KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA

Estd : 1984

REGULATIONS, CURRICULUM & SYLLABI – 2022

(CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION)

(For the students admitted during 2022 - 2023 and onwards)

MASTER OF COMPUTER APPLICATIONS DEGREE

IN

COMPUTER APPLICATIONS

DEPARTMENT OF COMPUTER APPLICATIONS

KONGU
Assuring the Best

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638060

(An Autonomous Institution Affiliated to Anna University)

REGULATIONS 2022

CHOICE BASED CREDIT SYSTEM AND OUTCOME BASED EDUCATION

MASTER OF COMPUTER APPLICATIONS (MCA) DEGREE PROGRAMME

These regulations are applicable to all candidates admitted into MCA Degree programme from the academic year 2022 – 2023 onwards.

1. DEFINITIONS AND NOMENCLATURE

In these Regulations, unless otherwise specified:

i. "University" means ANNA UNIVERSITY, Chennai.

ii. "College" means KONGU ENGINEERING COLLEGE.

iii. "Programme" means Master of Computer Applications (MCA) Degree programme

iv. "Course" means a Theory / Theory cum Practical / Practical course that is normally studied in a semester like Data structures and Algorithms, Data Communication Networks etc.

v. "Credit" means a numerical value allocated to each course to describe the candidate's workload required per week.

vi. "Grade" means the letter grade assigned to each course based on the marks range specified.

vii. "Grade point" means a numerical value (0 to 10) allocated based on the grade assigned to each course.

viii. "Principal" means Chairman, Academic Council of the College.

ix. "Controller of Examinations" means authorized person who is responsible for all examination related activities of the College.

x. "Head of the Department" means Head of the Department concerned of the College.

2. PROGRAMME

The MCA programme approved by Anna University, Chennai and All India Council for Technical Education, New Delhi is offered by the College.

3. ADMISSION REQUIREMENTS

Candidates seeking admission to the MCA Degree Programme shall be required to have passed an appropriate qualifying Degree Examination of Anna University or any examination of any other University or authority accepted by the Anna University, Chennai as equivalent thereto, subject to amendments as may be made by the Anna University, Chennai from time to time. The candidates shall also be required to satisfy all other conditions of admission prescribed by the Anna University, Chennai and Directorate of Technical Education, Chennai from time to time. To gain the fundamental knowledge of computer science, it is mandatory for the candidates from other than Computer Science, Information Technology, Computer Application or any other computer science equivalent backgrounds of study shall complete four additional non-credit courses as bridge courses in the first and second semesters as prescribed by the College.

4. STRUCTURE OF PROGRAMME

4.1 Categorisation of Courses

The MCA programme shall have a curriculum with syllabi comprising of theory, theory cum practical, practical courses in each semester, professional skills training/industrial training, project work, internship, etc. that have been approved by the respective Board of Studies and Academic Council of the College. All the programmes have well defined Programme Outcomes (PO), Programme Specific Outcomes (PSO) and Programme Educational Objectives (PEOs) as per Outcome Based Education (OBE). The content of each course is designed based on the Course Outcomes (CO). The courses shall be categorized as follows:

i. Bridge Courses (BC) like Problem Solving Techniques, C++ Programming, Computer Organization and Design, Operating Systems

ii. Foundation Courses (FC)

iii. Professional Core (PC) Courses

iv. Professional Elective (PE) Courses

v. Employability Enhancement Courses (EC) like Mini Project, Project work, Professional Skills/Industrial Training and Internship in Industry or elsewhere

4.2 Credit Assignment

4.2.1. Credit Assignment

Each course is assigned certain number of credits as follows:

Contact period per week	Credits
1 Lecture / Tutorial Period	1
2 Practical Periods	1
2 Project Work Periods	1
40 Training / Internship Periods	1

The minimum number of credits to complete the MCA programme is 85.

4.3 Employability Enhancement Courses

A candidate shall be offered with the employability enhancement courses like mini project, project work, professional skills training/ industrial training and internship during the programme to gain/exhibit the knowledge/skills.

4.3.1 Professional Skills Training/Industrial Training

A candidate may be offered with appropriate training courses imparting programming skills, communication skills, problem solving skills, aptitude skills etc. It is offered in second semester including vacation periods and it can carry two credits.

(or)

A candidate may be allowed to go for training at research organizations or industries for a required number of hours in second semester including first semester vacation period. Such candidate can earn two credits for this industrial training course in place of Professional Skills Training course in second semester.

4.3.2 Mini Project

A candidate shall earn two credits by successfully completing the project by using his/her innovations in third semester during his/her programme.

4.3.3 Internships

The curriculum enables a candidate to go for full time project through internship during entire final semester and can earn credits vide clause 7.6 and clause 7.10.

A candidate is permitted to go for full time project through internship during final semester in place of Project work. Such candidate shall earn the minimum number of credits required to complete final semester other than project/internship through either approved Value Added Courses /Online courses / Self Study Courses or Add/Drop courses as per clause 4.4 and clause 4.5 respectively.

Assessment procedure is to be followed as specified in the guidelines approved by the Academic Council.

4.4 One / Two Credit Courses / Online Courses / Self Study Courses

The candidates may optionally undergo One / Two Credit Courses / Online Courses / Self Study Courses as elective courses.

4.4.1 **One / Two Credit Courses:** One / Two Credit courses shall be offered by the college with the prior approval from the respective Board of Studies. A candidate can earn a maximum of six credits through one / two credit courses during the entire duration of the programme.

4.4.2 **Online Courses:** Candidates may be permitted to earn credits for online courses, offered by NPTEL / SWAYAM / a University / Other Agencies, approved by the respective Board of Studies.

4.4.3 **Self Study Courses:** The Department may offer an elective course as a self study course. The syllabus of the course shall be approved by the Board of Studies. However, mode of assessment for a self study course will be the same as that used for other courses. The candidates shall study such courses on their own under the guidance of member of the faculty. Self study course is limited to one per semester.

4.4.4 The elective courses in the final year may be exempted if a candidate earns the required credits vide clause 4.4.1, 4.4.2 and 4.4.3 by registering the required number of courses in advance (up to third semester).

4.4.5 A candidate can earn a maximum of 15 credits through all one / two credit courses, online courses and self study courses.

4.5 Flexibility to Add or Drop Courses

4.5.1 A candidate has to earn the total number of credits specified in the curriculum of the respective programme of study in order to be eligible to obtain the degree. However, if the candidate wishes, then the candidate is permitted to earn more than the total number of credits prescribed in the curriculum of the candidate's programme.

4.5.2 From the second to third semesters the candidates have the option of registering for additional elective courses or dropping of already registered additional elective courses within two weeks from the start of the semester. Add / Drop is only an option given to the candidates. Total number of credits of such courses during the entire programme of study cannot exceed six.

4.6 Maximum number of credits the candidate can enroll in a particular semester cannot exceed 30 credits.

4.7 The blend of different courses shall be so designed that the candidate at the end of the programme would have been trained not only in his / her relevant professional field but also would have developed to become a socially conscious human being.

4.8 The medium of instruction, examinations and project report shall be English.

5. DURATION OF THE PROGRAMME

5.1 A candidate is normally expected to complete the MCA Degree programme in 4 consecutive semesters (2 Years), but in any case not more than 8 semesters (4 Years).

5.2 Each semester shall consist of a minimum of 90 working days including continuous assessment test period. The Head of the Department shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus for the course being taught.

5.3 The total duration for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum duration specified in clause 5.1 irrespective of the period of break of study (vide clause 11) or prevention (vide clause 9) in order that the candidate may be eligible for the award of the degree (vide clause 16). Extension beyond the prescribed period shall not be permitted.

6. COURSE REGISTRATION FOR THE EXAMINATION

6.1 Registration for the end semester examination is mandatory for courses in the current semester as well as for the arrear courses failing which the candidate will not be permitted to move on to the higher semester. This will not be applicable for the courses which do not have an end semester examination.

6.2 The candidates who need to reappear for the courses which have only continuous assessment shall enroll for the same in the subsequent semester, when offered next, and repeat the course. In this case, the candidate shall attend the classes, satisfy the attendance requirements (vide clause 8), earn continuous assessment marks. This will be considered as an attempt for the purpose of classification.

6.3 If a candidate is prevented from writing end semester examination of a course due to lack of attendance, the candidate has to attend the classes, when offered next, and fulfill the attendance requirements as per clause 8 and earn continuous assessment marks. If the course, in which the candidate has a lack of attendance, is an elective, the candidate may register for the same or any other elective course in the subsequent semesters and that will be considered as an attempt for the purpose of classification.

7. ASSESSMENT AND EXAMINATION PROCEDURE FOR AWARDING MARKS

7.1

The MCA programme consist of Theory Courses, Theory cum Practical courses, Practical courses, Mini Project, Project Work, Industrial / Professional Training, and Internship. Performance in each course of study shall be evaluated based on (i) Continuous Assessments (CA) throughout the semester and (ii) End Semester Examination (ESE) at the end of the semester except for the courses which are evaluated based on continuous assessment only. Each course shall be evaluated for a maximum of 100 marks as shown below:

7.1

Sl. No.	Category of Course	Continuous Assessment Marks	End Semester Examination Marks
1.	Theory	40	60
2.	Theory cum Practical (The distribution of marks shall be decided based on the credit weightage assigned to theory and practical components.)	50	50
3.	Practical	60	40
4.	Professional Skills Training / Industrial Training / Bridge Course / Mandatory Course	100	---
5.	Mini Project / Project Work /Internship	50	50
6.	One / Two credit Course	The distribution of marks shall be decided based on the credit weightage assigned	---
7.	All other Courses		

7.2 Examiners for setting end semester examination question papers for theory courses, theory cum practical courses and practical courses and evaluating end semester examination answer scripts, project works, and mini project shall be appointed by the Controller of Examinations after obtaining approval from the Principal.

7.3 Theory Courses

For all theory courses out of 100 marks, the continuous assessment shall be 50 marks and the end semester examination shall be for 50 marks. However, the end semester examinations shall be conducted for 100 marks and the marks reduced to 50. The continuous assessment tests shall be conducted as per the schedule laid down in the academic schedule. Three tests shall be conducted for 50 marks each and reduced to 30 marks each. The total of the continuous assessment marks and the end semester examination marks shall be rounded off to the nearest integer.

7.3.1 The assessment pattern for awarding continuous assessment marks shall be as follows:

Sl. No.	Type	Max. Marks	Remarks
1.	Test - I	12.5	---
	Test - II	12.5	
2.	Tutorial / Others (Tutorial/Problem Solving (or) Simulation (or) Simulation & Mini Project (or) Mini Project (or) Case Studies (or) Any other relevant to the course)	10	Type of assessment is to be chosen based on the nature of the course and to be approved by Principal
3.	Assignment / Paper Presentation in Conference / Seminar / Comprehension / Activity based learning / Class notes	05	To be assessed by the Course Teacher based on any one type.
Total		40	Rounded off to the one decimal place

However, the assessment pattern for awarding the continuous assessment marks may be changed based on the nature of the course and is to be approved by the Principal.

7.3.2 A reassessment test or tutorial covering the respective test or tutorial portions may be conducted for those candidates who were absent with valid reasons (Sports or any other reason approved by the Principal).

7.3.3 The end semester examination for theory courses shall be for duration of three hours.

7.4 Theory cum Practical Courses

For courses involving theory and practical components, the evaluation pattern as per the clause 7.1 shall be followed. Depending on the nature of the course, the end semester examination shall be conducted for theory and the practical components. The apportionment of continuous assessment and end semester examination marks shall be decided based on the credit weightage assigned to theory and practical components approved by Principal.

7.5 Practical Courses

For all practical courses out of 100 marks, the continuous assessment shall be for 60 marks and the end semester examination shall be for 40 marks. Every exercise / experiment shall be evaluated based on the candidate's performance during the practical class and the candidate's records shall be maintained.

7.5.1 The assessment pattern for awarding continuous assessment marks for each course shall be decided by the course coordinator based on rubrics of that particular course, and shall be based on rubrics for each experiment.

7.5.2 The end semester examination shall be conducted for a maximum of 100 marks for duration of 3 hours and reduced to 40 marks. The appointment of examiners and the schedule shall be decided by chairman of Board of Study of the relevant board.

7.6 Project Work

7.6.1 Project work shall be carried out individually. Candidates can opt for full time internship (vide clause 7.10) in lieu of project work. The project work is mandatory for all the candidates.

7.6.2 The Head of the Department shall constitute review committee for project work. There shall be three assessments by the review committee during the semester. The candidate shall make presentation on the progress made by him/her before the committee.

7.6.3 The continuous assessment and end semester examination marks for Project Work and the Viva-Voce Examination shall be distributed as indicated below.

Continuous Assessment (Max. 50 Marks)						End Semester Examination (Max. 50 Marks)			
Review I (Max..10 Marks)		Review II (Max.. 20 Marks)		Review III (Max. 20 Marks)		Report Evaluation (Max. 20 Marks)	Viva - Voce (Max. 30 Marks)		
Rv. Com	Guide	Review Committee (excluding guide)	Guide	Review Committee (excluding guide)	Guide	Ext. Exr.	Guide	Exr. 1	Exr. 2
5	5	10	10	10	10	20	10	10	10

7.6.4 The Project Report prepared according to approved guidelines and duly signed by the Supervisor shall be submitted to Head of the Department. The candidate(s) must submit the project report within the specified date as per the academic schedule of the semester. If the project report is not submitted within the specified date then the candidate is deemed to have failed in the Project Work and redo it in the subsequent semester.

7.6.5 If a candidate fails to secure 50% of the continuous assessment marks in the project work, he / she shall not be permitted to submit the report for that particular semester and shall have to redo it in the subsequent semester and satisfy attendance requirements.

7.6.6 Every candidate shall, based on his/her project work, publish a paper in a reputed journal or reputed conference in which full papers are published after usual review. A copy of the full paper accepted and proof for that shall be produced at the time of evaluation.

7.6.7 The project work shall be evaluated based on the project report submitted by the candidate in the respective semester and viva-voce examination by a committee consisting of two examiners and guide of the project work.

7.6.8 If a candidate fails to secure 50 % of the end semester examination marks in the project work, he / she shall be required to resubmit the project report within 30 days from the date of declaration of the results and a fresh viva-voce examination shall be conducted as per clause 7.6.7.

7.6.9 A copy of the approved project report after the successful completion of viva-voce examination shall be kept in the department library.

7.7 Mini Project

The evaluation method shall be same as that of the Project Work as per clause 7.6 excluding clause 7.6.6.

7.8 Industrial Training

After completion of Industrial training the candidate shall submit a brief report on the training undergone and a certificate obtained from the organization concerned. The evaluation will be made based on this report and a Viva-Voce Examination. A copy of the certificate (issued by the Organization) submitted by the candidate shall be attached to the mark list and sent to Controller of Examinations by the Head of the Department.

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Continuous Assessment (Max. 100 Marks)		
Report Evaluation (Max. 40 Marks)	Viva - Voce (Max. 60 Marks)	
Review Committee	Guide	Review Committee
40	20	40

7.9 Professional Skills Training

The Professional Skills Training shall be conducted for minimum 80 hours in 1st semester vacation and during 2nd semester. The evaluation procedure shall be approved by the board of the offering department and Principal.

7.10 Projects through Internships

Each candidate shall submit a brief report about the project through internship undergone and a certificate issued from the organization concerned at the time of Viva-voce examination to the review committee. The evaluation method shall be same as that of the Project Work as per clause 7.6.

7.11 One / Two Credit Course

Minimum of two assessments shall be conducted during the one / two credit course duration by the offering department concerned.

7.12 Online Course

The Board of Studies will provide methodology for the evaluation of the online courses. The Board can decide whether to evaluate the online courses through continuous assessment and end semester examination or through end semester examination only. In case of credits earned through online mode from NPTEL / SWAYAM / a University / Other Agencies approved by Chairman, Academic Council, the credits may be transferred and grades shall be assigned accordingly.

7.13 Self Study Course

The member of faculty approved by the Head of the Department shall be responsible for periodic monitoring and evaluation of the course. The course shall be evaluated through continuous assessment and end semester examination. The evaluation methodology shall be the same as that of a theory course.

7.14 Audit Course

A candidate may be permitted to register for specific course not listed in his/her programme curriculum and without undergoing the rigors of getting a 'good' grade, as an Audit course, subject to the following conditions.

The candidate can register only one Audit course in a semester starting from second semester subject to a maximum of two courses during the entire programme of study. Such courses shall be indicated as 'Audit' during the time of Registration itself. Only courses currently offered for credit to the candidates of other branches can be audited.

A course appearing in the curriculum of a candidate cannot be considered as an audit course. However, if a candidate has already met the Professional Elective and Open Elective credit requirements as stipulated in the curriculum, then, a Professional Elective or an Open Elective course listed in the curriculum and not taken by the candidate for credit can be considered as an audit course.

Candidates registering for an audit course shall meet all the assessment and examination requirements (vide clause 7.3) applicable for a credit candidate of that course. Only if the candidate obtains a performance grade, the course will be listed in the semester Grade Sheet and in the Consolidated Grade Sheet along with the grade SC (Successfully Completed). Performance grade will not be shown for the audit course.

Since an audit course has no grade points assigned, it will not be counted for the purpose of GPA and CGPA calculations.

7.15 Bridge Courses

Four additional bridge courses shall be offered by the department. Since these courses have no credits, each one shall be evaluated through two continuous assessment tests for a maximum of 50 marks each. Letter grades will be assigned and It will not be considered for the calculation of GPA and CGPA.

8. REQUIREMENTS FOR COMPLETION OF A SEMESTER

8.1 A candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester and permitted to appear for the examinations of that semester.

8.1.1 Ideally, every candidate is expected to attend all classes and secure 100 % attendance. However, a candidate shall secure not less than 80 % (after rounding off to the nearest integer) of the overall attendance taking into account the total number of working days in a semester.

8.1.2 A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to medical reasons (hospitalization / accident / specific illness) but has secured not less than 70 % in the current semester may be permitted to appear for the current semester examinations with the approval of the Principal on payment of a condonation fee as may be fixed by the authorities from time to time. The medical certificate needs to be submitted along with the leave application. A candidate can avail this provision only twice during the entire duration of the degree programme.

8.1.3 In addition to clause 8.1.1 or 8.1.2, a candidate shall secure not less than 60 % attendance in each course.

8.1.4 A candidate shall be deemed to have completed the requirements of study of any semester only if he/she has satisfied the attendance requirements (vide clause 8.1.1 to 8.1.3) and has registered for examination by paying the prescribed fee.

8.1.5 Candidate's progress is satisfactory.

8.1.6 Candidate's conduct is satisfactory and he/she was not involved in any indisciplined activities in the current semester.

8.2. The candidates who do not complete the semester as per clauses from 8.1.1 to 8.1.6 except 8.1.3 shall not be permitted to appear for the examinations at the end of the semester and not be permitted to go to the next semester. They have to repeat the incomplete semester in next academic year.

8.3 The candidates who satisfy the clause 8.1.1 or 8.1.2 but do not complete the course as per clause 8.1.3 shall not be permitted to appear for the end semester examination of that course alone. They have to repeat the incomplete course in the subsequent semester when it is offered next.

9. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION

9.1 A candidate shall normally be permitted to appear for end semester examination of the current semester if he/she has satisfied the semester completion requirements as per clause 8, and has registered for examination in all courses of that semester. Registration is mandatory for current semester examinations as well as for arrear examinations failing which the candidate shall not be permitted to move on to the higher semester.

9.2 When a candidate is deputed for a National / International Sports event during End Semester examination period, supplementary examination shall be conducted for such a candidate on return after participating in the event within a reasonable period of time. Such appearance shall be considered as first appearance.

9.3 A candidate who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of letter grades / marks.

10. PROVISION FOR WITHDRAWAL FROM EXAMINATIONS

10.1 A candidate may, for valid reasons, be granted permission to withdraw from appearing for the examination in any regular course or all regular courses registered in a particular semester. Application for withdrawal is permitted only once during the entire duration of the degree programme.

10.2 The withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination (vide clause 9) and has applied to the Principal for permission prior to the last examination of that semester after duly recommended by the Head of the Department.

10.3 The withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for First Class with Distinction/First Class.

10.4 If a candidate withdraws a course or courses from writing end semester examinations, he/she shall register the same in the subsequent semester and write the end semester examinations. A final semester candidate who has withdrawn shall be permitted to appear for supplementary examination to be conducted within reasonable time as per clause 14.

10.5 The final semester candidate who has withdrawn from appearing for project viva-voce for genuine reasons shall be permitted to appear for supplementary viva-voce examination within reasonable time with proper application to Controller of Examinations and on payment of prescribed fee.

11. PROVISION FOR BREAK OF STUDY

11.1 A candidate is normally permitted to avail the authorised break of study under valid reasons (such as accident or hospitalization due to prolonged ill health or any other valid reasons) and to rejoin the programme in a later semester. He/She shall apply in advance to the Principal, through the Head of the Department, stating the reasons therefore, in any case, not later than the last date for registering for that semester examination. A candidate is permitted to avail the authorised break of study only once during the entire period of study for a maximum period of one year. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for the break of study.

11.2 The candidates permitted to rejoin the programme after break of study / prevention due to lack of attendance shall be governed by the rules and regulations in force at the time of rejoining.

11.3 The candidates rejoining in new Regulations shall apply to the Principal in the prescribed format through Head of the Department at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

11.4 The total period of completion of the programme reckoned from the commencement of the semester to which the candidate was admitted shall not exceed the maximum period specified in clause 5 irrespective of the period of break of study in order to qualify for the award of the degree.

11.5 If any candidate is prevented for want of required attendance, the period of prevention shall not be considered as authorized break of study.

11.6 If a candidate has not reported to the college for a period of two consecutive semesters without any intimation, the name of the candidate shall be deleted permanently from the college enrollment. Such candidates are not entitled to seek readmission under any circumstances.

12. PASSING REQUIREMENTS

12.1 A candidate who secures not less than 50 % of total marks (continuous assessment and end semester examination put together) prescribed for the course with a minimum of 45 % of the marks prescribed for the end semester examination in all category of courses vide clause 7.1 except for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course in the examination.

12.2 A candidate who secures not less than 50 % in continuous assessment marks prescribed for the courses which are evaluated based on continuous assessment only shall be declared to have successfully passed the course. If a candidate secures less than 50% in the continuous assessment marks, he / she shall have to re-enroll for the same in the subsequent semester and satisfy the attendance requirements.

12.3 For a candidate who does not satisfy the clause 12.1, the continuous assessment marks secured by the candidate in the first attempt shall be retained and considered valid for subsequent attempts. However, from the fourth attempt onwards the marks scored in the end semester examinations alone shall be considered, in which case the candidate shall secure minimum 50 % marks in the end semester examinations to satisfy the passing requirements.

13. REVALUATION OF ANSWER SCRIPTS

A candidate shall apply for a photocopy of his / her semester examination answer script within a reasonable time from the declaration of results, on payment of a prescribed fee by submitting the proper application to the Controller of Examinations. The answer script shall be pursued and justified jointly by a faculty member who has handled the course and the course coordinator and recommended for revaluation. Based on the recommendation, the candidate can register for revaluation through proper application to the Controller of Examinations. The Controller of Examinations will arrange for revaluation and the results will be intimated to the candidate concerned. Revaluation is permitted only for Theory courses and Theory cum Practical courses where end semester examination is involved.

14. SUPPLEMENTARY EXAMINATION

If a candidate fails to clear all courses in the final semester after the announcement of final end semester examination results, he/she shall be allowed to take up supplementary examinations to be conducted within a reasonable time for the courses of final semester alone, so that he/she gets a chance to complete the programme.

15. AWARD OF LETTER GRADES

For all the passed candidates, the relative grading principle is applied to assign the letter grades.

Marks / Examination Status	Letter Grade	Grade Point
Based on the relative grading	O (Outstanding)	10
	A+ (Excellent)	9
	A (Very Good)	8
	B+ (Good)	7
	B (Average)	6
	C (Satisfactory)	5
Less than 50	U (Reappearance)	0
Successfully Completed	SC	0
Withdrawal	W	-
Absent	AB	-
Shortage of Attendance in a course	SA	-

The Grade Point Average (GPA) is calculated using the formula:

$$GPA = \frac{\sum[(\text{course credits}) \times (\text{grade points})] \text{ for all courses in the specific semester}}{\sum(\text{course credits}) \text{for all courses in the specific semester}}$$

The Cumulative Grade Point Average (CGPA) is calculated from first semester (third semester for lateral entry candidates) to final semester using the formula

$$CGPA = \frac{\sum[(\text{course credits}) \times (\text{grade points})] \text{ for all courses in all the semesters so far}}{\sum(\text{course credits}) \text{for all courses in all the semesters so far}}$$

The GPA and CGPA are computed only for the candidates with a pass in all the courses.

The GPA and CGPA indicate the academic performance of a candidate at the end of a semester and at the end of successive semesters respectively.

A grade sheet for each semester shall be issued containing Grade obtained in each course, GPA and CGPA.

A duplicate copy, if required can be obtained on payment of a prescribed fee and satisfying other procedure requirements.

Withholding of Grades: The grades of a candidate may be withheld if he/she has not cleared his/her dues or if there is a disciplinary case pending against him/her or for any other reason.

16. ELIGIBILITY FOR THE AWARD OF DEGREE

A candidate shall be declared to be eligible for the award of the MCA Degree provided the candidate has

i. Successfully completed all the courses under the different categories, as specified in the regulations.

ii. Successfully gained the required number of total credits as specified in the curriculum corresponding to the candidate's programme within the stipulated time (vide clause 5).

iii. Successfully passed any additional courses prescribed by the Board of Studies whenever readmitted under regulations other than R-2020 (vide clause 11.3)

iv. No disciplinary action pending against him / her.

17. CLASSIFICATION OF THE DEGREE AWARDED

17.1 First Class with Distinction:

17.1.1 A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the four semestersin the **First Appearance** within four consecutive semesters excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 8.50

(OR)

17.1.2 Acandidate who joins from other institutions on transfer or a candidate who gets readmitted and has to move from one regulations to another regulations and who qualifies for the award of the degree (vide clause 16) and satisfies the following conditions shall be declared to have passed the

examination in First class with Distinction:

- Should have passed the examination in all the courses of all the four semesters in the **First Appearance** within four consecutive semesters excluding the authorized break of study (vide clause 11) after the commencement of his / her study.
- Submission of equivalent course list approved by the Board of studies.
- Withdrawal from examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 9.00

17.2 First Class:

A candidate who qualifies for the award of the degree (vide clause 16) and who satisfies the following conditions shall be declared to have passed the examination in First class:

- Should have passed the examination in all the courses of all four semesters within six consecutive semesters excluding authorized break of study (vide clause 11) after the commencement of his / her study.
- Withdrawal from the examination (vide clause 10) shall not be considered as an appearance.
- Should have secured a CGPA of not less than 6.50

17.3 Second Class:

All other candidates (not covered in clauses 17.1 and 17.2) who qualify for the award of the degree (vide clause 16) shall be declared to have passed the examination in Second Class.

17.4 A candidate who is absent for end semester examination in a course / project work after having registered for the same shall be considered to have appeared for that examination for the purpose of classification.

18. MALPRACTICES IN TESTS AND EXAMINATIONS

If a candidate indulges in malpractice in any of the tests or end semester examinations, he/she shall be liable for punitive action as per the examination rules prescribed by the college from time to time.

19. AMENDMENTS

Notwithstanding anything contained in this manual, the Kongu Engineering College through the Academic council of the Kongu Engineering College, reserves the right to modify/amend without notice, the Regulations, Curricula, Syllabi, Scheme of Examinations, procedures, requirements, and rules pertaining to its MCA programme.

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MASTER OF COMPUTER APPLICATIONS CURRICULUM – R2022
(For the students admitted from the academic year 2022-23 onwards)

SEMESTER – 1									
Course Code	**Course Title**	**Hours/Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22MCT11	Mathematical Foundation of Computer Applications	3	1	0	4	40	60	100	FC
22MCC11	Python Programming	3	0	2	4	50	50	100	PC
22MCT12	Advanced Data Structures and Algorithms	3	0	0	3	40	60	100	PC
22MCT13	Advanced Database Technologies	3	0	0	3	40	60	100	PC
22MCT14	Software Engineering Methodologies	3	1	0	4	40	60	100	PC
22MCB01	Problem Solving Techniques using C	3	0	0	0	100	0	100	BC
22MCB02	Computer Organization and Design	3	0	0	0	100	0	100	BC
Practical/Employability Enhancement									
22MCL11	Advanced Data Structures and Algorithms Laboratory	0	0	4	2	60	40	100	PC
22MCL12	Advanced Database Technologies Laboratory	0	0	4	2	60	40	100	PC
22MCP11	Mini Project – I	0	0	4	2	50	50	100	EC
Total Credits to be earned					**24**				

SEMESTER – 2									
Course Code	**Course Title**	**Hours/Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22MCT21	Advanced Java Programming	3	0	0	3	40	60	100	PC
22MCT22	Machine Learning	3	0	0	3	40	60	100	PC
22MCT23	Data Communication Networks	3	1	0	4	40	60	100	PC
22MCC21	Internet of Things	3	0	2	4	50	50	100	PC
	Professional Elective – I	3	0	0	3	40	60	100	PE
22MCB03	C++ Programming	2	0	2	0	100	0	100	BC
22MCB04	Operating Systems	3	0	0	0	100	0	100	BC
Practical/Employability Enhancement									
22MCL21	Advanced Java Programming Laboratory	0	0	4	2	60	40	100	PC
22MCL22	Machine Learning Laboratory	0	0	4	2	60	40	100	PC
22GCL21	Professional Skills Training*	-	-	-	2	100	0	100	PC
22MCP21	Mini Project – II	0	0	4	2	50	50	100	EC
Total Credits to be earned					**25**				

*80 hours of Training

MASTER OF COMPUTER APPLICATIONS CURRICULUM – R2022
(For the students admitted from the academic year 2022-23 onwards)

SEMESTER – III									
Course Code	**Course Title**	**Hours/Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Theory/Theory with Practical									
22MCT31	Cloud Computing Technologies	3	0	0	3	40	60	100	PC
22MCT32	C# and ASP.Net	3	0	0	3	40	60	100	PC
22MCT33	Data Science	3	1	0	4	40	60	100	PC
	Professional Elective – II	3	0	0	3	40	60	100	PE
	Professional Elective – III	3	0	2	4	50	50	100	PE
	Professional Elective – IV	3	0	0	3	40	60	100	PE
Practical/Employability Enhancement									
22MCL31	Cloud Computing Technologies Laboratory	0	0	4	2	60	40	100	PC
22MCL32	C# and ASP.Net Laboratory	0	0	4	2	60	40	100	PC
Total Credits to be earned					**24**				

SEMESTER – IV									
Course Code	**Course Title**	**Hours/Week**			**Credit**	**Maximum Marks**			**Category**
		L	**T**	**P**		**CA**	**ESE**	**Total**	
Practical/Employability Enhancement									
22MCP41	Project Work	0	0	24	12	50	50	100	EC
Total Credits to be earned					**12**				

Total Credits :85

LIST OF PROFESSIONAL ELECTIVES (PEs)							
S. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**	**Domain/ Stream**
Semester –II							
Elective – I							
1.	22MCE01	Artificial Intelligence	3	0	0	3	DS
2.	22MCE02	Advanced Design and Analysis of Algorithms	3	0	0	3	SD
3.	22MCE03	Web Technologies	3	0	0	3	SD
4.	22GET11	Introduction to Research	2	1	0	3	GEN
5.	22MCE04	Big Data Technologies	3	0	0	3	DS
6.	22MCE05	Optimization Techniques	3	0	0	3	GEN
Semester – III							
Elective – II							
7.	22MCE06	Mobile Computing	3	0	0	3	NS
8.	22MCE07	Blockchain Technologies	3	0	0	3	NS
9.	22MCE08	Distributed Systems	3	0	0	3	NS
10.	22MCE09	Software Project Management	3	0	0	3	SDE
11.	22MCE10	Deep Learning	3	0	0	3	DS
12.	22MCE11	Service Oriented Architecture	3	0	0	3	NS
Elective – III							
13.	22MCF01	Software Testing	3	0	2	4	SDE
14.	22MCF02	PHP and MYSQL	3	0	2	4	SD
15.	22MCF03	Cross-Platform Mobile Application Development	3	0	2	4	SD
16.	22MCF04	Full Stack Framework	3	0	2	4	SD
17.	22MCF05	Data Visualization Techniques	3	0	2	4	DS
18.	22MCF06	Accounting and Financial Management	3	0	2	4	GEN
Elective – IV							
19.	22MCE12	Bioinformatics	3	0	0	3	DS
20.	22MCE13	Business Intelligence	3	0	0	3	DS
21.	22MCE14	Cryptography and Network Security	3	0	0	3	NS
22.	22MCE15	Economics and Management for Information Technology	3	0	0	3	GEN
23.	22MCE16	Social Network Analysis	3	0	0	3	DS
24.	22GEE02	Innovation, Entrepreneurship and Venture Development	3	0	0	3	GEN

22MCT11 - MATHEMATICAL FOUNDATION OF COMPUTER APPLICATIONS							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**FC**	**3**	**1**	**0**	**4**
Preamble	To demonstrate the basic knowledge of Mathematics, probability and statistics to solve computational problems						
Unit – I	**Mathematical Logic:**						**9 + 3**
Propositions - Logical operators - Truth tables - Laws of logic - Proofs in propositional calculus – Predicates - Quantifiers - free & bound variables - Universe of discourse - Inference in Predicate calculus - Mathematical induction.							
Unit – II	**Set Theory:**						**9 + 3**
Basic definitions - Venn diagrams and set operations - Laws of set theory – principle of inclusion and exclusion. Relations - Properties of relations - Matrices of relations - Closure operations on relations. Functions - Injective, surjective and bijectivefunctions.							
Unit – III	**Probability and Random Variables:**						**9 + 3**
Probability - Axioms of Probability – Mutually exclusive events – Independent events - Conditional Probability - Addition and multiplication laws of Probability - Baye'stheorem. One dimensional Random Variables - Discrete and continuous random variables - Probability mass function and Probability density functions - Cumulative distribution function –Expectationand variance of random variables - Binomial, Poisson, Uniform, Normal distributions..							
Unit – IV	**Statistical hypothesis testing:**						**9 + 3**
Sampling distributions - Tests based on small and large samples - Normal, Student's t, Chi-square and F distributions for testing of mean and variance, testing of difference of means and variances - Tests for independence of attributes and goodness of fit.							
Unit – V	**Design of experiments:**						**9 + 3**
Analysis of variance - Completely randomized design - Random block design (One-way and Two-way classifications) - Latin square design.							
Lecture:45, Tutorial:15, Total: 60							
REFERENCES:							
1.	KennethH.Rosen,"DiscreteMathematicsanditsApplications",8th Edition,McGraw-HillEducation,India,2019.(Unit I – II)						
2.	Devore, J.L, "Probability and Statistics for Engineering and Sciences", Cengage Learning, 8thEdition, New Delhi, 2014. (Unit III – V)						
3.	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8thEdition, 2015.						

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply logical operations and predicate calculus to solve problems	Applying (K3)
CO2	explain the concept of sets, relation and functions for designing and solving problems	Understanding (K2)
CO3	make use of probability and the distribution of discrete and continuous ideas in solving real world problems	Applying (K3)
CO4	apply the concept of testing of hypothesis for small and large samples in real life problems	Analyzing(K4)
CO5	use the appropriate statistical technique to design of experiments in data analysis	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		1			1					1	1	1
CO2	3	2										1		
CO3	3	3	1	2	1		1				1	1	1	1
CO4	3	3	1	2	1		1				1	1	1	1
CO5	3	3	1	2	1		1			1	1	1	1	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	40	45	-	-	-	100
CAT2	15	40	45	-	-	-	100
CAT3	15	20	15	50	-	-	100
ESE	10	20	35	35	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCC11- PYTHON PROGRAMMING							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**PC**	**3**	**0**	**2**	**4**

Preamble	To make the students to be able to create and run scripts using python for real time applications.	
Unit – I	**Python Basics:**	**9**
Introduction to Python – Writing our First Python Program – Data types in python- operators in python - Input and Output-Control Statements: if..else - if..elif - while – for - infinite loops - nested loops - else suite – break – continue –pass – assert – return-command line arguments.		
Unit – II	**Sequential and Non Sequential Collection Operations:**	**9**
Arrays in Python: creating Arrays-Mathematical operations on Arrays- Comparing-Aliasing- Slicing and Indexing-Strings and Characters - Functions: defining – calling - returning results - Formal and Actual arguments- Types of actual arguments-Local and Global variables - Recursive function - Anonymous function - List and Tuples - Dictionaries.		
Unit – III	**Object Oriented Programming in Python:**	**9**
Introduction to Oops: Features of OOPs - Classes and Objects: creating a class – self variable – constructor – types of variables and methods – passing members – inner classes - Inheritance and Polymorphism - Abstract classes and Interfaces - Exceptions.		
Unit – IV	**Python Advances:**	**9**
Files: Types - open, close and working file - Binary files- with statement – seek() and tell() methods- Access binary files - zipping and unzipping files – Working with directories - Regular Expressions in Python-Date and Time: combining -formatting - comparing – sorting - Working with Calendar module.		
Unit – V	**Graphical User Interface:**	**9**
GUI in Python- Root Window - Fonts and Colors- Working with Containers- Canvas- Frame- Types of Widget: button-label – message – text – scrollbar - checkbutton – radiobutton – entry – spinbox - listbox - menu- Creating Tables- Pythons Database Connectivity - CRUD operations.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Develop python code to demonstrate different types of operators.
2.	Develop python code to demonstrate the use of control structures.
3.	Implement python code to demonstrate built in functions of array and string.
4.	Write python code to demonstrate the user defined function with different types of arguments, call by object reference and multiple returning statements.
5.	Demonstrate the different types of techniques like filter (), map () and reduce () using user defined functions and anonymous function.
6.	Implement python code to demonstrate built in functions of list, tuple, dictionary and set.
7.	Develop python code to implement bank operations using OOPS concepts.
8.	Develop python code to implement payroll calculation of an employee using OOPS concepts.
9.	Develop python code to implement electricity bill calculation based on commercial and non-commercial constraintsusing OOPS concepts.
10.	Implement the python code to perform various text file operations using different types modes
11.	Implement the python code to perform various binary file operations using different types modes
12.	Write python code to extract necessary information from the .txt file using different string patterns of regular expression.
13.	Write python code to manipulate date and time using datetime module and calendar module.
14.	Develop an CUI application to perform CRUD operations on database (MySQL/Oracle)
15.	Develop a GUI based application to perform CRUD operations on database (MySQL/Oracle)

Lecture:45, Practical:30, Total:75

REFERENCES/ MANUAL / SOFTWARE:

1.	Nageswara Rao R., “Core Python Programming”, 2nd Edition, Dreamtech Press, New Delhi, 2018.
2.	Kenneth A. Lambert, “Fundamentals of Python – First Programs”, 2nd Edition, Cengage Publication, New Delhi, 2019.
3.	Paul Barry, “Head First Python”, 2nd Edition, O’Reilly Media, Beijing, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the fundamental concepts of python programming on real time applications	Applying (K3) Manipulation(S2)
CO2	implement python code to perform various operations using sequential and non-sequential collections	Applying (K3) Manipulation(S2)
CO3	develop python applications using object oriented programming concepts	Applying (K3) Precision(S3)
CO4	apply operations on files, search the patterns using regular expression and working with date and time modules	Applying (K3) Manipulation(S2)
CO5	develop real-time applications to know about the interaction between front-back end.	Applying (K3) Precision(S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3				2	3		2	2	2
CO2	3	2	2	2	3				2	3		2	2	2
CO3	3	2	2	2	3				2	3		2	2	2
CO4	3	2	2	2	3				2	3		2	2	2
CO5	3	2	2	2	3				2	3		2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50	-	-	-	100
CAT2	10	40	50	-	-	-	100
CAT3	10	40	50	-	-	-	100
ESE	5	35	60	-	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCT12 - ADVANCED DATA STRUCTURES AND ALGORITHMS							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**PC**	**3**	**0**	**0**	**3**

Preamble	To focus on a variety of ideas, methods, and algorithmic implementations relevant to linear-Nonlinear data structures.	
Unit – I	**Linked Lists,Stacks and Queues:**	**9**
Introduction - Representation and Operations: Linear Linked List - Doubly Linked List– Circular Linked List – Header Linked Lists - Applications of Linked list -Stacks: Operations on stacks-Representation of a stack in memory – Applications of stack – Queues: Operations – Representation of Queues in memory – Applications of Queues.		
Unit – II	**Trees:**	**9**
Introduction – Tree terminology – Binary trees – Tournament trees – Binary search trees: Representation of a binary and Binary search tree –Operations on binary and Binary search tree – Creation – Traversal – AVL Trees – Threaded binary trees – B Tree – B+ Trees - Heaps.		
Unit – III	**Graphs:**	**9**
Introduction – Graph terminology – Representation of Graphs –Operations on Graphs – Applications of Graph - Topological Sort – Minimum Spanning Tree – Finding Shortest paths - Articulation Points, Bridges, and Biconnected Components, Strongly connected components – Eulerian Tour – Hamiltonian Tour.		
Unit – IV	**Hash Tables and Hashing:**	**9**
Introduction – Direct Address table - Hash Table – Hash Function – Resolving collisions: Synonyms Chaining– Open Addressing - Rehashing.		
Unit – V	**Sorting, Searching and Merging:**	**9**
Introduction – Bubble sort – Selection sort –Insertion Sort – Bucket / Radix Sort - Merge Sort – Quick Sort – Heap Sort – Tree sort – Shell Sort – Searching: Linear – Binary search – Merging.		
		Total:45

REFERENCES:

1.	R.S.Salaria, “Data structures & Algorithms Using C”, 5th Edition, Khanna Book Publishing Co.Pvt. Ltd.,SRS Enterprises, New Delhi, 2022.
2.	ReemaThareja.,“Data Structures using C”, 2ndEdition, Oxford University Press, New Delhi, 2018.
3.	Jean Paul Tremblay and Paul G. Sorensen, “An Introduction to Data Structures with Applications”, 2nd Edition, Tata McGraw Hill, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	solve the problems using linear data structures.	Applying (K3)
CO2	construct a tree and perform various operations on a tree along with implementation	Applying (K3)
CO3	examine the solution for solving various computing problems using graph data structure	Analyzing (K4)
CO4	make use of Hashing Techniques to generate hash address and to resolve the collision on it.	Applying (K3)
CO5	perform sorting, searching and merging of input elements.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2						2	2	3	3
CO2	3	2	2	2	2						2	2	3	3
CO3	3	3	2	2	2						2	2	3	3
CO4	3	2	2	2	2						2	2	3	3
CO5	3	2	2	2	2						2	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50	-	-	-	100
CAT2	10	30	45	15	-	-	100
CAT3	10	40	50	-	-	-	100
ESE	10	30	45	15	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCT13 - ADVANCED DATABASE TECHNOLOGIES							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**PC**	**3**	**0**	**0**	**3**

Preamble	To understand the designing, modeling, manipulating, storing and retrieving of information
Unit – I	**Data Models:** **9**
Introduction – Database System Applications – Purpose of database systems – View of data – Database Languages – Relational Databases – Database Design – Data Storage and Querying – Transaction Management – Database Architecture – Database Users and administrators – Relational Model – Structure of Relational Databases – Database Schema – Keys – Schema Diagrams – Relational Query Languages – Relational Operations- Database Design and E-R model : E-R model- Constraints – ER diagrams – Reduction to Relational Schema – ER design issues	
Unit – II	**Query Evaluation and Relational Query Language:** **9**
Overview – SQL data definition – Basic structure – Operations – Aggregate Functions –Nested Sub queries – Modification of the database – Intermediate SQL : Joins – views- Integrity Constraints– SQL data types and schemas – Authorization – Formal Relational Query Languages - Relational Algebra	
Unit – III	**Normalization Concepts , Indexing and Query Processing:** **9**
Relational Database Design: Features of good relational designs- atomic domains and first normal form-functional dependency theory – Decomposition using functional dependencies: 2NF, 3NF, BCNF – Decomposition using Multivalued Dependencies- 4NF, 5NF- Indexing – Types of Indices - Query Processing: Overview – Measures of Query Cost -Query optimization – Overview – Transformation of Relational Expressions – Choice of Evaluation Plan	
Unit – IV	**Transaction Processing and Management:** **9**
Transaction Concept – Properties - Transaction States – Serializability – Lock-Based Protocols- Multiple Granularity - Timestamp-Based Protocols – Validation-Based Protocols – Recovery System – Failure Classification – Storage – Recovery and Atomicity	
Unit – V	**Distributed and Advanced Database Models:** **9**
Distributed Database - Types of Distributed Database Systems- Distributed Database Architectures - Enhanced Data Models for Advanced Applications - Active Database Concepts and Triggers - Temporal Database -Spatial Databases - Multimedia Database	
	Total:45

REFERENCES:

1.	Abraham Silberschatz, Henry F. Korth and Sudharshan S., "Database System Concepts", 7thEdition, Tata McGraw Hill, New York, 2019 . (Unit I, II, IV)
2.	RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 7thEdition, Pearson, 2017. (Unit III, V)
3.	Lee Chao, "Database Development and Management", Auerbach Publications, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	outline the necessity of database along with various Data models	Understanding (K2)
CO2	express the ways to work with combined table using relational model and algebra	Applying (K3)
CO3	explain different normalization techniques and organize the order of storing data	Analyzing (K4)
CO4	illustrate the transaction processing and concurrency control concepts	Applying (K3)
CO5	Summarize distributed databases, multimedia databases.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	2	1		1	1	1		1	1	2
CO2	3	2	1	1	2	1	1	1			1	1	1	2
CO3	2	3	2	2	2	1			1		1	1	2	1
CO4	3	2	1	1	2	1	1	1		1	1	1	2	2
CO5	2	2	3	1	1	1		1	1	1	1	1	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	10	40	40	10	-	-	100
CAT3	15	35	50	--	-	-	100
ESE	15	35	40	10	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCT14 - SOFTWARE ENGINEERING METHODOLOGIES							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**PC**	**3**	**1**	**0**	**4**

Preamble	To facilitate and understand the formal method to develop software project, analyze the requirement ,design, management advanced technologies of software development
Unit – I	**Formal and Agile Methodologies:** 9+3
The Nature of software- Software Engineering – Software Process Models – Prescriptive process model–Specialized process model- The Unified Process – Agile Development: Agile Process – Extreme Programming-Other Agile process	
Unit – II	**Requirements Analysis and Modeling:** 9+3
Understanding Requirements - Requirements Modeling: Scenario Based Methods-Class Based Methods – Behavior, Patterns, Web/ Mobile Apps.	
Unit – III	**Software Design:** 9+3
Design Concepts - Architectural Design - Component Level Design - User Interface Design - Pattern Based Design – Web App Design – Mobile App Design.	
Unit – IV	**Review Techniques and Project Scheduling :** 9+3
Review metrics and their use-informal reviews-formal technical reviews-Project scheduling - Risk management - Maintenance-Reengineering: Business Process Reengineering – Software Reengineering - Reverse Engineering –restructuring-Forward Engineering	
Unit – V	**Advances in software Engineering:** 9+3
SPI-SPI process-CMMI-people CMM-SPI Frameworks- Technology Evolution-Observing software Engineering trends- identifying soft trends-Technology directions-Tools related trends- Software engineer's responsibility.	
Lecture:45, Tutorial:15, Total: 60	

REFERENCES:

1.	RogerS.Pressman,BruceR.Maxim, "Software Engineering -A Practitioner's Approach", 8th Edition, Tata McGraw Hill, New York, 2020.
2.	PankajJalote, "An Integrated Approach to Software Engineering", 3rd Edition, Narosa publications, 2011.
3.	Somerville Ian, "Software Engineering", 9th Edition, Pearson Education Asia, Singapore, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the various formal and agile life cycle models of software engineering	Applying (K3)
CO2	develop the various features of requirement analysis and modeling of software	Applying (K3)
CO3	apply architectural and functional design of the software	Applying (K3)
CO4	evaluate the quality of software process	Evaluating (K5)
CO5	estimate an idea about risk management and software maintenance	Evaluating (K5)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		3	2	3		3			3		3	3	2
CO2		2			2			3	2			2	3	3
CO3	2	3	3	2	3	3			3				2	2
CO4			3		2	2		2			2		3	3
CO5	3	3	2	2			2			3		3	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	30	45	-	-	-	100
CAT2	25	25	50	-	-	-	100
CAT3	20	20	35	15	10	-	100
ESE	10	25	35	15	15	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCL11 - ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**PC**	**0**	**0**	**4**	**2**

Preamble	To provide the set of problems covering the basic algorithms as well as numerous computing problems demonstrating the applicability of various data structures and related algorithms Implementation.

LIST OF EXPERIMENTS / EXERCISES:

1.	Compute the Polynomial Addition d=a + b using singly linked list where a and b be the pointers to two polynomials.
2.	Design a data structure to represent a stack in an array named elements of size n. Also write a functions for demonstrating push (), pop () and peep () operations on stack i, where the stack is initially empty.
3.	Design an application to demonstrate the use of stack data structure in checking whether the arithmetic expression is properly parenthesised.
4.	Design a Queue data structure and to perform various operations using linked list along with its size n, where n=10.
5.	Program to illustrate the implementation of Insert, Delete and Searching operations on a binary search tree.
6.	Write a function to implement pre-order, in-order and post-order traversals of a binary tree.
7.	Consider an undirected graph G= (V, E). Assume that the vertices V are numbered 1, 2, 3 … and perform traversal of graph using iterative DFS Technique. The DFS starts from first node.
8.	Implement a program using Hashing Techniques
9.	Write a Program to sort an array of integers in ascending order using selection sort.
10.	Develop a program to sort an array of integers in ascending order using divide and conquer techniques.
11.	Write a program to find an element among the list of elements in an array using Linear search Techniques.
12.	Implement a program to find an element among the list of elements in an array using Divide and Conquer Technique.
13.	Design an application for online shopping system using appropriate data structure.
14.	Implementing forward and backward buttons of a Browser using stack or linked list.
15.	Design chess game applications using graph data structures.

Total:60

REFERENCES/ MANUAL /SOFTWARE:

1.	Front End : Windows/Linux OS
2.	Software : Turbo/Borland/GCC compilers
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	implement a program using Linear and Non Linear Data Structures.	Applying (K3) Manipulation (S2)
CO2	make use of hashing technique to implement a program and to resolve collisions	Applying (K3) Manipulation (S2)
CO3	perform sorting, searching and Merging operations on input elements	Applying (K3) Manipulation (S2)

Mapping of Cos with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3						3	3	3	3
CO2	3	3	2	2	3						3	3	3	3
CO3	3	3	2	2	3						3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MCL12 - ADVANCED DATABASE TECHNOLOGIES LABORATORY							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**PC**	**0**	**0**	**4**	**2**

Preamble	To deliver students the elementary concepts of a database management system and equips them to design and implement a database application built over those concepts.

LIST OF EXPERIMENTS / EXERCISES:

1.	Consider a University Database and use necessary schema (Student, Department, Faculty, Courses...etc), Make use of DDL operations to perform creation of table, alter, modify, drop and truncate. Additionally apply DML transactions over the schema and use appropriate Integrity constraints like Primary Key, Unique key, Foreign Key, Check, Default, Null and Not Null.
2.	Construct the University database and schema to perform the controlling privileges operations with TCL –Commit, Save point and Rollback the transactions. To deal with the rights, permissions, and other controls of the database system use DCL that includes commands such as GRANT and REVOKE.
3.	Build the essential DB objects using view, sequences ,indexes and synonyms for University Database
4.	Make use of Employee Database and perform SQL Statements on i. Single row General functions, Case Conversion functions, Character functions, Date functions, Number functions. ii. Aggregate functions AVG, COUNT, MAX, MIN, SUM. iii. Set operations Union, UnionAll, Intersect, Minus.
5.	Experiment with Employee Database and Perform various Joins & Sub queries for displaying data from multiple tables using SQL operators, GROUPBY, HAVING and ORDERBY clause
6.	Construct a basic block to combine database language and procedural programming language using PL/SQL programs
7.	Generate a payroll process for employee tables by stored functions and stored procedures using PL/SQL programs
8.	Iterate n number of employees using Cursors in PL/SQL programs and perform Implicit, Explicit Cursor Operations for the table.
9.	Create Triggers for DML Statement, DDL Statement, System and User event. Make Use of PL/SQL block to call multiple functions, procedures, cursors using package.
10.	Write PL/SQL programs to Handle Exceptions with inbuilt libraries and customized way to raise an exceptions.
	Total:60

REFERENCES/ MANUAL /SOFTWARE:

1.	Front End: Microsoft Visual Studio 6.0, Microsoft .NET Framework SDK v2.0, Java Eclipse.
2.	Back End : ORACLE /MongoDB/ SQL Server / MYSQL
3.	Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	develop SQL and PL/SQL commands to create and manipulate databases	Applying (K3) Manipulation (S2)
CO2	make use of the complex queries using SQL	Applying (K3) Manipulation (S2)
CO3	solve real world problems using SQL and PL/SQL	Applying (K3) Manipulation (S2)

Mapping of Cos with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	1	1				1	1	1	2
CO2	3	2	2	1	3	1	1		1	1	2	1	2	2
CO3	3	2	1	2	2	1	1	1		1	2	1	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MCP11 - MINI PROJECT – I							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**EC**	**0**	**0**	**4**	**2**
							Total:60

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify the problem by applying acquired knowledge	Applying (K3) Precision (S3)
CO2	analyze and categorize executable project modules after considering risks	Analyzing (K4) Precision (S3)
CO3	analyze efficient tools for designing project modules	Analyzing (K4) Precision (S3)
CO4	integrate all the modules through effective teamwork after efficient testing and validation	Evaluating (K5) Precision (S3)
CO5	elaborate the completed work and compile the project documentation	Creating (K6) Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MCT21 - ADVANCED JAVA PROGRAMMING							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**PC**	**3**	**0**	**0**	**3**

Preamble	To develop general purpose applications using object-oriented design principles with database connectivity in java language.	
Unit – I	**Basics of Java, Classes and Objects:**	**9**
The Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators – Control Statements – Introducing Classes – Methods and Classes: Overloading Methods – Passing and returning Objects – Recursion – Access control – static – final – Nested and Inner classes.		
Unit – II	**Inheritance, Packages and Interfaces:**	**9**
Inheritance : Basics – Using super – Method Overriding – Dynamic Method dispatch – Abstract classes – final with Inheritance. Packages and Interfaces : Packages – Packages and Member Access – importing Packages – Interfaces – Default Interface Methods – static Methods in Interface - Private Interface methods.		
Unit – III	**Exception Handling, Multithreading and Collection Frameworks:**	**9**
Fundamentals – Types – Uncaught Exceptions – try and catch – Multiple catch – Nested try – throw – throws – finally – Built-in Exceptions – Multithreaded: Java Thread Model – Main Thread – Creating a Thread and Multiple threads – is Alive() and join() - Collection Frameworks: Collection Interfaces - Collection Classes: ArrayList - LinkedList - HashSet - TreeSet - PriorityQueue - Iterator - Map: Map Interfaces - Map Classes: HashMap – TreeMap - Comparators.		
Unit – IV	**Servlets and Java server Pages:**	**9**
Working with Servlets: Features – Servlet API – Servlet Life Cycle – Creating a Sample Servlet - Java Server Pages: Architecture of JSP pages – Life Cycle of JSP – Working with JSP Basic Tags and implicit objects – Exploring Action Tags.		
Unit – V	**JDBC, Hibernate and Spring:**	**9**
Working with JDBC: Introduction - JDBC Drivers – Features of JDBC – JDBC API – Major Classes and Interfaces – Process with java.sql package – Working with Hibernate: Architecture – Downloading hibernate - Exploring HQL – Hibernate O/R mapping – Working with Hibernate. Introduction to Spring: Overview – Dependency Injection – Spring Libraries – Spring Tool Suite – Developing a simple Spring Application – RESTful Applications.		
		Total:45

REFERENCES:

1.	Herbert Schild, "Java: The Complete Reference", 12th Edition, McGraw Hill, 2021(Unit I – III)
2.	CDAC, "Core and Advanced Java - Black Book", 1st Edition, Dreamtech Press, 2018 (Unit IV- V)
3.	Cay Horstmann, "Core Java -Volume 1: Fundamentals", 12thEdition , Oracle Press, 2021

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	dramatize object oriented programming concepts for solving simple logics	Applying (K3)
CO2	construct reusable classes using inheritance, packages and interfaces	Applying (K3)
CO3	apply the concepts of Multithreading, Exception handling and Collection Frameworks to develop efficient and error free codes.	Applying (K3)
CO4	develop Serverside java applications using Servlet and JSP concepts	Applying (K3)
CO5	construct simple applications to best interact with relational database systems using JDBC and hibernate	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2								2	3
CO2	3	2	2	2	2								2	3
CO3	3	2	2	2	2								2	3
CO4	3	2	2	2	2								2	3
CO5	3	2	2	2	2								2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50	-	-	-	100
CAT2	5	30	65	-	-	-	100
CAT3	5	30	65	-	-	-	100
ESE	5	30	65	-	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCT22 - MACHINE LEARNING							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**PC**	**3**	**0**	**0**	**3**

Preamble	To provide core concepts of machine learning to endorse research ideas among the students.	
Unit – I	**Machine Learning Fundamentals:**	**9**
Machine Learning Landscape: Introduction- Types of Machine Learning Systems- Main Challenges of Machine Learning- Testing and Validating-End to End Machine Learning Project: Working with Real Data- Discover and visualize the data to gain insights- Prepare the data for Machine Learning algorithms-Select and Train a model-Fine-Tune the model.		
Unit – II	**Feature Engineering:**	**9**
Motivation towards Feature Engineering - Basic Feature engineering processes- Feature Selection-Dimensionality Reduction: The Curse of Dimensionality - Main Approaches for Dimensionality Reduction-PCA-Kernel PCA-LLE- Other Dimensionality Reduction Techniques.		
Unit – III	**Concepts of Classification and Regression:**	**9**
Classification: Training a Binary Classifier – Performance Measures - Multiclass Classification- Error Analysis- Multilabel Classification and Multioutput Classification-Training Models: Linear Regression- Gradient Descent- Polynomial Regression- Learning Curves.		
Unit – IV	**Supervised Learning:**	**9**
Classification: Introduction-Example-Classification Model-Learning Steps- Common classification algorithms- K-Nearest Neighbor- Decision Tree-Random Forest Model - Support Vector Machines. **Regression:** Introduction-Example-Multiple linear regression- Assumptions and problems in Regression Analysis- Improving the accuracy.		
Unit – V	**Unsupervised Learning and Artificial Neural Network:**	**9**
Introduction - Unsupervised Learning Vs Supervised Learning – Applications – Clustering - Introduction-Biological neuron - Artificial Neuron- Types of activation function-Architectures of NN – Learning process in ANN – Backpropagation.		
		Total:45

REFERENCES:

1.	AurelienGeron, "Hands – On Machine Learning with SciKit-Learn, Keras&TensorFlow – Concepts, Tools and Techniques to Build Intelligent Systems", 2nd Edition, O'Reilly Media , CA, 2019. (Unit I - III)
2.	SaikatDutt, Subramanian Chandramouli and Amit Kumar Das, Machine Learning, 1st Edition, Pearson Education, India, 2019. (Unit IV - V)
3.	Henrik Brink, Joseph W Richards, Mark Fetherolf, Real World Machine Learning, 1stEdition Reprint, Dreamtech Press, New Delhi, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the foundations of machine learning and end to end machine learning project development steps	Understanding(K2)
CO2	make use of feature engineering process and dimensionality reduction approaches	Applying(K3)
CO3	analyze the concepts of classification and regression in performance measures	Analyzing(K4)
CO4	develop various classification and regression algorithms	Applying(K3)
CO5	apply clustering and neural networks concepts to solve real world problems	Applying(K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1						2	2	2	2	2		2
CO2	3	2	2	2		1	1		1		2	2	2	2
CO3	3	3	3	2		1	1		1		2	2	2	2
CO4	3	2	2	2		1	1		1		2	2	2	2
CO5	3	2	2	2		1	1		1		2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	10	20	50	20	-	-	100
CAT3	10	40	50	-	-	-	100
ESE	10	40	40	10	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCT23 - DATA COMMUNICATION NETWORKS							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**PC**	**3**	**1**	**0**	**4**

Preamble	To provide the basic concepts of computer networking model with different data communication techniques and protocols.	
Unit – I	**Introduction:**	**9+3**
Uses of computer networks - Network hardware - Network software - Reference models - Example networks: RFID and Sensor Networks - Physical Layer: Theoretical basis for data communication - Guided transmission media: Twisted pairs - Coaxial cable - Fiber Optics - Unguided transmission: The Electromagnetic spectrum - Radio wave transmission- Micro wave transmission - Infrared transmission.		
Unit – II	**Data Link Layer:**	**9+3**
Design issues : Services provided to the network layer - Framing - Flow Control - Error Control - Error detection and correction - Elementary data link protocols: A Simplex Stop-and-Wait protocol - Sliding window protocols: A One-Bit Sliding window Protocol - MAC Layer: Channel allocation problem - Multiple access protocols: ALOHA - CSMA.		
Unit – III	**Network Layer:**	**9+3**
Design issues: Services provided to the Transport Layer - Routing algorithms: Shortest Path events - Distance Vector Routing - Link State Routing - Congestion control algorithms: Traffic aware routing - Admission Control - Internetworking: Tunneling - Internetwork Routing - Packet Fragmentation.		
Unit – IV	**Transport Layer:**	**9+3**
Transport service: Services provided to upper layer - Transport Service primitives - Elements of transport protocols: Addressing - Connection Establishment and Release - Error Control and Flow Control - Multiplexing – The internet transport protocols: UDP – RPC - TCP: Service Model - Connection Establishment and Release.		
Unit – V	**Application Layer:**	**9+3**
Domain Name System: The DNS Name Space - Resource Records - Name Servers - Electronic mail: Architecture and Services - The User Agents - Message Formats - Message Transfer and Delivery - World Wide Web: Architectural overview - Static and Dynamic Web Pages - HTTP - Mobile Web - Web Search.		
		Lecture:45, Tutorial:15, Total:60

REFERENCES:

1.	Andrew S. Tanenbaum,David J Wetherall, Nick Feamster, “Computer Networks”, 6th Edition, Pearson Education., New Delhi, 2022.
2.	ForouzanBehrouz A., “Data Communication and Networking”, 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2018.
3.	William Stallings, "Data and Computer Communication", Pearson Education, 10th Edition, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify the components required to build different types of networks and have an understanding of network models.	Understanding (K2)
CO2	illustrate the various error and flow control mechanisms and protocols of data link layer	Applying (K3)
CO3	apply various routing protocols, demonstrate the best routing between nodes and describe the network functionalities for a given application.	Applying (K3)
CO4	identify the protocols involved at the various layers and demonstrate the role of each protocol.	Applying (K3)
CO5	analyze and describe the working principles of Internet.	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2									1	2
CO2	3	2	1	1									1	2
CO3	3	2	1	1									1	2
CO4	3	2	1	1									1	2
CO5	2	1	3	1									2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
CAT3	20	40	30	10	-	-	100
ESE	10	30	40	20	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCC21 - INTERNET OF THINGS							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**PC**	**3**	**0**	**2**	**4**

Preamble	To study and implement the Internet concept of things by the integration of various technologies.	
Unit – I	**Technologies in Internet of Things:**	**9**
Various Technologies Used in IoT - IoT Revolution - Benefits of IoT - IoT Frameworks: Value Chain - Frameworks and Platforms - AWS IoT–WastonIoT Platform-IoT Ecosystem - Elements for IoT Implementation - Case Studies: E-Health System - Environmental Monitoring.		
Unit – II	**Components In Internet of Things: Design Pattern, IoT Architecture and Core Modules**:	**9**
Various Design Patterns - Challenges and Solutions for Designing Architecture for IoT - Four Layer Architecture - Seven Layer Architecture - Core Modules: Protocols – Sensors – Endpoints - Data Communication - IoT Data Managements - Analytics.		
Unit – III	**IoT Implementation:**	**9**
IoT Implementation Strategies: Challenges and Solutions - Things to Know Before an IoT Implementation - Types of Testing in IoT - Testing Challenges and Tools - Testing Smart Wearables. Case Studies: Monitoring Traffic Volume in Petrol Stations to Improve Sales Strategies, Smartphone Detection System in the Crowd.		
Unit – IV	**Technologies Behind IoT:**	**9**
Artificial Intelligence for IoT: Exploring the world of AI, IoT and AI in the context of Industry 4.0 – Data Analytics and Machine Learning for IoT – Security Challenges for IoT.		
Unit – V	**Internet of Things in Industry:**	**9**
Industries: Manufacturing – Oil and Gas – Transportation – Public Safety.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Familiarization with concept of IoT, Arduino/Raspberry-Pi and perform necessary software installation.
2.	Study of different operating systems for Raspberry-Pi. Understanding the process of OS installation on Raspberry-Pi.
3.	Study of connectivity and configuration of Raspberry-Pi with basic peripherals, LED ON / OFF using Push Button, understanding GPIO and its use in program.
4.	Understanding and connectivity of Raspberry-Pi with Distance measuring using Ultrasonic Sensor. Write an application to measure the distance of the obstacle using Ultrasonic Sensor.
5.	Understanding and connectivity of Raspberry-Pi with Temperature and Humidity Sensor. Write an application to read an environment temperature and Humidity value. If a temperature crosses a threshold value, the application indicated user using LEDs.
6.	Understanding and connectivity of Raspberry-Pi with IR Sensor. Write an application to detect obstacle and notify user using LEDs.
7.	Understanding and connectivity of Raspberry-Pi with camera. Write an application to detect the color of the object or obstruction detection.
8.	Write an application using Raspberry-Pi based health monitoring using heartbeat and Pulse Sensor.
9.	Write an application using Raspberry-Pi based Eye blinking/closeness detection sensor.
10.	Write an application using Raspberry-Pi based Rain fall detection using Rain Sensor.

Lecture:45, Practical:30, Total:75

REFERENCES/ MANUAL / SOFTWARE:

1.	MayurRamgir, "Internet of Things- Architecture, Implementation, and Security", 1st Edition, Pearson Publication, 2020. (Unit I - IV)
2.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 9th Impression, Pearson Publication, 2022. (UnitV)
3.	Dr. OvidiuVermesan and Dr. Peter Friess, "Internet of Things: From research and innovation to market deployment", River Publishers, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain working principles of different technologies with IoT platforms.	Understanding (K2)
CO2	describe about the components of IoT, IoT architecture and core modules.	Understanding (K2)
CO3	demonstrate the process of IoT implementation in various applications.	Applying (K3) Manipulation(S2)
CO4	explain the various technologies behind IoT and Industrial IoT	Understanding (K2)
CO5	implementation of IoT using different sensors to solve the real world problems.	Applying (K3) Precision(S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1						2	2	2	2	3		2
CO2	3	1						2	2	2	2	2		2
CO3	3	2	2	2	3				2	3		2	2	2
CO4	3	1						2	2	2	2	2		2
CO5	3	2	2	2	3				2	3		2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60	-	-	-	-	100
CAT2	20	30	50	-	-	-	100
CAT3	20	40	40	-	-	-	100
ESE	10	55	35	-	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCL21 - ADVANCED JAVA PROGRAMMING LABORATORY							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**PC**	**0**	**0**	**4**	**2**

Preamble	To develop General purpose and web based applications

LIST OF EXPERIMENTS / EXERCISES:

1.	Design a Class which consists of instance variables and methods. Create an object for the class to access all the members of the class and create more than one objects and store the reference of all objects in a single variable.
2.	Construct a class with more than one methods having same name but with different signature. Also test the static methods with same name, with different input parameters.
3.	Design a java classes which acquire the properties of the parent class and also design a subclass which provides the specific implementation of the method that has been declared by one of its parent class and create an object which should bound its functionality at runtime. Design another class that implements two or more interfaces and all the implemented interfaces contain default methods with the same name and signature.
4.	Develop an application with a custom-container that should bundle related types like classes and interfaces into a single group with proper access protection and namespace management.
5.	Design error events in java that occurs during the execution of a program and disrupts the normal execution of the program's code.
6.	Write a java program with Light-weight sub-processes that should be executed concurrently to maximize the utilization of CPU.
7.	Design a dynamic array using collection class ArrayList and implement the Linked list datastructure using LinkedList collection class.
8.	Implement a Java Servlet Program to implement a dynamic HTML using Servlet and JSP.
9.	Design a java application that should establish the connection from Java Client to any relational database systems using JDBC API and Hibernate.
10.	Create a simple applicationusing Spring Framework.
11.	Develop a Library management system with basic modules and users like Database module: This has two functions – Insertion of data and extraction of data. Report module: For the borrowed books list to display. Availability module: To view the availability of books. Search Module: search facility for books and members. Users in the system: Librarian Student User functions: Librarian: Add, view, delete the book details and user details, issue and return books. Student: view and requesting books, returning books.
12.	Design an employee payroll management system with basic modules and its processes as Admin: • Admin can Add/Edit/delete the employees. • Admin can Add/Edit/delete the schedule the work of the employees. • Admin can Add and calculate/Edit/Delete the Salary of the employee. Employee: • Employees can view his/her schedule set by Admin. • Employees can check his/her attendance. • Employees can update his/her details. • Employees can View their salary details.
13.	Design a Hospital Management with basic modules and its processes as Three main actors of the system who are going to manage or run the complete application are Admin, Doctor and Receptionist. Admin Module: • Admin can ADD/DELETE/UPDATE a doctor. • Admin can VIEW the list of doctors. • Admin can ADD/DELETE/UPDATE a receptionist. • Admin can VIEW the list of receptionists. • Admin can ADD/DELETE/UPDATE a patient.

	• Admin can ADD/DELETE/UPDATE an appointment. Doctor Module: • The doctor can VIEW the appointments. • The doctor can VIEW the patient list. Receptionist Module: • The receptionists can ADD/EDIT/VIEW appointments. • The receptionists can ADD/EDIT/VIEW the patient.
14.	Design an Electricity bill management system with basic modules and its processes as follows Login registration: • Admin(Electricity board user), and User(Customer) can log in and register in the application. • Admin can add a new user in the application as well as a new customer also can log in by itself by using its consumer number. Billing: • Admin can add details about the consumer details according to the consumed electricity units consumed by the consumer. • Users can view the bill
15.	Design an online Quiz system with basic modules and its processes as follows Users of the System • Teacher • Student Functional Requirements Teacher: • Can create quiz after getting logged in. • Can enter subjects and enter question with its options and answer at the time of creating quiz. • 10 Question for each quiz required to be completed. Student: • Can search quiz according to their interest. • select the id of quiz and ready to start it. • After completing all questions, result will be displayed automatically. • Can view the description about each and every question in the respective quiz.
	Total:60

REFERENCES/ MANUAL /SOFTWARE:

1.	JDK / IDEs: Eclipse / Netbeans
2.	Database system: MYSQL
3.	Laboratory Manual

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	solve basic logics using arrays, class and objects and to implement reusable concepts using inheritance, packages and interfaces.	Applying (K3) Manipulation(S2)
CO2	make use of the exception handling to develop error free codes, multithreading to implement multiprocessing and collection classes in java program.	Applying (K3) Manipulation(S2)
CO3	develop simple real time applications using Servlets, JSP, JDBC, hibernate and Spring framework.	Applying (K3) Manipulation(S2)

Mapping of Cos with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2								2	3
CO2	3	2	2	2	2								2	3
CO3	3	3	3	3	3								3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MCL22 - MACHINE LEARNING LABORATORY							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**PC**	**0**	**0**	**4**	**2**

Preamble	To promote the development knowledge among the students in the field of machine learning.

LIST OF EXPERIMENTS / EXERCISES:

1.	Exploration of a Data Set in the IDE, to perform various pandas operations
2.	Exploration of a Data Set in the IDE , to perform various numpy operations
3.	Write a python program to calculate mean, median, variance, standard deviation and exploring relationship between variables of the given numerical data
4.	Implement various data preprocessing techniques on real time dataset using python
5.	Develop a python code to perform dimensionality reduction using PCA
6.	Write a python code to perform different visualization for the given data set
7.	Construct a python program to find the attribute with maximum information gain and gain ratio and construct the decision tree for the given data
8.	Develop a python program to implement K-NN algorithm for the given data
9.	Develop a python program to implement Random Forest Algorithm for the given data
10.	Construct a python program to implement Support Vector Machines learning algorithm for the given data
11.	Write a python program to implement Naïve Bayes Classifier Algorithm for the given data
12.	Construct a python code to implement Simple Linear regression for the given data
13.	Develop a python code to implement Multi Linear regression algorithms for the given data set
14.	Write a python program to implement k-means clustering algorithm
15.	Implement Multi-Layer Artificial Neural Network analysis for the given dataset using python code

Total:60

REFERENCES/ MANUAL /SOFTWARE:

1.	Operating System : Windows/Linux
2.	Software : Python packages, IDE etc.,
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	apply basic operations, preprocessing and visualization using data set	Applying (K3) Manipulation(S2)
CO2	analyze the performance of various classification machine learning algorithms	Analyzing (K4) Manipulation(S2)
CO3	apply regression, unsupervised learning and neural network algorithms to solve real world problems	Applying (K3) Manipulation(S2)

Mapping of Cos with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3				2	3		2	2	2
CO2	3	3	3	2		1	2		1	2	2	2	2	2
CO3	3	2	2	2	3				2	3		2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22GCL21 – PROFESSIONAL SKILLS TRAINING

Programme & Branch	Master of Computer Applications	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	PC	0	0	80	2

Preamble	This subject is to enhance the employability skills and to develop career competency.	
Unit – I	**Soft Skills:**	**20**

Soft skills and its importance: Pleasure and pains of transition from an academic environment to work – environment-Need forchange- Fears, stress and competition in the professional world-Importance of positive attitude- Self motivation and continuousknowledge up gradation-Self-confidence.**Professional grooming and practices:** Basics of corporate culture-Key pillars of businessetiquette- Basics of etiquette-Introductions and greetings-Rules of the handshake, earning respect, business manners-Telephoneetiquette- Body Language.**Group discussions:** Advantages of group discussions-Structured GD- **Team work:** Value of team work inorganizations- Definition of a team, why team-Elements of leadership, disadvantages of a team, stages of team formation- Groupdevelopment activities.**Facing an interview:** Foundation in core subject- industry orientation / knowledge about the company-professional personality-Communication skills-Activities before Interview, upon entering interview room, during the interview and at theendMockinterviews.

Unit – II	**Quantitative Aptitude and Logical Reasoning:**	**30**

Problem Solving: Number Systems - LCM/HCF - divisibility - Simple Equations - Ratio Proportion Variations - Percentages; Profitand Loss - Partnerships -Simple Interest Compound Interest -Averages - Mixtures and Allegations - Time and Work -Time andDistance -Data Interpretations-Tables -Bar Graph -Line Graph -Pie Chart -Caselets - Geometry - Mensuration -Permutation andCombinations - Probability -Quadratic Equations - Special Equations and Inequalities - Sequence and Series - Statistics - Logarithms -Data Sufficiency - Trigonometry - Coordinate Geometry.**Logical Reasoning:** Letter Series - Number Series -Blood Relations -Direction Sense - Coding-Decoding - Symbols and Notations -Clocks and Calendars - Puzzles - Seating Arrangement (Linear andCircular) - Selections and Distributions -Cubes - Venn Diagrams -Deductions/Syllogism -Cyrptogrithms - Flaw Detection – BinaryLogic

Unit – III	**Grammar, Vocabulary, Listening, Speaking, Reading and Writing:**	**30**

Grammar: Tenses - Articles and Prepositions - Direct & Indirect Speeches - Active & Passive voice - Vocabulary: Analogies - Syllogism - Spelling test - Cloze test - Concord - Spotting Errors - Unscrambling words - Assertion and Reason - Verbal puzzle - Pair words - Logical sequence of words - Listening: Listening to TED talks, ESL & ESOL Videos - Podcasts - Speaking: Mock Interviews - Personality traits - Better pronunciation - Extempore talk - Telephonic conversations - Technical project presentations - Role Play - Negotiation skills - Mock Interview - Life skills - Team Management - Leadership skills - Group Discussion - Reading: Reading with stress, pauses, slurs and fillers - Soft skills - Stress & Intonation - Effective reading strategies - Notices & book reviews - GATE type reading comprehension - Writing: Job application letter & resume - Video resume - Jumbled sentences - Professional e-mail writing - Business letters - One page essay - Report writing - Editing & proofreading - Writing skills for IELTS - Summary Writing - Review of real time interviews/Competitive examinations.

Total:45

REFERENCES:

1.	R.S. Aggarwal, “Quantitative Aptitude”, 7th Edition, S. Chand Publication, 2022.
2.	R.S. Aggarwal, “A Modern Approach to Logical Reasoning”, S. Chand Publication, 2022 edition.
3.	Edgar Thorpe and Showick Thorpe, “Objective English for Competitive Examination”, 6th Edition, Pearson India Education Services Pvt Ltd, 2017.
4.	Stephen Bailey, “Academic Writing: A practical guide for students”, Routledge, New York, 2011.
5.	Meenakshi Raman and Sangeeta Sharma. “Technical Communication- Principles and Practice”. 4th Edition, Oxford University Press, New Delhi, 2022.
6.	Aruna Koneru, “Professional Speaking Skills,” Oxford University Press India, 2015.
7.	Edgar Thorpe and Showick Thorpe, “Winning at Interviews,” 5th Edition, Pearson Education, India, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	developthesoftskillsoflearnerstosupportthemworkefficientlyinanorganizationasanindividualandasateam	Applying (K3), Precision (S3)
CO2	solverealtimeproblemsusingnumericalabilityandlogicalreasoning	Applying (K3), Precision (S3)
CO3	apply English language skills for various academic and professional purposes	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	0	0	0	3	3	0	3	0	3	2	1	1
CO2	3	2	0	0	0	3	3	0	3	0	3	2	1	1
CO3		2					3	3		3	3	3	2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN - THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	-	50	50	-	-	-	100
Assessment Test	-	50	50	-	-	-	100

* ±3% may be varied (CAT 1 & 2 – 60 marks &Assessment Test – 100 marks)

22MCP21 - MINI PROJECT – II							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**EC**	**0**	**0**	**4**	**2**
							Total:60

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify the problem by applying acquired knowledge	Applying (K3) Precision (S3)
CO2	analyze and categorize executable project modules after considering risks	Analyzing (K4) Precision (S3)
CO3	analyze efficient tools for designing project modules	Analyzing (K4) Precision (S3)
CO4	integrate all the modules through effective teamwork after efficient testing and validation	Evaluating (K5) Precision (S3)
CO5	elaborate the completed work and compile the project documentation	Creating (K6) Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MCT31 - CLOUD COMPUTING TECHNOLOGIES							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Nil.	**3**	**PC**	**3**	**0**	**0**	**3**
Preamble	To become familiar with the various cloud architecture and service model principles						
Unit - I	**Cloud Computing Fundamentals, Architecture:**						**9**
Define Cloud Computing – Cloud Types –Examining the Characteristics – Benefits, Disadvantages – Cloud Computing Architecture-Exploring the Cloud Computing Stack - Connecting to the Cloud.							
Unit - II	**Understanding Services and Virtualization:**						**9**
Infrastructure as a Services-Platform as a Service-Software as a Service-Identity as a Service – Compliance as a Service – Virtualization Technologies –Load Balancing and Virtualization-Understanding Hypervisors							
Unit - III	**Cloud Platform:**						**9**
GoogleWeb Services- Amazon WebServices - Components – Working with the Elastic Compute Cloud –Amazon Storage Systems - Amazon Database Services - Microsoft Cloud Services.							
Unit - IV	**Cloud Security and Web Mail Services:**						**9**
Securing the Cloud-Securing Data-Establishing Identity and Presence - Working with Productivity Software - Web Mail Services:Exploring the Cloud Mail Services - Exploring Instant Messages..							
Unit - V	**Best Practices and the future of cloud Computing&Migrating to the cloud:**						**9**
Cloud services individuals**-**skytap solution-cloud services at the mid-market-Enterprise class cloud offerings-Migration-Analyze your services**-**Establishing a baseline and metrics-Tools-Best Practices-Finding the Right vendor-Finding the Right Vendor-How Cloud Computing Might Evolve-Researcher Predictions.							
							Total:45

REFERENCES:

1.	Barrie Sosinsky, “Cloud Computing”, 1st Edition, Wiley Publishing inc, Canada, 2018. (Unit I - IV)
2.	Anthony T.Velte,Toby.J.Velte,RobertElsenpeter,”Cloud Computing A practical Approach”,MCGraw Hill,2012.(Unit - V)
3.	RajkumarBuyya,ChristianVecchiola.,ThamaraiSelvi.S, “Mastering Cloud Computing”, 1st Edition, McGraw hill , 2015

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	gain understanding of the characteristics and evolution of cloud computing	Understanding (K2)
CO2	implement cloud services and virtualization concepts.	Analyzing (K4)
CO3	learn about Amazon Web Services ,Google App Engine and PaaS cloud services.	Applying (K3)
CO4	discover how identification is utilized to enable safe cloud access.	Analyzing (K4)
CO5	utilize the proper cloud computing solutions and advice in accordance with the apps being employed.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2			2	2	2	3		3	2	2	2	
CO2		2	3	2		2			2		3			2
CO3			2		3		2	2		2		3	2	2
CO4	3	2	2	2		2			3	2	2		2	
CO5	2		3	2	2						2	3	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	40	10	-	-	100
CAT2	10	30	40	20	-	-	100
CAT3	10	40	35	15	-	-	100
ESE	10	40	35	15	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCT32 - C# AND ASP.NET							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**3**	**0**	**0**	**3**

Preamble	To make the student to understand the object oriented feature of C# under the .NET framework and to develop Web based applications on ASP.NET.	
Unit – I	**Object Oriented Concepts and Advanced C# Features:**	**9**
Inheritance and Polymorphism- Interfaces - Exception Handling- Collections and Generics – Boxing and UnBoxing, ListT: QueueT, StackT, SortedSetT, Delegates, Multicast Delegates, Events, and Lambda Expressions, Anonymous Method, - Advanced C# Language Features: Indexer Method, Operator Overloading.		
Unit – II	**Windows Workflow Foundation and WPF:**	**9**
Introducing Windows Workflow Foundation: Defining a Business Process, building a Simple Workflow, Examining Workflow Activities, building a Flowchart Workflow, Introducing Windows Presentation Foundation and XAML: Building a WPF Application Without XAML and using only XAML, Programming with WPF Controls: Controlling Content Layout using Panels, building a Window`s Frame using Nested Panels, Introducing the WPF Data-Binding Model		
Unit – III	**Language-Integrated Query:**	**9**
LINQ to Objects: LINQ, Types of LINQ, LINQ Queries to Primitive Arrays: Deferred Execution, Immediate Execution, – Understanding Object Lifetime: Garbage Collection, Generations of Garbage Collection, Finalizable and Disposal Objects, – Building and Configuring Class Libraries: Role of .NET Assemblies – Understanding Late Binding – Introducing LINQ to XML: XElement and XDocument.		
Unit – IV	**ADO.NET:**	**9**
ADO.NET: Introduction, ADO.NET architecture, The Connected Layer: DataProviders, DataReader, DataAdapter, ExecuteNonQuery method, ExecuteReader method, Connected Oriented Architecture, The Disconnected Layer: DataSet, Features of DataSet, Architecture of Disconnected Layer, Difference between DataReader and DataSet.		
Unit – V	**ASP.NET WEB FORMS:**	**9**
Introducing ASP.NET web forms: The Role of HTTP, The Role of HTML, The Role of Client Side Scripting, Posting Back to the Web Server, interacting with the Incoming HTTP Request, Interacting with the Outgoing HTTP Response, The Life Cycle of an ASP.NET Web Page, ASP.NET Web Controls, Master Pages, and Themes: Understanding the Nature of Web Controls, Building the ASP.NET Cars Web Site, The Role of the Validation Controls, Working with Themes.		
		Total:45

REFERENCES:

1.	Andrew Troelsen, Philip Japikse, “C# 6.0 and the .NET 4.6 Framework”, 7th Edition, Apress, 2015.
2.	Herbert Schildt, “The Complete Reference: C# 4.0”, 1stEdition, Tata McGraw Hill, 2012.
3.	Ben Albahari, Peter Drayton and Brad Merrill, “C# Essentials”, 2ndEdition, O’Reilly, 2002

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	build an application using advanced concepts of C#.	Applying (K3)
CO2	gain knowledge in the concepts of the work flow and Windows Presentation Foundations	Analyzing (K4)
CO3	become familiar with LINQ	Applying (K3)
CO4	create windows applications with database access using ADO.NET.	Applying (K3)
CO5	construct web forms using ASP.NET	Applying (K3)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2	1	1	1		1	1	1	1	2
CO2	2	3	2	2	2	1			1		1	1	2	1
CO3	3	2	1	2	2	1	1	1		1	1	1	2	2
CO4	2	3	2	1	1	1	1		1	1	1	1	1	1
CO5	3	2	1	1	2	1	1	1		1	1	1	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	30	10	-	-	100
CAT2	20	35	35	10	-	-	100
CAT3	15	40	45	-	-	-	100
ESE	15	35	40	10	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCT33 - DATA SCIENCE							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Python Programming**	**3**	**PC**	**3**	**1**	**0**	**4**

Preamble	To apply the knowledge for describing and visualizing data using Python	
Unit – I	**Basics of Data Science:**	**9 + 3**
Needfordatascience–benefitsanduses–facetsofdata–datascienceprocess–settingthe research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis–build the models–presenting and building applications		
Unit – II	**Statistics:**	**9 + 3**
Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs –averages — mode — median — mean — averages for qualitative and ranked data — describingvariability–range–variance–standarddeviation–degreesoffreedom–interquartilerange–variabilityforqualitativeandrankeddata		
Unit – III	**Data manipulation using Python:**	**9 + 3**
BasicsofNumpyarrays–aggregations–computationsonarrays–comparisons,masks,booleanlogic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection — operating on data — missing data — hierarchical indexing — combining datasets –aggregation and grouping–pivot tables		
Unit – IV	**Normal Distribution, Correlation & Regression analysis:**	**9 + 3**
Normal distributions – z scores – normal curve problems – finding proportions – finding scores – correlation – scatter plots – correlation coefficient for quantitative data – computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean		
Unit – V	**Data Visualization using Python:**	**9 + 3**
Visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms, binnings, and density – three dimensional plotting – geographic data – data analysis using statmodels and seaborn – graph plotting using Plotly – interactive data visualization using Bokeh		
		Lecture:45, Tutorial:15, Total: 60

REFERENCES:

1.	David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit – I)
2.	Robert S. Witte and John S. Witte, “Statistics”, 11thEdition, Wiley Publications, 2017. (Unit – II,IV)
3.	Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2019 Reprint (Unit – III,V)

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the skills of data inspecting and cleansing	Understanding (K2)
CO2	determine the relationship between data dependencies using statistics	Applying (K3)
CO3	handle data using Python tools.	Applying (K3)
CO4	describe the relationship between the variables using statistical techniques	Applying (K3)
CO5	visualize the data using Python tools and techniques	Applying (K3)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		2						1	1	1	1
CO2	3	3	1	1	2						1	1	1	1
CO3	2	2	1	2	2						1	1	1	1
CO4	3	3	1	1	2						1	1	1	1
CO5	3	3	2	1	2						1	1	3	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30	-	-	-	100
CAT2	15	25	60	-	-	-	100
CAT3	15	25	60	-	-	-	100
ESE	15	25	60	-	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCL31 - CLOUD COMPUTING TECHNOLOGIES LABORATORY							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**0**	**0**	**4**	**2**

Preamble	To equip students with the knowledge and abilities needed for practical applications of cloud computing and the internet of things.

LIST OF EXPERIMENTS / EXERCISES:

1.	Demonstrate the procedure for creating AWS instance and install compiler and run program
2.	Create S3 bucket and upload a file using AWS S3 bucket.
3.	Demonstrate the procedure for creating AWS RDS instance and execute sample SQL statement
4.	Host a web application in AWS instance
5.	Develop and deploy an application using Microsoft Azure
6.	Create a Customer Relationship Management System (CRM) using salesforce.com portal.
7.	Design scheduler and personal information management using zohoworkerly
8.	Create and use a repository using github
9.	Create visually appealing data visualizations and insightful dashboards using Zoho
10.	Create a blog to show the profile of our MCA department
11.	Demonstrate the steps for web application deployment using azure devops
12.	Create a web application and deployment in 000webhost cloud platform

Total:60

REFERENCES/ MANUAL /SOFTWARE:

1.	Operating System : Windows/Linux
2.	Software : open source
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	use and investigate various cloud computing services	Applying (K3) Precision (S3)
CO2	utilize productivity software, create and develop cloud apps.	Applying (K3) Precision (S3)
CO3	install a program on cloud platform.	Applying (K3) Precision (S3)

Mapping of Cos with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		2	3		1		2	2	1	2	1
CO2	3	2	1	1	2	3		1		1	3		2	1
CO3	3	2	1	1	3	3		2		1	2		2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MCL32 - C# AND ASP.NET LABORATORY							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PC**	**0**	**0**	**4**	**2**

Preamble	To make the student to develop the object oriented feature of C# under the .NET framework for windows and web based applications with ADO.NET

LIST OF EXPERIMENTS / EXERCISES:

1.	C# program using Late Binding
2.	Attribute based Programs using C#
3.	Language Integrated Query (LINQ) based programs using C#
4.	C# program that used Lambda Expressions
5.	Program for creating web services using C#
6.	C# program for Windows Presentation Foundation (WPF)
7.	C# programs for Windows Workflow foundations (WF)
8.	Program to perform ADO.NET
9.	Design a web application in ASP using ADO.
10.	Creating a Custom Data-Bound ASP.NET Web Control for ASP.NET2.0

Total:60

REFERENCES/ MANUAL /SOFTWARE:

1.	Front End: Microsoft Visual Studio 10.0, Microsoft .NET Framework SDK v2.0.
2.	Back End : ORACLE /MongoDB/ SQL Server / MYSQL
3.	Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	ability to write programs using C#, LINQ based queries	Applying (K3) Precision (S3)
CO2	develop the web applications using WPF and to create web services using .NET	Applying (K3) Precision (S3)
CO3	develop ASP.NET web Forms and Connectivity through ADO.NET	Applying (K3) Precision (S3)

Mapping of Cos with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	1	1				1	1	1	2
CO2	2	3	2	1	3	1	1		1	1	2	1	2	3
CO3	3	2	2	2	2	1	1	1		1	2	1	2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MCP41- PROJECT WORK							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**4**	**EC**	**0**	**0**	**24**	**12**
							Total:360

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1	identify the problem by applying acquired knowledge	Applying (K3) Precision (S3)
CO2	analyze and categorize executable project modules after considering risks	Analyzing (K4) Precision (S3)
CO3	analyze efficient tools for designing project modules	Analyzing (K4) Precision (S3)
CO4	integrate all the modules through effective teamwork after efficient testing and validation	Evaluating (K5) Precision (S3)
CO5	elaborate the completed work and compile the project documentation	Creating (K6) Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

22MCE01 - ARTIFICIAL INTELLIGENCE							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	To provide an introduction to the basic principles and applications of Artificial Intelligence.	
Unit – I	**Introduction:**	**9**
The Foundations of Artificial Intelligence - History of AI - State of the Art - Intelligent Agents: Agents and Environments – Good Behaviour – Nature of Environments - Structure of Agents.		
Unit – II	**Problem Solving Methods:**	**9**
Problem - Solving Agents - Example Problems - Searching for Solutions - Uninformed Search Strategies – Heuristic Functions.		
Unit – III	**Knowledge and Reasoning:**	**9**
Logic Agents: Knowledge based agents - WumpusWorld - Logic - Propositional logic - Syntax and Semantic of FOL - Using FOL - Propositional vs First order inference - Unification and Lifting - Forward chaining - Backward chaining – Resolution.		
Unit – IV	**Planning:**	**9**
Classical Planning: Definitions - Algorithms for Planning as state space search - Planning graphs - Planning and acting in the real world: Time, Schedule and Resources - Hierarchical planning - Planning and acting in Non-deterministic domain - Multiagent planning.		
Unit – V	**Learning:**	**9**
Forms of Learning - Supervised Learning – Learning Decision Trees – Evaluating and Choosing the Best Hypothesis – Theory of Learning – Regression and Classification with Linear Models.		
		Total:45

REFERENCES:

1.	S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach”, 3rdEdition, Prentice Hall, 2021.
2.	Daugherty, Paul R., and H. James Wilson, “Human + Machine: Reimagining Work in the Age of AI”, Harvard Business Review Press, 2018.
3.	Joshi Prateek, “Artificial Intelligence with Python”, 1stEdition, Packt Publishing Ltd, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	recognize fundamental concepts of Artificial Intelligence	Understanding (K2)
CO2	provide the techniques of Problem Solving in Artificial Intelligence	Applying (K3)
CO3	use the knowledge and the process of inference to derive new facts	Applying (K3)
CO4	learn how to construct plans of actions	Applying (K3)
CO5	make use of models that learns from samples of data	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	3	2		1						1	1
CO2	3	3	1	3	1		2						2	1
CO3	3	3	2	3	1		2						2	1
CO4	3	3	2	3	1		2						2	1
CO5	3	3	2	3	1		2						2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	50	35		-	-	100
CAT2	10	30	60		-	-	100
CAT3	10	30	60		-	-	100
ESE	10	30	60		-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCE02 –ADVANCED DESIGN AND ANALYSIS OF ALGORITHMS							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Data Structures and Algorithms**	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	To obtain a knowledge in algorithm design techniques and solve the problem in most effective and efficient way.	
Unit – I	**Introduction:**	**9**
Algorithm Definition – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithm Efficiency: Analysis Frame Work –Asymptotic Notations – Mathematical Analysis of Non-recursive and Recursive Algorithms.		
Unit – II	**Brute Force and Exhaustive search:**	**9**
Sequential search and Brute Force String Matching – Closest Pair and Convex- Hull Problems by Brute Force – Exhaustive Search: Traveling Salesman Problem – Knapsack Problem – Assignment Problem – Decrease and Conquer: Decrease by a Constant Factor Algorithms – Variable Size Decrease Algorithms.		
Unit – III	**Dynamic Programming and Greedy Technique:**	**9**
Three Basic Examples – The Knapsack Problem and Memory Functions – Optimal Binary Search Trees – Warshall"s and Floyd"s Algorithms – Greedy Technique.		
Unit – IV	**Iterative Improvement and Limitations of Algorithm Power:**	**9**
Iterative Improvement: The Maximum Flow Problem – Maximum Matching in Bipartite Graphs – The Stable Marriage Problem – Limitations of Algorithm Power: Decision Trees – P, NP and NP Complete Problems.		
Unit – V	**Coping with the Limitations of Algorithm Power:**	**9**
Backtracking: n-Queens problem – Hamiltonian circuit problem – Subset sum problem – Branch and Bound: Assignment problem – Knapsack problem – Traveling salesman problem – Approximation Algorithms for NP – Hard Problems..		
		Total:45

REFERENCES:

1.	AnanyLevitin,"Introduction to the Design and Analysis of Algorithms", 3rdEdition, Pearson Education, New Delhi, 2018.
2.	Ellis Horowitz, SartajSahni and SanguthevarRajasekaran, "Fundamentals of Computer Algorithms", 2ndEdition, Galgotia Publications, Hyderabad, 2012.
3.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rdEdition, Prentice Hall of India, New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	know the fundamental needs of algorithms in problem solving.	Understanding (K2)
CO2	utilize brute force and exhaustive searchtechniques to solve a problem	Applying (K3)
CO3	solve problems by applying dynamic programming and greedy techniques	Applying (K3)
CO4	analyze the results by applying iterative improvement algorithms along with limitations of algorithm power.	Analyzing (K4)
CO5	analyze the solution using backtracking and branch and bound techniques.	Analyzing (K4)

Mapping of Cos with POs and PSOs

Cos/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2					2			3	2
CO2	3	2	3	3	3					3			2	3
CO3	3	2	3	3	3					3			2	3
CO4	3	3	2	2	3					3			2	3
CO5	3	3	2	2	3					3			2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	50	40		-	-	100
CAT2	10	50	40		-	-	100
CAT3	10	30	45	15			100
ESE	10	30	45	15	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCE03 – WEB TECHNOLOGIES							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	Nil.	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	To be developed to provide an interactive real time online applications	
Unit – I	**WebEssentials:**	**9**
Clients, Servers and Communication: The Internet - Basic Internet Protocols - The World Wide Web - HTTP Request Message - Response Message -Web Clients - Web Servers - Markup Languages: HTML – History and Versions - Basic XHTML Syntax andSemantics-HTMLElements-RelativeURLs–Lists–Tables–Frames –Forms- XML –CreatingHTML Documents.		
Unit – II	**StyleSheets:**	**9**
CSS – Features - Core Syntax - Style Sheets and HTML - Style Rule Cascading and Inheritance - Text Properties - Box Model – NormalFlow Box Layout - Client-Side Programming: The JavaScript Language- JavaScript in Perspective – Syntax - Variables and DataTypes-Statements-Operators– Literals– Functions– Objects– Arrays -Built-inObjects-JavaScriptDebuggers.		
Unit – III	**DOM:**	**9**
DOM - DOM History and Levels - Intrinsic Event Handling - Modifying Element Style -The Document Tree - DOM Event Handling - Accommodating Noncompliant Browsers - Properties of Window.		
Unit – IV	**XML andJSP:**	**9**
XML - Documents and Vocabularies - Versions and Declaration - Namespaces - JavaScript and XML: Ajax - DOM based XMLProcessing- JSP Technology - JSP and Servlets - Running JSP Applications -Basic JSP-Tag LibrariesandFiles- Model-View-ControllerParadigm		
Unit – V	**Angular JS:**	**9**
Introduction to Angular JS-Directives, Expressions, Controllers, Filters, Module, Events, Forms, Validations, Examples.		
		Total:45

REFERENCES:

1.	Jeffrey C.Jackson, "Web Technologies--A Computer Science Perspective", 1st Edition, Pearson Education, 2015.(Unit I -IV)
2.	Krishna Rungta,"Learn AngularJS in 1 Day" Independent Publication, 2018. (Unit V)
3.	Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", 5th Edition, Pearson Education, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply the necessary HTML elements to the Document's design.	Applying (K3)
CO2	create the Programs Using Scripting Language and CSS Presentation	Analyzing (K4)
CO3	utilize server side scripting technologies, develop dynamic web sites.	Applying (K3)
CO4	develop a web application using JSP Technology	Analyzing (K4)
CO5	use a variety of web service languages to implement the web service.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2			2	2		2		2		2	2	2
CO2	3	2	2	2		2				3		1		
CO3	3		3	2	2	2		2				2	3	
CO4		3	1	2				2		2			2	2
CO5	2		2	2						2			2	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	40	30	-	-	100
CAT2	10	25	35	30	-	-	100
CAT3	10	25	40	25	-	-	100
ESE	10	30	40	20	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22GET11- INTRODUCTION TO RESEARCH							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**PE**	**2**	**1**	**0**	**3**

Preamble	Preamble: This course will familiarize the fundamental concepts/techniques adopted in research, problem formulation and patenting. Also will disseminate the process involved in collection, consolidation of published literature and rewriting them in a presentable form using latest tools.	
Unit – I	**Concept of Research:**	**9**
Meaning and Significance of Research: Skills, Habits and Attitudes for Research - Time Management - Status of Research in India. Why, How and What a Research is? - Types and Process of Research - Outcome of Research - Sources of Research Problem - Characteristics of a Good Research Problem - Errors in Selecting a Research Problem - Importance of Keywords - Literature Collection – Analysis - Citation Study - Gap Analysis - Problem Formulation Techniques.		
Unit – II	**Research Methods and Journals:**	**9**
Interdisciplinary Research - Need for Experimental Investigations - Data Collection Methods - Appropriate Choice of Algorithms / Methodologies / Methods - Measurement and Result Analysis - Investigation of Solutions for Research Problem - Interpretation - Research Limitations. Journals in Science/Engineering - Indexing and Impact factor of Journals - Citations - h Index - i10 Index - Journal Policies - How to Read a Published Paper - Ethical issues Related to Publishing - Plagiarism and Self-Plagiarism.		
Unit – III	**Paper Writing and Research Tools:**	**9**
Types of Research Papers - Original Article/Review Paper/Short Communication/Case Study - When and Where to Publish? - Journal Selection Methods. Layout of a Research Paper - Guidelines for Submitting the Research Paper - Review Process - Addressing Reviewer Comments. Use of tools / Techniques for Research - Hands on Training related to Reference Management Software - EndNote, Software for Paper Formatting like LaTeX/MS Office. Introduction to Origin, SPSS, ANOVA etc., Software for detection of Plagiarism.		
Unit – IV	**Effective Technical Thesis Writing/Presentation:**	**9**
How to Write a Report - Language and Style - Format of Project Report - Use of Quotations - Method of Transcription Special Elements: Title Page - Abstract - Table of Contents - Headings and Sub-Headings - Footnotes - Tables and Figures - Appendix - Bibliography etc. - Different Reference Formats. Presentation using PPTs.		
Unit – V	**Nature of Intellectual Property:**	**9**
Patents - Designs - Trade and Copyright. Process of Patenting and Development: Technological research - innovation - patenting - development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents.		
		Total:45

REFERENCES:

1.	DePoy, Elizabeth, and Laura N. Gitlin, “Introduction to Research-E-Book: Understanding and Applying Multiple Strategies”, Elsevier Health Sciences, 2015.
2.	Walliman, Nicholas, “Research Methods: The basics”, Routledge, 2017.
3.	Bettig Ronald V., “Copyrighting culture: The political economy of intellectual property”, Routledge, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	list the various stages in research and categorize the quality of journals.	Analyzing (K4)
CO2	formulate a research problem from published literature/journal papers.	Analyzing (K4)
CO3	write,present a journal paper/ project report in proper format.	Creating (K6)
CO4	select suitable journal and submit a research paper.	Applying (K3)
CO5	compile a research report and the presentation.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1										1	
CO2	3	2	3										1	
CO3	3	3	1										1	
CO4	3	2	1										1	
CO5	3	2	1										1	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	-	30	40	30	-	-	100
CAT2	-	20	30	30	10	10	100
CAT3	-	40	60	-	-	-	100
ESE	-	40	60	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCE04 - BIG DATA TECHNOLOGIES							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	Provides basic knowledge about Big data, its framework and its storage technologies	
Unit – I	**Big Data and Big Data Analytics:**	**9**
Types of Digital Data – Introduction to Big Data: Characteristics – Evolution – Challenges – Big Data – Big Data Analytics : Data science – Terminologies – Analytical Tools.		
Unit – II	**Hadoop:**	**9**
Introduction – Distributed Computing Challenges – Hadoop Overview – Hadoop Distribution – HDFS – Processing Data with Hadoop – Managing Resources and Applications with Hadoop YARN – Hadoop Ecosystem.		
Unit – III	**Big Data Technology Landscape and MongoDB:**	**9**
NoSQL: Types of NoSQL – SQL versus NoSQL – MongoDB - Terms used in RDBMS and MongoDB – Datatypes – MongoDB Query Language - Introduction to MapReduce Programming		
Unit – IV	**Hive & Pig:**	**9**
Hive – Hive Architecture – Data Types - File Format – Hive Query Language – Pig: Anatomy – Pig Latin Overview - Data Types – Running Pig – Execution Modes of Pig – HDFS commands - Relational Operators - Eval function – Complex Datatypes – Piggy Bank – User-Defined Functions – Parameter substitution.		
Unit – V	**Cassandra:**	**9**
Introduction – Features – Data Types – CQLSH – CRUD – Collections – Using a Counter – Time to Live - Alter Commands – Import and Export – Querying System Tables.		
		Total:45

REFERENCES:

1.	Seema Acharya,SubhashiniChellappan,"Big Data and Analytics", 2nd Edition, Wiley, 2019.
2.	DT Editorial Services, "Big Data, Black Book: Covers Hadoop 2, MapReduce, Hive, YARN, Pig, R and Data Visualization", Dreamtech Press, 1st Edition, 2018.
3.	Dr.AnilMaheshwari,"Big Data", 1st Edition, McGraw Hill Education, 2017

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the concepts, characteristics of big data and tools used in bigdata analytics	Understanding (K2)
CO2	implement MapReduce programs in Hadoop framework	Applying (K3)
CO3	experiment NoSQL using MongoDB	Applying (K3)
CO4	develop solutions for big data problems using Hive and Pig	Applying (K3)
CO5	build a database application using Cassandra	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3												2
CO2	3	2	2	2	2		2						2	3
CO3	3	2	2	2	2		2						2	3
CO4	3	2	2	2	2		2						2	3
CO5	3	2	2	2	2		2						2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20	-	-	-	100
CAT2	10	50	40	-	-	-	100
CAT3	10	50	40	-	-	-	100
ESE	5	55	40	-	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCE05 - OPTIMIZATION TECHNIQUES							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understand the importance of optimization techniques in finding optimum or nearly optimum solution for difficult decision-making problems	
Unit – I	**Linear Programming Models:**	**9**
Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables: big-M method, degeneracy and unbound solutions		
Unit – II	**Transportation and Assignment Models:**	**9**
Formulation - Methods for finding basic Feasible Solution - Optimality Test - MODI method -Degeneracy in Transportation Problem - Unbalanced Transportation Problem. Assignment Method: Mathematical formulation of assignment models – Hungarian Algorithm – Variants of the Assignment problem		
Unit – III	**Scheduling By PERT And CPM:**	**9**
Introduction - Rules to frame a Network - Fulkerson's Rule to numbering of events - Activity, Times - Critical Path Computation - Slack and Float - PERT- Steps and computing variance, Merits and demerits of PERT, CPM- Time estimating & Limitations, Comparison between PERT & CPM		
Unit – IV	**Inventory Models:**	**9**
Introduction to inventory – Cost involved in inventory problems - Economic Order Quantity (EOQ) – Deterministic Single Item inventory Models– EOQ problem without shortages with uniform demand – EOQ problem with no several production runs of unequal lengths - production problem with no shortage – purchasing problem with shortages - EOQ problems with price breaks.		
Unit – V	**Game Theory:**	**9**
Basic Terminology - Two person zero sum game – Games with saddle point-Games without saddle point - Dominance principle-Graphical solution for $2 \times n$ or $m \times 2$ games.		
		Total: 45

REFERENCES:

1. Taha H.A., "Operations Research: An Introduction", 10th Edition, Prentice Hall of India, New Delhi, 2017
2. KantiSwarup, P.K. Gupta, Man Mohan, "Operations Research", 15th Revised Edition, S. Chand& Sons Education Publications, New Delhi, 2017
3. Natarajan A.M, Balasubramanie R, and Tamilarasi A, "Operations Research" Pearson Education Publishers, 4th Edition, 2009

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	solve linear programming problems using appropriate techniques	Applying (K3)
CO2	apply transportation and assignment models to find optimal solution	Applying (K3)
CO3	construct network modeling for planning and scheduling the project activities	Applying (K3)
CO4	understand about inventory models	Understanding(K2)
CO5	analyze the best strategy and value of the given game model	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	1		1					1	1	1
CO2	3	3	2	1	1							1		
CO3	3	3	2	1	1		1				1	1	1	1
CO4	3	3	2	1	1		1				1	1	1	1
CO5	3	3	2	1	1		1			1	1	1	1	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	15	25	60	-	-	-	100
CAT2	15	25	60	-	-	-	100
CAT3	15	35	15	35	-	-	100
ESE	10	20	50	20	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCE06 - MOBILE COMPUTING							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Data Communication Networks**	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	To realize the vision of "Optimally Connected Anywhere, Anytime" supported by all system levels from access methods and networks to services for Mobile Devices.	
Unit – I	**Introduction to Wireless Transmission:**	**9**
Introduction: Applications, Reference Model - Signals - Antennas - Signal Propagation: path loss of radio signals, signal propagation – Multiplexing: SDM, FDM, TDM, CDM - Modulation: ASK, FSK, PSK, AFSK, APSK, multi carrier modulation - Spread Spectrum.		
Unit – II	**Wireless Communication Techniques:**	**9**
Medium Access Control: Hidden and Exposed Terminals, Near and Far Terminals –S/F/T/CDMA - GSM – Architecture, Services, Protocols, Localization and Calling, Handover, Security - DECT system: System and Protocol architecture - UMTS: architecture, UTRAN.		
Unit – III	**Mobile Computing Architecture and through Telephony:**	**9**
Internet – The Ubiquitous Network – Architecture – Design Considerations for Mobile Computing –Mobile Computing through Internet – Making Existing Applications Mobile–Enabled Evolution of Telephony – Multiple Access Procedures – Satellite Communication Systems – Mobile Computing through Telephone – Developing an IVR Application – Telephony Application Programming Interface.		
Unit – IV	**Data Networks:**	**9**
Bluetooth – RFID - WiMAX - SMS – GPRS network architecture – GPRS services and features - EDGE – CDMA vs GSM – 3G Networks – Applications on 3G.		
Unit – V	**Overview of Intelligent Networks and Next Generation Networks:**	**9**
Introduction – Fundamentals of Call Processing – Intelligence in the Networks – Signaling – IN Conceptual Model – Softswitch – Technologies and Interface for IN – SS7 Security – MAPSec – Virtual Private Network – All in One: The Converged Scenario – Narrowband to Broadband – All IP and B3G Network – OFDM- FAMA/DAMA – MPLS - .		
		Total:45

REFERENCES:

1.	Schiller Jochen, “Mobile Communications”, 2nd Edition, Pearson Education, New Delhi, 2014. (Unit I - II)
2.	Asoke K Talukder, Hasan Ahmed, RoopaYavagal, “Mobile Computing: Technology, Applications and Service Creation”, 2nd Edition, McGraw Hill Education, 2018. (Unit III - V)
3.	M.Bala Krishna, Jaime LloretMauri, “Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks”, 1st Edition, CRC, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understanding the concepts of wireless transmission models	Understanding (K2)
CO2	survey on effective communication mechanisms like medium access control and telecommunication systems	Understanding (K2)
CO3	discover the mobile computing architecture and mobile computing through telephony	Applying (K3)
CO4	explain the basic concepts of data networks for various applications	Understanding (K2)
CO5	discuss the concept of an intelligent networks and next generation networks.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1						2	2	2	2	3		2
CO2	2	1						2	2	2	2	3		2
CO3	3	2	2	2	3				2	3		2	2	2
CO4	2	1						2	2	2	2	3		2
CO5	2	1						2	2	2	2	3		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60	-	-	-	-	100
CAT2	20	30	50	-	-	-	100
CAT3	40	60	-	-	-	-	100
ESE	20	60	20	-	-	-	100

* ±3% may be varied, CAT1, 2, 3 – 50 marks, ESE – 100 marks

22MCE07 - BLOCKCHAIN TECHNOLOGIES							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**0**	**3**
Preamble	To know about the basics in Blockchain Technology and its Applications with different Framework and Platforms.						
Unit – I	**Blockchain Essentials:**						**9**
History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization.							
Unit – II	**Cryptocurrency:**						**9**
Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts.							
Unit – III	**Ethereum:**						**9**
Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.							
Unit – IV	**Web3 and Hyperledger:**						**9**
Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.							
Unit – V	**Alternative Blockchain and Emerging Trends:**						**9**
Kadena – Ripple – Rootstock – Quorum – MaidSafe – BigchainDB - Tendermint – Scalability – Privacy – Blockchain Research – Notable Projects – Miscellaneous Tools.							
							Total:45

REFERENCES:

1.	Imran Bashir, “Mastering Blockchain”, 2nd Edition, Packt Publication, Mumbai, 2018.
2.	ArshdeepBahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”, VPT Publisher, 2017.
3.	Andreas M. Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, 1st Edition, O"Reilly Media Inc, USA, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify the basics of block chain technology concepts and its applications	Understanding (K2)
CO2	discover the implementation of crypto currency	Applying (K3)
CO3	relate deep understanding of the Ethereum model, its consensus model and code execution	Applying (K3)
CO4	illustrate the architectural components of a hyperledger and its development framework	Applying (K3)
CO5	infer the alternative blockchain and emerging trends in blockchain	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1		1				1			1	1
CO2	3	2	1	1									1	1
CO3	3	1	2	1					1				1	1
CO4	3	1	2	2	1				2				1	1
CO5	3	2	1	2	1				2			1	1	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	50	20	-	-	-	100
CAT2	10	40	50	-	-	-	100
CAT3	10	30	50	10	-	-	100
ESE	10	40	40	10	-	-	100

* ±3% may be varied (CAT 1, 2,3 – 50 marks & ESE – 100 marks)

22MCE08 - DISTRIBUTED SYSTEMS							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Data Communication Networks**	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	To understandthe architecture of distributed systems and the guiding concepts behind the creation of the internet, distributed applications, and file systems	
Unit – I	**Introduction and System Models:**	**9**
Characterization – Trends in Distributed systems –resource sharing – challenges – case study-System Models :Introduction – Physical models – Architectural Models – Fundamental models		
Unit – II	**Networking and Internetworking & Interprocess communication:**	**9**
Types of Network – Network principles – internet protocols – case studies:Ethernet,WiFi and Bluetooth- –Interprocess communication-The API for the internet protocols – External data representation and marshaling – Multicast communication-Network Virtualization: Overlay networks		
Unit – III	**Remote Invocation and indirect communication:**	**9**
Request reply protocols-Remote procedure call-Remote method invocation-Group communication-Publish Subscribe systems-Message ques- Shared memory approaches		
Unit – IV	**Operating systems support and peer to peer systems:**	**9**
The operating system layer – Protection – Processes and threads – communication and threads –communication and invocation – Operating system architecture – Virtualization at the operating system level – Napster and its legacy – peer to peer middleware - Routing overlays– cast studies		
Unit – V	**Distributed file systems and Nameservices:**	**9**
File service Architecture – Name services and the domain Name system– Directory services-Time and Global states: clocks, events, process statesl – Synchronizing physical clocks-Logical time and logical clocks – Global states- Distributed Debugging		
		Total:45

REFERENCES:

1.	Coulouris George, Dollimore Jean, Kindberg Tim and Blair Gordon, “Distributed Systems - Concepts and Design”, 5thEdition, Pearson Education, New Delhi, 2017.
2.	Liu M.L., “Distributed Computing Principles and Applications”, Pearson Education, 2014.
3.	Tanenbaum Andrew S and Maarten Van Steen, “Distributed Systems – Principles and Paradigms”, 2nd Edition, Pearson Education, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	discuss the traits and concepts of distributed systems and use them to construct applications.	Understanding (K2)
CO2	use a variety of communication models while developing distributed applications.	Analyzing (K4)
CO3	describe the services provided by distributed systems and provide examples from real-world situations.	Analyzing (K4)
CO4	use synchronization and concurrency in transactions	Applying (K3)
CO5	choose an appropriate architecture for distributed multimedia systems that are fault resistant.	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2			3	2						2	2	1
CO2	3	2	1	2				2	2	3				
CO3	2		2		3	2		2		2	2	2		2
CO4		2		3		2			2				2	
CO5	2		3	2	2			2				2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	30	10	-	-	100
CAT2	10	40	30	20	-	-	100
CAT3	10	35	40	15	-	-	100
ESE	10	40	30	20	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCE09 - SOFTWARE PROJECT MANAGEMENT							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Software Engineering Methodologies**	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	To perform various activities for successful completion of a project in spite of all the risks.	
Unit – I	**Software Project Management and Evaluation:**	**9**
Software Project Definition - Software Projects Versus Other Types of Projects – Contract Management and Technical Project Management - Plans, Methods and Methodologies – Categorizing Software Projects - Stakeholders - Setting Objectives - Business Case - Project Success and Failure - Management Control – Project Portfolio Management – Evaluation of Individual Projects – Cost-benefit Evaluation Techniques – Risk Evaluation – Programme Management.		
Unit – II	**Project Planning and Software Effort Estimation:**	**9**
Step Wise Project Planning - Where are the Estimates Done - Problem with Over and Under Estimates - The Basis for Software Estimating - Software Effort Estimation Techniques - Bottom up Estimating - The Top Down Approach and Parametric Models - Expert Judgment - Estimating by Analogy - Function Points – COCOMO – Cost Estimation – Staffing Pattern.		
Unit – III	**Activity Planning and Risk Management:**	**9**
Objectives - Project Schedules - Sequencing and Scheduling Activities - Network Planning Models - Formulation of a Network Model - Forward Pass - Backward Pass - Critical Path - Activity Float - Risk Management Approaches - Risk Identification, Assessment, Planning and Management – Evaluating the Risks – PERT Technique.		
Unit – IV	**Resource Allocation, Monitoring and Managing Contracts:**	**9**
Nature of Resources, Identifying Resource Requirements, Scheduling, Critical Paths – Creating the Framework, Collecting the data, Visualizing Progress, Cost Monitoring, Change Control - Managing Contracts - Types of Contracts - Stages in Contract Placement - Contract Management.		
Unit – V	**Software Quality and Project Closure:**	**9**
The Place of Software Quality in Project Planning - Importance – Definition - Product versus Process Quality Management - Quality Management Systems - Process Capability Models - Techniques to Help Enhance Software Quality – Reasons for Project Closure, Project Closure Process, Performing a Financial Closure.		
		Total:45

REFERENCES:

1.	Bob Hughes, Mike Cotterell&Rajib Mall, “Software Project Management”, 6th Edition, McGraw Hill, New Delhi, 2018.
2.	S. A. Kelkar, ”Software Project Management”, 3rd Edition, PHI, New Delhi, 2013.
3.	Adolfo Villafiorita , “Introduction to Software Project Management“, 1st Edition, CRC Press, 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the modern project management practices for different applications.	Understanding (K2)
CO2	understand the concept of the effective project delivery in software	Understanding (K2)
CO3	apply adequate knowledge about cost and effort estimation of the software development.	Applying (K3)
CO4	identify the activities and the risks involved in various activities like resource allocation, monitoring, and managing contracts.	Understanding (K2)
CO5	summarize the quality of software and project closures.	Understanding(K2)

Mapping of COs with POs and PSOs

COs/Pos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1						2	3	2	2	2		2
CO2	2	1						2	3	2	2	2		2
CO3	3	2	2	2	3				2	3		2	2	2
CO4	2	1						2	3	2	2	2		2
CO5	2	1						2	2	2	3	2		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	40	60	-	-	-	-	100
CAT2	20	30	50	-	-	-	100
CAT3	40	60	-	-	-	-	100
ESE	10	55	35	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCE10 - DEEP LEARNING							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Machine Learning**	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	Explores the knowledge in fundamental concepts of deep learning and popular architectures of deep neural network to build the effective models.	
Unit – I	**Deep Networks:**	**9**
Overview of neural networks- Loss functions- Hyperparameters-Defining Deep Learning - Common Architectural Principles of Deep Networks: Core Components - Building Blocks of Deep Networks: RBMs – Autoencoders – VariationalAutoencoders.		
Unit – II	**Mathematical Building Blocks of Neural Networks:**	**9**
Data Representation for neural networks – The gears of neural networks: Tensors operations-The engine of Neural networks: gradient based optimization-Introduction to Keras - Setting up a deep learning work station – Classifying Movie reviews: Binary Classification example.		
Unit – III	**Architectures of Deep Networks:**	**9**
Unsupervised Predefined Networks: Deep Belief Networks – Generative Adversarial Networks- Convolutional Neural Networks- Recurrent Neural Networks- Recursive Neural Networks.		
Unit – IV	**Building Deep Networks:**	**9**
Matching Deep Networks to the right problems-DL4J suite of tools- Basic concepts of the DL4J API-Modeling CSV data with Multilayer Perceptron Networks- Modeling handwritten images using CNN-Modeling Sequence data by using RNN.		
Unit – V	**Deep Learning for Computer Vision:**	**9**
Introduction to Convnets – Training a convent from scratch on a small dataset – Using a predefined convent: Feature Extraction – Fine Tuning – Wrapping up – Visualizing convent: intermediate activations – convent filters – heatmaps of class activation.		
		Total:45

REFERENCES:

1.	Josh Patterson & Adam Gibson, "Deep Learning - A Practitioner's Approach", 4th Indian Reprint, O'Reilly Media, CA, 2021**.** **(**Unit I, III, IV)
2.	Francois Chollet, "Deep Learning with Python", 1st Edition, Manning Publications, New York, 2018. (Unit II, V)
3.	Nikhil Buduma, "Fundamentals of Deep Learning – Designing Next Generation Machine Intelligence Algorithms", 1st Edition, O'Reilly Media, CA, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the fundamentals, architectural principles and building blocks of neural networks	Understanding(K2)
CO2	implement an application using Keras module	Applying (K3)
CO3	explain various deep network architectures	Understanding(K2)
CO4	discover a predefined model using CNN and RNN	Analyzing (K4)
CO5	analyze convents and know the step by step implementation in feature extraction and fine tuning.	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1						2	2	2	2	2		2
CO2	3	2	2	2	3				2	3		2	2	2
CO3	3	1						2	2	2	2	2		2
CO4	3	3	3	2		1	1		1		2	2	2	2
CO5	3	3	3	2		1	1		1		2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	60	30	-	-	-	100
CAT2	10	50	40	-	-	-	100
CAT3	10	20	50	20	-	-	100
ESE	10	40	30	20	-	-	100

* ±3% may be varied (CAT1,2,3 – 50 marks & ESE – 100 marks)

22MCE11 - SERVICE ORIENTED ARCHITECTURE							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	To provide thebasic set of services that each application can access the common functionalities.	
Unit – I	**Service Oriented Architecture:**	**9**
Fundamental SOA- Common characteristics of contemporary SOA-Common misperceptions about SOA-Common tangible benefits of SOA-Common pitfalls of adopting SOA - Evolution of SOA - An SOA timeline - The continuing evolution of SOA - The roots of SOA.		
Unit – II	**Web Services and Primitive SOA:**	**9**
The Web services framework - Service descriptions with WSDL - Messaging with SOAP - Web Services and Contemporary SOA - Message exchange patterns - Service activity - Coordination - Atomic transactions - Business activities - Orchestration - Choreography		
Unit – III	**SOA and Service-Orientation:**	**9**
Web Services and Contemporary SOA - Addressing - Reliable messaging - Correlation - Policies - Metadata exchange - Security - Notification and eventing - Principles of Service-Orientation - Service-orientation and the enterprise- Anatomy of a service-oriented architecture-Common principles of service-orientation-How service-orientation principles inter-relate		
Unit – IV	**Service Layers & Building SOA -Planning and Analysis:**	**9**
Service-orientation and contemporary SOA - Service layer abstraction - Application service layer - Business service layer - Orchestration service layer - Service layer configuration scenarios - SOA Delivery Strategies - SOA delivery lifecycle phases- The top-down strategy - The bottom-up strategy - The agile strategy		
Unit – V	**Building SOA - Technology and Design & WS Specifications:**	**9**
Introduction to service-oriented design - WSDL-related XML Schema language basics - WSDL language basics - SOAP language basics - Service interface design tools - Steps to composing SOA - Considerations for positioning core SOA standards - Considerations for choosing SOA extensions -WS-BPEL language basics - WS-Addressing language basics.		
		Total:45

REFERENCES:

1.	Thomas Erl, “Service-Oriented Architecture : Concepts, Technology, and Design”, Pearson Education, 2019
2.	Munindar P. Singh and Michael N. Huhns ,"Service-Oriented Computing: Semantics, Processes, Agents", John Wiley & Sons, Ltd., 2005
3.	Michael Papazoglou , “Web Services and SOA: Principles and Technology “, Pearson Canada; 2nd Edition ,2012

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	gain understanding of the basic principles of service orientation	Understanding (K2)
CO2	learn advanced concepts such as orchestration and Choreography	Applying (K3)
CO3	become skilled at technology underlying the service design	Understanding (K2)
CO4	identify about various layers of SOA Service Layers	Understanding (K2)
CO5	know Technology, Design of SOA and WS- specification standards	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	2	1		1	1	1		1	1	2
CO2	3	2	1	1	2	1	1	1	1		1	1	1	1
CO3	2	2	3	2	2	1	1		1	1		1	1	2
CO4	2	2	3	2	2	1		1	1	1		1	1	1
CO5	3	2	1	1	2	1	1	1			1	1	1	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	60	20	-	-	-	100
CAT2	20	60	20	-	-	-	100
CAT3	20	60	20	-	-	-	100
ESE	20	60	20	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCF01 -SOFTWARE TESTING							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Software Engineering Methodologies**	**3**	**PE**	**3**	**0**	**2**	**4**

Preamble	To learn the ways to improve software testing and quality assurance through planning, establishing a productive work environment to deliver the customer expected product.	
Unit – I	**Fundamentals of Software Testing:**	**9**
Principles of Testing – Phases of Software Project – Quality Assurance and Control – Verification and Validation - White Box Testing: Static Testing – Structural Testing – Challenges.		
Unit – II	**Black Box Testing and Levels of Testing**:	**9**
Black Box Testing: Requirements based Testing – Positive and Negative Testing – Boundary Value Analysis – Decision Tables – Equivalence Class Partitioning – State Based Testing – Compatibility Testing – User Documentation Testing – Domain Testing. Levels of Testing: System and Acceptance Testing.		
Unit – III	**Performance, Regression and Ad-hoc Testing:**	**9**
Factors – Methodology – Tools – Challenges. Regression Testing: Types – Methods. Internationalization Testing – Ad-hoc Testing: Buddy and Pair Testing – Exploratory Testing – Iterative Testing – Agile and Extreme Testing. Usability and Accessibility Testing.		
Unit – IV	**Life Cycle Based Testing:**	**9**
Life Cycle Based Traditional Waterfall Testing, Testing in Iterative Life Cycles, Agile Testing, Agile Model–Driven Development - Model-Based testing: Testing Based on Models - Integration Testing: Decomposition-Based Integration, Call Graph–Based Integration, Path-Based Integration.		
Unit – V	**Test-Driven Development:**	**9**
Object-Oriented Testing: Issues in Testing Object-Oriented Software, Object-Oriented Unit Testing, Object-Oriented Integration Testing, Object-Oriented System Testing - Software Complexity: Unit-Level Complexity, Integration-Level Complexity, System-Level Complexity - Model-Based Testing for Systems of Systems: Characteristics, Sample Systems of Systems Software Engineering for Systems of Systems.		

LIST OF EXPERIMENTS / EXERCISES:

1.	To Prepare Test Plan for the implemented system under test. The Test Plan shall be based on System Requirement Specification. The Test plan consists of the following issues. a. Purpose of the test. /Location and schedule of the test. b. Test descriptions. /Pass and Fail Criteria.
2.	To perform Unit testing, especially indicating the traced Independent data paths, Control paths, and Error handling paths. Prepare control flow graphs for the unit under test and compute the Cyclomatic Complexity of the unit.
3.	Test a program to login a specific web page.
4.	Test a program to update 10 student records inside the Excel file based on user conditions.
5.	Test a program to select the number of students who have scored more than 60 in all the subjects.
6.	Test a program to provide the total number of objects present/available on the page.
7.	Design, develop, code, and run the program in any suitable language to solve the commission problem. Analyze it from the perspective of dataflow testing, derive at least 10 different test cases, execute these test cases and discuss the test results.
8.	Design, develop, code, and run the program in any suitable language to solve the NextDate problem. Analyze it from the perspective of decision table-based testing, derive at least 10 different test cases, execute these test cases and discuss the test results.
9.	Design, develop, code, and run the program in any suitable object-oriented language to solve the calendar problem. Analyze it from the perspective of OO testing, derive test cases to test the method that increments the date and the method that increments the month, execute these test cases and discuss the test results.
10.	Design, develop, code and run the program in any suitable object-oriented language to solve the currency converter problem. Analyze it from the perspective of use case-based system testing, derive appropriate system test cases, execute these test cases and discuss the test results.

Lecture:45, Practical:30, Total:75

REFERENCES/ MANUAL / SOFTWARE:	
1.	Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing Principles and Practices", 1st Edition, Pearson Education, New Delhi, 2016. (Unit I - III)
2.	Paul C. Jorgensen, "Software Testing: A Craftsman's Approach", 4th Edition, CRC Press (Auerbach) Publications, New York, 2017. (Unit IV - V)
3.	William E. Perry, "Effective Methods for Software Testing", 3rd Edition, Wiley India, New Delhi, 2017.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the importance of software testing in software development.	Understanding (K2)
CO2	apply testing operations, manage software defects, and generate a testing report using testing techniques.	Applying (K3) Precision (S3)
CO3	implement the various software testing techniques like performance testing, regression testing, and ad-hoc testing.	Applying (K3) Manipulation (S2)
CO4	understand the concepts of software testing and appraise the most appropriate life cycle based testing and model based testing approaches for a given situation.	Understanding (K2)
CO5	use the test driven development approaches and identify the complexity of the project by developing the necessary test cases and testing methods based on the implementation of various problems.	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1						2	3	2	2	2		2
CO2	3	2	2	2	3				2	3		2	2	2
CO3	3	2	2	2	3				2	3		2	2	2
CO4	2	1						2	3	2	2	2		2
CO5	2	1						2	3	2	2	2		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	30	50	-	-	-	100
CAT2	20	20	60	-	-	-	100
CAT3	40	60	-	-	-	-	100
ESE	10	55	35	-	-	-	100

* ±3% may be varied (CAT 1,2,3– 50 marks & ESE – 100 marks)

22MCF02 - PHP and MYSQL							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**2**	**4**

Preamble	To provide the strong foundation in PHP Programming and MYSQL platform for web application development.	
Unit – I	**PHP:**	**9**
Incorporating PHP Within HTML-The Structure of PHP-Expressions and Control Flow in PHP: Expressions-Operators-Conditionals-Looping.		
Unit – II	**PHP Functions, Objects and Arrays:**	**9**
PHP Functions-Including and Requiring Files-PHP Version Compatibility-PHP Objects-PHP Arrays: Basic Access- for each loop-Multidimensional Arrays-Array Functions.		
Unit – III	**MySQL:**	**9**
MySQL Basics-Accessing MySQL via the Command Line-Indexes-MySQL Functions-Database Design-Normalization-Relationships-Transactions-Backing Up and Restoring.		
Unit – IV	**Form Handling:**	**9**
Building Forms-Retrieving Submitted Data-HTML5 Enhancements-Cookies, Sessions, Authentication-Using Cookies in PHP-HTTP Authentication-Using Sessions.		
Unit – V	**jQuery:**	**9**
jQuery Syntax-Selectors-Handling Events-Event Functions and Properties-Special Effects-Manipulating the DOM-Modifying Dimensions-DOM Traversal-Using jQuery Without Selectors-Using Asynchronous Communication.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Write a PHP to evaluate expressions using different kind of operators
2.	Write a PHP program to demonstrate the use of decision making control structures using a. If statement b. If-else statement c. Switch statement
3.	Write a PHP program to demonstrate the use of looping structures using- a. While statement b. Do-while statement c. For statement d. Foreach statement
4.	Develop a PHP code to perform various task using user defined functions
5.	Write a PHP code to perform string handling operations with and without using built in functions.
6.	Write a PHP program for creating and manipulating- a. Indexed array b. Associative array c. Multidimensional array
7.	Write a PHP program to a. Inherit members of super class in subclass. b. Create constructor to initialize object of class by using object oriented concepts.
8.	Create a MySQL database with proper normalization and perform DDL and DML operations
9.	Using MySQL, perform various file format like excel, csv data loading, backup and restoring the database information.
10.	Design a PHP Form and use regular expression to validate the fields.
11.	Write a PHP program to – a. set cookies and read it. b. demonstrate session management.
12.	Write a PHP program for sending and receiving plain text message (e -mail).
13.	Implement a PHP application to process student on-duty requisition
14.	Implement a PHP application to store and retrieve student co and extracurricular information
15.	Develop a PHP code to create and download PDF file while accessing database information(Report Generation)

Lecture:45, Practical:30, Total:75

REFERENCES/ MANUAL / SOFTWARE:	
1.	Robin Nixon, "Learning PHP, MySQL & JavaScript - with jQuery CSS and HTML5", 5th Edition, O'Reilly Media, Incorporated, 2018.
2.	Larry E. Ullman, "PHP and MySQL for Dynamic Websites: Visual QuickPro Guide", 4th Edition, Peachpit Press, CA, 2014.
3.	Marty Matthews, "PHP And Mysql Web Development: A Beginner's Guide", Indian Edition, McGraw Hill, India, 2015.

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	describe the fundamental concepts of the PHP Programming	Applying (K3) Imitation(S1)
CO2	develop a PHP code to handle various task using array and function	Applying (K3) Manipulation(S2)
CO3	make use of MySQL, to create a back end platform	Applying (K3) Precision(S3)
CO4	design a front end application task and various event handling mechanism using jquery	Applying (K3) Manipulation(S2)
CO5	design a web application with PHP GUI and MySQL as back end	Applying (K3) Precision(S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3				2	3		2	2	2
CO2	3	2	2	2	3				2	3		2	2	2
CO3	3	2	2	2	3				2	3		2	2	2
CO4	3	2	2	2	3				2	3		2	2	2
CO5	3	2	2	2	3				2	3		2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	30	60	-	-	-	100
CAT2	10	40	50	-	-	-	100
CAT3	10	40	50	-	-	-	100
ESE	10	40	50	-	-	-	100

* ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)

22MCF03 – CROSS-PLATFORM MOBILE APPLICATION DEVELOPMENT							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**2**	**4**

Preamble	To build beautiful cross platform mobile apps for iOS and Android devices using Flutter Framework	
Unit – I	**Getting Started with Flutter:**	**9**
Introducing Flutter – Widget Lifecycle Events- Widget Tree and Element Tree- Installing the Flutter SDK – Creating a Hello World APP: Setting Up the Project – Hot Reload – Themes to style – Stateless and stateful widgets – External Packages.		
Unit – II	**Learning Dart:**	**9**
Variables – Operators – Flow Statements – Functions – Packages – Classes – Asynchronous Programming – Creating a Starter Project Template – Understanding the Widget Tree: Building the full widget tree – building a shallow Widget Tree.		
Unit – III	**Intermediate Flutter:**	**9**
Common Widgets: Using Basic Widgets:SafeArea – Container – Text – RichText – Column – Row – Buttons – Images and Icons – Decorators – Form Widgets – Checking Orientation. Adding Animation to an APP: AnimatedContainer – AnimatedCrossFade – AnimatedOpacity- AnimationController		
Unit – IV	**Navigation, Effects and Layouts:**	**9**
Navigator – Hero Animation – BottomNavigationBar – BottomAppBar – TabBar and TabBarView – Drawer and ListView – Card – ListView and ListTile – Gridview – Stack – CustomScrollView with Slivers – High-Level View of the Layout – Creating the LayoutSetting Up GestureDetector – Draggable and Dragtarget widgets – Moving and Scaling.		
Unit – V	**Database and Cloud Deployment:**	**9**
Saving Data with Local Persistence: JSON Format – Database Classes – Formatting Dates – Sorting – Retrieving Data – Adding the Firebase and Firestore Backend: Firebase and Cloud Firestore – Configuring the Firebase Project – Adding a Cloud Firestore Database and Implementing Security.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Write a dart program to implement string and array concept
2.	Write a dart program using OOPS concept
3.	Develop a dart program using list and set objects
4.	Write a dart programs using Iterating Collections
5.	Develop an application in android studio to understand the basics of the Flutter application
6.	Develop a Flutter App by applying the Widgets, layouts and user management
7.	Write a Flutter code to perform navigation through screens
8.	Develop an application using importing external libraries
9.	Design a code to work with JSON data in Flutter
10.	Implement session management using packages for login page
11.	Use cloud Firestore in a flutter application and perform operations like reading, writing and retrieving data.
12.	Use firebase cloud real-time database with Flutter APP

Lecture:45, Practical:30, Total:75

REFERENCES/ MANUAL / SOFTWARE:

1.	Marco L. Napoli "Beginning Flutter A Hands On Guide To App Development", 1st Edition, John Wiley & Sons, 2020
2.	Alessandro Biessek, "Flutter for Beginners: An introductory guide to building cross-platform mobile applications with Flutter and Dart 2", Packt Publishing, 1st Edition, 2019
3.	Frank Zammetti, "Practical Flutter", 1st Edition, Apress, 2019

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	sketch the internal and external packages of flutter framework	Understanding (K2) Imitation(S1)
CO2	use various features in Dart Programming Language	Applying (K3) Manipulation(S2)
CO3	develop an application using various components in Flutter Framework	Applying (K3) Manipulation(S2)
CO4	make use of navigation, effects and layouts during app development	Applying (K3) Manipulation(S2)
CO5	construct a web based mobile application that accesses database and cloud	Applying (K3) Manipulation(S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3					2	2		2	2	2
CO2	3	3	3	3	2				2	3		2	2	2
CO3	3	3	3	3	2				2	3		2	2	2
CO4	3	3	3	3	2				2	3		2	2	2
CO5	3	3	3	3	2				2	3		2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	-	40	60	-	-	-	100
CAT2	-	40	60	-	-	-	100
CAT3	-	40	60	-	-	-	100
ESE	-	40	60	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCF04 - FULL STACK FRAMEWORK							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**2**	**4**

Preamble	To understand the development procedure for full stack application development	
Unit – I	**Full-Stack Development Overview**	**9**
Introducing Full-Stack Development : The Web Server/platform – Express Framework –MongoDB Database – Angular Front-end Framework : jQuery Vs Angular – Two-Way Data Binding – Load New Pages – Developing in TypeScript - Supporting Cast: Twitter Bootstrap – Git for Source Control – Hosting – Mean Stack Components Work Together		
Unit – II	**MEAN Stack Architecture and Building a Node Web Application**	**9**
MEAN Stack Architecture – Beyond SPAs – Flexible MEAN Architecture –Planning a Real Application – Development into stages – Hardware Architecture – Creating and Setting up a MEAN Project : Look at Express, Node and npm – Creating an Express Project – Modifying Express for MVC – Importing Bootstrap – Making it Live.		
Unit – III	**Node, Express, MongoDB and Mongoose**	**9**
Building a Static Site: Defining the routes in Express – Building Basic controllers – Views – Adding the rest of the Views – Taking the Data Out of the Views – Building a Datamodel with MongoDB and Mongoose: Connecting the Express Application to MongoDB–Model the Data - Mongoose Schemas – MongoDB Shell – Database Live		
Unit – IV	**REST API**	**9**
Writing a REST API: The Rules of a REST API – Setting up the API in Express - Reading Data from MongoDB – Adding Data to MongoDB – Updating Data in MongoDB – Delete Method – Consuming a REST API: Call an API from Express – Lists of Data from an API – Single Documents from an API – Adding Data to the Database via the API		
Unit – V	**Dynamic Front End with Angular**	**9**
Angular Application with TypeScript: Getting up and Running with Angular – Angular Components – Getting Data from an API – Angular Application into Production – Building a Single-age Application with Angular:Foundations – Adding Navigation – Multiple Nested Components – Adding Geolocation– Binding HTML Content -Building a Single-Page Application with Angular: The Next Level – Authenticating Users, Managing Sessions and Securing APIs – Authentication API in Angular Applications		

LIST OF EXPERIMENTS / EXERCISES:	
1.	Create a NodeJS server that serves static HTML and CSS files to the user without usingExpress.
2.	Create a NodeJS server using Express that stores data from a form as a JSON file anddisplays it in another page. The redirect page should be prepared using Handlebars
3.	Create a NodeJS server using Express that creates, reads, updates and deletesstudents' details and stores them in MongoDB database. The information about the usershould be obtained from a HTML form
4.	Create a counter using AngularJS
5.	Create a Todo application using AngularJSStore the data to a JSON file using a simpleNodeJS server and retrieve the information from the same during page reloads.
6.	Create a simple Sign up and Login mechanism and authenticate the user using cookies.The user information can be stored in either MongoDB or MySQL and the server shouldbe built using NodeJS and Express Framework.
7.	Create and deploy a virtual machine using a virtual box that can be accessed from thehost computer using SSH.
8.	Create a docker container that will deploy a NodeJS ping server using the NodeJSimage.
9.	Build an online MCQ quiz app. The questions and options should be fetched based on the chosen topic from a NodeJS server. The questions can be stored in a JSON file in the backend. Once the user has answered the questions, the frontend must send the chosen options to the backend and the backend must identify the right answers and send the score back to the front end. The frontend must display the score in a separate neatly designed page
10.	Build a blog website where you can add blog posts through a simple admin panel and the users can view the blog posts. The contents of the blog posts can be stored in either MongoDB or MySQL database. The home page should contain the titles of the blog post and the full post can be viewed by clicking the title. Frontend can be built either using AngularJS or through template engines served by the NodeJS server
11.	Build a simple calculator app with AngularJS. The user should be able to add numbers and operations to the app by clicking on buttons, just like you would do in a mobile phone. The moment the operation and the two operations are defined, the answer should be displayed
	Lecture:45, Practical:30, Total:75

REFERENCES/ MANUAL / SOFTWARE:	
1.	SmonHolmoes, Clive Harber, "Getting MEAN with Mongo,Express, Angular and Node", Manning Publications, 2nd Edition, 2019
2.	Colin Ihrig, Adam Bretz, "Full Stack Javascript Development with Mean: MongoDB, Express, AngularJS, and Node.JS", 1st Edition, SitePoint,2015
3.	Ravi Kant Soni, "Full Stack AngularJS for Java Developers", Apress, 1st Edition, 2018

COURSE OUTCOMES: **On completion of the course, the students will be able to**		**BT Mapped (Highest Level)**
CO1	understand the fundamentals of full stack development	Understanding (K2) Imitation (S1)
CO2	interpret the components of mean architecture and development environment	Applying (K3) Precision (S3)
CO3	employ the various techniques of node, express and mongoDB	Applying (K3) Precision (S3)
CO4	prioritize the different forms of REST API in the web application development	Analyzing (K4) Manipulation (S2)
CO5	make use of the advanced techniques to develop dynamic front end with angular	Applying (K3) Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2		2								3	
CO2	3	3	3										3	
CO3	3	3	3	2	2	2	2		2	2	2		3	
CO4	3	3	3	3	2		2	2	2	2	2	2	3	
CO5	3	3	3	2		2	2					2	3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	30	60	-	-	-	100
CAT2	20	20	60	-	-	-	100
CAT3	10	20	50	20	-	-	100
ESE	10	20	50	20	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCF05 - DATA VISUALIZATION TECHNIQUES							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**2**	**4**

Preamble	To understand the various types of data, apply and evaluate the principles of data visualization.	
Unit – I	**Data Visualization Fundamentals:**	**9**
Visualization Basics– Visualization Process – Role of Cognition – Pseudocode Conventions – Scatter plot - Data foundation : Types of data - Structure within and between Records - Data Preprocessing – Human Perceptions and Information Processing – Visualization Foundations.		
Unit – II	**Tree, Graph, Networks, Text and Document:**	**9**
Displaying Hierarchical Structure – Displaying Arbitrary Graphs/Networks – Other Issues - Levels of Text Representation – Vector Space Model – Single Document Visualization – Document Collection Visualization- Extended Text Visualizations.		
Unit – III	**Spatial and Geospatial Data:**	**9**
Visualization Techniques for Spatial Data: One, Two, and Three Dimensional Data – Dynamic Data- Combining Techniques - Visualization Techniques for Geospatial Data : Visualizing Spatial Data - Visualization of Point Data - Visualization of Line Data - Visualization of Area Data - Other Issues in Geospatial Data Visualization		
Unit – IV	**Time-Oriented and Multivariate Data:**	**9**
Visualization Techniques for Time-Oriented: Introduction - Characterizing Time-Oriented Data- Visualizing Time-Oriented Data - TimeBench: A Data Model and Software Library for Visual Analytics of Time-Oriented Data- Visualization Techniques for Multivariate Data: Point-Based Techniques – Line-Based Techniques - Region-Based Techniques - Combinations of Techniques		
Unit – V	**Visualizing Distributions:**	**9**
Empirical Cumulative Distribution Functions and Q-Q Plots-Visualizing many Distribution at once – Visualizing Proportions – Nested Proportions – Association among Two or More Quantitative Variables – Trends - Uncertainty		

LIST OF EXPERIMENTS / EXERCISES:

1.	Acquiring and plotting data using various plotting techniques
2.	Use statistical analysis – such as Multivariate Analysis, PCA, LDA, Correlation regression and analysis of variance for visualizing the data
3.	Visualize and analysis the financial data set using Histogram,density plots and HeatMap
4.	Use Time-series and stock market datasets to visualize the data using nested proportions
5.	Visualization of various massive dataset - Finance - Healthcare - Census - Geospatial
6.	Design a Visualization on Streaming dataset (Stock market dataset, weather forecasting)
7.	Using Visualization proportions techniques for Market-Basket Data analysis-visualization
8.	Show the text visualization using web analytics
9.	Visualizing a Single Distribution
10.	Visualizing Multiple Distributions at the Same Time

Lecture:45, Practical:30, Total:75

REFERENCES/ MANUAL / SOFTWARE:

1.	Matthew O. Ward , Georges Grinstein , Daniel Keim "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC Press, United States, 2015
2.	Claus O. Wilke, "Fundamentals of Data Visualization", 1st Edition, O'Reilly, 2019
3.	David Baldwin ,"Mastering Tableau", 1st Edition, Packt Publishing, Mumbai, 2016

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	describe the principles of visual perception	Understanding (K2)
CO2	apply visualization techniques for various data analysis tasks	Applying (K3) Precision (S3)
CO3	design effective visualization techniques for Spatial and Geospatial Data	Applying (K3) Precision (S3)
CO4	manage the visualization techniques for Time-Oriented and Multivariate Data	Evaluating (K5) Manipulation (S2)
CO5	discriminate the designing Visualization techniques for various data distribution	Analyzing (K4) Manipulation (S2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2					2	2		2	2	2
CO2	3	3	3	2	2				2	3		2	2	2
CO3	3	3	3	2	2				2	3		2	2	2
CO4	3	3	3	2	3				2	3		2	2	2
CO5	3	3	3	3	3	3	3		3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	20	60	-	-	-	100
CAT2	10	30	60	--	-	-	100
CAT3	-	20	60	10	10	-	100
ESE	-	20	60	10	10	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCF06 - ACCOUNTING AND FINANCIAL MANAGEMENT							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**2**	**4**

Preamble	To deal with managing the monetary transactions in an organization that enables in taking useful financial and costing related decisions by accounting tools and techniques.	
Unit – I	**Financial Accounting:**	**9**
Meaning and Scope of Accounting – Classifications of Accounts – Accounting Cycle, Golden Rule - Fundamental Concepts and Conventions – Preparation of Journal – Ledger - Trial Balance – Trading, Profit and Loss Account - Balance Sheet.		
Unit – II	**Ratio Analysis:**	**9**
Introduction to Financial Statement Analysis – Advantages, Limitations of Ratio Analysis– Classification of Ratios: Profitability and Liquidity Ratio.		
Unit – III	**Cost Accounting:**	**9**
Meaning and Objectives – Classification of Cost – Elements of Costs – Preparation and Interpretation of Cost Sheet.		
Unit – IV	**Budgetary Control:**	**9**
Introduction – Types of Budgets – Preparation and Interpretation of Functional Budgets: Sales Budget, Production Budget, Cash Budget - Flexible Budget.		
Unit – V	**Financial Management:**	**9**
Objectives and Functions of Financial Management – Time Value of Money Concepts – Capital Budgeting: Discounting and Compounding Techniques.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Creation of Company
2.	Creation of Voucher
3.	Voucher Alteration, Delete and Printing reports
4.	Creation of Journal to record transactions
5.	Creation of Ledger, Trial Balance and Balance Sheet
6.	Creation of Group and Stock
7.	Report Generation with inventory
8.	Creation of payroll including generation of pay slip, pay head, employee group and salary details
9.	Payroll voucher
10.	Report generation of payroll

Lecture:45, Practical:30, Total:75

REFERENCES/ MANUAL / SOFTWARE:

1.	Maheshwari SN, MaheshwariSuneel K, MaheshwariSharad K (CA), "Financial and Management Accounting", 6th Revised Edition, Sulthan Chand & Sons, 2022.
2.	I.M.Pandey, "Financial Management", 12th Edition, Pearson India Education Services Pvt. Ltd., 2021.
3.	M.N.Arora, "A Textbook of Cost and Management Accounting", 11th Edition, Vikas Publishing House Pvt. Ltd., 2021.
4.	Tally Software

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	illustrate journal, ledgers and trail balance, trading account and balance sheet for various transactions	Applying (K3) Precision (S3)
CO2	apply ratio analysis for financial statement	Applying (K3) Precision (S3)
CO3	demonstrate the concepts of cost accounting in preparing cost sheet	Applying (K3) Precision (S3)
CO4	implement the various budgets using budgetary control	Applying (K3) Precision (S3)
CO5	interpret the various functions and techniques in financial management and financial accounting statements in tally	Applying (K3) Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2								3		1	1
CO2	3	3	1	1	1						2		1	1
CO3	3	2	1	1	1						2	1	1	1
CO4	3	2	1	1	1						2	1	1	1
CO5	3	2	1	1	1						2	1	1	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	20	70	-	-	-	100
CAT2	10	20	70	-	-	-	100
CAT3	10	20	70	-	-	-	100
ESE	10	30	60	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCE12 – BIOINFORMATICS							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**0**	**3**
Preamble	To understand the usage of R tool as an open source language for learning bioinformatics data processing						
Unit – I	**Bioinformatics Fundamentals:**						**9**
Starting Bioinformatics with R – Introduction to Bioconductor – Packages – Annotation – ID conversions- KEGG Annotation - GO Annotation – GO Enrichment - KEGG Enrichment – Bioconductor in cloud							
Unit – II	**Sequence Structure Analysis:**						**9**
Introduction- Retrieving a sequence – Reading and Writing FASTA file – Sequence Composition- Pairwise sequence Alignment – Multiple sequence alignment – phylogenetic analysis and tree plotting – BLAST results – Pattern finding							
Unit – III	**Protein Structure Analysis:**						**9**
Retrieving a sequence from Uniport - Protein sequence Analysis – Computing Features – PDB File – InterProdomain annotation – Ramachandran plot – searching for similar proteins – secondary structure features – Visualizing the protein structure							
Unit – IV	**Analyzing Microarray Data:**						**9**
CEL Files – ExpressionSet Objects – AffyBatch Object – Checking the quality of data – Artificial expression data – Data normalization – Overcoming batch effects – Analysis of data with PCA – Differentially expressed genes – multiple classes - time series data – fold changes – functional enrichment – clustering –co-expression network – Visualization.							
Unit – V	**Machine Learning in Bioinformatics:**						**9**
Data clustering – Visualizing clusters – Supervised learning for classification – Probabilistic learning in R with Naïve Bayes – Bootstrapping in machine learning – Cross-validation for classifiers – Measuring the performance of the classifier – ROC curve – Biomarker identification using array data							
							Total:45

REFERENCES:

1.	Paurush Praveen Sinha ,"Bioinformatics with R Cookbook", 1st Edition, PACKT Publishing, 2014.
2.	Bryan Bergeron, "Bio Informatics Computing", 1st Edition, Pearson Education, New Delhi, 2015.
3.	Yi-Ping Phoebe Chen , "BioInformatics Technologies", 1st Indian Reprint, Springer Verlag, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	express the various fundamental concepts of bioinformatics	Understanding (K2)
CO2	employ the basics of Sequence Structure Analysis and how to retrieve sequence data	Applying (K3)
CO3	demonstrate the protein sequence structure and analysis the various computing features	Applying (K3)
CO4	prepare the techniques of analyzing Microarray Data using R	Evaluating (K5)
CO5	inspect the various methods of Machine Learning in Bioinformatics	Analyzing(K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2					2	2		2	2	2
CO2	3	2	2	2	2				2	3		2	2	2
CO3	3	2	2	2	2				2	3		2	2	2
CO4	3	3	2	2	3				2	3		2	2	2
CO5	3	3	3	3	3	3	3		3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	20	60	-	-	-	100
CAT2	20	20	60	-	-	-	100
CAT3	-	20	60	10	10	-	100
ESE	-	20	60	10	10	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCE13 - BUSINESS INTELLIGENCE							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	To recognize the Business Intelligence as expert information, knowledge and technologies, for the management of organizational and individual business in an efficient manner.	
Unit – I	**Overview of Business Intelligence, Analytics and Decision Support:**	**9**
Changing Business Environments and Computerized Decision Support - A Framework for Business Intelligence - Intelligence Creation, Use, and BI Governance - Transaction Processing Versus Analytic Processing - Successful BI Implementation - Analytics Overview - Brief Introduction to Big Data Analytics.		
Unit – II	**Business Reporting, Visual Analytics and Business Performance Management:**	**9**
Business Reporting Definitions and Concepts - Data and Information Visualization – Different Types of Charts and Graphs - The Emergence of Data Visualization and Visual Analytics - Performance Dashboards - Business Performance Management - Performance Measurement - Balanced Scorecards – Six Sigma as a Performance Measurement System.		
Unit – III	**Data Mining:**	**9**
Data Mining Concepts and Applications - Data Mining Applications - Data Mining Process - Data Mining Methods - Data Mining Software Tools - Data Mining Privacy Issues, Myths and Blunders.		
Unit – IV	**Text and Web Analytics:**	**9**
Text Analytics and Text Mining Overview - Natural Language Processing - Text Mining Applications - Text Mining Process - Sentiment Analysis - Web Mining Overview - Search Engines - Web Usage Mining - Social Analytics.		
Unit – V	**Business Analytics: Emerging Trends and Future Impacts:**	**9**
Location Based Analytics for Organizations - Analytics Applications for Consumers - Recommendation Engines - The Web 2.0 Revolution and Online Social Networking - Cloud Computing and BI - Impacts of Analytics in Organizations -Issues of Legality, Privacy and Ethics.		
		Total:45

REFERENCES:

1.	Ramesh Sharda, DursunDelen and Efraim Turban “Business Intelligence – A Managerial Perspective on Analytics”, 3rd Edition, Pearson Education, India, 2018.
2.	Efraim Turban, Ramesh Sharda and DursunDelen, “Decision Support and Business Intelligence Systems”, 9th Edition, Pearson Education, India, 2017.
3.	David Loshin, “Business Intelligence – The Savvy Manager’s Guide”, 2nd Edition, Morgan Kaufmann Publishers, USA, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the overview of analytics and decision support for business applications.	Understanding (K2)
CO2	design the business reporting, visual analytics and business performance management for business applications.	Applying (K3)
CO3	utilize the data mining concepts for business intelligence.	Applying (K3)
CO4	examine the text and web analytics with respect to business intelligence.	Analyzing (K4)
CO5	analyze the emerging trends and future impacts in business analytics.	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3				1	1			2		1	2	2
CO2	3	2	2	2	2	2	2			3		2	1	3
CO3	3	2	2	2	2	2	2			3		2	2	3
CO4	3	3	3	3	3	2	3			3		2	2	3
CO5	3	3	3	3	3	2	3			3		2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	50	30	-	-	-	100
CAT2	20	40	40	-	-	-	100
CAT3	20	30	30	20	-	-	100
ESE	10	40	35	15	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCE14 - CRYPTOGRAPHY AND NETWORK SECURITY							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**0**	**3**
Preamble	To aim the explosive growth in computer systems and their interconnections via networks, has increased the dependence of both organizations and individuals on the information stored and communication be secure using cryptography techniques.						
Unit – I	**Computer and Network Security Concepts:**						**9**
Computer Security Concepts – The OSI Security Architecture – Security Attacks – Services and Mechanisms – Model for Network Security – Introduction to Number Theory.							
Unit – II	**Symmetric Ciphers:**						**9**
Classical Encryption techniques: model – substitution – Transposition – Rotor machines – Steganography – Block Cipher and Data Encryption Standard - Advanced Encryption Standard							
Unit – III	**Asymmetric Ciphers:**						**9**
Public key cryptography and RSA: Principles - RSA Algorithm - The Diffie–Hellman Problem – Elgamal cryptographic systems - An Introduction to Elliptic curve Arithmetic - Cryptography – Application of Cryptographic Hash Functions.							
Unit – IV	**Cryptographic Data Integrity Algorithms:**						**9**
Cryptographic hash functions: Applications - Two simple hash functions - Secure Hash Algorithm (SHA) - Message Authentication codes: Requirements – Functions – HMAC – DAA and CMAC – Digital Signatures: Schemes –Key Management and Distribution: Symmetric key distribution using Symmetric and Asymmetric Encryption – Distribution of public keys – X.509 certificates – Public key infrastructures.							
Unit – V	**Network and Internet Security:**						**9**
Network Access Control – Cloud computing – Cloud Security Risks and countermeasures – Cloud Security as a service – Wireless network security: Wireless security – Mobile device security – Electronic Mail Security: Internet Mail Architecture – Email Formats – Threats – Pretty Good Privacy.							
							Total:45

REFERENCES:

1.	William Stalllings, "Cryptography and Network Security: Principles and Practice", 7thEdition, Pearson India Education Services Pvt., Ltd., 2017.
2.	AtulKahate, "Cryptography and Network Security", 3rdEdition ,Tata McGraw Hill Education, 2013.
3.	Bernard Menezes," Network Security and Cryptography," 2nd Edition, Cengage Learning, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	apply various Cryptographic Techniques and symmetric key cryptography techniques to solve real world problems.	Applying (K3)
CO2	design various public key cryptography techniques to real case scenarios	Applying (K3)
CO3	interpret Public and Private key cryptosystems and authentication to ensure confidentiality	Evaluating(K5)
CO4	evaluate Hash functions and Digital Signature to ensure the data Integrity	Evaluating(K5)
CO5	implement the security challenges in Wireless networks and describe the system security.	Evaluating(K5)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		3	2	3		3			3		3	2	3
CO2		2			2			3	2			2	3	3
CO3	2	3	3	2	3	3			3				2	2
CO4			3		2	2		2			2		3	3
CO5	3	3	2	2			2			3		3	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40	-	-	-	100
CAT2	15	20	40	15	10	-	100
CAT3	15	20	40	15	10	-	100
ESE	20	30	30	15	5	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCE15 - ECONOMICS AND MANAGEMENT FOR INFORMATION TECHNOLOGY							
Programme& Branch	**MCA**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**0**	**3**
Preamble	To create fundamental knowledge on management by introducing concepts like economics national income, marketing, operations management, accounting principles.						
Unit – I	**Micro Economics:**						**9**
Economics – Basics Concepts and Principles – Demand and Supply –Determinants - Law of demand and Supply Circular Flow of Economic activities and Income. – Market Equilibrium.							
Unit – II	**Macro Economics, Business Ownership and Management concepts:**						**9**
National Income and its measurement techniques. Inflation - Causes of Inflation – Controlling Inflation – Business Cycle. Forms of business – Ownership types. Management concepts: Functions of Management - Managerial Skills- Levels of Management - Roles of manager							
Unit – III	**Marketing Management :**						**9**
Marketing - Core Concepts of Marketing - Four Ps of Marketing - New product development – Intellectual Property rights (IPR), Product Life Cycle - Pricing Strategies and Decisions.							
Unit – IV	**Operations Management :**						**9**
Operations Management - Resources - Types of Production system - Site selection, Plant Layout, Steps in Production Planning and Control - Inventory - EOQ Determination.							
Unit – V	**Financial Management:**						**9**
Financial Statements and its uses – Depreciation: Straight Line and Diminishing Balance Method – Break Even Analysis – Capital Budgeting: Significance –Traditional and discounted cash flow methods.– Aggregation							
							Total:45

REFERENCES:

1.	Compiled by Department of Management Studies, Kongu Engineering College, "Economics and Management for Engineers", 1st Edition, McGraw Hill Education, Noida, 2017
2.	Geetika, Piyali Ghosh and Purba Roy Choudhury, “Managerial Economics”, 3rd Edition, McGraw-Hill, New Delhi, 2018.
3.	William J. Stevenson, “Operations Management”, 14th Edition, McGraw-Hill Education, 2021.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the Concepts and Principles of micro Economics	Understanding (K2)
CO2	design Functions of Management and Managerial Skills for their organization	Applying (K3)
CO3	develop different New product development ,aware of pricing strategies	Evaluating(K5)
CO4	evaluate the Steps in Production Planning and Control	Evaluating(K5)
CO5	implement the Financial Statements and its uses	Evaluating(K5)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2			3	3			3		3	2	3
CO2	2		3		2	2		3	2		3	2	3	3
CO3	3	2	2	3					3				2	2
CO4				2	3	2		2			2		3	3
CO5	2	3	2				2			3		3	2	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	25	35	40	-	-	-	100
CAT2	15	20	40	15	10	-	100
CAT3	15	20	40	15	10	-	100
ESE	15	30	30	20	5	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCE16 - SOCIAL NETWORK ANALYSIS							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course aims to provide core knowledge of Social network analysis along with real world data.	
Unit – I	**Social Network Data Analytics:**	**9**
Introduction - Statistical Properties of Social Networks: Preliminaries – Static Properties - Dynamic Properties – Random Walks on Graphs: Background – Random Walk based Proximity Measures - Other Graph-based Proximity Measures – Graph theoretic Measures for Semi-Supervised Learning - Clustering with Random Walk based Measures - Related Work: Applications.		
Unit – II	**Community Discovery and Node Classification in Social Networks:**	**9**
Communities in Context - Core Methods: Quality Functions - The Kernighan Lin(KL) Algorithm – Agglomerative / Divisive Algorithms - Spectral Algorithms - Multi-Level Graph Partitioning - Markov Clustering – Emerging Fields and Problems - Node Classification in Social Networks: Problem Formulation - Methods using Local Classifiers - Random Walk based Methods - Applying Node Classification to Large Social Networks -Variations on Node Classification.		
Unit – III	**A Survey of Social Influence Analysis, Expert Location and Link Prediction in Social Networks:**	**9**
Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Expert Location in Social Networks: Expert Location without Graph Constraints - Expert Location with Score Propagation – Expert Team Formation – Link Prediction in Social Networks: Feature based Link Prediction - Bayesian Probabilistic Models - Probabilistic Relational Models.		
Unit – IV	**Visualizing, Mining and Multimedia Information Networks in Social Media:**	**9**
Introduction – Taxonomy of Visualizations – Data Mining Methods for Social Media - Text Mining in Social Networks: Keyword Search - Classification Algorithms - Clustering Algorithms – Multimedia Information Networks: ontology based Learning- Link from community media – Network of Personal Photo Albums – Network of Geographical Information.		
Unit – V	**Social Tagging and Applications:**	**9**
Introduction – Tags – Tag Generation Models – Tagging System Design – Tag Analysis – Visualization of Tags – Tag Recommendations – Applications of Tag – Integration -Tagging Problems.		
		Total:45

REFERENCES:

1.	Charu C. Aggarwal, “Social Network Data Analytics”, 1st Edition, Springer, US, 2015.
2.	Peter Mika. “Social Networks and the Semantic Web”, 1st Edition, Springer, New York, 2007
3.	BorkoFurht. “Handbook of Social Network Technologies and Applications”, 1stEdition, Springer, US, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the Statistical properties and various measures of the social network	Understanding (K2)
CO2	utilize various methods and algorithms in social networks to predict interaction among the different network communities.	Applying (K3)
CO3	get a survey of Social Influence Analysis along with Expert location and Link Prediction in Social Networks	Analyzing (K4)
CO4	applyvisualization,Mining and Multimedia Techniques in Social networks.	Applying (K3)
CO5	examine various applications of tags in Social Networks	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	3	3		2						2	2
CO2	3	2	2	3	2		2						2	2
CO3	3	3	2	2	2		2						2	2
CO4	3	2	2	3	2		2						2	2
CO5	3	3	2	2	2		2						2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	50	40	-	-	-	100
CAT2	10	40	40	10	-	-	100
CAT3	10	40	40	10	-	-	100
ESE	10	45	35	10	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22GEE02 - INNOVATION, ENTREPRENEURSHIP AND VENTURE DEVELOPMENT							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**3**	**PE**	**3**	**0**	**0**	**3**

Preamble	This course will direct the students on how to employ their innovations towards a successful entrepreneurial venture development.	
Unit – I	**Innovation and Entrepreneurship:**	**9**
Creativity and Innovation – Types of innovation – challenges in innovation- steps in innovation management- Meaning and concept of entrepreneurship - Role of Entrepreneurship in Economic Development - Factors affecting Entrepreneurship – Entrepreneurship vs Intrapreneurship.		
Unit – II	**Design Thinking and Product Design:**	**9**
Design Thinking and Entrepreneurship – Design Thinking Stages: Empathize – Define – Ideate – Prototype – Test. Design thinking tools: Analogies – Brainstorming – Mind mapping. Techniques and tools for concept generation, concept evaluation – Product architecture –Minimum Viable Product (MVP)- Product prototyping – tools and techniques– overview of processes and materials – evaluation tools and techniques for user-product interaction.		
Unit – III	**Business Model Canvas (BMC) and Business Plan Preparation:**	**9**
Lean Canvas and BMC - difference and building blocks- BMC: Patterns – Design – Strategy – Process–Business model failures: Reasons and remedies. Objectives of a Business Plan - Business Planning Process and Preparation.		
Unit – IV	**IPR and Commercialization:**	**9**
Need for Intellectual Property- Basic concepts - Different Types of IPs: Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design– Patent Licensing - Technology Commercialization – Innovation Marketing.		
Unit – V	**Venture Planning and Means of Finance:**	**9**
Startup Stages - Forms of Business Ownership - Sources of Finance – Idea Grant – Seed Fund – Angel & Venture Fund – Institutional Support to Entrepreneurs – Bank and Institutional Finance to Entrepreneurs.		
		Total:45

REFERENCES:

1. Gordon E. & Natarajan K., "Entrepreneurship Development", 6th Edition, Himalaya Publishing House, Mumbai, 2017.
2. Sangeeta Sharma, "Entrepreneurship Development", 1st Edition, PHI Learning Pvt. Ltd., New Delhi, 2017.
3. CharantimathPoornima M., "Entrepreneurship Development and Small Business Enterprises", 3rd Edition, Pearson Education, Noida, 2018.
4. Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, "Entrepreneurship", 10th Edition, McGraw Hill, Noida, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the relationship between innovation and entrepreneurship	Understanding (K2)
CO2	understand and employ design thinking process during product design and development	Analyzing (K4)
CO3	develop suitable business models as per the requirement of the customers	Analyzing (K4)
CO4	practice the procedures for protection of their ideas IPR	Applying (K3)
CO5	understand and plan for suitable type of venture and modes of finances	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1				3	2	1	3	2		1	1	
CO2	1	2			3	2	1						1	
CO3	3	1	3			1							1	
CO4	1	2				3							1	
CO5	1	2				3							1	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	30	40	20	10	-	-	100
CAT2	30	40	20	10			100
CAT3	30	40	30	-	-	-	100
ESE	30	40	30	-	-	-	100

* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)

22MCB01 - PROBLEM SOLVING TECHNIQUES USING C							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**BC**	**3**	**0**	**0**	**0**

Preamble	To introduce the basic knowledge of programming fundamentals of C language and problem solving	
Unit – I	**Computer Fundamentals and Introduction to Programming, Algorithms and Flowcharts:**	**9**
Computer Fundamentals: Evolution, Generations, Classification of Computers – Anatomy – Memory – Operating System. Programs and Programming – Programming Languages – Generations and Classification of programming Languages – Structured Programming – Algorithms – Pseudocode – Flowcharts – Strategy and Tracing Algorithms - Converting Algorithms to Programs.		
Unit – II	**Basics of C:**	**9**
Introduction – Parts of C program – Variables – Data Types – Statements – Tokens – Operators and Expressions – Lvalues and Rvalues – Type Conversion – Input and Output – Control Statements.		
Unit – III	**Arrays and Strings, Functions:**	**9**
Arrays: One-dimensional Array – Strings – Multidimensional Arrays. Functions : Using functions – Call by Value – Working with Functions – Passing Array – Scope and Storage Classes – Inline Function – Recursion.		
Unit – IV	**Pointers in C:**	**9**
Introduction – Pointer – void, Null pointers – Arrays and Pointers – Pointers and strings - Pointer Arithmetic – Pointer to Pointers – Array of Pointers – Pointers to an Array – Pointers to Functions - Dynamic Memory Allocation.		
Unit – V	**User-Defined Datatypes:**	**9**
Structures : Declaration- Accessing Members- Initialization – typedef – Nesting of Structures – Arrays of Structures – Initializing Arrays of Structures – Arrays within Structures – Structures and Pointers – Structures and Functions – Union – Enumeration – Bitfields.		
		Total:45

REFERENCES:

1.	PradipDey, Manas Ghosh, " Programming in C", 1st Edition, Oxford University Press, 2018
2.	Balagurusamy E., "Computing Fundamentals and C Programming", 2nd Edition, Tata McGraw-Hill Education Pvt. Ltd., 2017
3.	YashavantKanetkar , "Let Us C" , BPB Publications, 15th Edition, July 2016

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	summarize the fundamental concepts of problem solving technique.	Understanding (K2)
CO2	apply basic C programming knowledge to solve simple Logics.	Applying (K3)
CO3	experiment homogeneity of data by array techniques and modularity by functions.	Applying (K3)
CO4	use pointers to manage computer memory efficiently.	Applying (K3)
CO5	produce heterogeneous data using structure and union.	Applying (K3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2											3	2
CO2	3	2	2	2									3	2
CO3	3	2	2	2									3	2
CO4	3	2	2	2									3	2
CO5	3	2	2	2									3	2

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	50	-	-	-	100
CAT2	10	30	60	-	-	-	100
ESE	-	-	-	-	-	-	NA

* ±3% may be varied (CAT 1 & 2 – 50 marks & ESE – NA)

22MCB02 - COMPUTER ORGANIZATION AND DESIGN							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**1**	**BC**	**3**	**0**	**0**	**0**

Preamble	To provide the basic knowledge necessary to understand the hardware operation of digital computers	
Unit – I	**Digital Logic Circuits and Digital Components:**	**9**
Digital Computers – Logic Gates – Boolean Algebra – Map Simplification – Combinational Circuits – Flip-Flops – Sequential Circuits – Decoders – Multiplexers – Registers and Counters		
Unit – II	**Digital Representation, Register Transfer and Micro Operations:**	**9**
Data Types and Number Conversion – Complements – Fixed Point Representation – Floating-point Representation - Register Transfer Language – Register Transfer - Bus and Memory Transfer – Arithmetic, Logic and Shift Micro operations.		
Unit – III	**Basic Computer Organization and Design, Programming the Basic Computers:**	**9**
Instruction Codes – Computer Registers – Computer Instructions - Timing and Control – Machine and Assembly Language – Programming Arithmetic and Logic Operations.		
Unit – IV	**Central Processing Unit:**	**9**
General Register Organization – Stack Organization – Instruction Formats - Addressing Modes - Data Transfer and Manipulation.		
Unit – V	**Input-Output and Memory Organization:**	**9**
Input-Output Organization: Peripheral Devices – Asynchronous Data Transfer -Modes of Transfer - Direct Memory Access. Memory Organization**:** Memory Hierarchy - Main Memory - Auxiliary - Associative - Cache - Virtual Memory.		
		Total:45

REFERENCES:

1.	Morris Mano M., “Computer System Architecture”, 3rdEdition, Pearson India Education Services Pvt.Ltd., NewDelhi, 2017.
2.	Morris Mano M., Michael D.Ciletti, “Digital Design”, 5thEdition, Pearson Education, Delhi, 2013.
3.	William Stallings, “Computer Organization and Architecture – Designing for Performance”, 9th Edition, Pearson Education, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	solve digital logic problems using various digital components	Applying (K3)
CO2	experiment various number system conversion and operations	Applying (K3)
CO3	identify the fundamental designing of elementary computer	Understanding (K2)
CO4	summarize the components of central processing unit	Understanding (K2)
CO5	illustrate the organization and architecture of input-output and memory	Understanding (K2)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1									3	
CO2	3	2	1	1									3	
CO3	2	2	1										3	
CO4	2	2	1										3	
CO5	2	2	1										3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	40	60	-	-	-	-	100
ESE	-	-	-	-	-	-	NA

* ±3% may be varied (CAT 1 & 2 – 50 marks & ESE – NA)

22MCB03 - C++ PROGRAMMING							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**BC**	**2**	**0**	**2**	**0**

Preamble	To learn and apply the object oriented concepts in problem solving	
Unit – I	**Perspective on C++ :**	**10**
Principles of Object Oriented Programming – Beginning with C++ - Tokens, Expressions and Control structures. Functions: Main Function, Function Prototyping, Call by Value, Call by Reference, Inline Functions, Default Arguments, Const Arguments, Recursion, Function Overloading.		
Unit – II	**Classes, Objects and Operator Overloading:**	**10**
Classes and Objects – Constructors and Destructors. Operator Overloading: overloading Unary and Binary Operators – overloading Binary Operator using Friend function – Friend Class.		
Unit – III	**Inheritance and Runtime Polymorphism:**	**10**
Inheritance: Single, Multilevel, Multiple, Hierarchical, Hybrid, Virtual Base Classes, Constructors in Derived classes. Runtime Polymorphism: Pointers, Dynamic Memory Allocation, Virtual Functions and Polymorphism.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Simple C++ program for simple Functions, Inline function, default function argument
2.	Program to implement Recursion in simple tasks
3.	C++ program to implement Class and Objects
4.	Program to demonstrate Constructors & Destructors
5.	Design applications using Function overloading
6.	Program to implement Operator overloading in operators.
7.	Program to illustrate Friend Function and Friend Class.
8.	Programs to Implement Inheritance concepts.
9.	Write a program for Function overriding concept.
10.	Use new and delete operators to implement Dynamic memory allocation.

Lecture:30, Practical:15, Total:45

REFERENCES/ MANUAL / SOFTWARE:

1.	Balagurusamy E., “Object-Oriented Programming with C++”,8th Edition, McGraw Hill EducationPvt.Ltd., 2021.
2.	Herbert Schildt, “C++: The Complete Reference”, 4th Edition, McGraw Hill EducationPvt.Ltd.,2021.
3.	Harvey M. Deitel and Paul J. Deitel, "C++ How to Program", 10thEdition, Pearson Education, 2022.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the fundamentals of the Object Oriented concepts and C++ features	Understanding (K2)
CO2	make use of Constructor, Destructor, Friend function and Operator Overloading to solve problems	Applying (K3) Manipulation (S2)
CO3	solve various scenarios using the Concepts of the Inheritance and Polymorphism	Applying (K3) Manipulation (S2)
CO4	model the applications for demonstrating basic C++ features	Applying (K3) Precision (S3)
CO5	experiment the working of Inheritance, Polymorphism and Exception Handling under various circumstances	Applying (K3) Precision (S3)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	1									1	2
CO2	3	2	2	2									1	3
CO3	3	2	2	2									1	3
CO4	3	3	2	2									1	3
CO5	3	3	2	2									1	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	40	-	-	-	100
CAT2	20	40	40	-	-	-	100
ESE	-	-	-	-	-	-	NA

* ±3% may be varied (CAT 1 & 2 – 50 marks & ESE – NA)

22MCB04 - OPERATING SYSTEMS							
Programme& Branch	**MCA & Computer Applications**	**Sem.**	**Category**	**L**	**T**	**P**	**Credit**
Prerequisites	**Nil**	**2**	**BC**	**3**	**0**	**0**	**0**
Preamble	To get understanding of the internal processes that a computer performs						
Unit – I	**Operating Systems Overview:**						**9**
Introduction: Computer System Organization – Architecture – Operations – OS Structures: OS Services – System Calls: – Process Control – File – Device Management – Information Maintenance – Communication – Protection.							
Unit – II	**Process Management:**						**9**
Processes: Process concepts – Scheduling - Operations on Process – Inter Process Communication - Threads Multithreading Models – Synchronization: Peterson"s Solution – Semaphores–CPU Scheduling: Scheduling Criteria – Algorithms: –FCFS – SJF – Priority – Round Robin.							
Unit – III	**Deadlock:**						**9**
Characterization: Conditions – Resource Allocation Graph – Methods for Handling Deadlocks: Deadlock Prevention – Deadlock Avoidance: Banker"s Algorithm – Deadlock Detection – Recovery from Deadlock.							
Unit – IV	**Memory Management:**						**9**
Main Memory: Contiguous Memory Allocation – Segmentation - Paging – Structure of Page Table – Swapping –Virtual Memory:Demand Paging - Page Replacement Algorithms: FIFO, Optimal and LRU .							
Unit – V	**Storage Management:**						**9**
Overview of Mass Storage Structure: Disk Structure – Attachment – Scheduling Algorithms: FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK– Management - File System: Concepts – Access Methods – Directory Structure.							
							Total:45

REFERENCES:

1.	Abraham Silberschatz, Greg Gagne, Peter B. Galvin, "Operating System Concepts", 9thEdition, John Wiley & Sons Inc., USA, 2018.
2.	Andrew S. Tanenbaum, Herbert Bos, "Modern Operating Systems", 8thEdition, Pearson Education India, 2022.
3.	William Stallings, "Operating Systems: Internals and Design Principles", 9thEdition, Pearson Education India, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	understand the knowledge of system organization and its structure.	Understanding (K2)
CO2	make use of various scheduling algorithm to solve a problem	Applying (K3)
CO3	analyze the system state by applying different methods and algorithms	Analyzing (K4)
CO4	apply the principles of memory management techniques and various strategies	Applying (K3)
CO5	examine the disc scheduling policies in light of various storage structures	Analyzing (K4)

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2								3	2
CO2	3	2	2	2	3								2	3
CO3	3	3	3	3	3								2	3
CO4	3	2	2	2	3								2	3
CO5	3	3	3	3	3								2	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	40	40	10	-	-	100
CAT2	10	40	40	10	-	-	100
ESE	-	-	-	-	-	-	NA

* ±3% may be varied (CAT 1 & 2 – 50 marks & ESE – NA)