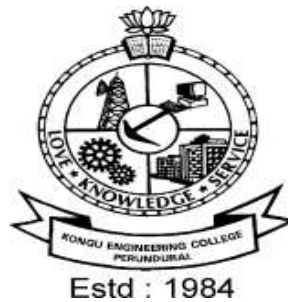


KONGU ENGINEERING COLLEGE

(Autonomous Institution Affiliated to Anna University, Chennai)

PERUNDURAI ERODE – 638 060

TAMILNADU INDIA



REGULATIONS, CURRICULUM & SYLLABI - 2022

(CHOICE BASED CREDIT SYSTEM)

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

MASTER OF SCIENCE IN SOFTWARE SYSTEMS

DEPARTMENT OF COMPUTER TECHNOLOGY-PG



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 SCIENCE (MSc) DEGREE PROGRAMME – 5 YEARS

These regulations are applicable to all candidates admitted into MSc Degree programmes 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 Science (MSc) Degree programme
- iv. “Branch” means specialization or discipline of MSc Degree Programme, like Software Systems, etc.
- v. “Course” means a Theory / Theory cum Practical / Practical course that is normally studied in a semester like Computer Architecture, Data structures etc.
- vi. “Credit” means a numerical value allocated to each course to describe the candidate’s workload required per week.
- vii. “Grade” means the letter grade assigned to each course based on the marks range specified.
- viii. “Grade point” means a numerical value (0 to 10) allocated based on the grade assigned to each course.
- ix. “Principal” means Chairman, Academic Council of the College.
- xi. “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 AND BRANCH OF STUDY

The MSc programme in Software Systems approved by Anna University, Chennai is offered by the college.

3. ADMISSION REQUIREMENTS

Candidates for admission to the first semester of the MSc Programme shall be required to have passed the Higher Secondary Examination (academic / vocational) of the (10+2) curriculum prescribed by the appropriate authority of Govt. of Tamil Nadu or any examination of any other authority accepted by the Anna University, Chennai as equivalent thereto.

4. STRUCTURE OF PROGRAMMES

4.1 Categorisation of Courses

The MSc 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 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. Humanities and Social Sciences (HS) including Management Courses
- ii. Basic Science (BS) Courses
- iii. Engineering Science (ES) Courses
- iv. Professional Core (PC) Courses
- v. Professional Elective (PE) Courses
- vi. Employability Enhancement Courses (EC) like Mini Project, Project work, Professional Skills/Industrial Training, Entrepreneurships/Start ups and Internship in Industry or elsewhere
- vii. Audit Courses (AC)
- viii. Mandatory Courses (MC) like Student Induction Program and Universal Human Values.

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 MSc programme is 190.

4.3 Employability Enhancement Courses

A candidate shall be offered with the employability enhancement courses like project work, internship, professional skills training/ industrial training, comprehensive test & viva, internship and entrepreneurship/start ups during the programme to gain/exhibit the knowledge/skills.

4.3.1 Professional Skills Training/Industrial Training/ Entrepreneurships/Start Ups

A candidate may be offered with appropriate training courses imparting programming skills, communication skills, problem solving skills, aptitude skills etc. It is offered in two phases as phase I in fifth semester and phase II in sixth semester including vacation periods and each phase 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 sixth semester vacation period. Such candidate can earn two credits for this training course in place of Professional Skills Training course II in sixth semester. He/She shall attend Professional Skills Training Phase I in fifth semester and can earn two credits.

(OR)

A candidate may be allowed to set up a start up and working part-time for the start ups by applying his/her innovations and can become a student entrepreneur during MSc programme. Candidates can set up their start up from fifth semester onwards either inside or outside of the college. Such student entrepreneurs may earn a maximum of 2 credits per semester for two semesters each in place of either Professional Skills Training I / II or Industrial Training I / II respectively. The area in which the candidate wants to initiate a start up may be interdisciplinary or multidisciplinary. The progress of the startup shall be evaluated by a panel of members constituted by the Principal through periodic reviews.

4.3.2 Internships

The curriculum enables a candidate to go for full time internship during entire seventh semester and/or entire final semester and can earn credits through it for his/her academics vide clause 7.6 and 7.11.

Such candidate can earn the number of credits for the internship in seventh semester / final semester same as that of Project Work I in the seventh semester / Project Work II in final semester.

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 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 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 respective 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 ninth semester 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.

4.4.5 A candidate can earn a maximum of 35 credits through all value added 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 first to ninth 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 eight.

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 MSc Degree programme in 10 consecutive semesters (5 Years), but in any case not more than 16 semesters (8 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 MSc programme consist of Theory Courses, Theory cum Practical courses, Practical courses, Mini Project, Project Work, Industrial Training / Professional Skills Training, Internship and Entrepreneurships/ Start ups. 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:

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	50	50
3.	Practical	60	40
4.	Professional Skills Training / Industrial Training / Entrepreneurships / Start ups / Mandatory Course	100	---
5.	Mini Project/Project Work I/ Project Work II/ Internships	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, internships and entrepreneurship/start ups 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 obtained shall be 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 and shall be conducted between November and January during odd semesters and between April and June during even semesters of every year.

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 I/Project Work II

7.6.1 Project work shall be carried out individually. Candidates can opt for full time internship (vide clause 7.11) in lieu of project work I/ II. 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 two 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 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 I 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 respective Head of the Department.

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

Phase I training shall be conducted for minimum 80 hours in 4th semester vacation and during 5th semester. Phase II training shall be conducted for minimum 80 hours in 5th semester vacation and during 6th semester. The evaluation procedure shall be approved by the board of the offering department and Principal.

7.10 Entrepreneurships/ Start ups

A start up/business model may be started by a candidate individually or by a group of maximum of three candidates during the programme vide clause 4.3.1. The head of the department concerned shall assign a faculty member as a mentor for each start up.

A review committee shall be formed by the Principal for reviewing the progress of the Start ups / Business models, innovativeness, etc. The review committee can recommend the appropriate grades for academic performance for the candidate(s) involved in the start ups. This course shall carry a maximum of two credits in fifth semester and two credits in sixth semester respectively and shall be evaluated through continuous assessments for a maximum of 100 marks vide clause 7.1. A report about the start ups to be submitted to the review committee for evaluation for each start up and the marks will be given to Controller of Examinations after getting approval from Principal.

7.11 Internships

Each candidate shall submit a brief report about the 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 II as per clause 7.6 excluding 7.6.6.

7.12 One / Two Credit Course

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

7.13 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.

7.14 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.

7.15 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.

7.16 Mandatory Course

A candidate shall attend and complete a three week mandatory course namely Student Induction Program including Universal Human Values and Yoga, etc at the beginning of the first semester. No credits shall be given for such courses and shall be evaluated through continuous assessment tests only vide clause 7.1 for a maximum of 100 marks each. Upon the successful completion, these courses will be listed in the semester grade sheet and in the consolidated grade sheet with the grade “SC” (Successfully Completed). Since no grade points are assigned, these courses will not be counted for the purpose of GPA and CGPA calculations.

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.

A candidate who could not satisfy the attendance requirements as per clause 8.1.1 due to his/her entrepreneurship/ start ups activities, but has secured not less than 60 % in the current semester can be permitted to appear for the current semester examinations with the recommendation of review committee and approval from the Principal.

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, but the grade awarded shall be only the lowest passing grade irrespective of the marks secured.

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 secure 50 % of the end semester examination marks in the project work I / II, he / she shall be required to resubmit the Project Report within 30 days from the date of declaration of the results. The candidate can register for the supplementary examination and the viva voce examination shall be conducted as per clause 7.6.5.

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:

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

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

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

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 MSc Degree provided the candidate has

- Successfully completed all the courses under the different categories, as specified in the regulations.
- 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).
- Successfully passed any additional courses prescribed by the Board of Studies whenever readmitted under regulations other than R-2020 (vide clause 11.3)
- 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 ten semesters in the **First Appearance** within ten 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 A candidate 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 ten semesters in the **First Appearance** within ten 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 ten semesters within twelve 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 MSc programme.

M.Sc SOFTWARE SYSTEMS CURRICULUM – R2022
(For the students admitted from the academic year 2022-23 onwards)

SEMESTER – I									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22IST11	Communicative English - I	3	0	0	3	40	60	100	HS
22IST12	Applied Mathematics	3	1	0	4	40	60	100	BS
22IST13	Problem Solving and Programming	3	0	0	3	40	60	100	PC
22IST14	Digital Principles and Logic Design	3	0	0	3	40	60	100	ES
22IST15	Fundamentals of Software Engineering	3	0	0	3	40	60	100	PC
Practical / Employability Enhancement									
22ISL11	Communicative English - I Laboratory	0	0	2	1	60	40	100	HS
22ISL12	Problem Solving and Programming Laboratory	0	0	4	2	100	0	100	PC
22ISL13	Digital Principles and Logic Design Laboratory	0	0	2	1	60	40	100	ES
Mandatory Non Credit Courses									
22MNT13	Student Induction Program	2	0	0	0	100	0	100	MC
Total Credits to be earned					20				

SEMESTER – II									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22IST21	Communicative English -II	3	0	0	3	40	60	100	HS
22ISC21	Probability and Statistics	3	0	2	4	50	50	100	BS
22IST22	Programming and Linear Data Structures	3	0	0	3	40	60	100	PC
22IST23	Web Programming	3	0	0	3	40	60	100	PC
22IST24	Computer Organization	3	0	0	3	40	60	100	PC
Practical / Employability Enhancement									
22ISL21	Communicative English - II Laboratory	0	0	2	1	60	40	100	HS
22ISL22	Programming and Linear Data Structures Laboratory	0	0	4	2	100	0	100	PC
22ISL23	Web Programming Laboratory	0	0	2	1	60	40	100	PC
Total Credits to be earned					20				

M.Sc SOFTWARE SYSTEMS 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									
22IST31	Object Oriented Programming with C++	3	0	0	3	40	60	100	PC
22IST32	Data Structures	3	0	0	3	40	60	100	PC
22IST33	UNIX and Shell Programming	3	0	0	3	40	60	100	PC
22IST34	Operating Systems	3	1	0	4	40	60	100	PC
22IST35	Design Thinking	3	0	0	3	100	0	100	PC
Practical / Employability Enhancement									
22ISL31	Object Oriented Programming with C++Laboratory	0	0	4	2	100	0	100	PC
22ISL32	Data Structures Laboratory	0	0	4	2	60	40	100	PC
22ISL33	UNIX and Shell Programming Laboratory	0	0	2	1	60	40	100	PC
Total Credits to be earned					21				

SEMESTER – IV									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22IST41	Python Programming and Frameworks	3	0	0	3	40	60	100	PC
22IST42	Database Management Systems	3	0	0	3	40	60	100	PC
22ISC41	Design and Analysis of Algorithms	3	0	2	4	50	50	100	PC
22IST43	Artificial Intelligence	3	0	0	3	40	60	100	PC
22ISC42	Computer Networks	3	0	2	4	50	50	100	PC
Practical / Employability Enhancement									
22ISL41	Python Programming and Frameworks Laboratory	0	0	2	1	100	0	100	PC
22ISL42	Database Management Systems Laboratory	0	0	2	1	60	40	100	PC
22ISL43	Communication Skills Development Laboratory	0	0	2	1	60	40	100	HS
Total Credits to be earned					20				

M.Sc SOFTWARE SYSTEMS CURRICULUM – R2022
(For the students admitted from the academic year 2022-23 onwards)

SEMESTER – V									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22IST51	Java Programming	3	0	0	3	40	60	100	PC
22IST52	Web Technology	3	0	0	3	40	60	100	PC
22ISC51	Data Mining	3	0	2	4	50	50	100	PC
22IST53	Principles of Compiler Design	3	0	0	3	40	60	100	PC
22IST54	Agile Methodologies	3	0	0	3	40	60	100	PC
	Elective – 1	3	0/1	2/0	4	50/40	50/60	100	PE
Practical / Employability Enhancement									
22ISL51	Java Programming Laboratory	0	0	2	1	100	0	100	PC
22ISL52	Web Technology Laboratory	0	0	2	1	60	40	100	PC
Total Credits to be earned					22				

SEMESTER – VI									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22IST61	Machine Learning	3	0	0	3	40	60	100	PC
22ISC61	C# and .NET Technologies	3	0	2	4	50	50	100	PC
22ISC62	Internet of Things and Cloud Computing	3	0	2	4	50	50	100	PC
22IST62	Cryptography and Network Security	3	0	0	3	40	60	100	PC
22IST63	Software Quality and Testing	3	0	0	3	40	60	100	PC
	Elective - 2	3	0	0	3	40	60	100	PE
Practical / Employability Enhancement									
22ISL61	Machine Learning Laboratory	0	0	2	1	60	40	100	PC
22ISP61	Mini Project	0	0	4	2	100	0	100	EC
22GCL61	Professional Skills Training - I	0	0	80	2	100	0	100	EC
Total Credits to be earned					25				

M.Sc SOFTWARE SYSTEMS CURRICULUM – R2022
(For the students admitted from the academic year 2022-23 onwards)

SEMESTER – VII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Practical / Employability Enhancement									
22ISP71	Project Work - I	0	0	30	15	50	50	100	EC
22GCL71	Professional Skills Training - II	0	0	80	2	100	0	100	EC
Total Credits to be earned					17				

SEMESTER – VIII									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
22IST81	Deep Learning	3	0	0	3	40	60	100	PC
22IST82	Data Science	3	0	0	3	40	60	100	ES
22IST83	Software Project Management	3	0	0	3	40	60	100	PC
	Elective - 3	3	0	0	3	40	60	100	PE
	Elective - 4	3	0	0	3	40	60	100	PE
Practical / Employability Enhancement									
22ISL81	Deep Learning Laboratory	0	0	2	1	60	40	100	PC
22GEP81	Comprehensive Test and Viva	0	0	0	2	100	0	100	EC
Total Credits to be earned					18				

M.Sc SOFTWARE SYSTEMS CURRICULUM – R2022
(For the students admitted from the academic year 2022-23 onwards)

SEMESTER – IX									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Theory/Theory with Practical									
	Elective – 5	3	0	0	3	40	60	100	PE
	Elective – 6	3	0	0	3	40	60	100	PE
	Elective – 7	3	0	0	3	40	60	100	PE
	Elective – 8	3	0	0	3	40	60	100	PE
	Elective – 9	3	0	0	3	40	60	100	PE
	Elective – 10	3	0	0	3	40	60	100	PE
Total Credits to be earned					18				

SEMESTER – X									
Course Code	Course Title	Hours / Week			Credit	Maximum Marks			Category
		L	T	P		CA	ESE	Total	
Practical / Employability Enhancement									
22ISP01	Project Work - II	0	0	30	15	50	50	100	EC
Total Credits to be earned					15				

LIST OF PROFESSIONAL ELECTIVES

Sl.No.	Course Code	Course Name	L	T	P	C	Domain/Stream
		Semester - V					
		Elective – 1					
1	22ISF01	Graphics and Multimedia	3	0	2	4	CS
2	22ISE01	Distributed Systems	3	1	0	4	CS
3	22ISF02	Open Source Software	3	0	2	4	CS
		Semester - VI					
		Elective – 2					
4	22ISE02	Mobile Communications	3	0	0	3	NW
5	22ISF03	Advanced Java Programming	2	0	2	3	Prg
6	22ISF04	Front End Technologies	2	0	2	3	Prg
		Semester - VIII					
		Elective – 3					
7	22ISE03	Network Communication Protocols	3	0	0	3	NW
8	22ISE04	Advanced Database Technologies	3	0	0	3	DB
9	22ISE05	Cyber Forensics	3	0	0	3	NW
		Elective – 4					
10	22ISE06	Object Oriented System Design	3	0	0	3	CS
11	22ISE07	Big Data Analytics	3	0	0	3	DB
12	22ISE08	Business Intelligence and its Applications	3	0	0	3	CS
		Semester - IX					
		Elective – 5					
13	22ISE09	Building Enterprise Applications	3	0	0	3	CS
14	22ISE10	Human Computer Interaction	3	0	0	3	CS
15	22ISE11	Web Mining	3	0	0	3	DB
		Elective – 6					
16	22ISE12	Information Retrieval	3	0	0	3	CS
17	22ISE13	Information Security	3	0	0	3	NW
18	22ISE14	Predictive Data Analytics	3	0	0	3	DB
		Elective – 7					
19	22ISE15	Decision Support Systems	3	0	0	3	Alg
20	22ISE16	Natural Language Processing	3	0	0	3	Alg
21	22ISE17	Blockchain Technologies	3	0	0	3	NW

		Elective – 8					
22	22ISE18	Software Metrics	3	0	0	3	SE
23	22ISE19	Social Media Analysis	3	0	0	3	CS
24	22ISE20	Augmented and Virtual Reality	3	0	0	3	CS
		Elective – 9					
25	22ISE21	Principles of Management	3	0	0	3	Mgt
26	22ISE22	Human Resource Management	3	0	0	3	Mgt
27	22ISE23	Innovation, Entrepreneurship and Venture Development	3	0	0	3	Mgt
		Elective – 10					
28	22ISE24	Engineering Economics and Management	3	0	0	3	Mgt
29	22ISE25	Digital Marketing	3	0	0	3	CS
30	22ISE26	Fundamentals of Research	3	0	0	3	Res

NW – Networks, WT – Web Technology, SE – Software Engineering, DB – Database, Prg – Programming, Alg – Algorithms, CG – Computer Graphics, CS – Computer Science, DM – Data Mining, AI – Artificial Intelligence

22IST11 – COMMUNICATIVE ENGLISH - I							
Programme& Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	HS	3	0	0	3
Preamble	To employ techniques of active reading, effective speaking and integrate ideas through writing skills. Learners can gain confidence to communicate in formal forum effectively and write long passages independently.						
Unit – I	Grammar and Vocabulary:						9
Parts of speech - Finite and non-finite verbs - Tenses- Reading: Prediction and Surveying - Writing: Essays- Dialogue writing - Activities: Listening: Types of listening - Speaking: Talking about oneself, one's family, friends and favorite persons.							
Unit – II	Grammar and Vocabulary:						9
Cause and effect expressions - Prefixes and Suffixes - Synonyms and Antonyms - Reading: Types: Skimming, Scanning, Word-by-word and Speed - Writing: Describing persons, places and products and processes - Activities: Listening: Process of listening - Speaking: Non-technical Presentation.							
Unit – III	Grammar and Vocabulary:						9
Active and Passive voice - Impersonal Passive - Reported Speech –Reading: Reading Comprehension – Summarizing and Paraphrasing - Writing: Warnings and Instructions - Activities: Listening: Effective listening strategies - Speaking: short talks.							
Unit – IV	Grammar and Vocabulary:						9
Abbreviations and Acronyms – Structure of captions / slogans - Prepositions - Reading: Intensive reading and Note-making - Writing: Informal and Formal Letters: Enquiry and placing order - Activities: Listening: Gap filling activity while listening - Speaking: Narrating an event/story							
Unit – V	Grammar and Vocabulary:						9
Connectives and Discourse Markers and Text organization - Sentence Patterns – Punctuations - Reading: Tongue twisters Rearranging jumbled sentences - Writing: E-mail Writing - Preparing the transcript for a speech - Activities: Listening: Listening to a lecture and taking notes – Speaking: Describing an image/picture							
							Total: 45
TEXT BOOK:							
1.	Sanjay Kumar and Pushp Lata, “Communication Skills”, 2 nd Edition, New Delhi: Oxford University Press, 2015.						
REFERENCES:							
1.	Raymond Murphy, “Essential English Grammar: Reference and Practice for South Asian Students”, 2 nd Edition, Cambridge: Cambridge University Press, 2012.						
2.	GlennisPye, “Vocabulary in Practice, Parts 1 and 2”, 1 st Edition, Cambridge: Cambridge University Press, 2011.						

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	identify and use content words which carry more meaning	Understanding (K2)
CO2	construct sentences in English	Applying (K3)
CO3	read short, simple messages and texts with complete understanding	Understanding (K2)
CO4	write at the sentence and paragraph level and beyond	Applying (K3)
CO5	speak in a given context	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				1		2		1	2	3		3	1	1
CO2				1		2		1	2	3		3	1	1
CO3				1		2		1	3	3		3	1	1
CO4				1		2		1	3	3		3	1	1
CO5				1		2		1	3	3		3	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	10	40	10	-	30	100
CAT2	10	10	40	10	-	30	100
CAT3	10	10	40	10	-	30	100
ESE	10	10	40	10	-	30	100

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

22IST12 – APPLIED MATHEMATICS

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	BS	3	1	0	4

Preamble	The course aims to deal with mathematical logic, counting techniques, finding best fitting curve to the given data, and to solve equations of certain types, interpolate polynomials for given data and perform integration and differentiation of numerical data.
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Unit – I	Mathematical Logic:	9 +3
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Logic – Propositional Calculus– Truth Table – Tautology and Contradiction –Equivalences and Implications – Normal Forms – Proofs in Propositional Calculus – Predicates and Quantifiers – Nested Quantifiers – Proofs in Predicate Calculus.

Unit – II	Counting Techniques:	9 +3
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Principle of Inclusion and Exclusion – Recurrence Relations – Formation – Solution of Non-Homogeneous Linear Recurrence Relations when the RHS is a Constant, a Linear Polynomial, an Exponential Function – Generating Functions – Solution of Recurrence Relations by using Generating Functions.

Unit – III	Curve Fitting:	9 +3
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Method of Least Squares: Fitting of Straight Line of the Form $y = ax + b$ - Fitting a Parabola of the Form $y = ax^2 + bx + c$ – Fitting of an Exponential Curve of the Form $y = ax^b$, $y = ae^{bx}$, $y = ab^x$ – Calculation of the Sum of Squares of Residuals in the Cases of Straight Line Fit and Parabola Fit.

Unit – IV	Solution of Algebraic and Transcendental Equations:	9 +3
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Bisection Method – Newton-Raphson Method – Regula-Falsi Method – Fixed Point Iterative Method – Solution of Simultaneous Linear Equations: Gauss Elimination Method – Gauss Jordan Method – Inverse of a Matrix – Gauss-Jacobi and Gauss-Seidel Iterative Methods.

Unit – V	Interpolation:	9 +3
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Newton – Gregory Forward Interpolation Formula – Newton – Gregory Backward Interpolation Formula for Equally Distributed Data – Newton’s Divided Difference Method for Unequally Distributed Data – Lagrange Interpolation Formula – Numerical Differentiation and Integration: Numerical Differentiation using Newton’s Forward and Backward Difference Formula – Numerical Integration using Simpson’s 1/3rd Rule – Simpson’s 3/8th Rule – Trapezoidal Rule.

Lecture: 45, Tutorial: 15, Total: 60

TEXT BOOK:

1.	Veerarajan T., “Discrete Mathematics with Graph Theory and Combinatorics”, 18 th Reprint, Tata McGraw Hill, New Delhi, 2017. For Unit I & II.
2.	Kandasamy P., Thilagavathy K. and Gunavathi K., “Numerical Methods”, 2 nd Edition, S.Chand& Company, Reprint, Tamil Nadu, 2013. For Unit III, IV & V.

REFERENCES:

1.	Kenneth H. Rosen, “Discrete Mathematics and its Applications”, 7 th Edition, Tata McGraw - Hill Pub. Co. Ltd., New Delhi, 2017.
2.	Sastry S.S., “Introductory Methods of Numerical Analysis”, 5 th Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)			
CO1	derive the inferences from Propositions and Predicates.												Analyzing (K4)		
CO2	make use of the counting techniques to some situations.												Applying (K3)		
CO3	determine the best fitting curve to the given data.												Applying (K3)		
CO4	solve the algebraic and transcendental equations and simultaneous linear equations.												Applying (K3)		
CO5	perform interpolation, extrapolation, numerical differentiation and numerical integration.												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	2	1								3	3	
CO2	3	2	1	1									3	3	
CO3	3	2	1	1									3	3	
CO4	3	2	1	1									3	3	
CO5	3	2	1	1									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		7		60		23						100	
CAT2		10		7		83		-						100	
CAT3		10		7		83		-						100	
ESE		10		7		83								100	
* ±3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)															

22IST13 – PROBLEM SOLVING AND PROGRAMMING

Programme& Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	PC	3	0	0	3

Preamble	To focus on developing programming skills using C language.
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UNIT –I	Introduction to Problem Solving:	9
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Overview of Computers – Applications of Computers – Characteristics of Computer – Basic Computer organization – Problem Solving: Planning the computer program – Algorithms – Flowcharts – Pseudocodes – Structuring the logic. Case Studies: Exchanging the values of two variables – Finding the biggest number – Summation of Numbers- Factorial computation.

Unit-II	Introduction to Programming and C:	9
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Introduction to C: Structure of a C program – Compiling and Executing C program – Comments – C Tokens – Character Set – Keywords – Identifiers – Data Types – Variables – Constants – Input/Output Statements – Operators – Type Conversion and Typecasting. Preprocessor Directives: Introduction – Types of Preprocessor Directives.

Unit-III	Decision Control and Looping Statements:	9
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Introduction to Decision Control Statements – Conditional Branching Statements – Iterative Statements – Nested Loops – Break and Continue Statement – goto statement. Case Studies: Roman number representation – day of the week.

Unit-IV	Arrays and Strings:	9
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Declaring, Initializing and Accessing Arrays – Operations – Two-dimensional Arrays – Operations on Two-dimensional Arrays – Multidimensional Arrays – Sparse Matrices – Applications of Arrays Strings: Introduction – Operations on Strings – Arrays of Strings.

Unit-V	Functions:	9
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Introduction – Function Declaration/Function Prototype – Function Definition – Function Call – Return Statement – Passing Parameters to Functions – Scope of Variables – Storage Classes – Recursive Functions – Types of Recursion – Passing One-dimensional Arrays and Two-dimensional Arrays to Functions - Recursion versus Iteration.

Total: 45

TEXT BOOK:

- | | |
|----|--|
| 1. | ReemaThareja., "Programming in C ", 2nd Edition, Oxford University Press, New Delhi, 2018 For UNIT-II,III,IV and V |
| 2. | Compiled by Department of CSE, "Problem Solving and Programming", 1st Edition, Internal circulation, Kongu Engineering College, 2017. For UNIT-I |

REFERENCES:

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| 1. | Sumitabha Das, "Computer Fundamentals and C Programming", 1 st Edition, McGraw Hill Education (India) Private Limited, 2018 |
| 2. | Yashavant Kanetkar, "Let us C", 16 th Edition, BPB publications, New Delhi, 2018. |
| 3. | Balagurusamy. E., "Programming in ANSI C", 7 th Edition, McGraw Hill Education (India) Private Limited, 2017. |

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	solve simple problems using problem solving techniques											Applying (K3)		
CO2	outline the basic concepts of C programming and write simple programs											Applying (K3)		
CO3	identify the appropriate decision control and looping statements in C and develop simple applications											Applying (K3)		
CO4	demonstrate the usage of arrays and strings to solve the given problems.											Applying (K3)		
CO5	develop simple applications using functions											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									3	3
CO2	3	2	1	2									3	3
CO3	3	2	1	2									3	3
CO4	3	2	1	2									3	3
CO5	3	2	1	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		60								100
CAT3		10		30		60								100
ESE		10		30		60								100
* ±3% may be varied (CAT 1,2&3 – 50 marks & ESE – 100 marks)														

22IST14 – DIGITAL PRINCIPLES AND LOGIC DESIGN							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	ES	3	0	0	3
Preamble	To emphasize the fundamental concepts and overview of Electrical and Electronics Engineering for beginners.						
Unit – I	Binary Systems and Logic Gates:						9
Digital Systems – Binary Numbers – Number Base Conversions – Octal Numbers – Hexadecimal Numbers – Complements (1's Complement and 2's Complement) – Binary Codes – Binary Storage and Registers – Binary Logic – Digital Logic Gates.							
Unit – II	Minimization and Boolean Algebra:						9
Basic Theorems and Properties of Boolean Algebra – Boolean Functions – Canonical and Standard Forms – K-Map Method: Two-Variables - Three-Variables - Four-Variables – Don't Care Conditions – NAND and NOR Implementation.							
Unit – III	Combinational Logic:						9
Combinational Circuits – Analysis Procedure – Design Procedure – Binary Adder: Half Adder – Full Adder – Binary Subtractor: Half Subtractor – Full Subtractor – Decoders – Encoders – Multiplexers - Demultiplexers.							
Unit – IV	Synchronous Sequential Logic:						9
Introduction – Sequential Circuits – Latches: SR, D Latches – Flip-Flops: SR Flip-Flop – D Flip-Flop – JK Flip-Flop – T Flip-Flop – Characteristic Table – Characteristic Equation. Analysis of Clocked Sequential Circuits: Analysis of D Flip-Flops – Analysis of T Flip-Flops – Analysis of JK Flip-Flops.							
Unit – V	Registers and Counters:						9
Registers – Types of Shift Registers: SISO – SIPO – PISO – PIPO – Universal Shift Registers – Ripple Counters: Binary Ripple Counters – BCD Ripple Counters – Ring Counters – Johnson Counter.							
							Total: 45
TEXT BOOK:							
1.	Morris R. Mano M., Michael D. Ciletti., "Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog", 6 th Edition, Pearson, India, 2020						
REFERENCES:							
1.	Ghoshal Subrata, "Digital Electronics", 2 nd Edition, Cengage Learning, New Delhi, 2018						
2.	Alam Mansaf, Alam Bashir Abhijit., Debnath Sudipta., "Digital Logic Design", 1 st Edition, PHI Learning Pvt. Ltd., New Delhi, 2016.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	solve problems related to number base conversions and binary codes.											Applying (K3)		
CO2	apply the concept of Boolean Algebra and implement minimization techniques.											Applying (K3)		
CO3	design the basic combinational circuits.											Applying (K3)		
CO4	demonstrate the functions of basic flip-flops.											Applying (K3)		
CO5	interpret the concepts of registers and counters.											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	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	2	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	10		35		55								100	
CAT2	10		35		55								100	
CAT3	10		60		30								100	
ESE	10		40		50								100	
* ±3% may be varied (CAT 1,2&3 – 50 marks & ESE – 100 marks)														

22IST15 – FUNDAMENTALS OF SOFTWARE ENGINEERING							
Programme& Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	PC	3	0	0	3
Preamble	To acquire knowledge in various software development processes						
Unit – I	Computer & Software fundamentals						9
Computer fundamentals – Evolution – Generation – Classification – Anatomy of a computer – Memory Revisited – Introduction to OS – Introduction to software: Programming Languages – Translators – compiling, loading and linking – Steps in Software Development							
Unit – II	Overview of Software Engineering						9
The Nature and Changing Nature of Software – Definition of Software Engineering – The Software Process – Software Engineering Practice – Process Models: A Generic Process Model – Defining a Framework Activity – Identifying a Task Set – Process Assessment and Improvement							
Unit – III	Process Models						9
Prescriptive Process Models – Specialized Process Models – The Unified Process – Personal and Team Process – Product and Process – Agility – Cost of change – Agile process							
Unit – IV	Understanding Requirements						9
Requirements Engineering – Establishing the Ground Work – Eliciting Requirements – Developing Use Cases – Negotiating, Monitoring and Validating Requirements – Avoiding common mistakes – Requirement Modeling Strategies – Flow oriented modeling - Data Flow Modeling							
Unit – V	Design Concepts						9
Design within the Context of Software Engineering – The Design Process – Design Concepts – Design model and Design elements – data design – architectural design – Interface design elements. Architectural Design – Software Architecture – Architectural Genres – Architectural Styles – Architectural Design.							
							Total: 45
TEXT BOOK:							
1.	Pradip Dey, Manas Ghosh, “ Computer Fundamentals and Programming in C”, 2 nd Edition, Oxford University Press, New Delhi, 2021 For Unit I.						
2.	Roger S.Pressman, Bruce R Maxim “Software Engineering - A Practitioner’s Approach”, 8 th Edition, Tata McGraw-Hill, New Delhi, 2019. For Unit II, III,IV and V						
REFERENCES:							
1.	Sommerville, Ian, "Software Engineering", 10 th Edition, Pearson Education, New Delhi, 2017.						
2.	Rajib Mall, "Fundamentals of Software Engineering", 5 th Edition, Prentice Hall of India, New Delhi, 2018.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	infer the basic concepts computers and software evolution											Understanding (K2)		
CO2	outline the software process											Understanding (K2)		
CO3	determine proper software engineering process model to develop application											Applying (K3)		
CO4	prepare software requirements specification											Applying (K3)		
CO5	explain implementable design concept for a software problem											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
CO2	2	1											2	2
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	2	1											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	30		50		20								100	
CAT3	30		50		20								100	
ESE	40		40		20								100	
* ±3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)														

22ISL11 - COMMUNICATIVE ENGLISH - I LABORATORY

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	HS	0	0	2	1

Preamble	To provide good exposure in the field of communication.
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LIST OF EXPERIMENTS / EXERCISES:

1.	Self-Introduction
2.	News Reading
3.	Making a non-technical Presentation
4.	Situational dialogues
5.	Speaking about a dream job/company
6.	Reading newspaper articles/magazines
7.	Listening comprehension
8.	Preparing review of a book/movie
9.	Writing about a recent scientific invention/technology
10.	Creative Writing: writing a poem/short story/ personal happenings – unforgettable moment in one's life

Total: 30

REFERENCES/ MANUAL /SOFTWARE:

1.	DVD, podcasts
2.	Authentic Videos
3.	Laboratory Manual

COURSE OUTCOMES:

On completion of the course, the students will be able to

**BT Mapped
(Highest Level)**

CO1	acquire proficiency through effective listening and reading	Understanding (K2), Imitation (S1)
CO2	write coherently without grammatical errors	Creating (K6)
CO3	take part in various professional and academic events	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				1		2		1	2	3		3	1	1
CO2				1		2		1	2	3		3	1	1
CO3				1		2		1	2	3		3	1	1

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

22ISL12 - PROBLEM SOLVING AND PROGRAMMING LABORATORY														
Programme & Branch		M.Sc & SOFTWARE SYSTEMS					Sem.	Category	L	T	P	Credit		
Prerequisites		Nil					1	PC	0	0	4	2		
Preamble		To introduce the field of programming using C language.												
LIST OF EXPERIMENTS / EXERCISES:														
1.	Programs for demonstrating exchange the value of two numbers.													
2.	Programs to implement the different types of algorithm: Sequential, Repetition and Decision													
3.	Programs for demonstrating the use of different types of operators like arithmetic, logical, relational and ternary operators (Sequential structures).													
4.	Programs to illustrate the different formatting options for input and output.													
5.	Programs using decision making statements like 'if', 'else if', 'switch', conditional and unconditional 'goto' (Selective structures).													
6.	Programs for demonstrating repetitive control statements like 'for', 'while' and 'do-while' (Iterative structures).													
7.	Programs for demonstrating one-dimensional and two-dimensional numeric array.													
8.	Programs to implement various character and string operations with and without built-in library functions.													
9.	Programs to demonstrate modular programming concepts using functions (Using built-in and user-defined functions).													
10.	Program to implement recursive functions.													
														Total: 60
REFERENCES/ MANUAL /SOFTWARE:														
1.	Laboratory Manual													
COURSE OUTCOMES: On completion of the course, the students will be able to														
CO1	demonstrate the execution of flowchart for the given problem using Raptor.												BT Mapped (Highest Level) Applying (K3) Precision (S3)	
CO2	demonstrate the application of sequential, selective and repetitive control structures.												Applying (K3) Precision (S3)	
CO3	implement solutions to the given problem using derived and user defined data types and functions.												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	1									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

22ISL13 - DIGITAL PRINCIPLES AND LOGIC DESIGN LABORATORY														
Programme & Branch		M.Sc & Software Systems						Sem.	Category	L	T	P	Credit	
Prerequisites		Nil						1	ES	0	0	2	1	
Preamble		To provide the knowledge in the basic concepts of Combinational and Sequential Circuits. It emphasizes on providing fundamental concepts related to electronics engineering.												
LIST OF EXPERIMENTS / EXERCISES:														
1.	Verification of AND, OR, NOT, NAND, NOR, XOR Logic Gates													
2.	Verification of Code Convertor													
3.	Verification of Parity Generator													
4.	Verification of Half Adder and Full Adder													
5.	Verification of Half Subtractor and Full Subtractor													
6.	Verification of Decoder and Encoder													
7.	Verification of Multiplexer and Demultiplexer													
8.	Verification of SR and D Flipflops													
9.	Verification of Binary and BCD counter													
10.	Verification of Up / Down 4 bit Binary Counter													
														Total: 30
REFERENCES/ MANUAL /SOFTWARE:														
1.	Laboratory Manual													
COURSE OUTCOMES: On completion of the course, the students will be able to													BT Mapped (Highest Level)	
CO1	perform the operation of identifying various digital ICs and understand their functionalities.												Applying (K3), Precision (S3)	
CO2	demonstrate basic combinational circuits and verify their functionalities.												Applying (K3), Precision (S3)	
CO3	master the design procedures to design basic sequential circuits.												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	1									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

22MNT13 - STUDENT INDUCTION PROGRAM

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	1	MC	2	0	0	0

Preamble	To make the student to understand the meaning of happiness and prosperity for a human being. Also, to facilitate the students to understand the harmony of human living and importance of physical and mental strength through yoga and meditation.						
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Unit – I	Overview of College and Department:	9
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General facilities - Autonomous System - Curriculum Overview & Assessment - Outcome Based Education – Placement and Higher Education Opportunities-Entrepreneurship-Value Added Course-Online Course.

Unit – II	Universal Human Values:	9
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Holistic Development & Role of Education - Understanding Happiness - Understanding the Human Being – Self & Body - Understanding the Human Being – Activities of Self - Prosperity - Understanding Relationship Trust - Understanding Relationship Respect - Understanding Relationship Other Feelings - Understanding Society - Understanding Nature Existence.

Unit – III	Yoga and Meditation:	9
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Introduction to Yoga – Objective – Physical Exercises: Need and Objectives of Simplified Physical Exercise – Types of Physical Exercises – Meditation: Qualities acquired through Meditation – Mental Health – Simple Meditation – Stress Management – Human Values: Self-control - Self-confidence – Honesty – Contentment – Humility – Modesty Tolerance – Adjustment – Sacrifice – Forgiveness – Importance of Thought Process – Self Realization.

Total: 20

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	interpret the values and culture of the Institution.											Understanding (K2)		
CO2	enhance the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human–human relationships and explore their role in ensuring a harmonious society.											Understanding (K2)		
CO3	know the value holistic vision of life and take steps to develop physical and mental health.											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				1	2	3
CO2						3		3				1	2	3
CO3						3		3				1	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	25	75					100

* ±3% may be varied (CAT – 100 marks)

22IST21 - COMMUNICATIVE ENGLISH - II							
Programme & Branch	MSc & Software Systems	Sem.	Cate gory	L	T	P	Credit
Prerequisites	Nil	2	BS	3	0	0	3
Preamble	To construct sentences effectively and facilitate to improve interpersonal skills of the learners.						
Unit – I	Grammar and Vocabulary:						9
Analogy - types of sentences - Assertive, Imperative, Interrogative and Exclamatory and Positive, Negative - Reading: Passages focusing on factual details, and features of text organization as well as gist, opinions and attitudes - Writing: Letter Writing: inviting guests, Job application with resume, seeking permission for Industrial Visit. Activities: Listening: Social Conversations - Speaking: Technical Presentation							
Unit – II	Grammar and Vocabulary:						9
Homonyms and homophones - Subject-verb agreement - Reading: Gapped-text exercises - Writing: Transcoding - Preparing proposals - Activities: Listening: Telephone conversations - Speaking: Role Play							
Unit – III	Grammar and Vocabulary:						9
Articles and determiners - Simple, compound and complex - Reading: Multiple matching - Writing: Checklist – Memorandum – Designing brochures. Activities: Listening: Telephonic conversation - Mock Group Discussions - Speaking: Group Discussion							
Unit – IV	Grammar and Vocabulary:						9
Error detection – Gerunds & Infinitives - Reading: Business English Certificate (BEC) type exercises - Writing: Recommendations - Activities: Listening: Motivational Talks - Speaking: Speaking with native accent.							
Unit – V	Grammar and Vocabulary:						9
Single word substitution - Definitions – Purpose and function – Interpreting news / advertisement - Reading: International English Language Testing System (IELTS) type exercises - Writing: Report Writing: special and technical reports - Activities: Listening: TED Talks - Speaking: Mock Interviews.							
							Total:45
TEXT BOOK:							
1.	Sanjay Kumar and Pushp Lata, "Communication Skills", 2nd Edition, New Delhi: Oxford University Press, 2015.						
REFERENCES:							
1.	Raymond Murphy, "Essential English Grammar: Reference and Practice for South Asian Students", 2nd Edition, Cambridge: Cambridge University Press, 2012.						
2.	GlennisPye, "Vocabulary in Practice, Parts 1 and 2", 1stEdition, Cambridge: Cambridge University Press, 2011.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	use structural words appropriately in spoken and written texts											Remembering (K1)		
CO2	construct different types of sentences											Applying (K3)		
CO3	read longer academic and business English texts with maximum understanding											Understanding (K2)		
CO4	write beyond the sentence level											Applying (K3)		
CO5	communicate effectively in a vast range of personal, professional, academic, and cultural situations											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				1		2		1	2	3		3	1	1
CO2				1		2		1	2	3		3	1	1
CO3				1		2		1	3	3		3	1	1
CO4				1		2		1	3	3		3	1	1
CO5				1		2		1	3	3		3	1	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														
ASSESSMENT PATTERN - THEORY														
Test / Bloom's Category*	Rememberin g (K1) %	Understanding (K2) %		Applying (K3) %		Analyzing (K4) %		Evaluating (K5) %		Creating (K6) %		Total %		
CAT1	10	10		40		10		-		30		100		
CAT2	10	10		40		10		-		30		100		
CAT3	10	10		40		10		-		30		100		
ESE	10	10		40		10		-		30		100		
* ±3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)														

22ISC21 - PROBABILITY AND STATISTICS

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	BS	3	0	2	4

Preamble	The introductory course which inculcates the knowledge of Probability, Statistics and its application in the field of business and also it gives adequate exposure in the basic concepts of test of hypothesis and control charts.	
Unit – I	Probability:	9
Basic Terminology - Mathematical Probability - Axiomatic Approach to Probability - Addition Theorem on Probability - Conditional Probability - Multiplication Theorem on Probability - Independence of Events - Total Probability - Baye's Theorem.		
Unit – II	Statistical Measures:	9
Measures of central tendency: Mean, Median, Mode. Measures of dispersion: Range - Quartile deviation - Mean deviation - Standard deviation.		
Unit – III	Correlation and Linear Regression:	9
Karl Pearson's Coefficient of Correlation - Rank Correlation - Spearman's Rank Correlation Coefficient - Repeated Ranks - Regression Line of Y on X - Regression Line of X on Y.		
Unit – IV	Test of Significance for Small Samples:	9
Introduction to sampling distributions - Types of sampling - Standard Error - Student's t-test: Test of significance between the sample mean and population mean – Test for difference between two sample means - F-test for difference between two population variances - Chi-square Test for Goodness of Fit - Chi-square Test for Independence of Attributes.		
Unit – V	Statistical Quality Control:	9
Control Charts - Control charts for variables: Mean Chart, R-Chart. Control Charts for attributes: c-Chart, p-Chart and np- chart.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Determination of the probability
2.	Compute the measures of central tendency and dispersion
3.	Determine the correlation coefficients and covariance
4.	Compute the linear regression lines for the given data
5.	Testing significance of means using student's t-test
6.	Testing the independence of attributes using Chi-square test
7.	Plot a control chart for variables
8.	Plot a control chart for attributes

	Lecture: 45, Practical: 30, Total: 75
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TEXT BOOK:

1.	Veerarajan T, "Probability and Statistics, Random process with Queueing Theory and Queueing Networks", 4 th Edition, McGraw-Hill Education (India), New Delhi, 2017 for Unit I, III, IV, V.
2.	S C Gupta & V K Kapoor, Fundamental of Mathematical Statistics, 12 th Edition, Sultan Chand and Sons, Educational Publishers, New Delhi, 2022 for Unit II.

REFERENCES/ MANUAL / SOFTWARE:

1.	Kandasamy P, Thilagavathy K, Gunavathy K, “Probability Statistics and Queueing Theory”, S.Chand & Co, New Delhi, 2016.
2.	Douglas C. Montgomery, George C. Runger, “Applied Statistics and Probability for Engineers” - 6 th Edition, New Delhi Wiley, 2020.
3.	MATLAB Manual.

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	make use of the concept of probability to real life scenarios											Applying (K3)		
CO2	determine the mean, median and mode for ungrouped and grouped data											Applying (K3)		
CO3	identify the relation between two variables understand the concepts of two-dimensional regression											Applying (K3)		
CO4	apply statistical tests for solving problems involving small sample tests											Applying (K3)		
CO5	prepare control charts to monitor the production process											Applying (K3)		
CO6	know the basis of descriptive statistics and visualization, dispersion standard deviation, variance and compute the correlation coefficients and covariance, test whether the given data is significant by hypothesis testing and obtain the control chart for variables and attributes using MATLAB.											Understanding (K2) 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
CO2	3	3												2
CO3	3	2	2										1	2
CO4	3	2	3										2	2
CO5	3	2	3										2	2
CO6					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		10		80								100
CAT2		10		10		80								100
CAT3		10		10		80								100
ESE		10		10		80								100
* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)														

22IST22 - PROGRAMMING AND LINEAR DATA STRUCTURES

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Problem Solving and Programming	2	PC	3	0	0	3

Preamble	To articulate the advanced concepts of C language and basic concepts and applications of linear data structures like linked list, stack and queue.
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Unit – I	User-Defined Data Types:	9
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Introduction to Structures – Nested Structures – Arrays of Structures – Structures and Functions – Self-referential Structures – Unions – Arrays of Union Variables – Unions Inside Structures – Structure Inside Union – Enumerated Data Type.

Unit – II	Pointers:	9
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Introduction – Declaring Pointer Variables – Pointer Expressions and Pointer Arithmetic – Null Pointers – Generic Pointers – Passing Arguments to Function Using Pointers – Pointers and Arrays – Passing an Array to a Function – Pointers and Strings – Arrays of Pointers – Pointers and 2D Arrays and 3D Array – Function Pointers – Array of Function Pointers – Pointers to Pointers – Drawbacks of Pointers.

Unit – III	Files:	9
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Introduction – Using Files in C – Reading and Writing Data to Files – Detecting the End-of-File – Error Handling During File Operations – Accepting Command Line Arguments – Functions for Selecting a Record Randomly – remove() – Renaming the File.

Unit – IV	Data Structures and Linked List:	9
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Introduction to Data Structures – Linked List Versus Arrays – Memory Allocation and Deallocation for a Linked List – Types of Linked Lists – Singly Linked Lists – Traversing – Searching – Inserting a New Node - Circular Linked List – Doubly Linked Lists – Circular Doubly Linked Lists – Applications of Linked Lists.

Unit – V	Stacks and Queue:	9
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Stack – Array Representation of Stacks – Operations – Applications – Queues: Array Representation of Stacks – Operations – Applications.

Total: 45

TEXT BOOK:

1.	Reema Thareja., "Programming in C", 2 nd Edition, Oxford University Press, New Delhi, 2018.
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REFERENCES:

1.	Sumitabha Das, “Computer Fundamentals & C Programming”, 1 st Edition, McGraw Hill Education (India) Private Limited, 2018.
2.	Yashavant Kanetkar, “Pointers in C”, 4 th Edition, BPP Publications, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to													BT Mapped (Highest Level)	
CO1	make use of user defined data types to solve given problems.												Applying (K3)	
CO2	recall the concepts pointers and develop C program using pointers.												Applying (K3)	
CO3	demonstrate the usage of file operations.												Applying (K3)	
CO4	implement the operations of different types of linked list.												Applying (K3)	
CO5	manipulate the operations on stacks and queues.												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									3	3
CO2	3	2	1	2									3	3
CO3	3	2	1	2									3	3
CO4	3	2	1	2									3	3
CO5	3	2	1	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	30	60				100							
CAT2	10	30	60				100							
CAT3	10	30	60				100							
ESE	10	30	60				100							
* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)														

22IST23 - WEB PROGRAMMING							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	PC	3	0	0	3
Preamble	To design interactive web applications using HTML, CSS, Java script and PHP						
Unit – I	Introduction to Internet:						9
Internet Overview- Evolution of the Internet and World Wide Web–Web Basics-Multitier Application Architecture-Client-side and server-side scripting- World Wide Web Consortium- Web 2.0- Data Hierarchy- Operating System- Types of Programming Languages- Object Technology							
Unit – II	HTML 5.0 and CSS:						9
Introduction to HTML5: Headings – Linking – Images –Lists – Tables– Forms -Frames- Media elements. Introduction to Cascading Style Sheets – Inline Styles – Embedded Style Sheets – Linking External Style Sheets – Positioning Elements-Backgrounds-Box Model and Text Flow-Text Shadows-Box Shadows-Animation.							
Unit – III	Java script:						9
Java Script: Introduction to Scripting – Control Statements–Looping statements–Logical Operators. Java script Functions: Introduction – Function Definitions – Scope Rules – JavaScript Global Functions – Recursion – Recursion vs. Iteration. -Java Script Arrays							
Unit – IV	Java script Object and DOM:						9
Java script Object – Document Object Model (DOM) Objects and Collections: Modeling a Document: DOM Nodes and Trees – Traversing and Modifying a DOM Tree – DOM Collections – Dynamic Styles							
Unit – V	PHP:						9
PHP's Syntax – Comments – Variables – Types in PHP –Output –Expressions – Branching – Looping – Using Functions – User Defined Functions – Functions and Variable Scope -Strings in PHP: String Functions – PHP Arrays: Creating Arrays – Retrieving Arrays – Multidimensional Arrays – Inspecting Arrays – Deleting Arrays							
Total: 45							
TEXT BOOK:							
1.	Paul Deitel, Harvey Deitel and Abbey Deitel, "Internet and World Wide Web – How To Program", 5 th Edition, Pearson Education, New Delhi, 2018. For Unit I, Unit II, Unit III and Unit IV						
2.	Steve Suehring, Tim Converse and Joyce Park, "PHP 6 and MySQL", 2 nd Edition, Wiley Publication, New Delhi, 2017. For Unit V.						
REFERENCES:							
1.	DT Editorial Services, "HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery)", 2 nd Edition, Dreamtech Press, New Delhi, 2016.						
2.	Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson Education, New Delhi, 2015.						
3.	Larry Ullman, "PHP and MySQL for Dynamic Web Sites", 5 th Edition, Peachpit Press, San Francisco, 2017.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	outline web protocols and web architecture											Understanding (K2)		
CO2	develop interactive web pages using HTML tags.											Applying (K3)		
CO3	implement java script control structures and functions											Applying (K3)		
CO4	outline Document Object Model and java script object.											Applying (K3)		
CO5	apply PHP looping structures, branching structures, functions, string functions and arrays											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	1			1		2	2	2		2		2	2
CO2	3	2	1	1	1		2	2	2		2		3	3
CO3	3	2	1	1	1		2	2	2		2		3	3
CO4	3	2	1	1	1		2	2	2		2		3	3
CO5	3	2	1	1	1		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		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)														

22IST24 - COMPUTER ORGANIZATION							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	PC	3	0	0	3
Preamble	To provide basic knowledge on the hardware architecture of the computer and exemplify the execution of complete instruction in it.						
Unit – I	Basic Structure and Instruction Set Architecture:						9
Basic Structure of Computers: Computer Types - Functional Units – Operational Concepts – Number Representation and Arithmetic Operations – Character Representation – Performance. Instruction Set Architecture: Memory Locations and Addresses – Memory Operations – Instructions and Instruction Sequencing – Addressing Modes.							
Unit – II	Arithmetic Operations:						9
Addition and Subtraction of Signed Numbers – Design of Fast Adders – Multiplication of Unsigned Numbers – Multiplication of Signed Numbers - Fast Multiplication – Integer Division – Floating Point Numbers and Operations.							
Unit – III	Basic Processing Unit and Pipelining:						9
Fundamental Concepts – Instruction Execution – Hardware Components – Instruction Fetch and Execution Steps – Control Signals – Hardwired Control. Pipelining: Basic Concepts – Pipeline Organization – Pipeline Issues - Data Dependencies – Memory Delays – Branch Delays- Resource Limitations - Performance Evaluation.							
Unit – IV	Memory Systems:						9
Basic Concepts – Semiconductor RAM Memories – Read Only Memories – Direct Memory Access – Memory Hierarchy – Cache Memories – Performance Considerations – Virtual Memory – Memory Management Requirements.							
Unit – V	Input/Output Organization:						9
Basic Input / Output: Accessing I/O Devices – Interrupts–Input/Output Organization: Bus Structure – Bus Operation – Arbitration – Interface Circuits – Parallel and Serial Interfaces.							
							Total:45
TEXT BOOK:							
1.	Hamacher Carl, Vranesic Zvonko, Zaky Safwat and Manjikian Naraig “Computer Organization and Embedded Systems”, 6 th Edition, McGraw Hill, New York, 2012.						
REFERENCES:							
1.	Patterson David A. and Hennessy John L., “Computer Organization and Design: The Hardware / Software Interface”, 5 th Edition, Harcourt Asia, Morgan Kaufmann, Singapore, 2014.						
2.	Hayes John P., “Computer Architecture and Organization”, 3 rd Edition, Tata McGraw Hill, New Delhi, 2014.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	infer computer components and employ the various addressing modes for the instruction set.											Applying (K3)		
CO2	compute arithmetic operations on signed and unsigned numbers.											Applying (K3)		
CO3	demonstrate the execution of instructions and apply pipelining to handle hazards.											Applying (K3)		
CO4	interpret the basic storage concepts and make use of mapping functions in cache memory.											Applying (K3)		
CO5	Utilize the interrupts in I/O transfer and examine the role of bus in I/O operations.											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									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	1	1									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	15		55		30								100	
CAT2	15		55		30								100	
CAT3	15		55		30								100	
ESE	5		55		40								100	
* ±3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)														

22ISL21 - COMMUNICATIVE ENGLISH - II LABORATORY

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	BS	0	0	2	1

Preamble	To provide good exposure in the field of communication.
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LIST OF EXPERIMENTS / EXERCISES:

1.	Mock Interview
2.	Job Application with resume
3.	Making a presentation on a technical topic/case study
4.	Group Discussion
5.	Reading Aloud
6.	Listening to native speakers' talks and imitating them
7.	Writing about a social issue
8.	Writing for blogs/social media
9.	Writing company profiles
10.	Pronunciation test

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Study skill success, Tense buster, Issues in English
2.	DVD, podcasts, Authentic Videos
3.	Laboratory Manual

COURSE OUTCOMES:

On completion of the course, the students will be able to

**BT Mapped
(Highest Level)**

CO1	understand the pronunciation of the native speakers (English) about their real time experience after listening to the videos	Understanding (K2), Manipulation (S2)
CO2	write coherently without grammatical errors.	Creating (K6),
CO3	take part in Group Discussion, Paper or project presentation and mock interview	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				1		2		1	2	3		3	1	1
CO2				1		2		1	2	3		3	1	1
CO3				1		2		1	2	3		3	1	1

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

22ISL22 - PROGRAMMING AND LINEAR DATA STRUCTURES LABORATORY														
Programme & Branch		M.Sc & Software Systems					Sem.	Category	L	T	P	Credit		
Prerequisites		Problem Solving and Programming					2	PC	0	0	4	2		
Preamble		To develop an in-depth knowledge in C language and implement linear data structures using C												
LIST OF EXPERIMENTS / EXERCISES:														
1.	Programs to illustrate the use of structures.													
2.	Programs to implement the use of union.													
3.	Programs to demonstrate the usage of pointers and functions.													
4.	Programs to demonstrate the usage of pointers and arrays.													
5.	Program to perform operations on files.													
6.	Program to implement command line arguments.													
7.	Program to implement singly linked list.													
8.	Program to implement doubly linked list.													
9.	Program to implement stack using array.													
10.	Program to implement queue using array.													
Total: 60														
REFERENCES/ MANUAL /SOFTWARE:														
1.	Laboratory Manual													
COURSE OUTCOMES: On completion of the course, the students will be able to														
CO1	implement programs to solve problems using pointers to arrays and structures.												BT Mapped (Highest Level)	
CO2	develop programs using files and preprocessor directives.												Applying (K3), Precision (S3)	
CO3	use appropriate linear data structure for solving given 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	3	2	1	1									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3

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

22ISL23 - WEB PROGRAMMING LABORATORY

Programme& Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	2	PC	0	0	2	1

Preamble	This course is designed to impart the knowledge to design and implement static and dynamic websites for real time applications.
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LIST OF EXPERIMENTS / EXERCISES:

1.	Develop a HTML document using the following tags: Heading, Anchor, Link, Paragraph and Image
2.	Create a HTML web page using Lists
3.	Create a web page using Table tag
4.	Design a Web page using Frame and Frameset element
5.	Design a web form using HTML form elements
6.	Design an attractive webpage using style sheets
7.	Design a form and validate using java Script
8.	Design a web page using java script and DOM
9.	Develop a web page using PHP functions
10.	Create a form and validate using regular expressions
11.	Miniproject

Total: 30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Visual Studio code, Browser, xampp server

COURSE OUTCOMES:

On completion of the course, the students will be able to

**BT Mapped
(Highest Level)**

CO1	Develop interactive web pages using HTML, CSS and Javascript	Applying (K3), Precision (S3)
CO2	perform HTML form validation using Java script and regular expressions	Applying (K3), Precision (S3)
CO3	develop a web application to maintain information in a database using PHP	Applying (K3), Precision (S3)

Mapping of Cos with POs and PSOs

[illegible]

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

22IST31 - OBJECT ORIENTED PROGRAMMING WITH C++

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Problem Solving and Programming	3	PC	3	0	0	3

Preamble	To acquire acquaintance in object oriented programming and develop solutions for real time applications in C++.
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Unit – I	Introduction to C++ and Functions:	9
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The Object-Oriented Approach – Characteristics of Object-Oriented Languages – Basics of C++: Structure of a C++ Program – Branching and Looping – Streams in C++ and Stream Classes - Unformatted Console I/O Operations-Functions: Passing Arguments & Returning Values from Functions – Reference Arguments – Overloaded Functions – Recursion – Inline Functions – Default Arguments – Scope and Storage Class.

Unit – II	Classes and Objects, Constructors and Destructors:	9
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A Simple Class – Objects as Physical Objects – Objects as Data Types – Constructors – Destructor – Objects as Function Arguments – Default Copy Constructor – Returning Objects from Functions – Static Class Data – Arrays and Strings – Array Fundamentals – Array of Objects – Standard C++ String Class

Unit – III	Compile Time Polymorphism and Inheritance:	9
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Overloading Unary Operator – Overloading Binary Operator – Date Conversion – Inheritance – Derived and Base Class – Derived Class Constructors – Overriding Member Functions – Class Hierarchies – Public and Private Inheritance – Levels of Inheritance

Unit – IV	Pointers, Virtual Functions:	9
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Pointers: Addresses and Pointers – The Address - of Operator (&) – Pointers and Arrays – Pointers and Functions – Pointers and C Type Strings – Pointer to Objects – Pointer to Pointer – Virtual Functions – Normal Member Function Accessed with Pointers – Virtual Member Functions Accessed with Pointers – Friend Functions and Friend Class – Static Functions – this Pointer

Unit – V	Streams, Files, Template and Exceptions:	9
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Stream Classes – Disk File I/O with Streams – File Pointers – Error handling in File I/O – Overloading extraction and insertion Operators – Templates and Exceptions: Function Templates – Class Templates – Exceptions

Total: 45

TEXT BOOK:

1. Robert Lafore, "Object-Oriented Programming in C++", 4th Edition, SAMS Publishers, USA, 2016.

REFERENCES:

1. Bjarne Stroustrup, "The C++ programming language", Addison Wesley, 2013.

2.	Ashok N. Kamthane, "Programming in C++", Pearson, 2 nd Edition, 2016
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3.	Venugopal K.R., Rajkumar Buyya, "Mastering C++", 2 nd Edition, McGraw-Hill Education, 2013.
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COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	deduce the basic concepts of object oriented programming with C++ along with IO and Functions.	Understanding (K2)
CO2	demonstrate the usage of classes objects, constructors and destructors.	Applying (K3)
CO3	implement application development using operator overloading and inheritance.	Applying (K3)
CO4	articulate the application of pointers, virtual functions.	Applying (K3)
CO5	practice the concepts of file handling, template and exceptions.	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	1	3	3					2		2		2	3
CO2	3	2	3	3					2		2		3	3
CO3	2	2	3	2					2		2		3	3
CO4	2	2	3	2									3	3
CO5	3	2	3	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	-	20	80				100
CAT2	-	20	80				100
CAT3	-	20	80				100
ESE	-	24	76				100

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

22IST32 – DATA STRUCTURES							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Programming and Linear Data Structures	3	PC	3	0	0	3
Preamble	The course focuses on the basic concepts and applications of linear structures and non linear data structures.						
Unit – I	Stacks and Queues:						9
Introduction – Singly Linked List – Doubly Linked List – Stacks: Linked Representation – Operations – Multiple Stacks – Applications: Reversing a List – Implementing Parentheses Checker – Recursion – Queues: Linked Representation – Types – Applications.							
Unit – II	Trees:						9
Introduction – Types – Creating a Binary Tree from a General Tree – Traversing a Binary Tree – Applications – Binary Search Trees (BST) – Operations: Searching – Insertion – Deletion – Finding the Smallest Node in BST – Finding the Largest Node in a BST – Threaded Binary Trees – AVL Trees: Operations							
Unit – III	Graphs:						9
Introduction – Graph Terminology - Directed Graphs – Bi-connected Components – Representations : Adjacency Matrix – Adjacency List – Adjacency Multi-List – Graph Traversal Algorithms : Breadth First Search – Depth First Search – Topological Sort – Applications of Graphs.							
Unit – IV	Searching and Sorting:						9
Searching: Introduction – Linear Search – Binary Search– Interpolation and Jump Search –Sorting: Introduction – Bubble Sort – Insertion Sort – Selection Sort – Merge Sort – Quick Sort – Radix Sort – Heap Sort – Shell Sort – Tree Sort –Comparison of Sorting Algorithms – External Sorting.							
Unit – V	Advanced Trees, Hashing and Collision:						9
Red-Black Trees – Splay Trees –B Trees – Heap – Hashing: Introduction – Hash Tables – Hash Functions – Different Hash Functions – Collisions: Collision Resolution by Open Addressing – Collision Resolution by Chaining – Pros and Cons of Hashing – Applications of Hashing.							
Total: 45							
TEXT BOOK:							
1.	Reema Thareja., “Data Structures using C”, 2 nd Edition, Oxford University Press, New Delhi, 2018.						
REFERENCES:							
1.	Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2 nd Edition, Pearson Education, New York, 2016						
2.	Jean Paul Tremblay and Paul G. Sorensen, “An Introduction to Data Structures with Applications”, 2 nd 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 computational problems using linear data structures.											Applying (K3)		
CO2	determine the structure and operations on trees.											Applying (K3)		
CO3	apply appropriate graph algorithms for solving computing problems.											Applying (K3)		
CO4	demonstrate the concept of searching and sorting techniques.											Applying (K3)		
CO5	implement the operations of special trees and demonstrate hashing and collision resolution 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	1									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	1	1									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		80								100	
CAT2	-		20		80								100	
CAT3	-		20		80								100	
ESE	-		20		80								100	
* ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)														

22IST33 – UNIX AND SHELL PROGRAMMING							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisite	Nil	3	PC	3	0	0	3
Preamble	To impart the knowledge in basic concepts of Unix Operating System ,File organization and Process Management and provides knowledge in writing shell scripts in UNIX						
Unit – I	Introduction to Unix:						9
Brief History – Salient Features – Components – Kernel – Shell – File System – Using Unix – Shell Prompt – Commands in Unix – Types of Unix Commands – Basic Commands – Getting Help – The manual and the man Command – The info Utility – Command Substitution – Giving Multiple Commands – Aliases.							
Unit – II	File Organization, Attributes and Permissions:						9
File organization – Unix files – Categories of files – Hidden files – File system – Path Names – Home Directory Commands – Dot (.) and (..) File names – File commands – Displaying and Printing Files – Comparing Files. File Attributes and Permissions: File Ownership – Attributes – ls, file, chmod, chown, chgrp, umask Commands							
Unit – III	Standard I/O, Redirection Pipes, Filters and vi Editor:						9
Standard I/O – Redirection – Pipes and Pipeline – Mixing input – Filter – tee command – Terminal and Trash Files – Database File – Handling Columns and Fields – sort, uniq, tr Commands. The vi Editor: Editing – Moving Cursor – Copying and Moving Text – Pattern Searching – Repeating the Last Editor Command – Undoing Commands – Joining and Writing Lines – Using shell from vi – Configuring vi Environment							
Unit – IV	Regular Expressions and Process:						9
Regular Expressions – grep, egrep, fgrep Commands – Stream Editor. The Process: Meaning – Parent and Child Processes – Types – Foreground and Background – Internal and External Commands – ps Command – Process Creation – nohup, nice, time, signals, trap, stty, kill, wait Commands – Job Control – Command History – Scheduling Job Execution							
Unit – V	Shell Programming:						9
Shell Variables – export Command - .profile File – read Command – Positioning Parameters - \$ Variables – set, exit Commands – Branching and Control – Loop Control – continue and break Statements – expr Command – Real Arithmetic – here Document – sleep Command – Debugging Scripts – script, eval, exec Commands							
Total: 45							
TEXT BOOK:							
1.	Venkateshmurthy M.G., “Introduction to UNIX & SHELL programming”, 1 st Edition, Pearson Education, 2015.						
REFERENCES:							
1.	Patrick H. Wood and Stephen G. Kochan, “Shell Programming in Unix, Linux and OS X”, 4 th Edition, Pearson Education, USA, 2016.						
2.	Sumitabha Das, “Unix Concepts and Applications”, 4 th Edition, McGraw Hill Higher Education, India, 2017.						

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	implement basic unix commands	Applying (K3)
CO2	examine unix file organization, attributes and permissions	Applying (K3)
CO3	inspect standard i/o, redirection pipes, filters and vi editor	Applying (K3)
CO4	create and terminate process	Applying (K3)
CO5	writing and executing shell programs	Applying (K3)

Mapping of COs with POs and PSOs

[illegible]

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	70				100
CAT2	-	30	70				100
CAT3	-	30	70				100
ESE	-	30	70				100

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

22IST34- OPERATING SYSTEMS

Programme& Branch	MSc - SOFTWARE SYSTEMS	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3	PC	3	1	0	4

Preamble	To provide background knowledge in operating system and its functionalities. It exemplifies the classical internal algorithms and memory management strategies of operating systems.						
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Unit – I	Overview:	9+3
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Introduction: Roles of Operating System – Computer System Organization– Computer System Architecture – Operating System Operations – Protection and Security – Computing Environments. System Structures: Operating Systems Services – User and Operating System Interface – System Calls –Types of System Calls – System Boot.

Unit – II	Process Management:	9+3
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Process Concept: Process Scheduling – Operation on Processes – Inter Process Communication. Process Scheduling: Scheduling Criteria – Scheduling algorithms. Multithreaded Programming: Overview – Multicore Programming - Multithreading models – Threading issues.

Unit – III	Synchronization and Deadlock:	9+3
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Synchronization: Background – The Critical-Section Problem – Peterson's Solution – Synchronization Hardware – Mutex Locks – Semaphores – Classic Problems of Synchronization – Monitors. Deadlocks: System Model – Deadlock Characterization - Methods for Handling Deadlock – Deadlock Prevention – Deadlock Avoidance – Deadlock Detection – Recovery from Deadlock.

Unit – IV	Memory Management:	9+3
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Memory Management Strategies: Swapping – Contiguous Memory Allocation – Segmentation – Paging – Structure of the Page Table. Virtual Memory Management: Demand Paging – Copy-on Write – Page Replacement – Allocation of Frames – Thrashing.

Unit – V	Storage Management:	9+3
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File System: File Concept – Access Methods – File System Structure – File System Implementation – Directory Implementation – Allocation Methods – Free-space Management. Mass Storage Structure: Overview – Disk Structure – Disk Attachment – Disk Scheduling – Disk Management.

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 10 th Edition, John Wiley & Sons, New Jersey, 2021.
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REFERENCES:

1.	Andrew S. Tanenbaum, Herbert Bos, "Modern Operating Systems", 4 th Edition, Pearson Education, New Jersey, 2015.
2.	William Stallings, "Operating System Internals and Design", 9 th Edition, Pearson, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the operating system structure, operations and system calls	Understanding(K2)
CO2	illustrate process scheduling algorithms and demonstrate multithreading models	Applying(K3)
CO3	determine deadlock handling methods and explain synchronization techniques	Applying(K3)
CO4	employ the memory management strategies and page replacement algorithms	Applying(K3)
CO5	infer the storage management concepts and make use of the disk scheduling algorithms	Applying(K3)

On completion of the course, the students will be able to

**BT Mapped
(Highest Level)**

CO1	interpret the operating system structure, operations and system calls	Understanding(K2)
CO2	illustrate process scheduling algorithms and demonstrate multithreading models	Applying(K3)
CO3	determine deadlock handling methods and explain synchronization techniques	Applying(K3)
CO4	employ the memory management strategies and page replacement algorithms	Applying(K3)
CO5	infer the storage management concepts and make use of the disk scheduling algorithms	Applying(K3)

Mapping of COs with POs and PSOs

[illegible]

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	-	60	40				100
CAT2	-	40	60				100
CAT3	-	40	60				100
ESE	-	50	50				100

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

22IST35 - DESIGN THINKING							
Programme & Branch	M.Sc – Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3	PC	3	0	0	3
Preamble	Design Thinking is human-centered problem solving tool which emphasize on empathy, collaboration, co-creation and stakeholder feedback to unlock creativity and innovation, to devise feasible and viable idea/solutions.						
Unit – I	Design Thinking and Explore:						9
Design Thinking: Key Principles and Mindset – Five Phases, Methods and Tools of Design Thinking – User Guide – Foundation Building for Design Thinking – Explore: Methods & Tools – STEEP Analysis – Strategic Priorities – Activity System – Stakeholder Mapping – Opportunity Framing.							
Unit – II	Empathize:						9
Empathize: Methods & Tools – Field Observation – Deep User Interview – Empathy Map – User Journey Map - Need Finding – User Insights - User Persona Development.							
Unit – III	Experiment:						9
Experiment: Methods & Tools – Ideation – SCAMPER – Analogous Inspiration – Deconstruct & Reconstruct – User Experience Journey – Prototyping– Idea Refinement.							
Unit – IV	Engage:						9
Engage: Methods & Tools – Story Telling – Art of Story Telling – Storyboarding – Co-Creation with Users – Collect Feedback from Users.							
Unit – V	Evolve:						9
Evolve: Methods & Tools – Concept Synthesis – Strategic Requirements – Evolved Activity Systems – Activity System Integration – Viability Analysis – Innovation Tools using User Needs, CAP, 4S – Change Management - Quick Wins.							
							Total:45
TEXT BOOK:							
1.	Lee Chong Hwa, "Design Thinking The Guidebook", Design Thinking Master Trainers of Bhutan, 2017. (E-Book)						
REFERENCES:							
1.	Jeanne Liedtka and Tim Ogilvie, "Designing for Growth: A Design Thinking Tool Kit for Managers", Columbia University Press, 2011.						
2.	Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, "The Designing for Growth FieldBook: A Step-by-Step Project Guide", Columbia University Press. 2014.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	Construct design challenge and reframe the design challenge into design opportunity.											Applying (K3)		
CO2	Interview the user, and know the feelings of users to foster deep user understanding and be able to uncover the deep user insights and needs.											Applying (K3)		
CO3	Develop ideas and prototypes by brain storming using the ideation tools.											Applying (K3)		
CO4	Organize the user walkthrough experience using ideal user experience journey.											Applying (K3)		
CO5	Develop smart strategies & implementation plan that will deliver/achieve the idea/solution deduced from earlier phases.											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	3	1					3	2	1		3	1
CO2	3	3	3	1					3	2	1		3	1
CO3	3	3	3	1					3	2	1		3	1
CO4	3	3	3	1					3	2	1		3	1
CO5	3	3	3	1					3	2	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	-		30		70								100	
CAT2	-		25		75								100	
CAT3	-		25		75								100	
ESE	-		20		80								100	
* ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)														

22ISL31 - OBJECT ORIENTED PROGRAMMING WITH C++ LABORATORY														
Programme & Branch		M.Sc & Software Systems					Sem.	Category	L	T	P	Credit		
Prerequisites		Programming in C					3	PC	0	0	4	2		
Preamble		To introduce object oriented programming concepts and develop solutions for real time applications in C++.												
LIST OF EXPERIMENTS / EXERCISES:														
1.	Implement simple C++ programs.													
2.	Construct a C++ program to manage the input and output operations using stream classes.													
3.	Design a C++ program to implement the concept of class and objects with data members and member functions.													
4.	Develop a C++ program to initialize the class members using constructors and destroy the objects by using destructor.													
5.	Develop C++ program to carry out compile time polymorphism using unary and binary operator overloading.													
6.	Implement different types of inheritance.													
7.	Develop a C++ program to implement runtime polymorphism.													
8.	Develop a C++ program to allow functions and classes to operate with generic types using templates.													
9.	Implement programs with sequential access and random access file.													
10.	Construct a class in C++ to handle predefined and user defined exceptions													
														Total: 60
REFERENCES/ MANUAL /SOFTWARE:														
1.	Laboratory Manual													
COURSE OUTCOMES: On completion of the course, the students will be able to														
CO1	develop C++ programs using classes and objects and demonstrate operator overloading and inheritance.												BT Mapped (Highest Level) Applying (K3), Precision (S3)	
CO2	implement the concepts of pointers, virtual and friend functions.												Applying (K3), Precision (S3)	
CO3	demonstrate the usage of Files, Template and Exceptions.												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	3	1	2	2							3	3
CO2	3	2	3	1	2	2							3	3
CO3	3	2	3	1	2	2							3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

22ISL32 - DATA STRUCTURES LABORATORY														
Programme & Branch		M.Sc & Software Systems					Sem.	Category		L	T	P	Credit	
Prerequisites		Nil					3	PC		0	0	4	2	
Preamble		This course provides knowledge to develop applications using the concepts of Linear and Non-linear Data Structures.												
LIST OF EXPERIMENTS / EXERCISES:														
1.	a) Implementation of singly linked list and its operations. b) Implementation of doubly linked list and its operations.													
2.	Program to implement stack operations using linked list.													
3.	Application of stack – parentheses checker.													
4.	Program to implement queue operations using linked list.													
5.	a) Program to implement binary tree traversal. b) Program to implement binary search tree operations.													
6.	Program to implement AVL tree operations.													
7.	Program to implement graph traversal techniques.													
8.	Program to implement searching techniques													
9.	Program to implement sorting algorithms.													
10.	Program to implement hash tables.													
														Total: 60
REFERENCES/ MANUAL /SOFTWARE:														
1.	Operating System : Windows / Linux													
2.	Software : C													
3.	Laboratory Manual													
COURSE OUTCOMES: On completion of the course, the students will be able to														
CO1	adapt the appropriate data structure for solving the given problem.												BT Mapped (Highest Level) Applying (K3), Manipulation (S2)	
CO2	use a data structure to implement another data structure.												Applying (K3), Manipulation (S2)	
CO3	synthesize operations like searching, insertion, deletion and traversing on various data structures.												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	1									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

22ISL33 - UNIX AND SHELL PROGRAMMING LABORATORY

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	3	PC	0	0	2	1

Preamble	To emphasis on Unix commands and make students to learn fundamentals of shell scripting and shell programming.
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LIST OF EXPERIMENTS / EXERCISES:

1.	Practice some basic UNIX commands.
2.	UNIX commands for file operations.
3.	Implement decision making statements using shell script.
4.	Implement looping statements using shell script.
5.	Write a program using the system calls of UNIX operating system process management.
6.	Implement interprocess communication using pipes and message queues.
7.	Write a program using file system related system calls to create, open, read, write, seek into, close files and open, write, search, close directories.
8.	Given the list of processes, their CPU burst times and arrival times, compute and print the average waiting time and average turnaround time using FCFS scheduling.
9.	Implement the page replacement algorithm using FIFO.
10.	Implementation of Bankers algorithm for the purpose of deadlock avoidance.

Total: 30

REFERENCES/ MANUAL /SOFTWARE:

1.	Unix operating system.
2.	C/C++ Compiler.
3.	Lab Manual

COURSE OUTCOMES:

COURSE OUTCOMES:
On completion of the course, the students will be able to

**BT Mapped
(Highest Level)**

CO1	execute basic unix/linux commands.	Applying (K3), Precision (S3)
CO2	demonstrate shell programs in unix operating system and implement system calls using c.	Applying (K3), Precision (S3)
CO3	experiment scheduling, page replacement and bankers algorithms using c.	Applying (K3), Precision (S3)

Mapping of Cos with POs and PSOs

[illegible]

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

22IST41 - PYTHON PROGRAMMING AND FRAMEWORKS

Programme & Branch	MSc - SOFTWARE SYSTEMS	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	4	PC	3	0	0	3

Preamble	This course provides an introduction to Python programming and skills to develop solutions for different real world problems using Python concepts. It also explores various packages for data manipulation and analysis.
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Unit – I	Basic Concepts:	9
Introduction – Variables, Expressions and Statements – Functions – Conditionals and Recursion – Fruitful Functions – Return Values – Incremental Development – Function Composition – Recursion – Iteration Statements – Strings – String Slices – Searching – Looping and Counting – String Methods – String Comparison.		

Unit – II	Data Structures:	9
Lists – List Operations – Slices and Methods – Dictionaries – Dictionaries as Collection of Counters – Looping and Dictionaries – Dictionaries and Lists – Tuples – Tuples Basics – Lists and Tuples – Dictionaries and Tuples – Sequences of Sequences – Case Study – Data Structure Selection – Files - Basic File Operations – Catching Exceptions - Databases.		

Unit – III	Object Oriented Programming:	9
Classes and Objects – Classes and Functions – Classes and Methods – Object-oriented Features – __init__() method – __str__() method – Operator Overloading – Type-based dispatch – Polymorphism – Interface and Implementation – Inheritance – Class Diagrams – Data Encapsulation.		

Unit – IV	Data Manipulation with NumPy Arrays:	9
NumPy: The Basics of NumPy Arrays – Computation on NumPy Arrays – Aggregations – Computation on Arrays: Broadcasting – Comparisons – Masks and Boolean Logic – Fancy Indexing - Sorting Arrays – Structured Data.		

Unit – V	Data Manipulation with Pandas and Visualization:	9
Data Manipulation with Pandas: Pandas Objects – Data Indexing and Selection – Operating on data – Handling missing data – Hierarchical Indexing – Concat and Append – Merge and Join – Aggregation and Grouping – Data Visualization with Matplotlib: Line plots: Line Colors and Styles – Axes Limits – Labeling Plots.		

		Total:45
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TEXT BOOK:

- | | |
|----|---|
| 1. | Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016 (Units I – III). |
| 2. | Jake Vander Plas, "Python Data Science Handbook Essential Tools for Working with Datall", 1st Edition, O'Reilly Publishers, India, 2016, for Unit IV & V. |

REFERENCES/ MANUAL / SOFTWARE:

- | | |
|----|---|
| 1. | Reema Thareja, Python Programming using Problem Solving Approachll, 1 st Edition, Oxford University Press,India, 2019. |
| 2 | Martin Brown. Python: The Complete Referencell, 4th Edition, Tata McGraw Hill Education, India, 2018. |

1.	Reema Thareja, Python Programming using Problem Solving Approachll, 1 st Edition, Oxford University Press,India, 2019.
2.	Martin Brown, Python: The Complete Referencell, 4th Edition, Tata McGraw Hill Education, India, 2018.

22IST42 – DATABASE MANAGEMENT SYSTEMS							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	PC	3	0	0	3
Preamble	To focus on database fundamentals, database designing and implementation of queries						
UNIT – I	Introduction:						9
Database System Applications – Purpose – View of Data – Data Models – Database Design and Database Engine – Database Architecture – Users and Administrators – Relational Model: Structure of Relational Databases- Database Schema – Keys – Schema Diagrams – Relational Query Languages – Relational Algebra.							
UNIT – II	SQL:						9
Introduction to SQL: SQL – Data Definition – Basic Structure – Basic Operations – Set Operations – Null Values and Aggregate Functions – Nested Sub Queries – Modification of Databases.							
UNIT – III	Intermediate SQL and ER modeling:						9
Join Expressions – Views – Transactions – Integrity Constraints – Triggers – SQL – Data Types and Schemas – Authorization – Database Design and ER Model – ER Diagrams – Complex Attributes – Mapping Cardinalities – Primary Key – Extended ER Features.							
UNIT – IV	Relational Database Design:						9
Features of Good Relational Designs – 1NF-Functional Dependencies-Decomposition Using Functional Dependencies – 2NF-Boyce Codd Normal Form – 3NF – Functional Dependency theory – Closure Set – Canonical Cover – Dependency Preservation.							
UNIT – V	Indexing and Hashing:						9
Physical Storage – Overview – RAID – Tertiary storage – File organization – Data dictionary – Indexing and Hashing – Basics Ordered indices – B+ tree index files – Hash Indices.							
							Total: 45
TEXT BOOK:							
1.	Silberschatz, Abraham, Korth, Henry F., S.Sudarshan, “Database System Concepts”, 7 th Edition, Mc Graw Hill, 2019.						
REFERENCES:							
1.	Ramez Elmasri, Shamkanth B.Navathe, “Fundamentals of Database Systems”, 7 th Edition, Pearson Education, 2016.						
2.	C.J.Date, A.Kannan, S.Swamynathan, “ An Introduction to Database Systems”, 8 th Edition Pearson Education, 2012.						

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	demonstrate the design and modelling of relational databases	Applying (K3)
CO2	implement SQL Queries and its operations for relational databases	Applying (K3)
CO3	design entity relationship modelling for real world problems	Applying (K3)
CO4	apply normalization techniques during database design	Applying (K3)
CO5	apply various indexing methods to sort files	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	2	2	3	3
CO2	3	2	1	1						2	2	2	3	3
CO3	3	2	1	1						2	2	2	3	3
CO4	3	2	1	1						2	2	2	3	3
CO5	3	2	1	1						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	-	40	60				100
CAT2	-	40	60				100
CAT3	-	40	60				100
ESE	-	40	60				100

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

22ISC41 - DESIGN AND ANALYSIS OF ALGORITHMS							
Programme & Branch	MSc-Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Data Structures	4	PC	3	0	2	4
Preamble	This course offers formal introduction to common algorithm design techniques and methods for analyzing the performance of algorithms.						
Unit – I	Introduction:						9+3
Algorithm - Fundamentals of Algorithmic Problem Solving - Important Problem Types. Fundamentals of the Analysis of Algorithm Efficiency: Analysis Framework - Asymptotic Notations and its properties - Mathematical analysis for Recursive and Non-recursive algorithms - Empirical analysis of algorithm - Algorithm visualization.							
Unit – II	Brute Force and Divide & Conquer:						9+3
Brute Force: Selection and Bubble Sort, Sequential search and String Matching - closest pair and convex hull problem. Divide and Conquer: Merge sort - Quick sort - Binary tree traversals and related properties - Multiplication of large integers and Strassen's Matrix Multiplication - closest pair and convex hull problem.							
Unit – III	Decrease & Conquer and Transform & Conquer:						9+3
Decrease & Conquer: Insertion sort - Topological Sorting - Fake coin problem - Computing a Median and the Selection Problem. Transform and Conquer: Presorting - Balanced search trees - AVL trees - 2-3 Trees - Heaps and Heap sort.							
Unit – IV	Dynamic Programming and Greedy Technique:						9+3
Dynamic Programming: Warshall's and Floyd's algorithm - Optimal Binary Search Trees - Knapsack Problem and Memory functions. Greedy Technique: Prim's algorithm - Kruskal's Algorithm - Dijkstra's Algorithm - Huffman Trees and codes.							
Unit – V	Backtracking and Branch & Bound:						9+3
Backtracking: n-Queens problem - Hamiltonian Circuit Problem - Subset Sum Problem. Branch and Bound: Assignment problem - Knapsack Problem - Traveling Salesman Problem - Overview of P, NP and NP-Complete Problems							
LIST OF EXPERIMENTS / EXERCISES:							
1.	Find the order of growth of the given problems. Identify the essential operation and count the times in which it is carried out						
2.	Analyze the different sorting algorithms and find out the best algorithm with respect to space and time						
3.	Make use of transform and conquer approach to sort 'n' numbers						
4.	Implement minimum spanning tree algorithm using greedy method						
5.	Construct the Huffman code for the given data. Also perform encoding and decoding (use Greedy technique)						
6.	Apply backtracking to solve the given instance of subset sum problem						
7.	Solve the travelling salesman problem of the given graph using branch and bound technique						
Lecture:45, Practical:30, Total:75							
TEXT BOOK:							
1.	Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3 rd Edition, Pearson Education, 2018.						
REFERENCES/ MANUAL / SOFTWARE:							
1.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3 rd Edition, Prentice Hall of India, 2022.						
2.	Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2 nd Edition, Orient Black Swan Pvt. Ltd., Hyderabad, 2018.						
3.	Operating System : Windows / Linux						
4.	Software : C, JAVA						
5.	Laboratory Manual						

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	analyse the efficiency of algorithms using various frameworks	Analyzing (K4) Precision (K3)
CO2	apply brute force and divide-and-conquer techniques to solve various problems	Applying (K3) Precision (K3)
CO3	make use of decrease-and-conquer and transform-and-conquer strategies for solving problems	Applying (K3) Precision (K3)
CO4	demonstrate dynamic programming and greedy techniques for real time applications	Applying (K3) Precision (K3)
CO5	solve combinatorial problems with backtracking and branch & bound techniques	Applying (K3) Precision (K3)

Mapping of COs with POs and PSOs

[illegible]

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	80				100
CAT3	-	20	80				100
ESE	-	20	70	10			100

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

22IST43 - ARTIFICIAL INTELLIGENCE							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Data Structures	4	PC	3	0	0	3
Preamble	The course focuses on search methods and the methodology of how to translate a data driven business problem into an effective solution by using the powerful AI technologies.						
Unit – I	Introduction, Overview of Artificial intelligence:						9
Problems of AI – AI technique – Tic - Tac-Toe problem. Intelligent Agents: Agents & environment – nature of environment – structure of agents – goal-based agents – utility-based agents – learning agent.							
Unit – II	Search Techniques:						9
Problem solving agents – searching for solutions – uniform search strategies: breadth first search – depth first search – depth limited search – bidirectional search – comparing uniform search strategies. Heuristic search strategies: Greedy best-first search – A* search– AO* search–memory bounded. Heuristic functions.Local search algorithms & optimization problems: Hill climbing search – simulated annealing search – local beam search.							
Unit – III	Adversarial search and Constraint Satisfaction Problems:						9
Adversarial search: Games – optimal decisions in games – alpha-beta pruning. Constraint Satisfaction Problem: Defining Constraint Satisfaction Problem – Constraint propagation – Backtracking Search for CSPs – Local search for CSP–The structure of problems.							
Unit – IV	Knowledge & Classical Planning:						9
Logic agents: Knowledge based agents – The Wumpus world problem – Logic & propositional logic – Propositional theorem proving – Effective propositional model checking – Agents based on propositional logic. First Order Logic – Inference in First Order Logic – Classical Planning: Definition of classical planning – Algorithms for planning as state space search – Planning graphs – Other planning approaches – Analysis.							
Unit – V	Planning & Probabilistic Reasoning:						9
Planning and Acting in Real world: Time, Schedules and resources – hierarchical planning – Planning and acting in nondeterministic domains. Probabilistic Reasoning: Representing knowledge in uncertain domain – Semantics of Bayesian network – Efficient representation of conditional distributions – Exact inference in Bayesian Networks – Approximate Inference in Bayesian Networks – Relational and First – Order probability models – Other approached to Uncertain Reasoning.							
							Total: 45
TEXT BOOK:							
1.	Russell, S. and Norvig, P. Artificial Intelligence - A Modern Approach, 3 rd Edition, Prentice Hall.,2015.						
REFERENCES:							
1.	Ric, E., Knight, K and Shankar, B. Artificial Intelligence, 3 rd Edition, Tata McGraw Hill. 2009.						
2.	Luger, G.F.. Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6 th Edition, Pearson, 2008.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	describe the foundations of AI methods											Understanding(K2)		
CO2	analyze and illustrate how search algorithms play vital role in problem solving											Applying(K3)		
CO3	apply basic principles of AI in solutions that require problem solving, inference, perception and outline the concepts of Constraint Satisfaction problems											Applying(K3)		
CO4	demonstrate knowledge of reasoning and knowledge representation for solving real world problems											Applying(K3)		
CO5	implement searching algorithm, planning techniques and problem solving with 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	3	2	1	1									3	1
CO2	3	2	1	1									3	1
CO3	3	2	1	1									3	1
CO4	3	2	1	1									3	1
CO5	3	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	-		60		40								100	
CAT2	-		45		55								100	
CAT3	-		45		55								100	
ESE	-		45		55								100	
* ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)														

22ISC42 - COMPUTER NETWORKS							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	PC	3	0	2	4
Preamble	This course provides an overview of the basics of data communications and networking. The course presents the top-down approach of layers and also the functionalities and protocols of different layers						
Unit – I	Introduction to the Internet:						9
Internet – Network edge: Access networks – Physical media – Network core: Packet switching – Circuit switching – Network of networks – Delay, loss and throughput in packet – switched networks – Protocol layers and their service models.							
Unit – II	Application Layer:						9
Principles of Network applications – The web and HTTP – Electronic mail in the internet – DNS-Internet's directory service – Peer-to - Peer File Distribution – Video Streaming and Content Distribution Networks.							
Unit – III	Transport Layer:						9
Introduction and transport layer services – Multiplexing and Demultiplexing – Connectionless transport: UDP – Principles of reliable data transfer – Connection-oriented transport: TCP – Principles of congestion control –TCP congestion control							
Unit – IV	Network Layer:						9
Overview – Inside a router – Internet Protocol (IP): IPv4, Addressing, IPv6 – Generalized forwarding and SDN – Routing algorithms: Link-State and Distance-Vector – Intra-AS routing in the Internet: OSPF – Routing among the ISPs: BGP – The SDN control plane – ICMP							
Unit – V	Link Layer and LAN:						9
Introduction to Link layer – Error detection and correction – Multiple access links and protocols – Switched LAN – Link Virtualization: A Network as a Link Layer – Data Center Networking – Security in Computer Networks: Introduction to Network Security – Principles of Cryptography.							
List of Exercises / Experiments							
1.	Installation and exploration of the packet analyzer/protocol analyzer tool Wireshark						
2.	Capture HTTP packets by retrieving different HTML files and experiment HTTP GET/POST connections and HTTP authentication using Wireshark						
3.	Capture the DNS packets produce the details of DNS query and response messages using Wireshark						
4.	Capture packet traces by retrieving an HTML file and investigate the operations of Ethernet protocol and the ARP protocol using Wireshark						
5.	Create TCP based network applications						
6.	Create UDP based network applications						
7.	Perform file transfer to remote server						
Lecture: 45, Practical: 30, Total: 75							
TEXT BOOK:							
1.	Kurose James F. and Ross Keith W., “Computer Networking: A Top-Down Approach”, 8 th Edition, Pearson Education, NewDelhi, 2020						
REFERENCES:							
1.	Andrew S. Tanenbaum, David J. Wetherall, “Computer Networks”, 6 th Edition, Pearson Education, 2021.						
2.	Behrouz A. Forouzan, “Data Communications and Networking”, 5 th Edition, McGraw Hill Education, 2017.						

COURSE OUTCOMES: On completion of the course, the students will be able to													BT Mapped (Highest Level)	
CO1	explain the fundamentals of internetworking and evaluate network QoS parameters												Applying (K3), Precision (S3)	
CO2	develop client-server applications using UDP/TCP socket program and explain various standard application layer protocols												Applying (K3), Precision (S3)	
CO3	apply congestion control techniques and explain transport layer services												Applying (K3), Precision (S3)	
CO4	make use of the knowledge of Internet Protocol, addressing schemes and apply various routing protocols for a given network scenario												Applying (K3), Precision (S3)	
CO5	determine suitable data link layer techniques and protocols												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	1	2								3	3
CO2	3	2	1	1	2								3	3
CO3	3	2	1	1	2								3	3
CO4	3	2	1	1	2								3	3
CO5	3	2	1	1	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	-		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)														

22ISL41 – PYTHON PROGRAMMING AND FRAMEWORKS LABORATORY

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	PC	0	0	2	1

Preamble	This course provides knowledge to solve real time problems using OOP concepts in python and to perform data manipulation and visualization using python packages.
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LIST OF EXPERIMENTS / EXERCISES:

1.	Develop programs using control structures
2.	Explore string manipulation functions
3.	Write programs using list, tuple and dictionary
4.	Write a python script using class and object
5.	Develop programs using inheritance
6.	Develop programs using exception handling
7.	Implement the concept of Encapsulation and Polymorphism
8.	Develop program to perform file operation
9.	Perform data manipulation using NumPy in Anaconda framework
10.	Demonstrate Data Visualization using Pandas and Matplotlib in Anaconda framework

Total: 30

REFERENCES/ MANUAL /SOFTWARE:

1.	Operating System : Windows / Linux
2.	Software : Anaconda Framework
3.	Laboratory Manual

COURSE OUTCOMES:	BT Mapped
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On completion of the course, the students will be able to	21 mapped (Highest Level)
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[illegible]

CO1	develop applications using control structures and functions.	Applying (K3) Precision(S3)
CO2	develop real time applications using Object Oriented Programming concepts.	Applying (K3) Precision(S3)
CO3	demonstrate data manipulation and data visualization using Numpy, Pandas and Matplotlib	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	1	3					2	2	2	3	1
CO2	3	2	1	1	3					2	2	2	3	1
CO3	3	2	1	1	3					2	2	2	3	1

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

22ISL42 - DATABASE MANAGEMENT SYSTEMS LABORATORY														
Programme & Branch		M.Sc & Software Systems						Sem.	Category	L	T	P	Credit	
Prerequisites		Nil						4	PC	0	0	2	1	
Preamble		To focus on implementation of database queries												
LIST OF EXPERIMENTS / EXERCISES:														
1.	Implementation of Data Definition statements, Data Manipulation and Keys													
2.	Apply commit, rollback and check points													
3.	Implementation of Data Control Statements													
4.	Perform Set and Join Operations													
5.	Perform Complex queries													
6.	Creating Views and index													
7.	Perform the Nested subqueries													
8.	Creating triggers in PL/SQL													
9.	Apply cursors in PL/SQL													
10.	Implementation of Exception Handling													
														Total: 30
REFERENCES/ MANUAL /SOFTWARE:														
1.	Laboratory Manual													
COURSE OUTCOMES: On completion of the course, the students will be able to														
CO1	implement creation of tables with key constraints												BT Mapped (Highest Level)	
CO2	use queries for data manipulation												Applying (K3), Precision (S3)	
CO3	implement triggers and cursors												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	3	1	2	2				2	2	2	3	3
CO2	3	2	3	1	2	2				2	2	2	3	3
CO3	3	2	3	1	2	2				2	2	2	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

22ISL43 - COMMUNICATION SKILLS DEVELOPMENT LABORATORY

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	4	HS	0	0	2	1

Preamble	This course is designed to impart necessary skills to listen, speak, read and write in order to obtain better professional communication skills.
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LIST OF EXPERIMENTS / EXERCISES:

1.	Self Introduction & Mock Interview
2.	Job Application letter with Resume
3.	Presentation: A Technical topic / Project report &a Case study
4.	Situational Dialogues / Telephonic Conversations
5.	Group Discussion
6.	Reading Aloud
7.	Listening Comprehension
8.	Writing Company Profiles
9.	Preparing reviews of a book/product/movie
10.	Pronunciation Test

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	Orell Digital Language Lab Software

COURSE OUTCOMES:

On completion of the course, the students will be able to

**BT Mapped
(Highest Level)**

CO1	enhance effective listening and reading skills	Understanding (K2), Imitation (S1)
CO2	acquire professional skills required for workplace/higher education	Applying (K3), Naturalization (S5)
CO3	use English language skills effectively in various situations	Applying (K3), Articulation (S4)

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	1	1
CO2									2	2		2	1	1
CO3									2	2		2	1	1

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

22IST51 - JAVA PROGRAMMING

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Object Oriented Programming with C++	5	PC	3	0	0	3

Preamble	To articulate the object-oriented programming concepts in core java.						
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Unit – I	Class and Objects	9
An overview of Java – Arrays – String – String Buffer – String Builder. Class Fundamentals – Declaring Objects and Methods – Constructor – this Keyword – Garbage Collection – Overloading methods and Constructors – Inheritance.		

Unit – II	Interfaces, Packages and Collections:	9
Method Overriding – Abstract Class – final with Inheritance – Packages – Interfaces – Using static methods in an Interface. Collections: List – Set – Queue – Map – Legacy Classes and Interfaces		

Unit – III	Exceptions, Multithreading and Java Networking:	9
Exception Handling – Fundamentals – types – try and catch – Multiple Catch – throw, throws and finally – Creating own Exceptions. Multi-threading - Java Thread model – Main thread – Creating Thread – Creating Multiple Thread – Thread Priority – Synchronization. Java Networking: RMI – Client Server Application using RMI.		

Unit – IV	Regex, Streams and JavaFX:	9
Regular Expression: Pattern class – Matcher Class Exploring Regular Expressions. Streams: Stream Interfaces – Reduction Operations – Parallel Streams – Mapping – Collecting Iterator and Streams. JavaFX: Architecture – 2D & 3D Shapes – Animations – Colors – Text – UI Controls.		

Unit – V	Springboot:	9
Spring Boot: Introduction - Microservices - 12-factor app - Spring Initializr - Spring Boot Starter Dependencies - Spring and Spring Boot Annotations- Building application using Maven and Gradle.		

Total:45

TEXT BOOK:

1.	Schildt Herbert, “Java – The Complete Reference”, 11th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2018, for Units I, II, III , IV
2.	Shagun Bakliwal, “Hands-on Application Development using Spring Boot: Building Modern Cloud Native Applications by Learning RESTFul API, Microservices, CRUD Operations, Unit Testing, and Deployment”, BPB Publications, 1st Edition, 2021, for Unit V.

REFERENCES:

1.	Deitel and Deitel, “Java How to Program”, 11th Edition, Pearson, New Delhi, 2019
2.	Claudio and Greg, “Developing Java Applications with Spring and Spring Boot”, Packt Publishing Ltd, 2018.
3.	M. Heckler, “JavaFX 8: Introduction by Example”, Second Edition, Apress

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	implement the basic concepts, class, objects and constructors in java programming.	Applying (K3)
CO2	develop programs interfaces, packages and collections.	Applying (K3)
CO3	make use of exception handling and threads and RMI to solve logical building problems.	Applying (K3)
CO4	implement the concept of regular expression, streams and JavaFX.	Applying (K3)
CO5	build real world applications using spring boot and its capabilities.	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	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1	2				1				3	3
CO5	3	2	1	1					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	-	20	80				100
CAT2	-	20	80				100
CAT3	-	20	80				100
ESE	-	24	76				100

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

22IST52 – WEB TECHNOLOGY

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Web Programming	5	PC	3	0	0	3

Preamble	This course provides an insight into Bootstrap5, MongoDB and Server-Side JS Framework. The course also addresses the application of ReactJS for developing web applications.
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Unit – I	UI Design & BOOTSTRAP5 (BS5):	9
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Introduction to BS5 – Containers – Typography – Colors – Tables – Images – Jumbotron – Alerts – Buttons - Button Groups - Progress Bars – Pagination - List Groups – Dropdowns – Collapse – Navs – Navbar – Carousel – Offcanvas - BS5 Forms: Select Menus - Checks and Radios – Range – Input Groups – Floating Labels – Form Validation.

Unit – II	MongoDB:	9
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MongoDB Overview – Advantages – Environment – Data Modeling – Create Database – Drop Database – Create Collection – Drop Collection – Data Types – Insert Document – Query Document – Update Document – Delete Document – Projection – Limiting Records – Sorting Records – Indexing – Aggregation – Case Study.

Unit – III	Server-side JS Framework:	9
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Node JS: Introduction – Architecture – Features – Creating Web Servers with HTTP Request – Response – Event Handling – GET and POST Methods – Modules – Express: Routing Middleware – Error Handling – Connect to NoSQL Database using Node JS – Implementation of CRUD operations.

Unit – IV	ReactJS Basics:	9
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React: Introduction – Installation – create React app – components – state – props - props validation – state vs props – constructor – Component API – Component Life cycle – Forms – controlled and uncontrolled component – Events – conditional rendering.

Unit – V	ReactJS Animation and API:	9
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ReactJS: list – keys – refs – Fragments - Router – CSS – Animation – Map – Table – Code splitting – hooks – useState- useEffect - useContext.

Total:45

TEXT BOOK:

1.	Daniel Charles Foreman, "Bootstrap 5 Foundations", 1 st Edition, Amazon Digital Services LLC - KDP Print US, 2021, for Unit I.
2.	Kristina Chodorow, "MongoDB-The definition guide", 3 rd Edition, Oreilly, 2019, for Unit II
3.	Robin Wieruch, "Road To React: Your Journey To Master React.js in JavaScript", 1 st Edition, 2022, for Units III, IV , V

REFERENCES:

1.	https://www.w3schools.com .
2.	https://tutorialspoint.com .
3.	Infosys campus connect material.
4.	https://www.javatpoint.com .

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	design static web pages using Bootstrap5.	Applying (K3)
CO2	identify the significant features of mongodb database	Applying (K3)
CO3	develop a web application using node JS with database connectivity.	Applying (K3)
CO4	apply the features of React to develop web applications.	Applying (K3)
CO5	utilize client side JS framework to develop web applications	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	3				2				3	3
CO2	3	2	1	1	3				2				3	3
CO3	3	2	1	1	3				2				3	3
CO4	3	2	1	1	3				2				3	3
CO5	3	2	1	1	3				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	-	15	85				100
CAT2	-	15	85				100
CAT3	-	15	85				100
ESE	-	20	80				100

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

22ISC51 – DATA MINING							
Programme& Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Database Management Systems	5	PC	3	0	2	4
Preamble	To articulate the data mining and data warehousing concepts and implement the various algorithmic techniques of data mining.						
Unit – I	Introduction to Data Mining and Data Warehousing:						9
Introduction to Data Mining Systems – Evolution – Knowledge Discovery Process – Kinds of Data – Data Mining Techniques – Applications – Issues – Data Warehousing and Online Analytical Processing: Basic Concepts – Data Warehouse Modeling – Data Cube and OLAP.							
Unit – II	Data Preprocessing:						9
Data Objects and Attributes Types – Statistical Descriptions of Data – Data Visualization – Data Similarity and Dissimilarity Measures–Data Preprocessing: Data Cleaning–Data Integration–Data Reduction–Data Transformation and Data Discretization.							
Unit – III	Association Rule Mining:						9
Mining Frequent Patterns, Associations and Correlations: Frequent Item set Mining Methods – Pattern Evaluation Methods – Pattern Mining Multilevel, Multidimensional Space–Constraint-Based Frequent Pattern Mining.							
Unit – IV	Classification:						9
Decision Tree Induction – Bayes Classification Methods – Rule – Based Classification – Model Evaluation and Selection– Techniques to improve Classification Accuracy– Bayesian Belief Networks – Classification by Back propagation.							
Unit – V	Clusters Analysis:						9
Requirements – Partitioning Methods – Hierarchical Methods – Density-Based Methods – Grid-Based Methods – Evaluation of Clustering – Outliers and Outlier Analysis – Outlier Detections Methods.							
LIST OF EXPERIMENTS / EXERCISES:							
1.	Perform data cleaning for a given data set.						
2.	Perform data reduction for a given data set.						
3.	Perform data transformation for a given data set.						
4.	Extract the frequent itemset using Apriori algorithm.						
5.	Find the strong association rule for the frequent itemset found.						
6.	Find the classification rule and classification accuracy using decision tree, Bayesian classification and back propagation algorithm.						
7.	Implement the partition-based clustering algorithm.						
Lecture: 45, Practical: 30, Total: 75							
TEXT BOOK:							
1.	JiaweiHan, Micheline Kamber, Jian Pei, “Data Mining Concepts and Techniques”, 3 rd Edition, Elsevier, 2016.						
REFERENCES/ MANUAL / SOFTWARE:							
1.	K.P. Soman, Shyam Diwakar, V. Ajay, “Insight into Data mining Theory and Practice”, Easter Economy Edition, Prentice Hall of India, 2014.						
2.	G.K.Gupta, “Introduction to Data Mining with Case Studies”, 3 rd Edition, Easter Economy Edition, Prentice Hall of India, 2014.						
3.	Laboratory Manual						
4.	R Tool / Python						

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	use data mining techniques in various applications	Applying (K3), Precision (S3)
CO2	implement the various preprocessing techniques and apply to clean the given data set.	Applying (K3), Precision (S3)
CO3	articulate frequent item sets in association rule mining and calibrate it for the given data set.	Applying (K3), Precision (S3)
CO4	apply the various classification methods and techniques to improve accuracy.	Applying(K3), Precision (S3)
CO5	demonstrate the clustering methods and detect outliers using outlier detection methods for the given data set.	Applying (K3), Precision (S3)

Mapping of COs with POs and PSOs

[illegible]

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

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

22IST53 - PRINCIPLES OF COMPILER DESIGN							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PC	3	0	0	3
Preamble	This course provides insight into the compiler construction process as well as the design techniques for the given programming language.						
Unit – I	Basics of Compilers:						9
Introduction: Language Processors–The structure of a compiler. Lexical Analysis: The Role of the Lexical Analyzer–Input Buffering–Specification of Tokens–Recognition of Tokens– The Lexical–Analyzer Generator Lex.							
Unit – II	Syntax Analysis:						9
Introduction– Context–Free Grammars– Writing a Grammar– Top–Down Parsing– Bottom–Up parsing. Introduction to LR Parsing: Simple LR – More Powerful LR Parsers.							
Unit – III	Intermediate Code Generation:						9
Three Address Code– Types and Declarations– Translation of Expressions– Control Flow– Back patching–Switch Statements–Intermediate code for Procedure.							
Unit – IV	Machine –Independent Optimizations:						9
The Principal Sources of Optimization– Introduction to Data–Flow Analysis– Peephole Optimization. Run–Time Environments: Storage organization– Stack allocation of space– Heap Management– Introduction to garbage collection.							
Unit – V	Code Generation:						9
Issues in the design of a code generation – The target Language – Addresses in the Target code – A simple code Generator–Register allocation and assignment.							
Total: 45							
TEXT BOOK:							
1.	Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques and Tools", 2 nd Edition, Pearson Education, New Delhi, 2020.						
REFERENCES:							
1.	Srikant Y.N. and Priti Shankar, "The Compiler Design Handbook: Optimizations and Machine Code Generation", 2 nd Edition, CRC Press, 2008.						
2.	V. Raghavan, "Principles of Compiler Design", Tata McGraw Hill Education Publishers, 2010.						

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	implement lexical analysis for the given source program.	Applying(K3)
CO2	design syntax-analyzer for the given grammar.	Applying(K3)
CO3	develop intermediate code for the given source program.	Applying(K3)
CO4	employ optimization techniques for the given intermediate code	Applying(K3)
CO5	determine the target code generation process of compiler.	Applying(K3)

Mapping of COs with POs and PSOs

[illegible]

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	80				100
CAT2	-	20	80				100
CAT3	-	20	80				100
ESE	-	20	80				100

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

22IST54 – AGILE METHODOLOGIES							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Fundamentals of Software Engineering	5	PC	3	0	0	3
Preamble	To focus on Agile project planning, estimation and management tools.						
Unit – I	Introduction:						9
Introduction to Agile Project Management – Agile Early History – Agile Manifesto – Values and Principles – Scrum Overview –Scrum Roles – Principles – Values.							
Unit – II	Agile Planning:						9
Planning Requirements and Product Backlog – Agile Planning Practices – Agile Requirements Practices – User Personas and Stories – Product Backlog – Agile Software Development Practices – Agile Quality Management Practices – Agile Testing Practices.							
Unit – III	Agile Project Management:						9
Time-Boxing – Kanban Process – Theory of Constraints – Agile Estimation Overview – Estimation Practices – Burn-Down and Burn-Up Charts – Agile Project Management – Shifts in Thinking – Potential Agile Project Management Roles.							
Unit – IV	Agile Communications and Tools:						9
Agile Communications Practices – Agile Project Management Tools – Product/Project Planning – Release and Sprint Planning – Sprint Tracking – Understanding Agile at a Deeper Level Systems Thinking – Influence of Total Quality Management (TQM) – Influence of Lean Manufacturing.							
Unit – V	Scaling Agile Projects:						9
Scaling Agile to an Enterprise Level Enterprise-Level – Agile Challenges – Enterprise-Level Obstacles to Overcome – Enterprise-Level Implementation Considerations – Enterprise-Level Management Practices – Adapting an Agile Approach to Fit a Business: The Impact of Different Business Environments on Agile – Typical Levels of Management – Corporate Culture and Values.							
Total: 45							
TEXT BOOK:							
1.	Charles G. Cobb, “The Project Manager’s Guide to Mastering Agile: Principles and Practices for an Adaptive Approach”, JohnWiley & Sons, Inc. Publications, Hoboken, New Jersey, 2015						
REFERENCES:							
1.	By Alan Moran, “Managing Agile: Strategy, Implementation, Organization and People”, Springer, New York, 2015						
2.	Roman Pichler, “Agile Product Management with Scrum Creating Products That Customers Love” Pearson Education, NewDelhi. 2010						

22ISL51 – JAVA PROGRAMMING LABORATORY

Programme & Branch	M .Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Object Oriented Programming with C++	5	PC	0	0	2	1

Preamble	To provide knowledge on object oriented programming concepts and core Java Programming.
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LIST OF EXPERIMENTS / EXERCISES:

1.	Implement Simple Java Programs using Arrays.
2.	Implement different operations using string and string buffer.
3.	Implement Inheritance and interface using class and objects
4.	Create and implement User – Defined Packages
5.	Develop Java Program using Collections
6.	Develop various applications by handling exceptions
7.	Implement multi-tasking concepts using threads
8.	Implement RMI to access Remote methods.
9.	Develop the graphics applications using JavaFX
10.	Building application using Maven and Gradle

Total:30

REFERENCES/ MANUAL /SOFTWARE:

1.	Laboratory Manual
2.	https://docs.oracle.com/javase/tutorial/

COURSE OUTCOMES:

On completion of the course, the students will be able to

**BT Mapped
(Highest Level)**

CO1	execute simple Java applications using classes and objects, inheritance, interfaces.	Applying (K3) Precision (S3)
CO2	demonstrate the execution of Java programs using packages, exception handling, multithreading, RMI and JavaFX.	Applying (K3) Precision (S3)
CO3	develop springboot application using maven and gradle.	Applying (K3) Precision (S3)

Mapping of Cos with POs and PSOs

[illegible]

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

22ISL52 – WEB TECHNOLOGY LABORATORY

Programme & Branch	M .Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PC	0	0	2	1

Preamble	This course is designed to impart the knowledge to design and implement static and dynamic websites for real time applications.
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LIST OF EXPERIMENTS / EXERCISES:

1.	Design a responsive website using Bootstrap5.
2.	Design a registration form using Bootstrap5 and perform form validation.
3.	Create a database and collections using MongoDB. Perform insertion, deletion and update operations in a document.
4.	Design a web application by creating web Servers with HTTP Request and Response using Node.js.
5.	Develop simple login page by performing event handling using GET and POST method in Node.js.
6.	Design a simple calculator using “Modules” in Node.js.
7.	Design a webpage to maintain personal information using CRUD operations in MongoDB.
8.	Design a web application using components in ReactJS.
9.	Design a reactive form to maintain personal information and perform validation using ReactJS.
10.	Implement Hooks in ReactJS.
10.	Mini Project.

	Total: 30
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REFERENCES/ MANUAL /SOFTWARE:	
1.	Laboratory Manual
2.	Visual Studio code/ GEdit, Node JS+NPM, MongoDB
3.	ReactJS

COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
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On completion of the course, the students will be able to		(Highest Level)
CO1	develop interactive web pages using HTML, CSS, JavaScript and Bootstrap5	Applying (K3),

CO1	develop interactive web pages using HTML, CSS, JavaScript and Bootstraps.	Precision (S3)
CO2	develop a web application to maintain information in a database using server-side scripting.	Applying (K3), Precision (S3)
CO3	apply the concepts of ReactJS to design web applications.	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	1	2				3	3	3	3	3	3
CO2	3	2	1	1	2				3	3	3	3	3	3
CO3	3	2	1	1	2				3	3	3	3	3	3

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

22IST61 – MACHINE LEARNING							
Programme& Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Data Mining and Data Warehousing	6	PC	3	0	0	3
Preamble	This course focuses on finding patterns from empirical data.It also explores techniques on supervised, unsupervised learning algorithms and reinforcement learning.						
Unit – I	Introduction:						9
Learning Problems – Designing a Learning System – Perspectives and Issues in Machine Learning. Concept Learning: Task – Search – Finding Maximally Specific Hypotheses – Version Spaces and Candidate Elimination Algorithm – Remarks on version spaces and Candidate Elimination – Inductive Bias.							
Unit – II	Supervised Learning – Prediction:						9
Regression: Linear Regression– Decision Tree Learning: Decision Tree Representation – Problems – Basic Decision Tree Learning Algorithms – Hypotheses Search –Inductive Bias- Issues. Artificial Neural Networks: Introduction – Representations – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithm – Example.							
Unit – III	Supervised Learning – Instance Based Learning:						9
Bayesian Learning: Bayes Theorem – Concept Learning – Maximum Likelihood and Least-Squared Error Hypothesis – Bayes Optimal Classifier – Gibbs Algorithm – Naive Bayes Classifier – Example – Instance Based Learning: Introduction – k-Nearest Neighbour Learning – Locally Weighted Regression – Radial Basis Functions – Case – Based Reasoning.							
Unit – IV	Evolutionary Learning:						9
Genetic Algorithms: Introduction – Example – Hypothesis Space Search – Genetic Programming – Models of Evolution and Learning – Parallelizing Genetic Algorithms. Genetic operators: Using Genetic Algorithms – Genetic Programming – Sampling with Evolutionary Learning.							
Unit – V	Learning Sets of Rules:						9
Learning Sets of Rules: Introduction – Sequential Covering Algorithms– First Order Rules – FOIL – Induction As Inverted Deduction – Inverting Resolution. Reinforcement Learning: Introduction – Markov Decision Processes – Values – SARSA vs Q-Learning.							
							Total:45
TEXT BOOK:							
1.	Tom M. Mitchell, “Machine Learning”, Indian Edition, McGraw-Hill Education (India), Chennai 2018, for Units I, II, III, first half-IV, V.						
2.	Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, 2 nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2015. for second half of Unit IV , V.						
REFERENCES:							
1.	Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das “Machine Learning”, 1 st Edition, Pearson, 2018.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	employ the perspectives of machine learning and formulate the hypothesis.											Applying (K3)		
CO2	apply regression, decision tree and artificial neural networks for real world problems.											Applying (K3)		
CO3	utilize parametric and non-parametric algorithms for solving a given problem.											Applying (K3)		
CO4	employ the principles of unsupervised learning and genetic algorithm for optimization.											Applying (K3)		
CO5	make use of algorithms for learning rules and outline reinforcement learning.											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									3	1
CO2	3	2	1	1									3	1
CO3	3	2	1	1									3	1
CO4	3	2	1	1									3	1
CO5	3	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	15		55		30								100	
CAT2	15		50		35								100	
CAT3	15		45		40								100	
ESE	10		35		55								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISC61 – C# AND .NET TECHNOLOGIES							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Object Oriented Programming with C++, Java Programming	6	PC	3	0	2	4
Preamble	To articulate the concepts of .Net and its platform in Model-View-Controller.						
Unit – I	Introduction to C#						9
Speaking C# - Understanding C# basics - Working with variables - Working with null values. Controlling Flow and Converting Types – Operating on Variables – Understanding Selection Statements – Understanding Iteration statements - Casting and Converting between Datatypes. Building Your Own Types with Object-Oriented Programming							
Unit – II	Object-Oriented Programming in C#						9
Implementing interface and inheriting classes – Implementing Interfaces – Inheriting from Classes. Understanding and Packaging .NET – Understanding .NET Core Components – Packaging libraries for NuGet Distribution. Working with common .net types							
Unit – III	ASP.NET Core Web Application using Razor Pages						9
The First ASP .NET Core Project – Anatomy of an ASP.NET core project – Dependency Injection Subsystem – Building a mini website. ASP .NET MVC Views – Razor Pages. Razor Syntax – Elements of Syntax – Razor Tag Helpers – Razor View Components.							
Unit – IV	Data Manipulation using Razor Pages						9
Design considerations – Dependency Injection infrastructure – Collecting Configuration Data – Layered Architecture – Dealing with Exceptions. Access to Application Data – Data Access in .NET Core – EF core common tasks.							
Unit – V	Designing Web API and ASP.NET Core Ecosystem						9
Designing Web API – Building a Web API with ASP .NET Core – Designing RESTful Interface – Securing a web API. ASP .NET Core Runtime Environment – ASP .NET core host – Embedded HTTP Server – ASP .NETcore middleware. Deploying an ASP .NET Core Application – Publishing – Deploying – Docker Containers							
LIST OF EXPERIMENTS / EXERCISES:							
1.	Implement Simple C# Programs using control statements, Arrays and Strings						
2.	Implement Inheritance and interface and packages using class and objects						
3.	Implement and Manage file system						
4.	Create a Windows application						
5.	Implementation of razor pages						
6.	Create a ADO.NET application and verify if the connection is established with OLEDB and DB						
7.	Create a ADO.NET applications to demonstrate the Data Reader, Data Set, Data Adapter and Data View Objects.						
8.	Host and deploy ASP.NET Core in a Windows Service						
Lecture:45, Practical:30, Total:75							
TEXT BOOK:							
1.	Mark J. Price, “C# 8.0 and .NET Core 3.0 – Modern Cross-Platform Development”, 4th Edition, Packt Publishing Limited, 2019, for Units I, II						
2.	Dino Esposito, “Programming ASP.NET Core”, 1st Edition, Pearson Education Inc., 2018 for Units III, IV, V						
REFERENCES/ MANUAL / SOFTWARE:							
1.	Herbert Schildt, “The Complete Reference: C# 4.0”, Tata McGraw Hill, 2012.						
2.	Christian Nagel et al. “Professional C# 2012 with .NET 4.5”, Wiley India, 2012.						
3.	Andrew Troelsen , “Pro C# 2010 and the .NET 4 Platform, Fifth edition, A Press, 2010						

COURSE OUTCOMES: On completion of the course, the students will be able to													BT Mapped (Highest Level)	
CO1	interpret the fundamental concept in c# programming language and make use of it in building applications.												Applying(K3) Precision (S3)	
CO2	develop programs using class, inheritance and interfaces for real time scenarios.												Applying(K3) Precision (S3)	
CO3	develop web pages for an application using asp.net platform.												Applying(K3) Precision (S3)	
CO4	perform data manipulation using razor pages.												Applying(K3) Precision (S3)	
CO5	deploy asp .net application in the cloud.												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	2	2		2								3	2
CO2	2	2	2		2								3	2
CO3	3	2	2		3	2							3	2
CO4	3	2	2		3	2			2				3	2
CO5	3	2	3		2	2			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	20		50		30								100	
CAT2	20		50		30								100	
CAT3	20		35		45								100	
ESE	10		50		40								100	
* ±3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)														

22ISC62 - INTERNET OF THINGS AND CLOUD COMPUTING

Programme & Branch	MSc - SOFTWARE SYSTEMS	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PC	3	0	2	4

Preamble	The course describes various communication protocols for IoT, IoT levels and design methodologies and illustrates the development of simple real time IoT applications. This course also demonstrates developing real-time IoT applications using AWS cloud services.
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Unit – I	Introduction to Internet of Things:	9
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Definition and Characteristics of IoT – Physical Design of IoT – IoT Protocols – IoT Communication Models – IoT Communication APIs – IoT Enabled Technologies – Wireless Sensor Networks – Communication Protocols –IoT Levels and Templates- IoT Levels and Templates – Domain Specific IoT- IoT and M2M - IoT Platform Design methodologies.

Unit – II	Infrastructure and Service Discovery Protocols for the IoT System	9
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Low Power Wide Area Networking Technologies - Layered Architecture of IoT-Protocol architecture of IoT Infrastructure Protocols – Device or Service Discovery for IoT – Protocols for IoT Service Discovery.

Unit – III	Python for IoT and Introduction to Raspberry Pi:	9
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Python packages for IoT-Introduction to Raspberry Pi – Interfaces (serial, SPI, 12C) Programming – Python program with Raspberry Pi (interfacing external devices) – controlling output – reading input from pins – connecting IoT to (Thing Speak) cloud.

Unit – IV	Cloud for IoT Applications:	9
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Unit - 11	Cloud for All Applications:	5
Cloud computing Service Models-Types of Cloud- Cloud Technology-Cloud Service Ecosystem-Cloud Enabled Environment-Cloud Inspired Enterprise Transformations- IoT and Cloud Inspired Smarter Environments- Hybrid Clouds- Federated Clouds-Special Purpose Clouds-The Emergence of Edge/Fog clouds-The Architectural Components of the Smarter Traffic System		

Unit – V	AWS IoT: Developing and Deploying in Internet of Things:	9
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Unit - 1	AWS IoT: Developing and Deploying in Internet of Things.	5
Introduction to AWSIoT-core-connecting to AWS IOT core – AWS IOT Tutorials – Managing devices with AWS IOT Tagging AWS IOT resources – Rules – Device shadow service – storing & retrieving sensor data using storage service – Creation of web based application for device communication		

LIST OF EXPERIMENTS / EXERCISES:

- | | |
|-----|--|
| 1. | Interface and control an LED with NODEMCU in online. |
| 2. | Simulating traffic light controller |
| 3. | Web page integration with Raspberry Pi |
| 4. | Sensing and sending the sensor value via SMS |
| 5. | Sending images and video via Gmail |
| 6. | Measuring sensor value and uploading the content onto cloud for analysis |
| 7. | Working with Cooja Simulator <ul style="list-style-type: none"> • Creating an IoT scenario • Sending data between an IoT client and server |
| 8. | Develop applications using Platform as a Service (like AWS greengrass/ AWS Elastic Bean Stack) |
| 9. | Develop applications implementing Infrastructure as a Service (like AWS s3) |
| 10. | Develop applications using Software as a Service (like AWS Lambda) |

Lecture:45, Practical:30, Total:75

TEXT BOOK:

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|----|--|
| 1. | Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands-on Approach", Universities Press, 2015 for Units I,II,III. |
| 2. | Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017, for Unit IV. |

REFERENCES/ MANUAL / SOFTWARE:

- | | |
|----|---|
| 1. | David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", 1st Edition, Cisco Press, 2017. |
| 2. | Rajkumar Buyya, James Broberg & Andrzej M. Goscinski, "Cloud Computing: Principles and Paradigms", Edition, Wiley,, 2013. |
| 3. | https://docs.aws.amazon.com/iot/latest/developerguide for Unit V. |

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	analyze the suitability of various IoT System levels in providing an IoT-based solution for a given problem											Applying (K3) Precision (S3)		
CO2	demonstrate the role of IoT protocols in building IoT applications											Applying(K3) Precision (S3)		
CO3	make use of Raspberry Pi and the supporting Python packages to develop real-time IoT applications											Applying(K3) Precision (S3)		
CO4	design smart applications using IoT with cloud computing services and deployment model											Applying(K3) Precision (S3)		
CO5	develop Real-time IoT applications using AWS cloud services											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
CO2	3	2	1										3	1
CO3	3	2	1										3	1
CO4	3	2	1										3	1
CO5	3	2	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		40		40								100
CAT2		20		40		40								100
CAT3		15		50		35								100
ESE		10		50		40								100
* ±3% may be varied (CAT 1,2 & 3 – 50 marks & ESE – 100 marks)														

22IST62 – CRYPTOGRAPHY AND NETWORK SECURITY

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PC	3	0	0	3

Preamble	It provides various cryptography techniques to encounter the data and network security.
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Unit – I	Introduction :	9
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OSI Security Architecture – Attacks – Services – Mechanisms – Model for Network Security – Symmetric Cipher Model – Substitution and Transposition Techniques – DES – Strengths – Block Cipher Design Principles – Advanced Encryption Standard.

Unit – II	Public Key Cryptography:	9
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Principles of Public Key Crypto Systems – RSA Algorithm – Diffie Hellman Key Exchange – Elgamal – Elliptic Curve Arithmetic – Elliptic Curve Cryptography.

Unit – III	Hash Functions:	9
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Cryptographic Hash Functions – Applications – Two Simple Hash Functions – Requirements and Security – Secure Hash Algorithm – Message Authentication Codes: Message Authentication Requirements – Functions – Message Authentication Code (MAC) – Security of MAC.

Unit – IV	Key Management and Distribution:	9
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Key Management and Distribution – Symmetric Key Distribution – Distribution of Public Keys – X.509 Certificates – Public Key Infrastructure – User Authentication – Remote User Authentication – Principles – Symmetric Encryption – Kerberos.

Unit – V	Network Security Practice:	9
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IP Security: Overview and Policy – ESP – Security Associations – Internet Key Exchange – Intruders – Intrusion Detection – Password Management – Malicious Software – Types – Viruses – Worms – Distributed Denial of Service Attacks.

	Total:45
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TEXT BOOK:

1.	Stallings William, "Cryptography and Network Security: Principles and Practice", 7 th Edition, Pearson Education, New York, 2017.
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REFERENCES:

1.	Behrouz A. Forouzan, "Cryptography and Network Security", 3 rd Edition, McGraw Hill, 2015.
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2.	Kaufman, Charlie, Perlman, Radia and Speciner, Mike, "Network Security–Private Communication in a Public World", 2 nd Edition, Pearson Education, 2016.
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COURSE OUTCOMES: On completion of the course, the students will be able to													BT Mapped (Highest Level)	
CO1	employ the methods of conventional encryption.												Applying(K3)	
CO2	articulate various public key cryptography mechanisms.												Applying(K3)	
CO3	demonstrate authentication mechanisms and hash functions.												Applying(K3)	
CO4	make use of various key distribution schemes for authentication.												Applying(K3)	
CO5	summarize security threats and counter measures.												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	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	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		15		35		50								100
CAT2		15		35		50								100
CAT3		15		40		45								100
ESE		10		45		45								100
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22IST63 - SOFTWARE QUALITY AND TESTING							
Programme& Branch	MSc - SOFTWARE SYSTEMS	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	6	PC	3	0	0	3
Preamble	To provide a basic foundation in software quality assurance and in-depth knowledge on various types of testing and exemplify the testcase writing.						
Unit – I	Software Quality Assurance and Review Techniques:						9
Software Quality in Global Business Context: Defining Quality – Quality Attributes. Software Quality Assurance Role in an Organization: Framework – QA v/s QC - Quality Assurance during SDLC Phases–SQA Function. Review Techniques: Need for Review – Structured Walkthroughs –Inspections – Comparison – Formats – Making Review Successful.							
Unit – II	White Box and Black Box Testing:						9
White Box Testing: Introduction – Static Testing – Structural Testing – Challenges In White Box Testing – Black Box Testing: Black Box Testing – Need - Procedure to do Black Box Testing – Requirements Based Testing – Positive and Negative Testing – Boundary Value Analysis – Decision Tables – Equivalence Partitioning – State–Based Testing – Compatibility Testing – User Documentation Testing - Domain Testing.							
Unit – III	Integration, System and Acceptance Testing:						9
Integration Testing: Introduction – Integration Testing as a Type and a Phase of Testing – Scenario Testing – Defect Bash. System and Acceptance Testing: Overview – Reason – Functional Versus Non-Functional Testing - Functional System Testing – Non-Functional Testing – Acceptance Testing – Testing Phases.							
Unit – IV	Performance, Regression Testing and Adhoc Testing:						9
Performance Testing: Introduction – Factors Governing Performance Testing – Methodology – Tools and Process for Performance Testing – Challenges. Regression Testing: Types – Methods to do Regression Testing – Best Practices. Ad hoc Testing: Overview – Buddy and Pair Testing – Exploratory and Iterative Testing – Agile and Extreme Testing – Defect Seeding.							
Unit – V	Test Management:						9
Test Planning, Management, Execution and Reporting: Introduction – Test Planning – Preparation – Scope – Strategy – Criteria – Identification – Tasks – Activity Breakdown and Scheduling – Communication and Risk Management - Test Management – Test Process – Test Reporting – Best Practices – Process – People – Technology.							
Total:45							
TEXT BOOK:							
1.	Nina S. Godbole, "Software Quality Assurance Principles and Practice", 2 nd Edition, Narosa Publishing House, 2017 for Unit I.						
2.	Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing: Principles and Practices", 1 st Edition, Pearson Education, New Delhi, 2020 for Units II, III, IV,V.						
REFERENCES:							
1.	Renu Rajani and Pradeep Oak, "Software Testing Effective Methods, Tools and Techniques", Tata McGraw Hill, New Delhi, 2013.						
2.	Perry William, "Effective Methods for Software Testing", 3 rd Edition, Wiley, India, 2013.						

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	Interpret the quality assurance steps at each phase of SDLC and demonstrate the process of reviews and inspections	Understanding(K2)
CO2	describe black box and white box testing techniques and design test cases in practice.	Applying(K3)
CO3	implement various levels of testing like integration, system and acceptance testing.	Applying(K3)
CO4	utilize the performance, regression testing tools and ad hoc testing strategies.	Applying(K3)
CO5	prepare test plan based on the document.	Applying(K3)

Mapping of COs with POs and PSOs

[illegible]

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	70	15				100
CAT2	15	55	30				100
CAT3	15	55	30				100
ESE	5	55	40				100

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

22ISL61 – MACHINE LEARNING LABORATORY

Programme& Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Python Programming and Frameworks	6	PC	0	0	2	1

Preamble	This course focuses on providing hand-on experience in designing and implementing machine learning algorithms for providing solutions to the real-world problems.
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LIST OF EXPERIMENTS / EXERCISES:

- | | |
|-----|---|
| 1. | Exploration of UCI repository datasets and tools like WEKA, Rapid Miner, etc., |
| 2. | Perform data manipulation using NumPy and pandas and data visualization using matplotlib. |
| 3. | Implement linear models to approximate the given data. |
| 4. | Find the attribute with maximum information gain and gain ratio for the given data. |
| 5. | Implement multi-layer perceptron algorithm and enhance it to other variations. |
| 6. | Implement Naïve Bayesian classification and predict the class label for the given data. |
| 7. | Implement K-NN algorithm for the specified data. |
| 8. | Implement K-means clustering algorithm for the given data and visualize and interpret the result. |
| 9. | Write a python program to implement Genetic operators. |
| 10. | Write a python program to implement Q-Learning algorithm for the given data. |

Total:30

REFERENCES/ MANUAL /SOFTWARE:

- | | |
|----|---|
| 1. | Laboratory manual |
| 2. | Weka/Rapid Miner/Python/Cloud Framework |

COURSE OUTCOMES:	BT Mapped
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On completion of the course, the students will be able to	BT mapped (Highest Level)
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COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
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CO1	Apply information theoretic approach for computing maximum information gain and gain ratio for the given data.	Applying (K3), Precision(S3)
CO2	Implement supervised and unsupervised learning algorithms in machine learning.	Applying (K3), Precision(S3)
CO3	Model the solutions for the given problem using Genetic Algorithms and reinforcement learning.	Applying (K3), Precision(S3)

Mapping of Cos with POs and PSOs

[illegible]

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

22ISP61 – MINI PROJECT

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit	
Prerequisites	Nil	6	EC	0	0	4	2	

		Total: 60
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COURSE OUTCOMES:
On completion of the course, the students will be able to

CO1	identify the requirements and apply the concepts of mathematics, science, engineering and management principles necessary to solve the real world problem.
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BT Mapped (Highest Level)	
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CO1	identify the requirements and apply the concepts of mathematics, science, engineering and management principles necessary to solve the real world problem.	Creating (K6), Precision (S3)
CO2	apply the engineering tools to solve the identified real world problem.	Creating (K6), Precision (S3)
CO3	analyze and interpret results of experiments conducted on the designed solution to arrive at valid conclusions.	Analyzing (K4), Precision (S3)
CO4	engage in effective written communication by presenting the technical project report.	Applying (K3), Precision (S3)
CO5	demonstrate an ability to work in the team and contribute to the team.	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	3	3	2	3	3	2	2	3	2	3	3
CO2	3	3	3	3	3	2	3	3	2	2	3	2	3	3
CO3	3	3	3	3	3	3	2	3	2	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	2	2	3	3	3	3	3	3	3	2	3	3	3	3

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

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	develop the soft skills of learners to support them work efficiently in an organization as an individual and as a team											Applying (K3), Precision (S3)		
CO2	solve real time problems using numerical ability and logical reasoning											Applying (K3), Precision (S3)		
CO3	apply communication skills effectively to understand and deliver information in various written discourses grammatically with accuracy											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				3	3		3		3	2	3	3
CO2	3	2				3	3		3		3	2	3	3
CO3		2				3	3		3	3	3	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	20	50	30				100							
CAT2		50	50				100							
CAT3		50	50				100							
ESE	NA													
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISP71 – PROJECT WORK - I														
Programme& Branch		M.Sc & Software Systems						Sem.	Category	L	T	P	Credit	
Prerequisites		Nil						7	EC	0	0	30	15	
Total:450														
COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	identify the requirements and apply the concepts of mathematics, science, engineering and management principles necessary to solve the real world problem.												Creating (K6), Precision (S3)	
CO2	apply the engineering tools to solve the identified real world problem.												Creating (K6), Precision (S3)	
CO3	analyze and interpret results of experiments conducted on the designed solution to arrive at valid conclusions.												Analyzing (K4), Precision (S3)	
CO4	engage in effective written communication by presenting the technical project report.												Applying (K3), Precision (S3)	
CO5	demonstrate an ability to work in the team and contribute to the team.												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	3	3	2	3	3	2	2	3	2	3	3
CO2	3	3	3	3	3	2	3	3	2	2	3	2	3	3
CO3	3	3	3	3	3	3	2	3	2	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	2	2	3	3	3	3	3	3	3	2	3	3	3	3
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

22GCL71 – PROFESSIONAL SKILLS TRAINING – II

Programme& Branch	M.Sc & SOFTWARE SYSTEMS	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	7	EC	0	0	80	2

Preamble	This subject is to enhance the employability skills and to develop career competency.
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Unit - I	Soft Skills – II:	20
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Group discussions: Advantages of group discussions – Structured GD – Team work: Value of team work in organizations – Definition of a team, why team – Elements of leadership, disadvantages of a team, stages of team formation – Group development 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 the end Mock interviews.

Unit - II	Quantitative Aptitude & Logical Reasoning – II:	30
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Problem solving level II: Money related problems – Mixtures – Symbol base problem – Clocks and calendars – Simple – linear – quadratic and polynomial equations – Special, equations – Inequalities – Sequence and series – Set theory – Permutations and combinations – Probability – Statistics – Data sufficiency – Geometry – Trigonometry – Heights and distances – Co-ordinate geometry – Mensuration. Logical reasoning: Conditionality and grouping – Sequencing and scheduling – Selections – Networks:- Codes: Cubes – Venn diagram in logical reasoning – Quant based reasoning – Flaw detection – Puzzles – Cryptarithms.

Unit - III	Reading & Speaking Skills:	30
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Reading: Reading comprehension – Effective Reading strategies – Descriptive, Inferential, & Argumentative reading passages – Identifying and locating factual information within a text – global reading/skimming for general understanding – selective comprehension / scanning for specific information – detailed comprehension / intensive reading – understanding the development of an argument – identifying the writer's attitude and opinions – Reading news articles in business magazines, newspapers – Reading notices and book reviews –Interpreting graphic data & Advertisements. Speaking: Mock Interviews –Self-Introduction – Sharing of Real Time Experience; Conversational Practices –Role Play – Short Talks / TED Talks –Extempore; Giving a Presentation on Various Topics – Technical / Non-Technical Topics – Project Review Presentation – Oratory and Effective Public Speaking; Pair Discussion – Group Discussion – The process of Group Discussion – Strategies to be adopted – Skills Assessed – Telephonic Conversations & Skills – Negotiating Skills.

		Total: 80
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TEXT BOOK:

1.	Thorpe, Showick and Edgar Thorpe, "Objective English For Competitive Examination", 6 th Edition, Pearson India Education Services Pvt Ltd. 2017.
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REFERENCES:

1.	Aruna Koneru, "Professional Speaking Skills," Oxford University Press India, 2015.
2.	Thorpe, Showick and Edgar Thorpe, "Winning at Interviews," 5 th edition, Pearson Education, India, 2013.
3.	Rizvi, Ashraf M, "Effective Technical Communication," 2 nd Edition, McGraw Hill Education India, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	develop the soft skills of learners to support them work efficiently in an organization as an individual and as a team											Applying (K3), Precision (S3)		
CO2	solve real time problems using numerical ability and logical reasoning											Applying (K3), Precision (S3)		
CO3	apply reading and speaking skills effectively 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				3	3		3		3	2	3	3
CO2	3	2				3	3		3		3	2	3	3
CO3		2				3	3		3	3	3	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	20	40	40				100							
CAT2		50	50				100							
CAT3		50	50				100							
ESE	NA													
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22IST81– DEEP LEARNING							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Machine Learning	8	PC	3	0	0	3
Preamble	This course is designed to impart the skills required to build different deep neural network architectures						
Unit – I	Training Deep Neural Networks:						9
Introduction - Backpropagation - Setup and Initialization Issues - Vanishing and Exploding Gradient Problems - Gradient Descent Strategies - Batch Normalization - Practical Tricks for Acceleration and Compression - Bias-Variance Trade-Off - Generalization Issues in Model Tuning and Evaluation - Penalty-based Regularization - Ensemble Methods - Early Stopping - Unsupervised Pretraining - Continuation and Curriculum Learning.							
Unit – II	Radial Basis Function Networks and Boltzmann Machines:						9
Radial Basis Function: Introduction - Training an RBF Network - Hopfield Network - The Boltzman Machine - Restricted Boltzman Machine - Applications of Restricted Boltzman Machines.							
Unit – III	Recurrent Neural Networks:						9
Introduction - Architecture of Recurrent Neural Networks - Challenges of training Recurrent Networks - Echo-State Networks - Long Short-Term Memory (LSTM) - Gated Recurrent Units (GRUs) - Applications of Recurrent Neural Networks.							
Unit – IV	Convolution Neural Networks:						9
Introduction - Basic Structure of Convolutional Network - Training a Convolutional Network - Case Studies of Convolutional Architectures - Visualization and Unsupervised Learning - Applications of Convolutional Networks.							
Unit – V	Deep Reinforcement Learning:						9
Introduction - Stateless Algorithms: Multi-Armed Bandits - The Basic Framework of Reinforcement Learning - Bootstrapping for Value Function Learning - Policy Gradient Methods - Monte Carlo Tree Search - Case Studies.							
							Total:45
TEXT BOOK:							
1.	Aggarwal, Charu C, “Neural Networks and Deep learning”, Springer, 2018.						
REFERENCES:							
1.	Ian Goodfellow, YoshuaBengio, and Aaron Courvill, “Deep Learning”, MIT Press, USA, 2016						
2.	Josh Patterson and Adam Gibson, “Deep Learning – A Practitioner’s Approach”, First Edition, O’Reilly Series, August 2017.						
3.	Indra den Bakker, “Python Deep Learning Cookbook”, First Edition, Packt Publishing, October 2017						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)			
CO1	solve simple real world problems using deep neural networks												Applying (K3)		
CO2	use the concepts of RBF and Boltzman machines to solve real world problems												Applying (K3)		
CO3	explicate the concepts of RNN models and apply it for solving Natural Language problems.												Applying (K3)		
CO4	exemplify the concepts of CNN models and apply it for solving computer vision related problems.												Applying (K3)		
CO5	use the concepts of Deep reinforcement Learning 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	3	2	1	1									3	3	
CO2	3	2	1	1									3	3	
CO3	3	2	1	1									3	3	
CO4	3	2	1	1									3	3	
CO5	3	2	1	1									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		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)															

22IST82 – DATA SCIENCE							
Programme& Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	ES	3	0	0	3
Preamble	To provide a broad introduction to different ways that the data scientists learn from data, including statistical reasoning, mathematical model computation and communication.						
Unit – I	Introduction:						9
Data Science: Computer Science, Data Science, and Real Science – Properties of Data – Classification and Regression. Data Munging: Languages for Data Science – Collecting Data – Cleaning Data – Crowd sourcing.							
Unit – II	Scores, Rankings and Statistical Analysis:						9
The Body Mass Index (BMI) - Developing Scoring Systems – Z-scores and Normalization – Advanced Ranking Techniques – Arrow's Impossibility Theorem. Statistical Analysis: Statistical Distributions – Sampling from Distributions – Statistical Significance –Permutation Tests and P-values – Bayesian Reasoning.							
Unit – III	Visualizing Data and Hypothesis Testing:						9
Exploratory Data Analysis – Developing a Visualization Aesthetic – Chart Types – Great Visualizations – Reading Graphs – Interactive Visualization. Hypothesis Testing: Tests on the Mean, Variance and Standard Deviation – Tests on a Population Proportion – Inference Procedures for a Single Sample – Testing for Goodness of Fit – Contingency Table Tests.							
Unit – IV	Linear and Logistic Regression:						9
Linear Regression – Better Regression Models – Regression as Parameter Fitting – Simplifying Models through Regularization – Classification and Logistic Regression – Issues in Logistic Classification. Distance and Network Methods: Measuring Distances – Nearest Neighbor Classification – Graphs, Networks, and Distances – Page Rank – Clustering.							
Unit – V	Applications, Evaluations and Methods:						9
Solving Data Problems – Collecting and Analyzing social media data. Data Collection Methods – Picking Data Collection and Analysis Method – Quantitative Methods – Qualitative Methods – Mixed Method Studies – Evaluation – Comparing Models – Training – Testing and A/B Testing – Cross-Validation.							
Total:45							
TEXT BOOK:							
1.	Steven S. Skiena, “The Data Science Design Manual”, 1 st Edition, Springer,2017. For Unit I, II, III-first half, IV						
2.	Douglas C.Montgomery, GeorgeC.Runger, “Applied Statistics and Probability for Engineers”, 6 th Edition, Wiley, 2013. For Units III-second half						
3.	Chirag Shah, “A Hands-on Introduction to Data Science”, 1 st Edition, Cambridge Univ. Press, 2020. For Unit-V						
REFERENCES:							
1.	Igual, Laura, and Santi Seguí, “Introduction to Data Science”, Introduction to Data Science. Springer, Cham, 2017.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)			
CO1	make use of the concepts in data science and data munging for building applications												Applying(K3)		
CO2	utilize statistical methods for solving problems												Applying(K3)		
CO3	make use of appropriate data visualization technique for communicating the result												Applying(K3)		
CO4	apply different machine learning techniques available for solving the given problem and propose an optimized solution												Applying(K3)		
CO5	demonstrate the data analysis techniques for applications handling large 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	3	2	1	1									3	3	
CO2	3	2	1	1									3	3	
CO3	3	2	1	1									3	3	
CO4	3	2	1	1									3	3	
CO5	3	2	1	1									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		15		55		30								100	
CAT2		15		45		40								100	
CAT3		15		40		45								100	
ESE		10		25		65								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)															

22IST83 – SOFTWARE PROJECT MANAGEMENT							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Software Engineering	8	PC	3	0	0	3
Preamble	This course provides knowledge about project management activities which include project evaluation, planning estimation, monitoring and control especially for software projects						
Unit – I	Software Project Management and Evaluation:						9
Introduction to Software Project Management – Software Project and Types – Contract and Project management – Activities – Plans, Methods and Methodologies – Stakeholders – Setting Objectives Project Success and Failure – Management Control – Project Management Life Cycle. Project Evaluation: Introduction – Business Case – Project Portfolio Management – Evaluation of Individual projects – Cost Benefit Evaluation Techniques – Risk Evaluation – Programme Management – Allocation resources – Benefits Management.							
Unit – II	Project Planning and Appropriate Project Approach:						9
Introduction to Step Wise Project Planning – Selection of an Appropriate Approach: Introduction – Choosing Methodologies and Technologies – Software Process and Choices of Process Models – Structure Versus Speed of Delivery – Software Prototyping – Categorizing Prototypes – Incremental Delivery – Atern/Dynamic Systems Development Method – Rapid Application Development – Selecting the Most Appropriate Process Model.							
Unit – III	Software Effort Estimation and Activity Planning:						9
Introduction – Estimates –Problems with Over and Under Estimates – Basis for Software Estimating –Estimation Techniques – Bottom-up Estimating – Top Down Approach – Expert Judgment – Estimating by Analogy – Albrecht Function Point Analysis- Function Points Mark II – Cosmic Full Function Points – COCOMO II:A Parametric Productivity Model. Activity Planning: Objectives – Project Schedule – Sequencing and Scheduling Activities – Network Planning Models – Formulating a Network Model-Adding the Time Diversion – Forward Pass – Backward Pass – Identifying the Critical Path – Activity Float – Shortening the Project Duration Activities – Activity on Narrow Networks.							
Unit – IV	Risk Management and Resource Allocation:						9
Introduction – Categories of Risk – Risk Management Approaches – Risk Identification – Risk Assessment – Risk Planning – Risk Management – Evaluating risk to the schedule – Applying the PERT Technique – Monte Carlo Simulation. Resource Allocation: Introduction – Nature of Resources – Identifying Resource Requirements – Scheduling Resources – Creating Critical Paths – Counting the Cost – Being Specific –Publishing the Resource Schedule – Cost schedules – Scheduling Sequence.							
Unit – V	Monitoring and Control, Managing Contracts and People in Software Environments:						9
Introduction – Creating the Framework –Collecting the Data –Visualizing Progress –Cost Monitoring –Earned Value Analysis – Prioritizing Monitoring – Getting Project Back to Target –Change Control. Managing Contracts: Introduction – Types of Contract – Stages in Contract Placement – Typical Terms of a Contract –Contract Management – Acceptance. Managing People: Introduction – Understanding Behaviour –A Background – Selecting the Right person for the Job – Instruction in the Best Methods – Motivation – The Oldham – Hackman Job Characteristics Model – Stress – Health and Safety.							
							Total:45
TEXT BOOK:							
1.	Bob Hughes, Mike Cotterell and Rajib Mall, "Software Project Management", 6 th Edition, Tata McGraw Hill, New Delhi, 2018.						
REFERENCES:							
1.	Roger S. Pressman, "Software Engineering", 7 th Edition, McGraw Hill Education Private Limited, 2016.						
2.	Pankaj Jalote, "Software Project Management in Practice", New Delhi: Pearson Education, 2013.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	make use of process of software project management and apply evaluation technique to choose best project											Applying(K3)		
CO2	illustrate the step wise project planning and select the appropriate project approaches											Applying(K3)		
CO3	identify the software effort estimation and produce an activity plan for a project											Applying(K3)		
CO4	identify the factors putting a project at risk and produce a work plan and resources schedule											Applying(K3)		
CO5	outline the methods of managing people and organizing teams											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									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	1	1									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	15		40		45								100	
CAT2	15		50		35								100	
CAT3	15		50		35								100	
ESE	10		45		45								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISL81- DEEP LEARNING LABORATORY														
Programme & Branch		M.Sc & Software Systems						Sem.	Category	L	T	P	Credit	
Prerequisites		Nil						8	PC	0	0	2	1	
Preamble		This course deals with various algorithms to enable computers to learn data without being explicitly programmed. An insight into various types of deep learning algorithms, strategies for model generation and evaluation.												
LIST OF EXPERIMENTS / EXERCISES:														
1.	Explore the various deep learning libraries like PyTorch, TensorFlow, MXNet, etc.,													
2.	Predict house prices using multi-layer neural network													
3.	Test the performance of multi-layer neural network with various activation and loss functions													
4.	Design a bidirectional RNN with multiple hidden layers													
5.	Implement Recurrent neural networks to generate new text.													
6.	Implement LSTM to perform time series prediction													
7.	Develop a chatbot using ChatGPT API													
8.	Demonstrate a simple application for Image classification using CNN													
9.	Implement a simple application for Human Face Detection using CNN													
10.	Build a simple application for Named Entity Recognition using LSTM													
														Total: 30
REFERENCES/ MANUAL /SOFTWARE:														
1.	Operating System : Windows / Linux													
2.	Software : Anaconda/Python													
3.	Laboratory Manual													
COURSE OUTCOMES:													BT Mapped (Highest Level)	
On completion of the course, the students will be able to														
CO1	build skills in DL tools/libraries in the field of designing, training and deploying simple neural networks for solving different practical/engineering problems.												Applying (K3) Precision(S3)	
CO2	identify and develop various CNN/RNN based models to solve real world problems.												Applying (K3) Precision(S3)	
CO3	identify suitable deep learning models for developing real world applications.												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	1	3								3	1
CO2	3	2	1	1	3								3	1
CO3	3	2	1	1	3								3	1
1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy														

22GEP81 - COMPREHENSIVE TEST AND VIVA

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	--	8	EC	0	0	0	2

COURSE OUTCOMES:	BT Mapped
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On completion of the course, the students will be able to	BT mapped (Highest Level)
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COURSE OUTCOMES: On completion of the course, the students will be able to	BT Mapped (Highest Level)
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CO1	demonstrate knowledge in their respective programme domain.	Applying(K3)
CO2	defend any type of interviews, viva-voce, and aptitude tests conducted for career progression	Applying(K3)
CO3	exhibit professional etiquette and solve related engineering problems	Applying(K3)
CO4	organize the contents of the courses and discover a holistic approach to problem solving	Applying(K3)
CO5	make use of all the core courses to qualify as a fully competent graduate in computer science and design field.	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	2					1	2	2	3	3	2
CO2	3	3	2	2					1	2	2	3	3	2
CO3	3	3	2	2					1	2	2	3	3	2
CO4	3	3	2	2					1	2	2	3	3	2
CO5	3	3	2	2					1	2	2	3	3	2

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

22ISP01 – PROJECT WORK - II

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	10	EC	0	0	30	15

	Total:450
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COURSE OUTCOMES:
On completion of the course, the students will be able to

On completion of the course, the students will be able to

BT Mapped (Highest Level)	
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CO1	identify the requirements and apply the concepts of mathematics, science, engineering and management principles necessary to solve the real world problem.	Creating (K6), Precision (S3)
CO2	apply the engineering tools to solve the identified real world problem.	Creating (K6), Precision (S3)
CO3	analyze and interpret results of experiments conducted on the designed solution to arrive at valid conclusions.	Analyzing (K4), Precision (S3)
CO4	engage in effective written communication by presenting the technical project report.	Applying (K3), Precision (S3)
CO5	demonstrate an ability to work in the team and contribute to the team.	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	3	3	2	3	3	2	2	3	2	3	3
CO2	3	3	3	3	3	2	3	3	2	2	3	2	3	3
CO3	3	3	3	3	3	3	2	3	2	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	2	2	3	3	3	3	3	3	3	2	3	3	3	3

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

22ISF01 – GRAPHICS AND MULTIMEDIA							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	5	PE	3	0	2	4
Preamble	This course provides knowledge on how the graphical objects are represented in a computer system and presented to the end user. In addition to this, this course explores the ways of representing the different types of digital content over Internet and demonstrates the creation of simple 2D animation.						
Unit – I	Introduction to Graphics:						9
Survey of Computer Graphics - Overview of Computer Graphics: Video Display Devices – Raster and Random Scan Systems – Input and Hard-copy devices – Graphics Software – Output Primitives: Points and Lines – DDA – Bresenham's Algorithms – Properties of Circles and Ellipse – Circle and Ellipse Drawing Algorithm.							
Unit – II	Two-Dimensional Modeling:						9
Two-Dimensional Geometric Transformation: Basic Transformations – Matrix Representations – Composite Transformations – Other Transformations. Two-Dimensional Viewing: Viewing Pipeline – Viewing Coordinate Reference Frame – Window-to-viewport Coordinate Transformation – Viewing Functions – Clipping Operations – Point Clipping - Line Clipping – Polygon Clipping – Curve Clipping – Text Clipping.							
Unit – III	Three-Dimensional Modeling:						9
Three-Dimensional Concepts: Three-Dimensional Display Methods – Three-Dimensional Graphics Packages – Three Dimensional Geometric and Modeling Transformations: Translation – Rotation – Scaling – Other and Composite Transformation – Transformation function – Modeling and Coordinate Transformation – Three Dimensional Viewing.							
Unit – IV	Multimedia-Sound, Animation and Video:						9
Sound: The Power of Sound - Digital Audio - MIDI Audio - MIDI vs. Digital Audio - Multimedia System Sounds - Audio File Formats -Vaughan's Law of Multimedia Minimums - Adding Sound. Animation: The Power of Motion - Principles of Animation -Animation by Computer - Making Animations. Video: Using Video – working of video – Digital Video Containers - Video Clips - Shooting and Editing Video.							
Unit – V	Making Multimedia:						9
Making Multimedia: The Stages of a Multimedia Project - The Intangibles - Multimedia Skills – Hardware – Software – Authoring Systems. Planning and Costing: The Process of Making Multimedia – Scheduling – Estimating - RFPs and Bid Proposals. Designing and Producing: Designing- Producing							
LIST OF EXPERIMENTS / EXERCISES:							
1.Implement line drawing algorithm.							
2.Implement circle drawing algorithm.							
3.Write a program to perform 2D Transformation.							
4.Write a program to perform 3D Transformation.							
5.Perform video editing using Blender or Pencil Studio open source software.							
6. Create a movie clip using Blender or Pencil Studio open source software.							
7. Create 3D models using Open shot tool.							
Lecture:45, Practical:30, Total:75							
TEXT BOOK:							
1.	Hearn Donald and Baker M. Pauline, “Computer Graphics C Version”, 2 nd Edition, Pearson Education, 2022, for Units I,II,III.						
2.	Tay Vaughan, “Multimedia: Making It Work”, 9 th Edition, McGraw-Hill Publications,2014 for Units IV,V						
REFERENCES:							
1.	Jeffcoate, Judith, “Multimedia in Practice: Technology and Applications”, 1 st Edition, Prentice Hall of India, 2007						
2.	Foley James D., Van Dam, Andries, Feiner Steven K. and Hughes John F., “Computer Graphics: Principles and Practice”, 2 nd Edition, Pearson Education, 2005.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	outline the fundamental concepts of computer graphics and the components that constitute 2D and 3D graphics and develop simple applications											Applying (K3) Precision (S3)		
CO2	manipulate 2D objects by applying transformation, clipping, and viewing operations											Applying (K3) Precision (S3)		
CO3	utilize transformations, visible surface detection and color models to manipulate 3D objects											Applying (K3) Precision (S3)		
CO4	apply the concept of sound, animation and video to make the animations											Applying (K3) Precision (S3)		
CO5	demonstrate the stages of multimedia project and apply for real time projects											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		3		2	2	2		2		3	1
CO2	3	2	1		3		2	2	2		2		3	1
CO3	3	2	1		3		2	2	2		2		3	1
CO4	3	2	1		3		2	2	2		2		3	1
CO5	3	2	1		3		2	2	2		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		55		30								100
CAT2		15		55		30								100
CAT3		15		60		25								100
ESE		10		50		40								100
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE01- DISTRIBUTED SYSTEMS

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Operating Systems, Computer Networks	5	PE	3	1	0	4

Preamble	This course provides an understanding of distributed systems architecture and fault tolerant systems
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Unit- I	Introduction:	9+3
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From Networked Systems to Distributed Systems – Design Goals – Classification of Distributed Systems – Architectures: Styles – Middleware and Distributed Systems – Layered System Architectures – Symmetrically Distributed Systems Architectures – Hybrid System Architecture.

Unit- II	Communication:	9+3
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Fundamentals – Remote Procedure Call: Basic RPC Operation - Parameter Passing - Asynchronous RPC – Message-Oriented Communication: Simple and Advanced Transient Messaging - Message Oriented Persistent Communication – Multicast Communication: Application-Level Tree-based and Flooding-based Multicasting – Gossip-Based Data Dissemination.

Unit- III	Coordination:	9+3
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Clock Synchronization - Logical Clocks – Mutual Exclusion: Centralized, Decentralized, Distributed and Token Ring Algorithms – Election Algorithms – Gossip based Coordination – Distributed Event Matching – Location Systems.

Unit- IV	Consistency and Replication:	9+3
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Introduction – Data-Centric Consistency Models – Client-Centric Consistency Models – Replica Management – Consistency Protocols.

Unit- V	Fault Tolerance:	9+3
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Introduction – Process Resilience – Reliable Client–Server Communication – Reliable Group Communication – Distributed Commit – Recovery.

Lecture:45, Tutorial:15, Total:60

TEXT BOOK:

1.	Andrew S. Tanenbaum, Maarten van Steen, "Distributed Systems: Principles and Paradigms", 4 th Edition, Pearson Education, 2023.
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REFERENCES:

1.	Coulouris George, Dollimore Jean, Kindberg Tim, Blair Gordon, "Distributed Systems Concepts and Design", 5 th Edition, Pearson Education, New Delhi, 2017.
2.	Liu M.L, "Distributed Computing: Principles and Applications", 1 st Edition, Pearson Education, New Delhi, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	discuss the characteristics, models of distributed system and apply it for application development.											Applying(K3)		
CO2	apply different communication models in distributed application development.											Applying(K3)		
CO3	apply synchronization and concurrency in transactions.											Applying(K3)		
CO4	express the methods of using the consistency models.											Applying(K3)		
CO5	infer the suitable architecture for fault-tolerant and multimedia distributed systems.											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	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	2	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		5		50		45								100
CAT2		5		50		45								100
CAT3		5		55		40								100
ESE		5		55		40								100
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISF02 - OPEN SOURCE SOFTWARE

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Web Programming	5	PE	3	0	2	4

Preamble	To design web applications using PHP and MySQL.	
Unit – I	String Handling and Arrays:	9
Overview of PHP - Strings in PHP – String Functions – PHP Arrays – Creating Arrays – Retrieving Arrays – Multidimensional Arrays – Inspecting Arrays – Deleting Arrays – Iteration – Numerical Types – Mathematical Operators – Simple Mathematical Functions – Randomness.		
Unit – II	Object-Oriented PHP:	9
Object Oriented Programming – Basics PHP constructs for OOP – Advanced OOP features – Introspection Functions – OOP Style in PHP.		
Unit – III	Regular Expressions, Session and Cookies:	9
Transformation of Arrays – Stacks and Queues – Translating between Variables and Arrays – Sorting – Printing Functions for Visualizing Arrays – Tokenizing and Parsing Functions – Regular Expressions – Advanced String Functions – Session – Session in PHP–Session Functions – Cookies.		
Unit – IV	Database Connectivity using MySQL:	9
Connecting to MySQL – Queries – Fetching Data Sets – Data About Data – Multiple Connections – Creating MySQL Databases with PHP – MySQL Functions – HTML Tables and Database Tables – Complex Mappings – Creating the Sample Tables.		
Unit – V	Integrating Web Forms and Databases and MySQL Gotchas:	9
HTML Forms – Basic Form Submission to a Database – Editing Data with an HTML Form – TEXT and TEXTAREA– CHECKBOX – RADIO – SELECT– MySQL Gotchas: No Connection – Problems with Privileges– Unescaped Quotes – Broken SQL Statements – Specific SQL Functions – Debugging and Sanity Checking.		

LIST OF EXPERIMENTS / EXERCISES:

1.	Write a PHP program using arrays.
2.	Create a registration form with PHP and MYSQL and apply sticky forms in it.
3.	Write a PHP Program to implement user-defined functions.
4.	Create a web page to insert records to student table, department table (with key constraints) using database connectivity.
5.	Develop a PHP code to retrieve the records from student and department table.
6.	Write a PHP code with MYSQL for changing the password in student table.
7.	Mini project.

Lecture:45, Practical:30, Total:75

TEXT BOOK:

1.	Steve Suehring, Tim Converse, Joyce Park, "PHP 6 and MySQL", 2 nd Edition, Wiley Publication, New Delhi, 2017.
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REFERENCES/MANUAL/SOFTWARE:

1.	Larry Ullman, "PHP and MySQL for Dynamic Web Sites", 5 th Edition, Peachpit Press, 2017
2.	Welling, Luke, "PHP and MYSQL Web Development", 5 th Edition, Addison-Wesley Professional, 2016.
3.	Laboratory Manual
4.	Software: Browser, xampp server

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	make use of string functions, arrays and functions in PHP.	Applying(K3) Precision (S3)
CO2	implement programs for given problems with object oriented programming concepts.	Applying(K3) Precision (S3)
CO3	apply regular expression, session and cookie to solve problems.	Applying(K3) Precision (S3)
CO4	develop web application using PHP and MySQL.	Applying(K3) Precision (S3)
CO5	demonstrate the integration of web forms with database and address the issues arise with using PHP and databases.	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	1	2				3	3	3	3	3	2
CO2	3	2	1	1	2				3	3	3	3	3	2
CO3	3	2	1	1	2				3	3	3	3	3	2
CO4	3	2	1	1	2				3	3	3	3	3	2
CO5	3	2	1	1	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	10	45	45				100
CAT2	10	45	45				100
CAT3	10	50	40				100
ESE	5	45	50				100

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

22ISE02 – MOBILE COMMUNICATIONS

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Computer Networks	6	PE	3	0	0	3

Preamble This course provides an insight on wireless communication technologies from 2G to 5G. System and Protocol architectures are also explored in design aspects with use case scenarios.

Unit – I **Introduction to Wireless Communication:** **9**

Wireless Networks and Mobile Communication – Applications. Wireless transmission: Frequencies for radio transmission – Signals – Antennas – Signal Propagation – Multiplexing – Modulation – Spread Spectrum – Cellular Systems. MAC: MAC for Motivation – SDMA – FDMA – TDMA – CDMA.

Unit – II **Telecommunication and Satellite systems:** **9**

Telecommunication Systems: GSM: Mobile Services - System Architecture - Radio Interface – Protocols - Localization and calling– Handover – Security - New Data Services – Satellite Systems – Basics – Routing – Localization - Handover.

Unit – III **Wireless LAN:** **9**

Wireless LAN: Infrared Vs Radio Transmission–Infrastructure Networks and Ad-hoc Networks.IEEE802.11 – System Architecture - Protocol Architecture – Physical Layer – Medium Access Control Layer – MAC Management. Bluetooth - User Scenarios – Architecture - Radio Layer – Baseband Layer – Link Manager Protocol – L2CAP – Security – SDP.

Unit – IV **Mobile Network and Transport Layer:** **9**

Mobile IP- Goals, Assumptions and Requirements – Entities and Terminologies – IP Packet Delivery – Agent Discovery – Registration – Tunneling and Encapsulation – Dynamic Host Configuration Protocol – Mobile ad-hoc Networks. Traditional TCP – Classical TCP Improvements.

Unit – V **Advanced Wireless Technologies** **9**

LTE Radio Access – Basic Technologies – Radio Interface Architecture – Overall System Architecture – 5G Wireless Access. Radio Technology: 5G General Design Principles – 5G Key Technology Components.

Total:45

TEXT BOOK:

1. Jochen Schiller,“MobileCommunications”,2nd Edition, PHI/Pearson Education,2020, for Units I, II, III , IV.
2. Erik Dahlman, Stefan Parkvall, Johan Skold, “4G, LTE-Advanced Proand The Road to 5G”,3rd Edition, Academic Press,2016, for Unit V.

REFERENCES:

1. Willim C Y Lee“ Mobile Communications Engineering: Theory and Applications”,2nd Edition, McGraw-Hill Series,1997.
2. Dharma P. Agarwal, Qing-An Zeng“ Introduction to Wireless and Mobile Systems”,4th Edition, Cengage Learning, 2020.

COURSE OUTCOMES: On completion of the course, the students will be able to													BT Mapped (Highest Level)	
CO1	summarize the fundamentals of wireless communication and determine the suitable medium access control techniques.												Applying (K3)	
CO2	demonstrate the GSM and Satellite system and protocol architectures												Applying (K3)	
CO3	examine the Wireless LAN medium access control methods and associated technologies												Applying (K3)	
CO4	implement the routing protocols and TCP congestion control mechanisms in wireless network												Applying (K3)	
CO5	summarize the advanced wireless technologies and determine the suitable technology for the wireless scenarios.												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										3	2
CO2	3	2	1										3	2
CO3	3	3	3										3	2
CO4	3	3	2										3	2
CO5	3	3	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		45		45								100
CAT3		10		10		50								100
ESE		10		45		45								100
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISF03 - ADVANCED JAVA PROGRAMMING							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Java Programming	6	PE	2	0	2	3
Preamble	This course enables the students to develop, test, and deploy applications ready for production and how to establish them as cloud-based applications using Spring Boot.						
Unit – I	Spring Boot						6
Introduction - Features - Advantages - Microservices - System Requirements - Setting up the environment - 12-factor app - Spring Initializr - Build Tools – Maven and Gradle - pom.xml and build.gradle - Building application using Maven and Gradle - entry point class - Bootstrap Application Context - Spring Boot Starter Dependencies - Auto-Configuration.							
Unit – II	Spring Annotations and Data						6
Spring Boot Annotations: Java annotations – Existence of Spring Annotations - Spring and Spring Boot Annotations. Working with Spring Data JPA and Caching: Accessing relational data using JdbcTemplate and Spring Data JPA with the in-memory database and MySQL - Query methods in Spring Data JPA - Caching.							
Unit – III	Learning RESTFul API						6
Building RESTFul Microservices: Creating and Consuming RESTFul APIs - Spring Boot Actuators - Custom health check indicators – Exception handling - Service discovery – RestTemplate - Routing a request – Spring Cloud Gateway. Securing a Web Application: Authentication and Authorization concepts – Spring security filters – Enabling and Disabling security – Oauth security – Accessing REST secured APIs –REST services.							
Unit – IV	Implementing Resilience4J and Swagger						6
Building Resilient System: Client-side load balancing – Circuit breaker – Implementing Resilience4J. Logging: Logging Data – Logback – Spring Cloud Sleuth and Zipkin – ELK. Working with the Swagger API Management Tool: API documentation – Implementing Swagger - Swagger UI – Swagger documentation – Swagger Codegen.							
Unit – V	Testing and Deploying						6
Testing a Spring Boot Application: Unit Testing and Integration Testing – JUnit and Mockito framework – Checking code coverage – Testing RESTFul web services – Cucumber automation testing. Deploying a Spring Boot Application – Docker and containerization - Setting up Docker- Heroku CLI and deployment.							
LIST OF EXPERIMENTS / EXERCISES:							
1.	Build a simple web application with Spring Boot and add some services to it.						
2.	Create REST Service with Spring Boot JPA with in-memory database / MySQL						
3.	Implementation of Form Data Binding and Validation with Spring Boot.						
4.	Demonstration of REST API Validation and Globally Error Handling with Spring Boot.						
5.	Implementing Reactive Circuit Breaker Using Resilience4j						
6.	Build out your API documentation by integrating an OpenAPI specification document into Swagger UI						
7.	Implementation of Unit Testing Rest Services with Spring Boot and JUnit						
8.	Deploy Spring Boot application in Docker.						
Lecture:30, Practical:30, Total:60							
TEXT BOOK:							
1.	Shagun Bakliwal, “Hands-on Application Development using Spring Boot”, BPB Publications, 1st Edition, 2022.						
REFERENCES/ MANUAL / SOFTWARE:							
1.	Rajput, D. “Mastering Spring Boot 2.0: Build modern, cloud-native, and distributed systems using Spring Boot”, Packt Publishing Ltd, 2018.						
2.	Claudio and Greg, “Developing Java Applications with Spring and Spring Boot”, Packt Publishing Ltd, 2018.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	apply the Spring Boot and all its capabilities.											Applying (K3), Precision (S3)		
CO2	demonstrate the common annotations of the Spring Data and Spring Data JPA											Applying (K3), Precision (S3)		
CO3	build RESTFul Microservices and Secured Web Application											Applying (K3), Precision (S3)		
CO4	implement Resilience4J and Swagger API and host the apps on Cloud.											Applying (K3), Precision (S3)		
CO5	demonstrate Testing and Deploying a Spring Boot Application											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	1									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	1	1									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		20		70								100	
CAT2	10		20		70								100	
CAT3	10		20		70								100	
ESE	10		20		70								100	
* ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)														

22ISF04 – FRONT END TECHNOLOGIES							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	6	PE	2	0	2	3
Preamble	To design interactive UI and web applications using jquery, angular and TypeScript.						
Unit – I	JavaScript and jQuery:						6
Query and JavaScript Syntax – Understanding and Using JavaScript Objects – Accessing DOM Elements Using JavaScript and jQuery Objects – Navigating and Manipulating jQuery Objects and DOM Elements with jQuery – Applying JavaScript and jQuery Events for Richly Interactive Web Pages.							
Unit – II	Building Interactive Web Pages with jQuery:						6
Dynamically Accessing and Manipulating Web Pages with JavaScript and jQuery – Working with Window, Browser, and Other Non-Web Page Elements – Enhancing User Interaction Through jQuery Animation and Other Special Effects – Interacting with Web Forms in jQuery and JavaScript.							
Unit – III	Server Side Interaction Through jQuery:						6
Accessing Server-Side Data via JavaScript and jQuery AJAX Requests – Introducing jQuery UI – Using jQuery UI Effects – Advanced Interactions With jQuery UI Interaction Widgets – Using jQuery UI Widgets to Add Rich Interactions to Web Pages.							
Unit – IV	TypeScript and Angular 6.0:						6
TypeScript: Introduction – Features – Variables – Data types – Enum – Array – Tuples – Functions – OOP concepts – Interfaces – Classes – Modules – Decorators. Angular 6.0 : Introduction – Needs – Features – Evolution – Setup and Configuration – Components and Modules – Templates – Change Detection – Directives –Nested Components.– Data Binding – Pipe.							
Unit – V	Client-side JS Framework:						6
Services – Dependency Injection -HTTP – Routing – Forms in Angular – Template Driven Forms – Model Driven Forms \ Reactive Forms – Custom Validators.							
LIST OF EXPERIMENTS / EXERCISES:							
1.	Design web form using HTML, CSS and perform form validation using Java Script.						
2.	Develop interactive user interface and handle request and response with jQuery.						
3.	Design web application using AngularJS and implement AngularJS services.						
4.	Implement TypeScript class.						
5.	Design web page using TypeScript						
Lecture:30, Practical:30, Total:60							
TEXT BOOK:							
1.	Brad Dayley, Brendan Dayley, “AngularJS, Java Script and jQuery”, 1st Edition, Pearson Education, New York, 2016, for Units I, II, III						
2.	Infosys campus connect material shared by infy , for Units IV , V.						
REFERENCES/ MANUAL / SOFTWARE:							
1.	https://www.tutorialspoint.com/angular6/index.htm						
2.	Simon Holmes, Clive Herber, “Getting MEAN with Mongo, Express, Angular, and Node”, 1st Edition, Manning Publications, New York, 2019.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	apply jQuery objects for designing web page.											Applying (K3), Precision (S3)		
CO2	implement advanced web page elements to build interactive web pages											Applying (K3), Precision (S3)		
CO3	use jQuery for server side interaction and utilize jQuery UI Widgets to add rich interactions to the web pages											Applying (K3), Precision (S3)		
CO4	design web application using TypeScript.											Applying (K3), Precision (S3)		
CO5	develop UI with angularJS for a real world application											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	1	3		2	2	2		2		3	3
CO2	3	2	1	1	3		2	2	2		2		3	3
CO3	3	2	1	1	3		2	2	2		2		3	3
CO4	3	2	1	1	3		2	2	2		2		3	3
CO5	3	2	1	1	3		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		20		70								100
CAT2		10		20		70								100
CAT3		10		20		70								100
ESE		10		20		70								100
* ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)														

22ISE03 – NETWORK COMMUNICATION PROTOCOLS

Programme& Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Computer Networks	8	PE	3	0	0	3

Preamble	This course provides to understand the basic concepts of internet working protocols and addressing concepts.
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Unit- I	Introduction and Protocol Layering:	9
<p>Internetworking Concepts and Architectural Model: Application and Network-Level Interconnection – Properties of the Internet – Internet Architecture – Interconnection of Multiple Networks with IP Routers – Protocol Layering: Need for Multiple Protocols – Conceptual layers of Protocol Software – Functionality – ISO and TCP/IP – Protocol layering Principles – Layering Principle – Layering in Mesh Networks.</p>		

Unit- II	Internet Addressing and Mapping Internet addresses:	9
<p>Internet Addressing: Universal Host Identifiers– Classful Addressing Scheme – Subnet Addressing - Fixed & Variable Length IPv4 Subnets – Implementation of Subnet Mask and Representation– Classless Addressing Scheme– IPv4 CIDR Blocks –IPv6. Mapping Internet Address to Physical Address: ARP – Resolution through Direct Mapping – Dynamic Binding – Cache – Refinements – Implementation – Encapsulation and Identification – Message Format – Automatic ARP Cache Revalidation – RARP – Proxy ARP – IPv6 Neighbor Discovery.</p>		

Unit- III	Forwarding IP Datagrams and Multicasting:	9
<p>Forwarding IP Datagram: Direct and Indirect Delivery– Table Driven IP Forwarding– NextHop Forwarding– Default and Host Specific Routes– IP Forwarding Algorithms– LongestPrefix Match Paradigm– Forwarding Tables and IP Address– Forwarding in Broadcast and Multicast. Internet Multicasting: Multicast Scheme – IPv4 and IPv6 Multicast Addresses and Semantics – Mapping IP Multicast to Ethernet Multicast – Host and Multicast Delivery with Scope – Host Participation – IGMP.</p>		

Unit- IV	Mobile IP, Voice and Video over IP:	9
Mobility and Mobile IP: Mobility via Host Address Change and Changes in Datagram Forwarding – Mobile IP – overhead and Frequency of Change – Mobile IPv4 – Communication – IPv6 Mobility Support – Datagram Transmission, Reception and Tunneling – Assessment – Alternative Identifier. Voice and Video over IP: Digitizing and Encoding – Transmission and Reproduction – Jitter and Playback Delay – RTP – RTCP – Operation – IP Telephony and Signaling – QOS – IntServ and DiffServ – Traffic Scheduling, Placing and Shaping		

Unit- V	Network Management and Software Defined Networking:	9
SNMP: Level of Management Protocols – Architectural Model – Protocol Framework – Structure of Management Information – ASN.1 – MIB – SNMP message format – Security in SNMPv3. Software Defined Networking: SDN – Separation of Data and Control – SDN Architecture and External Controllers – Multiple Devices – Implementing SDN with Conventional Switches – OpenFlow Technology – Basics – Specific Fields – Actions – Extensions and Additions – Messages – Uses – Excitement, Hype and Limitations. SDP		

Total:45

TEXT BOOK:

1.	Douglas E. Comer, "Internetworking with TCP/IP Vol.1: Principles, Protocols and Architecture", 6 th Edition, Pearson Education, New Delhi, 2015.
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REFERENCES:

1.	Behrouz A.Forouzan, "TCP/IP Protocol Suite", 4 th Edition, Tata McGraw–Hill, New Delhi, 2012.
2.	Black, Uyless, "Computer Networks–Protocols, Standards and Interfaces", 2 nd Edition, Prentice Hall of India, New Delhi, 2003.

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	interpret the design principles of internetworking protocol architecture											Understanding (K2)		
CO2	demonstrate the mapping of internet addresses											Applying(K3)		
CO3	identify the routing methodologies and internet multicasting.											Applying(K3)		
CO4	express the processes involved in mobile ip											Applying(K3)		
CO5	infer the work involved in network management and sdn											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	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	1	1									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	5		55		40								100	
CAT2	5		45		50								100	
CAT3	5		45		50								100	
ESE	5		55		40								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE04 – ADVANCED DATABASE TECHNOLOGIES

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Database Management Systems	8	PE	3	0	0	3

Preamble	To focus on transaction, distributed transactions, recovery and real time transaction concepts
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UNIT - I	Transaction and Concurrency Control	9
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Transaction Management: Transaction Concept – A Simple Model Transaction Atomicity and Durability – Isolation – Serializability – Isolation Levels Implementation – Transactions as SQL Statements– Testing for Serializability – Concurrency Control: Lock-Based Protocols – Timestamp – Based Protocols – Validation Based Protocols.

UNIT – II	Recovery system and DBMS Architecture	9
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Recovery System: Log Based Recovery – Recovery with Concurrent Transactions – Buffer Management - Database System Architecture: Centralized and Client-Server Architectures-Server System Architectures – Parallel Systems – Distributed Systems – Network Types

UNIT – III	Parallel Databases	9
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Parallel Databases – Introduction – I/O Parallelism – Interquery Parallelism – Intraquery Parallelism – Intraoperation Parallelism- Interoperation Parallelism.

UNIT – IV	Distributed databases	9
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Distributed Databases – Data Storage – Distributed Transactions– Commit Protocols – Concurrency Control In Distributed Databases – Availability – Distributed Query Processing Cloud Databases

UNIT - V	Spatial and Temporal Data	9
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Motivation – Time In Databases – Spatial and Geographic Data – Multimedia Databases – Mobility and Personal Databases. Advanced Transaction Processing: Transaction-Processing Monitors – Transactional Workflows – E-Commerce- Main-Memory Databases – Real-Time Transaction Systems – Long-Duration Transactions.

Total:45

TEXT BOOK:

1.	Silberschatz, Abraham, Korth, Henry F., S.Sudarshan, "Database System Concepts", 7 th Edition, Mc Graw Hill, 2020.
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REFERENCES:

1.	Ramez Elmasri, Shamkanth B.Navathe, “Fundamentals of Database Systems”, 7 th Edition, Pearson Education, 2016
2.	Wilfried Lemahieu, Seppe vanden Broucke, Bart Baesens, “Principles of Database Management: The Practical Guide to Storing, Managing and Analyzing Big and Small Data”, 1 st Edition Cambridge University Press, 2018

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	solve concurrency issues in transactions											Applying (K3)		
CO2	apply the recovery methods of databases											Applying (K3)		
CO3	infer parallel databases											Applying (K3)		
CO4	make use of concurrency control methods in distributed databases											Applying (K3)		
CO5	describe spatial and 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	3	2	1	1									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	2	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		15		55		30								100
CAT2		15		60		25								100
CAT3		15		60		25								100
ESE		10		55		35								100
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE05 – CYBER FORENSICS

Programme& Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Cryptography and Network Security	8	PE	3	0	0	3

Preamble	This course imparts fundamental principles and techniques for digital forensics investigation and security management.						
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Unit – I	Computer Forensics and Investigations:	9
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An Overview of Digital Forensics – Preparing for Digital Investigations – Maintaining Professional Conduct – Preparing a Digital Forensics Investigation – Procedures for Private-Sector High-Tech Investigations – Understanding Data Recovery Workstations and Software – Conducting an Investigation – The Investigator's Office and Laboratory: Understanding Forensics Lab Accreditation Requirements – Determining the Physical Requirements for a Digital Forensics Lab – Selecting a Basic Forensic Workstation.

Unit – II	Data Acquisition:	9
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Understanding Storage Formats for Digital Evidence – Determining the Best Acquisition Method – Contingency Planning for Image Acquisitions – Validating Data Acquisitions – Performing RAID Data Acquisitions – Using Remote Network Acquisition Tools – Processing Crime and Incident Scenes: Identifying Digital Evidence – Collecting Evidence in Private-Sector Incident Scenes – Processing Law Enforcement Crime Scenes – Preparing for a Search – Securing a Digital Incident or Crime Scene – Seizing Digital Evidence at the Scene – Storing Digital Evidence – Obtaining a Digital Hash.

Unit – III	Digital Forensics Tools, Analysis and Validation:	9
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Evaluating Digital Forensics Tool Needs – Digital Forensics Software Tools – Digital Forensics Hardware Tools – Validating and Testing Forensics Software – Digital Forensics Analysis and Validation: Determining what Data to Collect and Analyze – Validating Forensic Data – Addressing Data – Hiding Techniques.

Unit – IV	Recovering Graphics Files:	9
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Recognizing a Graphics File – Understanding Data Compression – Identifying Unknown File Formats – Understanding Copyright Issues with Graphics – Virtual Machine Forensics – Live Acquisitions – Network Forensics: An Overview of Virtual Machine Forensics – Performing Live Acquisitions – Network Forensics Overview.

Unit – V	Email and Social Media Investigations:	9
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Exploring the Role of E-mail in Investigations – Exploring the Roles of the Client and Server in E-mail – Investigating E-mail Crimes and Violations – Understanding E-mail Servers – Applying Digital Forensics Methods to Social Media Communications – Mobile Device Forensics and the Internet of Anything: Understanding Mobile Device Forensics – Understanding Acquisition Procedures for Mobile Devices – Understanding Forensics in the Internet of Anything.

Total:45

TEXT BOOK:

1.	Bill Nelson, Amelia Philips and Christopher Steuart, "Guide to Computer Forensics and Investigations", 6 th Edition, Cengage Learning, New Delhi, 2020
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REFERENCES:

1.	John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", 1 st Edition, Charles River MediaInc., 2014.
2.	Marie-Helen Maras, "Computer Forensics: Cybercriminals, Laws, and Evidence", 2 nd Edition, Jones & Bartlett Publishers, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	infer the systematic approach for digital forensic investigation											Understanding (K2)		
CO2	carry out acquisition of data using various tools											Applying(K3)		
CO3	determine the seizure of digital evidence in a crime scene											Applying(K3)		
CO4	make use of forensic tools in forensic examination											Applying(K3)		
CO5	carry out investigation using e-mail and graphic files											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	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	1	1									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	5		60		35								100	
CAT2	5		55		40								100	
CAT3	5		50		45								100	
ESE	5		55		40								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE06– OBJECT ORIENTED SYSTEM DESIGN

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Software Engineering	8	PE	3	0	0	3

Preamble	Understand the importance and basic concepts of object oriented analysis and design through Unified Modeling Language	
Unit – I	An Overview of Object Oriented Systems Development:	9
Introduction: Orthogonal Views of Software – Methodology – Overview of Unified Approach. Object Basics: An Object Oriented Philosophy – Objects – Attributes – Object Behavior and Methods – Objects Respond to Messages – Encapsulation and Information Hiding – Class Hierarchy – Polymorphism – Object Relationships and Associations – Aggregations and Object Containment – Object and Identity – Static and Dynamic Binding – Object Persistence – Meta Classes – Object Oriented System Development Life Cycle.		
Unit – II	Object–Oriented Methodologies and Unified Modeling Language:	9
Introduction: Rumbaugh Object Modeling Technique – The Booch Methodology – The Jacobson Methodologies – Patterns – Frameworks – The Unified Approach. Unified Modeling Language: Introduction: Static and Dynamic Models – UML Diagrams – UML Class Diagram – Use Case Diagram – UML Dynamic Modeling – UML Extensibility – UML Meta-Model.		
Unit – III	Object Oriented Analysis and Classification:	9
Introduction: Business Object Analysis – Use Case Driven Object Oriented Analysis – Business Process Modeling – Use Case Model – Developing Effective Documentation. Object Analysis Classification: Noun Phrase Approach – Common Class Pattern Approach – Use Case Driven Approach – Classes, Responsibilities and Collaborators.		
Unit – IV	Object Oriented Design Process and Axioms, Designing Classes:	9
Object Oriented Design Process and Design Axioms – Object Oriented Design Process – Object Oriented Design Axioms – Corollaries – Design Patterns – Designing Classes – Object Constraint Language – The Process – Class Visibility – Refining Attributes – Refining Attributes for the Vianet Bank Objects – Methods and protocols – Methods for the Vianet Bank Objects.		
Unit – V	View Layer and System Usability:	9
Introduction: User Interface Design – Designing View Layer Classes – Micro and Macro Level Process – Purpose of View Layer Interface – Prototyping User Interface. System Usability: Introduction – Usability Testing – User Satisfaction Test – A Tool For Analyzing User Satisfaction. Case Study: Test Cases For Vianet Bank ATM System.		

Total:45

TEXT BOOK:

1. Ali Bahrami, "Object Oriented System Development", McGraw Hill Education(India) Private Limited 25th Reprint 2018

REFERENCES:

1. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Language User Guide", Addison Wesley, 12th Impression 2012.
2. Michael R Blaha & James R Rumbaugh, "Object Oriented Modeling and Design with UML", 2nd Edition, Pearson, 2011

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	illustrate the object oriented concepts and outline the object oriented life cycle model for a project.											Understanding (K2)		
CO2	illustrate the methodologies using UML diagrams											Applying (K3)		
CO3	demonstrate object oriented analysis by identifying use cases, classes and their relationships											Applying (K3)		
CO4	design classes using axioms, corollaries and patterns											Applying (K3)		
CO5	design user interface classes and perform testing											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				3	3	3	3	3	2
CO2	3	2	1		1				3	3	3	3	3	2
CO3	3	2	1		1				3	3	3	3	3	2
CO4	3	2	1		1				3	3	3	3	3	2
CO5	3	2	1		1				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	15	55	30				100							
CAT2	15	45	40				100							
CAT3	15	40	45				100							
ESE	10	45	45				100							
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE07 - BIG DATA ANALYTICS

Programme& Branch	MSc - SOFTWARE SYSTEMS	Sem.	Category	L	T	P	Credit
Prerequisites	Database Management Systems	8	PE	3	0	0	3

Preamble	To provide basic knowledge about big data and its framework, storage and stream processing with SPARK and KAFKA.
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Unit – I	Bigdata Analytics:	9
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Types of Digital Data: Classification. Introduction to Big Data: Characteristics– Evolution – Definition – Challenges – Business Intelligence versus Big Data – Data Warehouse Environment – Hadoop Environment. Big Data Analytics: Introduction - Classification of Analytics – Challenges - Importance – Data Science – Terminologies. The Big Data Technology Landscape: NoSQL.

Unit – II	Hadoop & MapReduce Programming:	9
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The Big Data Technology Landscape: Hadoop. Introduction to Hadoop: Introduction – RDBMS versus Hadoop – Distributed Computing Challenges – HDFS – Processing Data with Hadoop – YARN - Interacting with Hadoop Ecosystem – Introduction to Map Reduce Programming: Mapper – Reducer – Combiner – Partitioner – Searching – Sorting – Compression.

Unit – III	MongoDB and Cassandra:	9
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Introduction to MongoDB: Introduction - RDBMS and MongoDB - Data Types - MongoDB Query Language. Introduction to Cassandra: Introduction - Features – CQL Data Types – CQLSH – Keyspaces – CRUD Operations – Collections – Counter – TTL - Alter – Import and Export – Querying System Tables.

Unit – IV	HIVE and PIG:	9
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Introduction to Hive: Hive - Architecture – Data Types – File Format – Hive Query Language (HQL) – RC File Implementation – SerDe – User-Defined Function. Introduction to Pig: Features – Anatomy - Pig on Hadoop – Philosophy – Use case – Pig Latin – Data Types – Running Pig – Execution Modes of Pig – HDFS Commands – Relational Operators – Eval Function – Complex Data Types.

Unit – V	Apache SPARK and KAFKA	9
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Introduction – SPARK architecture – SPARK SQL – SPARK Streaming – SPARK Eco system – SPARK for Big Data Processing – SPARK applications – Apache KAFKA – KAFKA Architecture – Use cases.

Total:45

TEXT BOOK:

1.	Seema Acharya, Subhashini Chellappan, "Big Data and Analytics", 2 nd Edition, Wiley India Pvt, New Delhi, 2022, for Units I, II, III, IV.
2.	https://spark.apache.org/docs/latest , https://kafka.apache.org/11/documentation/ , for Unit V.

REFERENCES:

1.	Dr.Anil Maheshwari, "Big Data", 2nd Edition, McGraw Hill Education, 2019.
2.	"Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", EMC Education Services, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to													BT Mapped (Highest Level)	
CO1	describe the characteristics of big data and use it for identifying the types of digital data.												Applying(K3)	
CO2	acquire the usage of Hadoop and MapReduce programming.												Applying(K3)	
CO3	determine the application of MongoDB and Cassandra.												Applying(K3)	
CO4	explore the architecture and formats of Hive and Pig.												Applying(K3)	
CO5	Utilize SPARK and KAFKA architecture for big data processing.												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									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	1	1									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		15		55		30								100
CAT2		15		55		30								100
CAT3		15		55		30								100
ESE		5		55		40								100
* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)														

22ISE08 - BUSINESS INTELLIGENCE AND ITS APPLICATIONS

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	8	PE	3	0	0	3

Preamble	To apply the BI concepts and techniques to various applications for making better decisions
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Unit – I	Business View of Information Technology Applications and Types of Digital data:	9
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Business View of Information Technology Applications: Business Enterprise Organization, Its Functions, and Core Business Processes– Baldrige Business Excellence Framework – Purpose of Using IT in Business – Characteristics of Internet-Ready IT Applications – Enterprise Applications – Information Users and their Requirements .Types of Digital Data: Introduction – Getting into “Good Life” Database – Structured Data – Unstructured Data – Semi-Structured Data – Difference Between Semi-structured and Structured data.

Unit – II	Business Intelligence and Data Integration:	9
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Business Intelligence: Definition – Evolution – Need for BI – BI Value Chain – Business Analytics. BI Definitions and Concepts: BI Framework –BI Areas- BI Users – BI Applications – BI Roles and Responsibilities. Data Integration: Need for Data Warehouse – Definition of Data Warehouse – Data Mart –ODS- Ralph Kimball's Approach vs. W.H.Inmon's Approach – Goals of Data Warehouse – ETL Process – Data Integration Technologies – Data Quality – Data Profiling.

Unit – III	OLTP, OLAP and Multidimensional Data Modeling:	9
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Introduction to OLTP and OLAP: OLTP – OLAP – OLAP Architectures – Data Models – Role of OLAP Tools in BI - OLAP Operations. Multidimensional Data Modeling: Basics of Data Modeling – Types of Data Model – Data Modeling Techniques – Fact Table – Dimension Table – Dimensional Models – Dimensional Modeling Life Cycle – Designing the Dimensional Model.

Unit – IV	Performance Management and Enterprise Reporting:	9
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Measures, Metrics, KPIs and Performance Management: Understanding Measures and Performance – Measurement System – Role of Metrics – KPIs. Enterprise Reporting: Reporting Perspectives – Report Standardization and Presentation Practices – Enterprise Reporting Characteristics – Balanced Scorecard – Dashboards – Creating Dashboards – Scorecards vs. Dashboards – Analysis.

Unit – V	Role of Statistics in Analytics and BI Applications:	9
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Understanding Statistics: Role of Statistics in Analytics–Data Description and Summarization – Statistical Test – Understanding Hypothesis and t-Test – Correlation Analysis – Application of Analytics: Application of Analysis in Industries. BI Applications: Understanding Business Intelligence and Mobility – Business Intelligence and Cloud Computing – Business Intelligence for ERP systems – Social CRM and Business Intelligence.

Total:45

TEXT BOOK:

1.	Prasad R.N. and Seema Acharya, “Fundamentals of Business Analytics”, 2nd Edition, Wiley-India Publication, 2016.
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REFERENCES:

1.	Ramesh Sharda, Dursun Delen, Efraim Turban, “Business Intelligence, Analytics, and Data Science: A Managerial Perspective” 4th Edition, Pearson Education, 2017.
2.	David Loshin, “Business Intelligence: The Savvy Manager’s Guide”, 2nd Edition, Morgan Kaufmann Publishers, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)			
CO1	demonstrate the enterprise view of IT applications and identify the different types of digital data												Applying (K3)		
CO2	make use of BI concepts and techniques to experiment ETL process												Applying (K3)		
CO3	compare OLTP with OLAP systems and design dimensional model												Applying (K3)		
CO4	apply different software design techniques for a given problem												Applying (K3)		
CO5	apply BI to mobile, cloud, ERP and social CRM systems												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									3	3	
CO2	3	2	1	1									3	3	
CO3	3	2	1	1									3	3	
CO4	3	2	1	1									3	3	
CO5	3	2	1	1									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		15		45		40								100	
CAT2		15		40		45								100	
CAT3		15		40		45								100	
ESE		10		45		45								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)															

22ISE09 - BUILDING ENTERPRISE APPLICATIONS

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	PE	3	0	0	3

Preamble	To impart knowledge in prescriptive technical architecture framework for raising a typical enterprise application
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Unit – I	Analysis and Modeling:	9
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Introduction: Enterprise applications – Software engineering methodologies – Life cycle of raising an enterprise application – Key determinants of successful enterprise applications – Measuring the success of enterprise applications. Incepting enterprise applications: Enterprise analysis –business modeling – requirements elicitation – use case modeling – prototyping – Nonfunctional requirements – requirements validation – planning and estimation.

Unit – II	Architecting and Designing:	9
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Architecting and Designing Enterprise applications: Concept of architecture – Views and viewpoints – Enterprise architecture – Logical architecture – Technical architecture and Design, Different technical layers, Object – Oriented Analysis and Design – Best practices – Data architecture and design – relational, XML, and other structured data representations.

Unit – III	Architectural Design:	9
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Technical architecture – Infrastructure architecture and design elements – Networking, Internetworking, and Communication Protocols – IT Hardware and Software – Middleware –Policies for Infrastructure Management, Deployment Strategy, Documentation of application architecture and design.

Unit – IV	Construction:	9
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Constructing Enterprise Applications: Construction readiness of enterprise applications – defining a construction plan – defining a package structure, setting up a configuration management plan – setting up a development environment – introduction to the concept of Software Construction Maps – construction of technical solutions layers – methodologies of code review – static code analysis – build and testing. Dynamic code analysis – code profiling and code coverage.

Unit – V	Testing and Rolling out Enterprise Applications:	9
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Testing an Enterprise Application – Testing Levels and Approaches – Testing Environments – Integration Testing – Performance Testing – Penetration Testing – Usability Testing – Globalization Testing and Interface Testing – User Acceptance Testing – Rolling Out an Enterprise Application.

Total: 45

TEXT BOOK:

- | | |
|----|--|
| 1. | Anubhav Pradhan, Satheesha B.Nanjappan, Senthil K.Nallasamy, Veerakumar Esakimuthu, "Raising Enterprise Applications", 1st Edition, Wiley India Pvt. Ltd., 2011. |
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REFERENCES:

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| 1. | Soren Lauesen, "Software Requirements: Styles & Techniques", 1st Edition, Addison-Wesley Professional Publications, 2002. |
| 2. | Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing Principles and Practices ", 1st Edition, Pearson Publications, 2006. |

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)			
CO1	apply the concepts of enterprise analysis and business modelling for an application												Applying (K3)		
CO2	design and document the application architecture												Applying (K3)		
CO3	determine the importance of application framework and design application components												Applying (K3)		
CO4	perform code review, code analysis and build process to implement enterprise applications												Applying (K3)		
CO5	illustrate various testing strategies and deploy enterprise applications												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									3	3	
CO2	3	2	1	1									3	3	
CO3	3	2	1	1									3	3	
CO4	3	2	1	1									3	3	
CO5	3	2	1	1									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		15		45		40								100	
CAT2		15		45		40								100	
CAT3		15		45		40								100	
ESE		10		45		45								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)															

22ISE10 – HUMAN COMPUTER INTERACTION

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	PE	3	0	0	3

Preamble	To design good user interface simple and efficient as possible in terms of accomplishing user goals.
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UNIT - I	User Interface Analysis and Design:	9
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The Golden Rules – User Interface analysis & Design – Interface analysis – Interface Design steps – Applying Design steps – UID patterns – Design Evaluation

Unit – II	Modeling Users: Personas and Goals:	9
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Model – Personas – Provisional Personas – Goals- User Goals and Cognitive Processing - Designing for Visceral Responses, Behavior and Reflection – Types of User Goals – Successful Products and User Goals- Constructing Personas – Other Models

Unit - III	Synthesizing Good Design:	9
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Design Principles – Design Values – Design Patterns – Posture – Designing Desktop Software – Designing for the Web – Other Platforms – Orchestration and Flow: Flow and Transparency – Designing Harmonious Interactions.

Unit - IV	Excise and Good Behavior:	9
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Eliminating Excise: GUI Excise – Proceedings – Traps – Metaphors, Idioms and Affordances: Interface Paradigms – Metaphors – Building Idioms – Manual Affordances.

Unit - V	Preventing Errors:	9
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Preventing Errors and Informing Decisions: Using Rich Modeless Feedback - Undo, Redo, and Reversible Histories - Compare and Preview – Designing for Different needs: Learnability and Help - Customizability - Localization and Globalization Accessibility.

Total:45

TEXT BOOK:

1.	Pressman. Roger, "Software Engineering: A Practitioner Approach", 8 th Edition, McGraw Hill, 2019, for Unit I.
2.	Alan Cooper, Robert Reimann and Dave Cronin, "About Face 3: The Essentials of Interaction Design", Wiley Publishing Inc, Fourth Edition, 2014, for Units II, III, IV , V.

REFERENCES:

1.	Wilbert, O.Galitz, "The Essential Guide to User Interface Design", 2nd Edition, John Wiley & Sons, 2007.
2.	Sheiderman Ben and Catherine Plaisant, "Designing the User Interface", 6 th Edition, Pearson Education, New Delhi, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	apply the design rules during interface analysis and design phases											Applying(K3)		
CO2	construct personas based on user goals											Applying(K3)		
CO3	implement the design principles during the design of desktop and web applications											Applying(K3)		
CO4	design user interface with good behavior.											Applying(K3)		
CO5	make use of interface paradigms in visual interface design.											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									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	1	1									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	15		65		20								100	
CAT2	15		60		25								100	
CAT3	15		60		25								100	
ESE	10		60		30								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE11 – WEB MINING

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	PE	3	0	0	3

Preamble This course provides knowledge about web searching, indexing, query processing and web content mining.

Unit – I **Information Retrieval and Web Search:** **9**

Basic Concepts – Information Retrieval Models – Relevance Feedback – Evaluation Measures – Text and Web Page Pre-processing – Inverted Index and its compression – Latent Semantic Indexing – Web Search – Meta-Searching and Combining - Multiple Rankings – Web Spamming.

Unit – II **Web Crawling:** **9**

Basic Crawler Algorithm – Implementation Issues – Universal Crawlers – Focused Crawlers – Topical Crawlers – Evaluation – Crawler Ethics and Conflicts.

Unit – III **Wrapper Generation:** **9**

Preliminaries – Wrapper Induction-Instance-Based Wrapper Learning – Automatic Wrapper Generation: Problems – String Matching and Tree Matching – Multiple Alignment – Building DOM Trees – Extraction Based on a Single List Page and Multiple pages – Introduction to Schema Matching – Pre-Processing for Schema Matching-Schema – Level Match – Domain and Instance-Level Matching – Combining similarities.

Unit – IV **Web Usage Mining:** **9**

Web Usage Mining – Click stream Analysis – Log Files – Data Collection and Pre-Processing – Data Modeling for Web Usage Mining – The BIRCH Clustering Algorithm – Affinity Analysis and the A Priori Algorithm – Discretizing the Numerical Variable: Binning – Applying the A Priori Algorithm to CCSU Web Log Data – Discovery and Analysis of Web Usage Patterns –Recommender Systems and Collaborative Filtering.

Unit – V **Opinion Mining:** **9**

The Problem of Opinion Mining – Document Sentiment Classification – Sentence Subjectivity and Sentiment Classification – Opinion Lexicon Expansion – Aspect-Based Opinion Mining – Mining Comparative Opinions Search and Retrieval – Opinion Spam Detection.

Total:45

TEXT BOOK:

1. Bing Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data Centric Systems and Applications)", Springer; 2nd Edition 2011, for Units I,II,III,IV part 1, V
2. Zdravko Markov, Daniel T. Larose, "Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage", John Wiley & Sons, Inc., 2010 , for Unit IV part 2.

REFERENCES:

1. Guandong Xu ,Yanchun Zhang, Lin Li, "Web Mining and Social Networking: Techniques and Applications", Springer; 1st Edition.2010
2. Soumen Chakrabarti, "Mining the Web: Discovering Knowledge from Hypertext Data", Morgan Kaufmann; Edition 2007

COURSE OUTCOMES: On completion of the course, the students will be able to													BT Mapped (Highest Level)	
CO1	determine information retrieval models and methods related to Web search												Applying (K3)	
CO2	apply algorithms for Web crawling applications												Applying (K3)	
CO3	make use of wrapper to extract structured data												Applying (K3)	
CO4	illustrate various clustering algorithms with corresponding analysis and filtering												Applying (K3)	
CO5	apply opinion mining techniques to classify opinions												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									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	1	1									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	15		50		35								100	
CAT2	15		50		35								100	
CAT3	15		45		40								100	
ESE	10		45		45								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE12 – INFORMATION RETRIEVAL							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Machine Learning	9	PE	3	0	0	3
Preamble	This course discusses about the basic concepts of IR and various modeling techniques to build a text or multimedia based IR system.						
Unit – I	Introduction and Classic IR Models:						9
Introduction and Classic IR Models: Information Retrieval – The IR Problem – The IR System – Search Interfaces Today- Visualization in Search Interfaces. Modeling: IR Models – Classic Information Retrieval – Algebraic Models: Neural Network Model.							
Unit – II	Feedback, Languages and Query Properties:						9
Relevance Feedback, Languages and Query Properties: A Framework for feedback methods – Explicit Relevance feedback – Implicit feedback through local analysis – Global analysis. Documents: Metadata – Documents formats. Queries – Query Language – Query Properties.							
Unit – III	Text Operations:						9
Text Operations: Text Properties – Document Preprocessing – Text Compression. Text Classification: Characterization of Text Classification – Unsupervised Algorithms – Supervised Algorithms: Decision Tree – SVM Classifier – Feature Selection or Dimensionality Reduction – Evaluation Metrics: Accuracy and Error.							
Unit – IV	Web Retrieval and Web Crawling:						9
Web Retrieval and Web Crawling: The Web – Search Engine Architectures: Cluster Based Architecture – Distributed Architectures – Search Engine Ranking – Browsing. Web Crawling: Applications of a Web Crawler – Taxonomy Architecture and Implementation – Scheduling Algorithms – Evaluation.							
Unit – V	Applications:						9
Applications: Enterprise Search – Tasks – Architecture. Library Systems: Online Public Access Catalogues – IR System and Document Databases. Digital Libraries: Architecture and Fundamentals.							
							Total:45
TEXT BOOK:							
1.	Ricardo Baeza-Yate, Berthier Ribeiro-Neto, “Modern Information Retrieval - The Concepts And Technology Behind Search”, 2 nd Edition, Pearson Education Asia, 2011.						
REFERENCES:							
1.	Chowdhury G.G., “Introduction to Modern Information Retrieval”, 2 nd Edition, Neal-Schuman Publishers, 2003.						
2.	Daniel Jurafsky and James H. Martin, “Speech and Language Processing”, 1 st Edition, Pearson Education, 2000.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	describe principles of various IR models and carryout issues of information retrieval in real time data											Applying (K3)		
CO2	apply feedback methods for local and global analysis and also discuss about document formats and query properties											Applying (K3)		
CO3	apply various text operations for the applications											Applying (K3)		
CO4	make use of web crawling and web retrieval techniques for the given problems											Applying (K3)		
CO5	interpret the concepts of registers and counters.											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									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	3	1	1									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	15	55	30				100							
CAT2	15	35	50				100							
CAT3	15	45	40				100							
ESE	10	45	45				100							
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE13 – INFORMATION SECURITY							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Computer Networks	9	PE	3	0	0	3
Preamble	This course focuses on wide spectrum of topics from legal and ethical issue, risk management, and implementation in the context of information security.						
Unit - I	Information Security and The Need for Security						9
The history of Information Security – CNSS Security model-Components of an Information System – Security in the system life cycle – Security professionals and the organization – Communities of interest – The need for Security: Threat and Attacks – Compromises to intellectual property – Deviations in Quality of Service-Espionage – Force of nature – Human Error – Information Extortion – Sabotage-Software attacks – Technical hardware failures – Technical software failures							
Unit - II	Issues in Information Security and Planning for Security						9
Law and ethics in information Security – Relevant U.S. Laws-International laws and legal bodies – Ethics and Information security – Codes of ethics of professional organizations – Key U.S. Federal agencies – Planning for Security: Information security policy, standards, and practices – The Information security blueprint – Security education, training, and awareness program – Continuity Strategies.							
Unit - III	Risk Management						9
Risk Identification: Planning and organizing the process – Identifying, inventorying and categorizing assets- Classifying and prioritizing threats – Specifying asset vulnerabilities; Risk assessment: Planning and organizing risk assessment-Determining the loss frequency – Calculating risk – Assessing risk acceptability – The FAIR approach to risk assessment – Risk control- Quantitative versus qualitative risk management practices-Recommended risk control practices.							
Unit - IV	Security Technology						9
Access Control: Access control mechanisms – Biometrics – Access control architecture models – Firewalls: Firewall processing modes – Firewall architecture – Selecting the right firewalls – Configuring and managing firewalls – Content filters – Protecting remote connections – Intrusion detection and prevention systems –Honeypots, Honeynets, and padded cell systems – Scanning and analysis tools.							
Unit - V	Implementing Information Security and Personnel						9
Information security project management – Technical aspects of implementation-Nontechnical aspect of implementation-Information security certification and accreditation-Credentials for information security professionals-Employment policies and practices-Security considerations for temporary employees, consultants, and other workers.							
							Total: 45
TEXT BOOK:							
1.	Michael E. Whitman and Herbert J. Mattord, "Principles of Information Security", 6 th Edition, Cengage Learning, India, 2018.						
REFERENCES:							
1.	Charles P. Pfleeger and Shari Lawrence Pfleeger, "Security in Computing", 5 th Edition, Prentice Hall, 2018.						
2.	Micki Krause, Harold F. Tipton, "Handbook of Information Security Management", Vol. 6, 6 th Edition, CRC Press, 2012.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	explore the basic concepts in information security and determine the type of attacks in a security breach											Understanding (K2)		
CO2	identify the legal, ethical, professional issues in information security and apply security policies, standards and practices											Applying (K3)		
CO3	identify the risks involved in information security and carry out risk assessment											Applying (K3)		
CO4	utilize security technologies for protecting information											Applying (K3)		
CO5	Make use of various aspects of implementing information security and, paraphrase the issues and concerns related to staffing the information security											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	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	1	1									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	5		55		40								100	
CAT2	5		45		50								100	
CAT3	5		45		50								100	
ESE	5		55		40								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE14 – PREDICTIVE DATA ANALYTICS							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	PE	3	0	0	3
Preamble	This course provides the fundamental concepts of predictive data analytics and knowledge on the applications to solve real world problems						
Unit – I	Predictive Analytics and Setting up the Predictive Modeling project						9
Overview of Predictive Analytics: Predictive Analytics–Predictive Analytics vs. Business Intelligence–Predictive Analytics vs. Statistics– Predictive Analytics vs. Data Mining– Challenges in Using Predictive Analytics. Setting up the Predictive Modeling project: Predictive Analytics Processing Steps: CRISP-DM–Defining Data for Predictive Modeling–Defining the Target Variable–Defining Measures of Success for Predictive Models.							
Unit – II	Data Understanding and Preparation						9
Data Understanding: Single Variable Summaries–Data Visualization in One Dimension – Histograms –Multiple Variable Summaries – Data Visualization Data Preparation: Variable Cleaning–Feature Creation							
Unit – III	Descriptive Modeling						9
Descriptive Modeling: Data Preparation Issues with Descriptive Modeling – Principal Component Analysis – Clustering Algorithms. Interpreting Descriptive Models: Standard Cluster Model Interpretation.							
Unit – IV	Model Ensembles and Deployment						9
Model Ensembles: Motivation for Ensembles–Bagging–Boosting– Improvements to Bagging and Boosting–Interpreting Model Ensembles. Model Deployment: General Deployment Considerations– Case Study.							
Unit – V	Healthcare data Analytics						9
Healthcare Data Sources and Basic Analytics- Advanced Data Analytics for Healthcare- Applications and practical Systems for Healthcare-Electronic Health Records-Components of HER-Coding Systems- Benefits of HER-Barriers and Challenges of using HER Data.							
Total:45							
TEXT BOOK:							
1.	Dean Abbott, “Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst”, John Wiley & Sons, Inc., 1 st Edition, 2014, for Units I, II, III , IV						
2.	Chandan K. Reddy, Charu C. Aggarwal "Healthcare Data Analytics", 1 st Edition, CRC Press, 2015, for Unit V.						
REFERENCES:							
1.	JohnD. Kelleher, Brain Mac Namee, AoifeD’Arcy, “Fundamentals of Machine Learning for Predictive Data Analytics”, MIT Press, 1 st Edition, 2015						
2.	Chris Chapman, Elea McDonnell Feit "R for Marketing Research and Analytics", Springer, 2015.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)			
CO1	explore the processing steps of predictive analysis for solving real-time problems												Applying(K3)		
CO2	make use of data for modeling project												Applying(K3)		
CO3	utilize various descriptive modeling algorithms												Applying(K3)		
CO4	determine the different types of predictive modeling algorithms												Applying(K3)		
CO5	apply predictive analytics concepts to real world applications												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										3	1	
CO2	3	2	1										3	1	
CO3	3	2	1										3	1	
CO4	3	2	1										3	1	
CO5	3	2	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	15		45		40								100		
CAT2	15		45		40								100		
CAT3	15		45		40								100		
ESE	10		40		40								100		
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)															

22ISE15 – DECISION SUPPORT SYSTEMS

Programme& Branch	MSc - SOFTWARE SYSTEMS	Sem.	Category	L	T	P	Credit
Prerequisites	NIL	9	PE	3	0	0	3

Preamble	This course focuses on various Decision Support Systems and their technologies collectively represented as analytics and the fundamental methods, techniques and the software used to design and develop these systems.						
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Unit – I	Decision Making and Analytics:	9
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Foundations and Technologies for Decision Making – Introduction – Phases of Decision Making Process – The Intelligence phase – Design Phase – Choice Phase – Implementation Phase – Decision Support System Capabilities – Classification – Components of Decision Support System – Application case study.

Unit – II	Descriptive Analytics:	9
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Data Warehousing – Definition – Data warehousing process overview – Data warehouse architecture – ETL process – Data warehouse development with application case study – Data warehouse implementation Issues – Real time Data warehouse with application case study – Data warehouse administration and security issues.

Unit – III	Predictive Analytics:	9
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Text Analytics, Text Mining and Sentiment Analysis – Concepts – Natural Language Processing – Text mining approaches – Text mining process with application case study – Text mining tools – Sentiment Analysis overview – Sentiment analysis applications – Sentiment analysis process.

Unit – IV	Web Analytics, Web Mining and Social Analytics:	9
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Web Analytics, Web Mining and Social Analytics – Web mining overview – Web content and web structure mining – Web usage mining – Web analytics maturity model and web analytics tools – Social analytics and social network analysis with application case study – Social media concepts – Social media analytics.

Unit – V	Prescriptive Analytics:	9
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Model based decision making – DSS modeling – Structure – Certainty, Uncertainty and Risk – Decision modeling with spreadsheets – Decision analysis with decision tables and trees – Automated Decision Systems and Expert Systems – Artificial intelligence – Basic concepts of expert systems – Structure of expert systems with application case study – Knowledge engineering – Development of Expert system.

Total: 45

TEXT BOOK:

1.	Ramesh Sharda, Dursun Delen, Efraim Turban, "Business Intelligence and Analytics Systems for Decision Support", 10th Edition, Pearson Education, 2018.
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REFERENCES:

2.	Diego Galar Pascual "Artificial Intelligence Tools: Decision Support Systems in Condition Monitoring and Diagnosis", 1st Edition, CRC Press, 2015.
3.	Michelle M.H. Seref, Ravindra A. Ahuja, Wayne L. Winston, " Developing Spreadsheet-Based Decision Support Systems", 2nd Edition, Dynamic Ideas, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)			
CO1	adapt to different phases, components and classifications in decision support systems.												Applying(K3)		
CO2	carry out descriptive analytics process and data warehouse development.												Applying(K3)		
CO3	perform text analytics, text mining and sentiment analysis for the given application.												Applying(K3)		
CO4	perform web analytics, web mining and social analytics for the specified application												Applying(K3)		
CO5	demonstrate model based decision support system and expert system for an application.												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									3	3	
CO2	3	2	1	1									3	3	
CO3	3	2	1	1									3	3	
CO4	3	2	1	1									3	3	
CO5	3	2	1	1									3	3	
CO6	3	2	1	1									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		50		40								100	
CAT2		10		50		40								100	
CAT3		10		50		40								100	
ESE		10		50		40								100	
* ±3% may be varied (CAT 1,2,3 – 50 marks & ESE – 100 marks)															

22ISE16 – NATURAL LANGUAGE PROCESSING

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	PE	3	0	0	3

Preamble	The course provides the foundation on Natural Language Processing concepts. Starting from words as the unit of a language, this course deals with statistical models, word embedding and sequence modelling using advanced neural architectures. It also illustrates some practical NLP systems like Machine translation, Question Answering systems and chatbots.
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Unit – I	Words and Their Statistical Models:	9
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Introduction to speech and language processing - Regular Expressions – Words – Corpora – Text normalization – Minimum edit distance. N-Gram Language Models – N-Grams –Evaluating Language Models – Generalizations and zeros – Smoothing – Kneser-Ney Smoothing – Huge Language Models –Backoff – Perplexity vs. Entropy. Naïve-Bayes classifiers –Naïve-Bayes as Language Model – Evaluation – Test set and cross validation – Statistical significance testing.

Unit – II	Vectors and Embeddings:	9
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Lexical Semantics – Vector Semantics – Words and Vectors – Cosine for measuring similarity – TF-IDF: weighing terms in vectors – pointwise Mutual Information (PMI) – Applications of TF-IDF and PPMI – Word2Vec – Visualizing embeddings – Bias and Embeddings – Evaluating vector models. Neural Network Language Models – Units – XOR problem – Feed Forward Neural Networks – Training Neural Nets – Neural Language Models—Case Study.

Unit – III	Sequence Labelling and Deep Learning Architectures:	9
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English word classes –Part-of-Speech (PoS) Tagging – Named Entities and Named Entities Tagging – HMM PoS – Conditional Random Fields – Evaluation of Named Entity Recognition. Deep Learning Architectures for sequence modelling – Recurrent Neural Networks – Managing contexts in RNNs: LSTMs and GRUs – Self Attention Networks (Transformers) – Potential harms from Language Models.

Unit – IV	Machine Translation and Encoder-Decoder Models:	9
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Language divergences and Typology – The Encode-Decoder model –Encoder-Decoder with RNNs – Attention – Beam Search – Encoder-Decoder with Transformers –Practical details on building MT systems – MT evaluation – Bias and ethical issues.

Unit – V	Practical NLP Systems:	9
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Question Answering: Information Retrieval – IR based Factoid Question Answering – Entity Linking – Knowledge based Question Answering – Using Language Models for Question Answering – Classic QA models – Evaluation of factoid answers
Chatbots and Dialogue systems – Properties of human conversations – Chatbots – GUS: a simple frame-based dialogue system – Evaluating dialogue systems – Dialogue system design–Case Study.

Total:45

TEXT BOOK:

1.	Daniel Jurafsky and James H. Martin, "Speech and Language Processing", 3 rd Edition, Pearson Education, New Delhi, 2020.
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REFERENCES:

1.	Christopher Manning and Hinrich Schuetze," Foundations of Statistical Natural Language Processing", 1 st Edition, MIT Press, London, 2000.
2.	Li Deng and Yang Liu, " Deep Learning in Natural Language Processing“,1 st Edition, Springer,2018.

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	apply formal and statistical models for word processing											Applying (K3)		
CO2	develop word vector embedding for a given language											Applying (K3)		
CO3	utilize deep learning architectures for modelling sequences in NLP											Applying (K3)		
CO4	make use of encoder-decoders models to build Machine Translation systems											Applying (K3)		
CO5	build question answering and chatbots for practical applications											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									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	1	1									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	15		55		30								100	
CAT2	15		35		50								100	
CAT3	15		45		40								100	
ESE	10		45		45								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE17 - BLOCKCHAIN TECHNOLOGIES							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	PE	3	0	0	3
Preamble	To provide a comprehensive introduction to the theoretical and practical aspects of blockchain technology.						
Unit – I	Blockchain 101:						9
Distributed systems-The history of blockchain – Introduction to blockchain – definitions – elements - Features – Applications of blockchain technology – Tiers – Types of blockchain – Consensus in blockchain – CAP theorem – Benefits and limitations of blockchain.							
Unit – II	Decentralization and Cryptography Technical Foundations:						9
Decentralization using blockchain – Methods – Routes – Blockchain and full ecosystem decentralization – Smart contract – Decentralized applications – Platforms for decentralization. Cryptography and Technical Foundations – Cryptography – Confidentiality – Integrity – Authentication – Cryptographic primitives – Asymmetric cryptography – Public and private keys – RSA - Discrete logarithm problem – Hash functions.							
Unit – III	Bitcoins and Alternative Coins:						9
Bitcoin – Transactions – Blockchain - Bitcoin payments – Alternative Coins – Theoretical foundations – Bitcoin limitations – Namecoin – Litecoin – Primecoin – Zcash – Smart Contracts.							
Unit – IV	Ethereum 101:						9
Introduction – Ethereum blockchain – Elements of the Ethereum blockchain - Precompiled contracts – Accounts – Block – Ether – Messages – Mining – Clients and wallets – The Ethereum network – Ethereum Development.							
Unit – V	Hyperledger:						9
Projects – Protocol – Hyperledger Fabric – Sawtooth Lake – Corda – Blockchains – Outside of Currencies: Internet of Things – Government – Health – Finance.							
							Total: 45
TEXT BOOK:							
1.	Imran Bashir, “Mastering Blockchain Distributed ledgers, decentralization and smart contracts Explained”, Packt Publishing, 1 st Edition, 2017.						
REFERENCES:							
1.	Brenn Hill, Samanyu Chopra, Paul Valencourt, “Blockchain Quick Reference: A guide to exploring decentralized blockchain application development”, Packt publishing, 1 st Edition 2018.						
2.	Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, “Beginning Blockchain: A Beginner’s Guide to Building Blockchain Solutions”, Apress, 2018.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)			
CO1	determine the basics and various real time applications of blockchain												Applying (K3)		
CO2	apply decentralization and cryptography for blockchain applications												Applying (K3)		
CO3	make use of blockchain technology for bitcoin, alternative coins and develop smart contracts												Applying (K3)		
CO4	develop a distributed application using Ethereum												Applying (K3)		
CO5	deploy an application using Hyperledger												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									3	3	
CO2	3	2	1	1									3	3	
CO3	3	2	1	1									3	3	
CO4	3	2	1	1									3	3	
CO5	3	2	1	1									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		15		45		40								100	
CAT2		15		45		40								100	
CAT3		15		40		45								100	
ESE		10		45		45								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)															

22ISE18 – SOFTWARE METRICS

Programme& Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Fundamentals of Software Engineering	9	PE	3	0	0	3

Preamble	To acquire knowledge in software metrics and measurement techniques.
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Unit – I	Basic Metrics for Software:	9
Fundamentals of Measurement–Measurement in Software Engineering – Scope of Software Metrics – Representation Theory of Measurement– Measurement and Models– Measurement Scales and Scale Types.		

Unit – II	Investigation Procedures:	9
Empirical investigation: Principles of Empirical Studies–Planning Experiments – Process Model for Performing Experiments–Key Experimental Design Concepts –Types of Experiment Design–Selecting Experimental Design.		

Unit – III	Software Metrics Data Collection:	9
Defining Good Data – Data Collection for Incident Reports – How to Collect Data – Reliability of Data Collection Procedures– Analyzing Software Measurement Data: Statistical Distributions and Hypothesis Testing – Examples of Simple Analysis Techniques.		

Unit – IV	Measurement of Software Attributes:	9
Measurement of Internal Product Attributes: Size– Properties of Software Size – Code Size – Design Size – Functional Size Measures and Estimators. Measurement of Internal Product Attributes: Structure – Control Flow Structure of Program Units.		

Unit – V	Software Quality Metrics:	9
Measuring External Product attributes–Modeling Software Quality–Measuring Aspects of Quality – Usability Measures – Maintainability Measures – Security Measures.		

Total:45

TEXT BOOK:

1.	Norman Fenton, James Bieman, "Software Metrics: A Rigorous and Practical Approach", 3 rd Edition, CRC Press, A Chapman and Hall Book, Florida, 2014.
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REFERENCES:

1.	Kan Stephen H, "Metrics and Models in Software Quality Engineering", 2nd Edition, Addison Wesley, New York, 2016
2.	Ravindranath Pandian.C, "Software Metrics A Guide to Planning, Analysis and Application", AUERBACH Publications, USA, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	interpret the fundamental of software measurement and scale for measurement.	Understand (K2)
CO2	make use of empirical investigation and experimental design concepts.	Applying(K3)
CO3	determine data collection and analysis techniques.	Applying(K3)
CO4	make use of measurement for internal product attributes.	Applying(K3)
CO5	outline the measuring of external product attributes	Understand (K2)

Mapping of COs with POs and PSOs

[illegible]

ASSESSMENT PATTERN – THEORY

Test / Bloom's Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	10	65	25				100
CAT2	10	55	35				100
CAT3	10	60	30				100
ESE	10	55	35				100

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

22ISE19 – SOCIAL MEDIA ANALYSIS

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	PE	3	0	0	3

Preamble	To Analyze and visualize data from the vast social media.
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Unit – I	Introduction to Social Media:	9
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Introducing social graph - Delving into social data - Understanding the process - Working environment - Getting the data - Analyzing the data - Visualizing the data-Harnessing Social Data: APIs in a nutshell - Introduction to authentication techniques - Parsing API outputs - Basic cleaning techniques - MongoDB to store and access social data - MongoDB using Python

Unit – II	Facebook and Twitter:	9
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Uncovering Brand Activity, Popularity, and Emotions on Facebook: Facebook brand page - Project planning - Analysis - Keywords - Noun phrases - Detecting Trends in Time series - uncovering emotions - Benefits - Analyzing Twitter Using Sentiment Analysis and Entity Recognition: Getting the data - Sentiment analysis - customized sentiment analysis

Unit – III	Youtube and GitHub:	9
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Campaigns and Consumer Reaction Analytics on YouTube – Structured and Unstructured - Scope and process - Getting the data - Data pull - Data processing - Data analysis - The Next Great Technology – Trends Mining on GitHub: Getting the data - Data pull - Data processing - Data analysis

Unit – IV	Extracting Data from Forum and Pinterest:	9
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Scraping and Extracting Conversational Topics on Internet Forums: Getting the data - Data pull and pre-processing - Data analysis - Introduction to topic models - Latent Dirichlet Allocation - Applying LDA to forum conversations - Topic interpretation - Demystifying Pinterest through Network Analysis of Users Interests - Getting the data using Pinterest API - Data Pulling and Pre-processing - Data Analysis

Unit – V	Social Data Analytics at Scale:	9
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Social Data Analytics at Scale – Spark and Amazon Web Services - Different scaling methods and platforms - Parallel computing - Distributed computing with Celery - Celery multiple node deployment - Distributed computing with Spark - Text mining With Spark - Topic models at scale - Spark on the Cloud – Amazon Elastic MapReduce

Total:45

TEXT BOOK:

1.	Siddhartha Chatterjee, Michal Krystyanczuk, "Python Social Media Analytics ", First Edition, Packt Publishing Ltd, 2017
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REFERENCES:

1.	Marco Bonzanini, "Mastering Social Media Mining with Python", 1st Edition, Packt, 2016
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2.	Embarak, "Data Analysis And Visualization Using Python: Analyze Data To Create Visualizations For Bi Systems", Apress, 2019
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COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	understand the basics of social media											Applying (K3)		
CO2	analyzing time series data and perform sentiment analysis.											Applying (K3)		
CO3	identifying trends by mining											Applying (K3)		
CO4	extracting data using conventional methods.											Applying (K3)		
CO5	utilizing the cloud platform for text mining											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	3				2	2	2	2	3	3
CO2	3	2	1	2	3				2	2	2	2	3	3
CO3	3	2	1	2	3				2	2	2	2	3	3
CO4	3	2	1	2	3				2	2	2	2	3	3
CO5	3	2	1	2	3				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		15		35		50								100
CAT2		20		30		50								100
CAT3		15		35		50								100
ESE		10		40		50								100
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE20 – AUGMENTED AND VIRTUAL REALITY

Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	PE	3	0	0	3

Preamble	This course introduces the fundamentals of the Virtual Reality and Augmented Reality to efficiently incorporate user experience, identifying and resolving conflicts in real life.
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Unit – I	Introduction to Virtual Reality	9
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Introduction to Virtual Reality: Definition – Key Elements of Virtual Reality Experience – History of VR. VR –The Medium: Communicating through a Medium – A Medium's Content – Common Issues of Human Communication Media – Narrative - Form and Genre – Experience Versus Information.

Unit – II	Virtual Reality Systems	9
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Interface to the Virtual World – Input: User Monitoring – World Monitoring. Interface to the Virtual World – Output: Visual Displays – Aural Displays – Haptic Displays.

Unit – III	Rendering and Future of the Virtual World	9
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Rendering of the Virtual World: Representation of the Virtual World – Visual – Aural – Haptic Representation. Rendering Systems – Visual – Aural – Haptic Rendering Systems. Future of VR: State of VR – Field of VR Research – Trends – Technology Futures – Software – Application Futures.

Unit – IV	Introduction to Augmented Reality	9
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Augmented Reality: Definition and Scope – History - Examples. Displays: Multimodal Displays – Visual Perception – Requirements and Characteristics – Spatial Display Model – Visual Displays. Tracking: Tracking, Calibration, and Registration - Coordinate Systems – Characteristics of Tracking Technology – Stationary Tracking Systems – Mobile Sensors – Optical Tracking - Sensor Fusion.

Unit – V	Vision, Interaction, Annotation and Collaboration	9
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Computer Vision: Marker Tracking – Natural Feature tracking by Detection – Incremental Tracking and Outdoor Tracking.
Interaction: Tangible interfaces – Virtual User Interfaces on Real Surfaces – Multi-view Interfaces – Haptic Interaction – Annotation
– Collaboration: Properties – Co-located Collaboration – Remote Collaboration.

Total:45

TEXT BOOK:

1.	Sherman William R, Craig Alan B., “Understanding Virtual Reality: Interface, Application and Design”, 1st Edition, Morgan Kaufmann Publishers, 2020, for Units I, II , III.
2.	Dieter Schmalstieg, Tobias Hollerer, Augmented Reality. Principles and Practice, 1st Edition, Addison-Wesley Publishers, 2016. for Unit IV . V.

REFERENCES:

1.	Jason Jerald, <i>The VR Book: Human Centric Design for Virtual Reality</i> , 1st Edition, Association for Computing Machinery and Morgan & Claypool Publishers, 2016.
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COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	demonstrate how VR is used to convey models of virtual worlds and compare the characteristics of virtual reality with other media for human communication.											Applying (K3)		
CO2	explore the many levels at which the user interacts with a virtual world using the medium of virtual reality											Understanding (K2)		
CO3	predict rendering and future of the virtual world.											Applying (K3)		
CO4	interpret the working principle of augmented reality and core technologies underlying augmented reality											Understanding (K2)		
CO5	determine vision, interaction, annotation and collaboration concepts in augmented reality.											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									3	3
CO2	2	1											3	2
CO3	3	2	1	1									3	3
CO4	2	1											3	2
CO5	3	2	1	1									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		65		25								100	
CAT2	10		65		25								100	
CAT3	10		65		25								100	
ESE	5		65		30								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE21 – PRINCIPLES OF MANAGEMENT							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	PE	3	0	0	3
Preamble	To present the basic concepts of management and various functions of managers.						
Unit – I	Management Science and Society:						9
Definition of Management –Managing Science or Art -The Evolution of Management Thought –Patterns of Management Analysis –The System Approach to Management Process-Functions of a Manager – Management and Society the External Environment, Social Responsibility and Ethics.							
Unit – II	Planning:						9
Types of Plans – Steps in Planning – Objectives – Evolving Concepts in Management by Objectives – Strategies, Policies and Planning Premises: Nature and Purpose of Strategies and Policies – Strategic Planning Process – The TOWS Matrix – Blue Ocean Strategy – Portfolio Matrix – Major Kinds of Strategies and Policies – Hierarchy of Company Strategies – Porter's Industry Analysis and Generic Competitive Strategies – Premising and Forecasting – Decision Making.							
Unit – III	Organizing and Staffing:						9
Formal and Informal Organization – Organizational Division – Organization Levels and the Span of Management – An Organizational Environment for Entrepreneurship and Intrapreneurship – Reengineering the Organization – The Structure and Process of Organizing – Basic Question for Effective Organizing – Organization Structure Departmentation – Line / Staff Authority, Empowerment and Decentralization – Human Resource Management and Selection.							
Unit – IV	Motivation & Leadership:						9
Human Factors in Managing – Motivation – Motivation – An Early Behavioral Model – Maslow's Hierarchy of Needs Theory – Alderfer's ERG Theory – Herzberg's Motivation Hygiene Theory – The Expectancy Theory of Motivation – Equity Theory – Goal Setting Theory of Motivation – Skinner's Reinforcement Theory – McClelland's Needs Theory of Motivation – Special Motivational Techniques – Job Enrichment – A Systems and Contingency Approach to Motivation – Leadership – Communication: Purpose of Communication – Communication Process – Communication in the Organization – Barriers and Breakdowns in Communication – Toward Effective Communication – Electronic Media in Communication.							
Unit – V	Controlling:						9
The Basic Control Process – Critical Control Points, Standards and Benchmarking – Control as a Feedback System – Real Time Information and Control – Feed Forward or Preventive Control – Control of Overall Performance – Profit and Loss Control – Control Through Return on Investment – Management Audits and Accounting Firms – The Balanced Scorecard- Bureaucratic and Clan Control – Requirements for Effective Control – Control Techniques and Information Technology.							
							Total:45
TEXT BOOK:							
1.	Koontz Harold and Weihrich Heinz, "Essentials of Management", 11 th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2020.						
REFERENCES:							
1.	Tripathi.P.C and Reddy. P.N, "Principles of Management", 5 th Edition, Tata McGraw–Hill Education, New Delhi, 2012.						
2.	Prasad L.M, "Principles and Practice of Management", 8 th Edition, Sultan Chand and Sons, New Delhi, 2013.						

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1	explain the management concepts as planning, organizing, staffing and controlling in real world environment.	Understanding(K2)
CO2	interpret the basic functions and strategies of management.	Understanding(K2)
CO3	articulate the steps in planning process.	Applying(K3)
CO4	outline various types of organizational structures.	Understanding(K2)
CO5	implement modern and traditional control devices in organization.	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	1	2	2	1
CO2								1	1	1	2	3	2	1
CO3								2	2	1	3	3	3	1
CO4						2		3	1	2	3	3	2	1
CO5						1		3	1	2	3	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	20	80					100
CAT2	15	55	30				100
CAT3	15	55	30				100
ESE	10	50	40				100

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

22ISE22 – HUMAN RESOURCE MANAGEMENT

Programme& Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	PE	3	0	0	3

Preamble	To explore the functions of human resource management, recruiting and training the employees.	
Unit – I	Introduction:	9
Nature and Scope of Human Resource Management – Objectives and Functions of HRM – Human Resource Planning Objectives – Process – Problems – Job analysis and Design – Process – HRM in a Changing Environment		
Unit – II	Recruitment:	9
Factors Affecting Recruitment – Sources of Recruitment – Recruitment Process – Selection – Need for Scientific Selection – Process – Placement – Induction – Internal Mobility – Promotion – Transfer – Demotions – Separation.		
Unit – III	Training:	9
Need for Training – Importance – Steps in Training Programme – Performance Appraisal – Purpose – Approaches – Process – Methods – Problems – Making Performance Appraisal More Effective.		
Unit – IV	Wage and Salary Administration:	9
Objectives – Principles – Components – Methods of Wage Payments –Theory of Wages – Incentives and Benefits.		
Unit – V	Maintenance and Control:	9
Employee Grievances – Cause – Procedure – Human Resource Information System – Need – Advantages – Uses of HRIS – Designing of HRIS – Limitations – Management of Turnover and Retention – International HRM.		
		Total:45

TEXT BOOK:

1.	S.S.Khanka, "Human Resource Management", 1 st Edition, S.Chand Publications, New Delhi, 2013.
REFERENCES:	
1.	V.S.P. Rao, "Human Resource Management", 3 rd Edition, Excel Books, New Delhi, 2010.
2.	Aswathappa, "Human Resource Management", 6 th Edition, Tata McGraw Hill, New Delhi, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	infer the functions of human resource management.											Understanding(K2)		
CO2	use the recruitment techniques for recruiting employees.											Applying(K3)		
CO3	explain the methods for training the employees.											Understanding(K2)		
CO4	summarize wage and salary procedure for employees.											Understanding(K2)		
CO5	interpret grievance handling mechanism.											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	2	1
CO2									2			2	3	1
CO3									2		2	3	2	1
CO4										3		1	2	1
CO5										3		1	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		55		30								100	
CAT2	15		55		30								100	
CAT3	20		80										100	
ESE	10		50		40								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE23 - INNOVATION, ENTREPRENEURSHIP AND VENTURE DEVELOPMENT							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	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
TEXT BOOK:							
1.	Elias G. Carayannis, Elpida T. Samara, Yannis L. Bakouros., " Innovation and Entrepreneurship", 1 st Edition, Springer publishing, Switzerland, 2015, for Units I, II.						
2.	Tomas Karlsson., " Business plans in New ventures", 1 st Edition, ARK Tryckaren AB, 2005, for Units III, IV, V.						
REFERENCES:							
1.	Gordon E. & Natarajan K., "Entrepreneurship Development", 6 th Edition, Himalaya Publishing House, Mumbai, 2017.						
2.	Sangeeta Sharma, "Entrepreneurship Development", 1 st Edition, PHI Learning Pvt. Ltd., New Delhi, 2017.						
3.	Charantimath Poornima M., "Entrepreneurship Development and Small Business Enterprises", 3 rd Edition, Pearson Education, Noida, 2018.						
4.	Robert D. Hisrich, Michael P. Peters & Dean A. Shepherd, "Entrepreneurship", 10 th 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.											Analysing (K4)		
CO3	develop suitable business models as per the requirement of the customers.											Analysing (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	2	1
CO2	1	2			3	2	1						3	1
CO3	3	1	3			1							3	1
CO4	1	2				3							3	1
CO5	1	2				3							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	20	40	40				100							
CAT3	20	40	40				100							
ESE	10	50	40				100							
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE24 - ENGINEERING ECONOMICS AND MANAGEMENT							
Programme & Branch	MSc - SOFTWARE SYSTEMS	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	PE	3	0	0	3
Preamble	The aim of the course is to create fundamental knowledge on management by introducing concepts like economics, national income, marketing, operations management, accounting principles etc.						
Unit – I	Micro Economics						9
Economics – Basics Concepts and Principles – Demand and Supply – Law of demand and Supply – Determinants – Market Equilibrium – Circular Flow of Economic Activities and Income.							
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: Taylor and Fayol's Principles – Functions of Management – Managerial Skills – Levels of Management – Roles of Manager.							
Unit – III	Marketing Management						9
Marketing – Core Concepts of Marketing – Four P's 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
Accounting Principles – Financial Statements and its Uses – Depreciation – Straight Line and Diminishing Balance Method – Break Even Analysis – Capital Budgeting – Significance –Traditional and Discounted Cash Flow Methods.							
							Total:45
TEXT BOOK:							
1.	Compiled by Department of Management Studies, Kongu Engineering College, "Economics and Management for Engineers", 1st Edition, McGraw Hill Education, Noida, 2013.						
REFERENCES:							
1.	Geetika, Piyali Ghosh and Purba Roy Choudhury, “Managerial Economics”, 3rd Edition, McGraw-Hill, New Delhi, 2018.						
2.	William J. Stevenson, “Operations Management”, 14th Edition, McGraw-Hill Education, 2021.						
3.	William G. Nickels, James M. McHugh, Susan M. McHugh, “Understanding Business”, 12th Edition, McGraw-Hill Education. New York. 2019.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)			
CO1	identify market equilibrium and interpret national income calculations and inflation issues												Applying (K3)		
CO2	choose a suitable business ownership for their enterprise and illustrate managerial functions												Applying (K3)		
CO3	infer marketing management decisions												Understanding (K2)		
CO4	apply appropriate operation management concept in business situations												Applying (K3)		
CO5	interpret financial and accounting statements and evaluate new proposals												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		2	2	3	3	3	
CO2	3	2	1	1				2		2	2	3	3	3	
CO3	2	1						2	3	2	2	2	2	3	
CO4	3	2	1	1				2	2	2	2	2	3	3	
CO5	3	2	1	1				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		20		40		40								100	
CAT2		20		40		40								100	
CAT3		20		40		40								100	
ESE		10		50		40								100	
* ±3% may be varied (CAT 1, 2, 3 – 50 marks & ESE – 100 marks)															

22ISE25 – DIGITAL MARKETING							
Programme & Branch	M.Sc & Software Systems	Sem.	Category	L	T	P	Credit
Prerequisites	Nil	9	PE	3	0	0	3
Preamble	This course provides basics of digital marketing, its underlying technologies and frameworks, consumer behaviour aspects including demand management and Integrated Marketing Communications for digital platform.						
Unit – I	Basics of Digital Marketing:						9
Evolution of Digital Marketing – Digital Marketing an Introduction – Internet Marketing: Underlying Technology and Frameworks – Digital Marketing Framework – Factors Impacting Digital Marketplace – Value Chain Digitization – The Consumer for Digital Marketing.							
Unit – II	Digital Marketing Strategy Development:						9
Relevance Feedback, Languages and Query Properties: A Framework for feedback methods – Explicit Relevance feedback – Implicit feedback through local analysis – Global analysis. Documents: Metadata – Documents formats. Queries – Query Language – Query Properties.							
Unit – III	Digital Marketing Planning and Setup:						9
Digital Marketing Communications and Channel Mix: Digital Marketing Planning Development – Designing the Communication Mix – Introduction to Digital Marketing Channels. Digital Marketing Operations Setup: Understanding Digital Marketing Conversion.							
Unit – IV	Digital Marketing Execution:						9
Digital Marketing Campaign Management: Basic Elements of Digital Campaigns – Basic Elements of Digital Campaign Management – Implementing Intent – Based Campaigns (Search Execution) – Implementing Brand – Based Campaigns (Display Execution) – Campaign Execution for Emerging Marketing Models – Campaign Analytics and Marketing Rol. Digital Marketing Execution Elements – Managing Digital Marketing Revenue – Managing Service Delivery and Payment – Managing Digital Implementation Challenges							
Unit – V	Digital Business Present and Future:						9
Digital Marketing – Landscape and Emerging Areas: Digital Marketing – Global Landscape – Digital Marketing – The Indian View – Digital Marketing – Emerging Trends and Concepts. A Career in Digital Marketing: Emerging Opportunities for Digital Marketing Professionals – Building a Career in Digital Marketing – Top Digital Marketing Areas as Career Tracks – Approaching a Career in Digital Marketing.							
							Total:45
TEXT BOOK:							
1.	Puneet Bhatia, “Fundamentals of Digital Marketing”, 2nd Edition, Pearson Education, 2019.						
REFERENCES:							
1.	R S N Pillai, Bagavathi, "Modern marketing Principles and Practices", 2nd Edition, 2020.						
2.	Dominik Kosorin, “Introduction to Programmatic Advertising”, 1st Edition, 2017.						

COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	explain the basic concepts of digital marketing and apply to solve the real world problems											Applying (K3)		
CO2	carry out the various digital marketing strategies											Applying (K3)		
CO3	explore digital marketing operation setup and apply for web development											Applying (K3)		
CO4	make use of the digital marketing campaign management											Applying (K3)		
CO5	determine the emerging areas of digital marketing											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									3	3
CO2	3	2	1	1									3	3
CO3	3	2	1	1									3	3
CO4	3	2	1	1									3	3
CO5	3	2	1	1									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	15		35		50								100	
CAT2	15		35		50								100	
CAT3	15		35		50								100	
ESE	10		40		50								100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														

22ISE26 – FUNDAMENTALS OF RESEARCH

UNIT - I	Introduction to Research:	9
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Unit – II	Literature Review:	9
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Unit – III	Research Methodology:	9
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Unit - IV	Journals and Papers:	9
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Unit - V	Reports and Presentations:	9
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	Total:45
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TEXT BOOK

1	Wellman, Nicholas. "Research Methods: The basics". 3rd edition. Routledge Publisher, 2021.
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REFERENCES:

	Melville S. Goddard W. "Research Methodology: An Introduction For Science and Engineering Students" Kenwyn: Juta &
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2.	Kumar, Ranjit. "Research Methodology: A step-by-step guide for beginners". SAGE Publications Limited, 2019.
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COURSE OUTCOMES: On completion of the course, the students will be able to												BT Mapped (Highest Level)		
CO1	classify the various stages in research and categorize the quality of journals.											Analyzing (K4)		
CO2	formulate a research problem from published literature/journal papers											Evaluating (K5)		
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	3	2	2	1	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	2	1	1		3	3	3	2	2	3	3	3	3
CO5	3	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	10		50		20		20						100	
CAT2	10		50		20		20						100	
CAT3	10		65		25								100	
ESE	10		50		25		15						100	
* ±3% may be varied (CAT 1, 2 & 3 – 50 marks & ESE – 100 marks)														