Heidelberg Dordrecht London New York, 2010.

ELECTIVE I

MCA 25 304 A - BIG DATA TECHNOLOGIES

Course Outcomes

CO1	Acquire knowledge about the importance of Big Data
CO2	Information about Stream Data Model in Big Data
CO3	Adapt the knowledge about the Big Data Analytics
CO4	Practice basics of R programming
CO5	Extend awareness about Hadoop Distributed File System

UNIT I

Introduction to Big Data – definition &importance of Big Data ,four dimensions of Big Data - volume, velocity, variety, veracity. Importance of big data, structured data, unstructured data, Technology Foundation for Big Data. Big Datastack – layer 0,1,2,3and 4 – Big Data Applications-Understanding the Basics of Virtualization-The cloud and BigData- Big Data management – operational databases ,relational databases –,non relational databases – NoSQL - key-value pair databases – document databases - columnar databases - graph databases - spatial databases.

UNIT II

Big Data analysis - basic analytics , advanced analytics-operationalized analytics, monetizing analytics- modifying business intelligence products to handle Big Data - Big Data analytics examples- Analytics solutions - text analytics - exploring unstructured data ,analysis and extraction techniques - the extracted information - text analytics tools for Big Data – New models and Approaches to support Big Data– Characteristics - Google Prediction API - Characteristics of a Big Data Analysis Framework.

UNIT III

Introduction to R Programming – Evolution ,Features, Basic Syntax , Data Types, Variables, Operators, Decision Making Loops, Functions, Strings ,Vectors ,Lists, Matrices, Arrays, Factors ,Data Frames ,Web Data, Databases ,Pie Charts ,Bar Charts, Boxplots, Histograms ,Line graphs, Scatterplots, Linear Regression, Multiple Regression, Normal Distribution, Binomial Distribution, Time Series Analysis.

UNIT IV

Hadoop – history – components – Hadoop Distributed File System –Analyzing Data with Hadoop - Application Development in Hadoop – Hadoop Streaming - getting our data into Hadoop - Map Reduce Basics – origins of MapReduce - map function – reduce function – putting them together– Map Reduce Applications – How Map Reduce Works – Map Reduce Types And Formats – Map Reduce Features

.

UNIT V

Application of Big Data Using Pig and Hive – Data Processing Operators in Pig – Hive Services – HiveQL _Querying Data in Hive – Fundamentals of HBase and Zookeeper – Visualization – Visual data analysis Techniques, interaction techniques; Systems and applications.

References:

1. Hurwitz, Alan Nugent, Fern Halper and Marcia Kaufman, Big Data for Dummies, Wiley,2013
2. Bill Franks Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with Advanced Analytics ,John Wiley & sons,2012.
3. Chris Elaton, Derk Deroos, Tom Deutsch, George Lapis and Paul Zikopoulos, Understanding
   Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGrawHill,2012
4. Garry Turkington, Hadoop Beginner's Guide, Packt Publishing Ltd.,213
5. Tom White, Hadoop: The Definitive Guide, 4thEd. O'Reilly Media,2015
6. Pete Warden, Big Data Glossary, O'Reilly Media, 2011.

MCA 25 304 B- DIGITAL IMAGE PROCESSING

Course Outcomes

CO1	Understand the fundamental concepts of a digital image processing
CO2	Describe various image enhancement techniques
CO3	Implement algorithms for handling intensive image restoration and Reconstruction problems.
CO4	Understand various image compression procedures.
CO5	Identify and compare various image segmentation and representation techniques.

UNIT I

Introduction, Digital Image Fundamentals: elements of visual perception, light and electromagnetic spectrum, image sensing and acquisition, image sampling and quantization, some basic relationship between pixels. Intensity Transformations: Basics of intensity transformations, some basic intensity transformation functions, histogram processing.

UNIT II

Spatial Filtering: fundamentals of spatial filtering, smoothing and sharpening filters. Frequency domain Filtering: Background, preliminary concepts, sampling, Fourier transforms and DFT, 2-D DFT and properties, frequency domain filtering, low pass filters, high pass filters, implementation.

UNIT III

Image restoration and Reconstruction: Noise models, restoration in the presence of noise, linear- positive invariant degradations, inverse filtering, Wiener filtering, constrained least square filtering, geometric mean filter.

UNIT IV

Image Compression: fundamentals, basic compression methods. Morphological Image Processing: preliminaries, erosion and dilation, opening and closing, basic morphological algorithms.

UNIT V

Image Segmentation: fundamentals, point, line and edge detection, thresholding, region based segmentation, use of motion in segmentation.

References:

1. Digital Image Processing, by Rafael C. Gonzalez & Richard E.Woods,3rd edition, PHI2008
2. Fundamentals of Digital Image Processing, by Anil K. Jain, Prentice Hall, 1995, 1st Ed.
3. Digital Image Processing, by William K. Pratt, John Wiley &Sons Inc., 3rd edition,2001.
4. Milan Sonka, Vaclav Hlavacand Roger Boyle, Image Processing Analysis and Machine Vision, 3rd Edition, Ceneage Learning India PvtLtd

MCA 25 304C- ADVANCED COMPUTER GRAPHICS

Course Outcomes

CO1	Understand various types of video displays and colour models.
CO2	Understand and implement various drawing primitives using OPENGL
CO3	Understand fundamental concepts within computer graphics such as geometrical transformations.
CO4	Understand various 3D object representation techniques
CO5	Understand the concept of illumination models, removal of hidden surfaces and rendering.

UNIT 1

Overview: Computer Graphics and OpenGL: Computer Graphics: Basics of computer graphics, Application of Computer Graphics, Video Display Devices: Random Scan and Raster Scan displays, color CRT monitors, Flat panel displays. Raster-scan systems: video controller, raster scan Display processor, graphics workstations and viewing systems, Input devices, graphics networks, graphics on the internet, graphics software. OpenGL: Introduction to OpenGL ,coordinate reference frames, specifying two-dimensional world coordinate reference frames in OpenGL, OpenGL point functions, OpenGL line functions, point attributes, line attributes, curve attributes, OpenGL point attribute functions, OpenGL line attribute functions, Line drawing algorithms(DDA, Bresenham's), circle generation algorithms (Bresenham's).

UNIT 2

Fill area Primitives, 2D Geometric Transformations and 2D viewing: Fill area Primitives: Polygon fill-areas, OpenGL polygon fill area functions, fill area attributes, general scan line polygon fill algorithm, OpenGL fill-area attribute functions. 2DGeometric Transformations: Basic 2D Geometric Transformations, matrix representations and homogeneous coordinates. Inverse transformations, 2DComposite transformations, other 2D transformations, raster methods for geometric transformations, OpenGL raster transformations, OpenGL geometric transformations function, 2D viewing: 2D viewing pipeline, OpenGL 2D viewing functions.

UNIT 3

Clipping,3D Geometric Transformations, Color and Illumination Models: Clipping: clipping window, normalization and viewport transformations, clipping algorithms,2D point clipping, 2D line clipping algorithms: cohen-sutherland line clipping only -polygon fill area clipping: Sutherland-Hodgeman polygon clipping algorithm only.3DGeometric Transformations: 3D translation, rotation, scaling, composite 3D transformations, other 3D transformations, affine transformations, OpenGL geometric transformations functions. Color Models: Properties of light, color models, RGB and CMY color models. Illumination Models: Light sources, basic illumination models-Ambient light, diffuse reflection, specular and phong model, Corresponding openGL functions.

UNIT 4

3D Viewing and Visible Surface Detection: 3DViewing:3D viewing concepts, 3D viewing pipeline, 3D viewing coordinate parameters , Transformation from world to viewing coordinates, Projection transformation, orthogonal projections, perspective projections, The viewport transformation and 3D screen coordinates. OpenGL 3D viewing functions. Visible Surface Detection Methods: Classification of visible surface Detection algorithms, back face detection, depth buffer method and OpenGL visibility detection functions.

UNIT 5

Input & interaction, Curves and Computer Animation: Input and Interaction: Input devices, clients and servers, Display Lists, Display Lists and Modelling, Programming Event Driven Input, Menus Picking, Building Interactive Models, Animating Interactive programs, Design of Interactive programs, Logic operations .Curved surfaces, quadric surfaces, OpenGL Quadric-Surface and Cubic-Surface Functions, Bezier Spline Curves, Bezier surfaces, OpenGL curve functions. Corresponding openGL functions.

References:

1. Donald D Hearn, M Pauline Baker and WarrenCarithers: Computer Graphics with OpenGL 4th Edition, Pearson, 2014
2. Foley J.D, Van Dam A, Eiener S.K. and Hughes J.F., “Computer Graphics Principles andPractice”, Second Edition, Pearson Education, 1996.
3. Rajiv Chopra , “Computer Graphics – A Practical Approach”
4. Edward Angel: Interactive Computer Graphics- A Top Down approach with OpenGL, 5th edition. Pearson Education, 2008.
5. James D Foley, Andries Van Dam, Steven K Feiner, John F Huges Computer graphics with OpenGL: Pearson education

MCA 25 305 D- INTERNET OF THINGS

Course Outcomes

CO1	Examine the concept of IoT
CO2	Analyze various protocols for IoT
CO3	Understand web of things and cloud of things
CO4	Apply data analytics and use cloud offerings related to IoT
CO5	Analyze applications of IoT in a real time scenario.

UNIT I

Introduction: Internet Layers - Protocols - Packets - Services - Performance parameters - Peer-to peer networks - Sensor networks - Multimedia - IOT Definitions and Functional Requirements – Motivation – Architecture - Web 3.0 View of IoT– Ubiquitous IoT Applications – Four Pillars of IoT,DNA of IoT - The Toolkit Approach for End-user Participation in the Internet of Things. Middleware for IoT: Overview – Communication middleware for IoT –IoT Information Security.

UNIT II

IoT protocols: Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4 – BACNet Protocol – point-to-point protocols - Ethernet protocals- cellular Internet access protocal- Machine-to-machine protocal- Modbus – KNX – Zigbee Architecture – Network layer – APS layer –Security.

UNIT III

Web of Things: Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware forWoT– Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middleware – Cloud Standards – Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture.

UNIT IV

Integrating IOT: Integrated Billing Solutions in the IoT, Business Models for the IoT – Network. Dynamics: Population Models – Information Cascades – Network Effects - Network Dynamics: Structural Models - Cascading Behavior in Networks - The Small World Phenomenon.

UNIT V

Applications: The Role of the IoT for Increased Autonomy and Agility in Collaborative Production Environments - Resource Management in the Internet of Things: Clustering, Synchronisation and Software Agents. Applications - Smart Grid – Electrical Vehicle Charging - Case studies: Sensor body-area-network and Control of a smart home.

References:

1. HonboZhou, The Internet of Things in the Cloud:AMiddleware Perspective-CRC Press2012.
2. Dieter Uckelmann; Mark Harrison; Florian Michahelles- (Eds.), Architecting the Internet of Things- Springer – 2011
3. David Easley and Jon Kleinberg, Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press -2010.
4. Olivier Hersent, Omar Elloumiand David Boswarthick, The Internet of Things: Applications to the Smart Grid and Building Automation, Wiley-2012
5. Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key applications and Protocols”, Wiley,2012.

MCA 25 304E- NEURAL NETWORK AND DEEP LEARNING

Course Outcomes

CO1	Understand the major technology trends in neural networks and deep learning
CO2	Build, train and apply neural networks and fully connected deep neural networks
CO3	Implement efficient (vectorized) neural networks for real time application

UNIT 1

Neural Networks-Application Scope of Neural Networks- Fundamental Concept of ANN: The Artificial Neural Network-Biological Neural Network Comparison between Biological Neuron and Artificial Neuron-Evolution of Neural Network. Basic models of ANN-Learning Methods-Activation Functions-Importance Terminologies of ANN.

UNIT 2

Shallow neural networks- Perceptron Networks-Theory-Perceptron Learning Rule Architecture- Flowchart for training Process-Perceptron Training Algorithm for Single and Multiple Output Classes. Back Propagation Network- Theory-Architecture-Flowchart for training process-Training Algorithm-Learning Factors for Back-Propagation Network. Radial Basis Function Network RBFN: Theory, Architecture, Flowchart and Algorithm.

UNIT 3

Introduction - Components of CNN Architecture - Rectified Linear Unit (ReLU) Layer - Exponential Linear Unit (ELU, or SELU) - Unique Properties of CNN -Architectures of CNN -Applications of CNN.

UNIT 4

Introduction- The Architecture of Recurrent Neural Network- The Challenges of Training Recurrent Networks- Echo-State Networks- Long Short-Term Memory (LSTM) - Applications of RNN.

UNIT 5

Introduction - Features of Auto encoder Types of Autoencoder Restricted Boltzmann Machine- Boltzmann Machine - RBM Architecture -Example - Types of RBM.

References:

1. S.N.Sivanandam, S. N. Deepa, Principles of Soft Computing, WileyIndia, 3rd Edition, 2018.
2. Dr. S Lovelyn Rose, Dr. L Ashok Kumar, Dr. D Karthika Renuka, Deep Learning Using Python, Wiley-India, 1st Edition, 2019

ELECTIVE II

MCA 25 305A- DATA MINING

Course Outcomes

CO1	Understand different types of data to be mined and different preprocessing techniques
CO2	Categorize the scenario for applying different data mining techniques
CO3	Evaluate different models used for classification and clustering
CO4	Focus towards research and innovation

UNIT I

Data Mining Introduction: An overview of Data Mining – Kinds of data and pattern to be mined –Technologies – Targeted Applications - Major Issues in Data Mining – Data Objects and Attribute Types – Measuring Data Similarity and Dissimilarity Data Preprocessing: Data Cleaning –Data Integration–Data Reduction–Data Transformation – Data Discretization

UNIT II

Basic Concepts – Frequent Itemset Mining Methods – Apriori Algorithm-Generating Association Rules from Frequent Itemsets – Pattern Evaluation Methods – Pattern Mining in Multilevel, Multidimensional space – Constraint-Based Frequent Pattern Mining – Mining Compressed or Approximate Patterns – Pattern Exploration and Application

UNIT III

Classification – Model Evaluation and Selection – Techniques to Improve Classification Accuracy – Classification by Backpropagation – Support Vector Machines – Learning from Neighbors.

UNIT IV

Cluster Analysis – Definition – Types of Data in Cluster Analysis, Clustering methods– Partitioning Methods – k-Means– k-Medoids– Hierarchical Methods –Agglomerative versus Divisive Hierarchical Clustering –BIRCH–Density-Based Methods–DBSCAN

UNIT V

Outliers and Outlier Analysis – Clustering-Based Approach – Classification-Based Approach – Mining Complex Data Types – Data Mining Applications.

References:

1 .Data Mining Concept and Techniques, Jiawei Han, Micheline Kamber, Jian Pie, Morgan and Kaufmann Publisher, Third Edition,2012

2 .Data Mining Techniques, Arun K Pujari, Second Edition, Universities Press India Pvt. Ltd.2010

MCA 25 305B- ADVANCED PYTHON PROGRAMMING

Course Outcomes

CO1	Create different visualizations using Python
CO2	Design websites using Python IDE frameworks
CO3	Apply Python for Image Processing and Text analysis
CO4	Develop Games using modern tools

UNIT I

Making 3D visualizations: Creating 3D bars- Creating 3D histograms – Animating in Matplotlib – Plotting Charts with Images and Maps: Processing images with PIL – Plotting with Images – Plotting data on a map using Basemap.

UNIT II

Python for Web Application: Introduction to StreamLit - Elements, Markdown, Input Widgets - Data Visualization - Additional Elements - Layouts

UNIT III

Python for Image Processing: Image and its Properties-Image types – Data structures for Image analysis - Filtering – Image Enhancement -Segmentation.

UNIT IV

Python for Text Analysis- Processing and understanding text: Text processing and wrangling – Text classifications: Automated Text classifications – Data retrieval – Classification models.

UNIT V

Python for Big Data: Introducing Big Data- Installing PySpark – Programming with RDDs - Big Data Cleaning and Wrangling - Powerful Exploratory Data Analysis with MLlib.

References:

1. Python Data Visualization Cook Book, Igor Mialovanovic, PACKT publications, First Edition, 2013
2. Streamlit for Data Science, Tyler Richards, packet publication, 2023.
3. Programming Computer Vision with Python, John Erik Solem, OREILLY publication, 2020.
4. Text Analytics with Python, Dipanjan Sarkar, Apress publications, Second Edition, 2019.
5. Hands-On Big Data Analytics using PySpark,Rudy Lai, Bartlomiej Potaczek, Packt, 2019.

MCA 25 305C -MOBILE APPLICATION DEVELOPMENT

Course Outcomes

CO1	Understand the basic concepts of Mobile application development
CO2	Design and develop user interfaces for the Android platforms
CO3	Apply Kotlin programming concepts to Android application development
CO4	Deploy mobile app with material design principles

UNIT I

Introduction to Android: History of Mobile Apps, Trends in Market-Web App Vs Mobile App-Mobile OS. Introduction to Android and Kotlin: Kotlin Basics – Classes and Objects-Inheritance- Functions – Extension Functions – First Android App – Anatomy of an Android App - Deploying the app: Running and Debugging app in Android Emulator.

UNIT II

Layout Navigation: Layouts in Android Constraint Layout - Displaying lists with RecyclerView Multiple activities and intents - App bar, navigation drawer, and menus Fragments - Navigation in an app - Navigation UI.

UNIT III

Activity and Fragment Lifecycle: Introduction to Activity-Activity Lifecycle – Logging. Fragment: Introduction - Lifecycle- Task and Back Stack. Android App Architecture - View Model -Data Binding – Live Data- Transform Live Data.

UNIT IV

Saving User Data: Store Data-Room Persistency Library-Asynchronous program Coroutines-Testing Databases. Introduction to Advanced Binding – Multiple Item View types-Headers - GridLayouts.

UNIT V

Advanced RecyclerView: Connect to the Internet-Android Permissions-connect to and from Network Resources – Connect to the Web Services-Display Images. Repository pattern – Work Manager – Work Input/Output – Work Request Constraints. App UI Design: Android Styling – Typography-Material Design- Material Components- Localization.

References:

1.John Horton, Android programming with Kotlin for beginners, Packt-Birmingham, Mumbai, 2nd edition, 2019.

2.Gardner, B., Sills, B., Stewart, C., Marsicano, K. Android Programming: The Big Nerd Ranch Guide. United Kingdom: Addison Wesley Professional, 4th edition,2022.

3. Dawn Griffiths and David Griffiths, Head First Android Development: A Brain-Friendly guide, O'Reilly, 2nd edition,2019.

4. Mark Wickham, Practical Android: 14 Complete Projects onAdvanced Techniques and Approaches, APRESS.

MCA 25 305D- BLOCKCHAIN

Course Outcomes

CO1	Understand the cryptographic techniques used in block chain to secure data and transactions..
CO2	Demonstrate the ability to write, deploy and interact the smart contracts on a block chain platform.
CO3	Explore the block chain tools and technologies and utilize the tools and technologies to implement secured real time applications

UNIT I

Introduction to Blockchain-Definition, Evolution of Blockchain, Historical Context and Origin, architecture, elements of blockchain, benefits and limitations, types of blockchain. Cryptography Basics in Blockchain-Introduction, Symmetric cryptography and Asymmetric cryptography.

UNIT II

Consensus and Decentralization Principle: Consensus – definition, types, consensus in blockchain. Consensus Mechanisms- Proof of Work (PoW), Proof of Stake (PoS), Types of PoS, Peer-to-Peer Networks and Network Models. Decentralization – Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization. Distributed Ledger Technology (DLT)

UNIT III

BlockChain Platforms: Ethereum- Introduction to Ethereum, Accounts and wallets, consensus in Ethereum. Mastering Ethereum Virtual Machine (EVM), EVM message calls; Smart Contract Design, Smart Contract Life Cycle, Ethereum DApps. Solidity-Basic Introduction and Overview: Introduction to Smart Contracts and Solidity, Blockchain basics of smart contracts and overview, Solidity Layouts, Solidity Types, Operators, Expression and control structure and Functions. Hyperledger- Introduction to Hyperledger, Hyperledger Architecture, Chain code, Applications on Hyperledger.

UNIT IV

BlockChain Tools: Introduction to BlockChain Tools, Hyperledger Fabric, Truffle, Ganache, MetaMask, Remix, Geth, Blockchain 2.0, Blockchain 3.0

UNIT V

Blockchain Security and Privacy- Security and Privacy, Interoperability issues, Use cases. Blockchain Applications- Government, Health care, Finance, Supply chain management. Case study. Emerging trends in Blockchain and allied technologies – Blockchain and Cloud Computing, Blockchain and Artificial Intelligence. Blockchain in IoT

References:

1. “Bitcoin and Cryptocurrency Technologies-a Comprehensive Introduction” Aravind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, Princeton University Press, 2016.

2. “Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more” Imran Bashir, Packt Publishing, Third edition, 2020.

3. “Hands-On Blockchain with Hyperledger-Building decentralized applications with Hyperledger Fabric and Composer”, Nitin Gaur, Luc Desrosiers, Venkatraman Ramakrishna, Petr Novotny, Dr. Salman A. Baset Anthony O'Dowd, Packt Publishing, 2018.

4. “Mastering Ethereum -Building Smart Contracts and dApps”, Andreas M. Antonopoulos, Dr. Gavin Wood, Ethereum Book LLC, 2019.

MCA 25 305E- THEORY OF COMPUTATION

Course Outcomes

CO1	Understand the theoretical foundations of computer science.
CO2	Introduce basic types of formal languages and interpret it and identify the machine equivalence.
CO3	Explore the capabilities and limits of computation, particular applications and capabilities of deterministic and non-deterministic finite automata, context-free grammars, and Turing machines.

UNIT I

Introduction: Structural Representations, Automata and Complexity. General Concepts of Automata Theory: Alphabets Strings, Languages. Finite Automata: The Ground Rules, The Protocol.

UNIT II

Deterministic Finite Automata: Definition, DFA with Strings, Simpler Notations for DFA's, Extending the Transition Function to Strings, The Language of a DFA Nondeterministic Finite Automata: The Extended Transition Function, Equivalence of Deterministic and Nondeterministic Finite Automata

UNIT III

Regular Expressions: The Operators of regular Expressions, Building Regular Expressions Finite Automata and Regular Expressions: From DFA's to Regular Expressions, Converting DFA's to Regular Expressions, Converting Regular Expressions to Automata.

UNIT IV

Definition of Context-Free Grammars, Derivations Using a Grammars Leftmost and Rightmost Derivations Parse Trees-Applications of Context-Free Grammars - Ambiguity in Grammars and Languages: Ambiguous Grammars, Removing Ambiguity from Grammars

UNIT V

Pushdown Automata: Formal Definition of Pushdown Automata, A Graphical Notation for PDA's, Nondeterministic Pushdown Automata: Formal Definitions, transition diagram. The Turing Machine: The Instantaneous Descriptions for Turing Machines, Transition Diagrams for Turing Machines.

References:

1. Introduction to Automata Theory, Languages, and Computation, John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, 3rd Edition, Pearson Education, 2014

2. Theory of Computer Science (Automata Language & Computations), by K.L.Mishra & N. Chandrashekhar, PHI, 2012. [3] Introduction to the Theory of Computation, Michael Sipser ,ACM Sigact News,2013.

MCA 25 306(P) - Mini Project

CO1	Identify a problem by considering realistic constraints
CO2	Classify already available literature or existing systems for selected problems.
CO3	Describe the requirements for the real world problem.
CO4	Describe the basic concepts of software and hardware used for solving the problem.
CO5	Design solution with Software Engineering practices and standards.
CO6	Evaluate the performance and document the outcome.
CO7	Compare the performance of the stated solution with already existing literatures

Course Outcomes

A mini-project should be done by the students based on concepts they have already learnt in the previous semesters of the MCA Programme. It may be based on database concepts, object-oriented concepts, computational intelligence, optimization tools, compiler design, Android application programs, Information retrieval etc.

SEMESTER-IV

MCA 25 401 MAIN PROJECT AND VIVA VOCE

After completion of this course, students will be able to design solutions to complex real world problems utilizing a systems approach.

Course Outcomes

CO1	Apply prior knowledge to designing solutions to open ended computational problems while considering realistic constraints.
CO2	Describe the literature or existing solutions to identify the gap
CO3	Analyze Database, Network and Application Design methods.
CO4	Design solution for the problem and document the outcome
CO5	Evaluate the performance of the solution using testing and security tools.
CO6	Analyze professional issues, including ethical, legal and security issues, related to computing projects.

General Pattern of Question Paper

Core and Elective Courses in MCA
(effective from 2025 Admission Onwards)

Code:

First Semester MCA) Degree Examination – 2025
Course Code: (Eg: MCA 25 101)
Course: (Eg: Full Stack Development)

Time: 3 Hours Total Marks:100

Answer five full questions; Each Question carries 20 marks.

Question Numbers: 1to7

Total Marks = 5 x 20 Marks = 100 Marks

NOTE: Minimum one question from each of the five modules. Remaining two questions can be from any module. There should not be more than two questions from the same module.