CONTENTS

BANNARI AMMAN INSTITUTE OF TECHNOLOGY
REGULATIONS 2021
(CHOICE BASED CREDIT SYSTEM)

Common to all M.E. / M.Tech. Degree Programmes

NOTE: *The regulations given hereunder are subject to amendments as may be decided by the Academic Council of the Institute from time to time. Any or all such amendments will be effective from such date and to such batches of students, including those already in the middle of the programme as may be decided by the Academic Council.*

1. ELIGIBILITY FOR ADMISSION

(i) Candidates seeking admission to the First Semester of M.E./M.Tech. degree programmes will be required to satisfy the eligibility criteria for admission thereto prescribed by the Directorate of Technical Education, Chennai and Anna University, Chennai.

(ii) Students admitted under 'Full-Time' should be available in the departments during the entire duration of working hours (from morning to evening on a full-time basis) for the curricular, co-curricular and extra-curricular activities.

The full-time students should not attend any other full-time programme(s) / course(s) or take up any full-time job / part-time job during working hours in any institution or company during the period of the full-time programme. Violation of the above rules will result in the cancellation of admission to the PG programme.

2. DURATION OF THE PROGRAMME

(i) **Minimum Duration:** Master of Engineering (M.E.) / Master of Technology (M.Tech.) extends over a period of two years. The two academic years will be divided into four semesters, with two semesters per year.

(ii) **Maximum Duration**: A candidate shall complete all the passing requirements of M.E./M.Tech. programmes within a maximum period of 4 years / 8 semesters, these periods being reckoned from the commencement of the first semester to which the candidate was first admitted, regardless of the break-of-study availed.

3. BRANCHES OF STUDY

Following M.E./M.Tech. programmes are offered by the institute

M.E. Programmes

1. Communication Systems
2. Computer Science and Engineering

3. Embedded Systems
4. Industrial Automation and Robotics
5. Industrial Safety Engineering
6. Power Electronics and Drives
7. Software Engineering
8. Structural Engineering

M. Tech. Programme

9. Biotechnology

4. STRUCTURE OF PROGRAMMES

(i) **Curriculum:** Every post-graduate programme will have a curriculum with syllabi consisting of theory and practical courses that include

Program Core Courses (PCC) include the core courses relevant to the chosen specialisation.

Program Elective Courses (PEC) include the elective courses relevant to the chosen specialisation.

Research Methodology and IPR Course to understand the importance and the process of creation of patents through research.

Employability Enhancement Courses (EEC) include project work, practical courses, internship, mini project and industrial/practical training.

Audit Courses (AC) expose the students to Disaster Management, Yoga, English for Research Paper Writing, Value education, Pedagogy Studies, Stress Management, and Personality Development through Life Enlightenment Skills. Registration for any of these courses is optional to students.

(ii) **Project Work:** Every student, individually, shall undertake Dissertation Phase I during the third semester and Dissertation Phase II during the fourth semester under the supervision of a qualified faculty. The project work can be undertaken in an industrial / research organisation or institute in consultation with the faculty guide and the Head of the Department. In the case of project work at an industrial / research organisation, the same shall be jointly supervised by a faculty guide and an expert from the organisation. The student shall be instructed to meet the supervisor periodically and attend the review committee meetings to evaluate the progress.

(iii) **Elective Courses: Five Elective** courses are offered to the students admitted in various disciplines as prescribed in the curriculum to widen their knowledge in their specialisation area.

(iv) **Online Courses:** A Student may be permitted to credit online courses with the approval of a Departmental Consultative Committee constituted by the Head of the Department, subject to a maximum of six credits. Such students may be exempted

from attending the classes if such course(s) are offered in the semester. Summary of such online courses, taken by the students, along with the offering agency shall be presented to the Academic Council for information and further suggestions. However, the student needs to obtain certification from the agency offering the course to become eligible for writing or seeking exemption from the End Semester Examinations. In case of credits earned through online mode from the Institute / University, the credits may also be transferred directly after due approval from the Departmental Consultative Committee and the Controller of Examinations.

(v) **Industrial Training:** Every full-time student shall take up training in industry/research laboratories, under the supervision of a faculty guide during summer/winter vacation till the pre-final semester of the programme subject to the evaluation prescribed in Clause 15.

If industrial training/internship is not prescribed in the curriculum, the student may undergo industrial training/internship optionally, and the credits earned will be indicated in the Mark Sheet. If the student earns three credits in industrial training/internship, the student may drop one Program Elective in the III semester. In such cases, industrial training/internships need to be undergone continuously from one organisation only. However, if the number of credits earned is 1 or 2, these credits shall not be considered for the classification of the degree. The student is only allowed to undergo a maximum of 6 weeks of industrial training/internship during the entire duration of the study.

Duration of Training / Internship	**Credits**
2 Weeks	1
4 Weeks	2
6 Weeks	3

(vi) **Mini Project**: The students shall undertake a mini project individually in consultation with the respective faculty and Head of the Department, as specified in the curriculum. A student is expected to make a presentation about the mini-project during the final evaluation as given in Clause 15.

(vii) **Value Added / Certificate Courses:** Students can opt for any one of the value-added courses in II and III semesters, approved by the Academic Council. A separate certificate will be issued on successful completion of the course by the Controller of Examinations.

(viii) **Credit Assignment:** Each course is normally assigned a certain number of credits with 1 credit per lecture hour per week, 1 credit for 2 hours of practical per week, 1 credit for 1 hour of tutorial per week. The exact numbers of credits assigned to the different courses of various programmes are decided by the respective Board of Studies.

(ix) **Minimum Credits:** For the award of the degree, the student shall earn a minimum number of total credits as prescribed by the respective Board of Studies as given below:

S.No.	M.E./M. Tech. Programmes	Total Credits
1.	M.E. Communication Systems	68
2.	M.E. Computer Science and Engineering	68
3.	M.E. Embedded Systems	68
4.	M.E. Industrial Automation and Robotics	68
5.	M.E. Industrial Safety Engineering	68
6.	M.E. Power Electronics and Drives	68
7.	M.E. Software Engineering	68
8.	M.E. Structural Engineering	68
9.	M.Tech. Biotechnology	68

5. COURSE ENROLLMENT AND REGISTRATION

5.1 Each student, on admission, shall be assigned to a Faculty Advisor (vide Clause 7) who shall advise/counsel the student about the details of the academic programme and the choice of courses considering the student's academic background and career objectives.

5.2 Every student shall enrol for the courses of the succeeding semester in the current semester. However, the student shall confirm the enrolment by registering for the courses within the first five working days after the commencement of the semester concerned.

5.3 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the End Semester Examinations.

5.3.1 Each student on admission to the programme shall register for all the **courses prescribed in the curriculum** in the **first semester of study**.

5.3.2 The enrolment for all the courses of semester II will commence 10 working days prior to the last working day of the semester I. The student shall confirm the enrolment by registering for the courses within the first five working days after the commencement of semester II.

5.3.3 If a student wishes, the student may drop or add courses (vide Clause 5.5)

within **five** working days after the commencement of the semester concerned and complete the registration process duly authorised by the PG coordinator of the programme. In this case, if a student fails in a course, he/she may be permitted to register for the course in the subsequent semester or when it is offered.

5.3.4 A student who has passed all the courses prescribed in the curriculum for the award of the degree shall not be permitted to re-enrol to improve the student's marks in a course or the aggregate marks / CGPA.

5.4 Minimum Credits to Register for Project work

The Project work for M.E./M.Tech. consists of dissertation phase I and dissertation phase II. Dissertation phase I is to be undertaken during the III semester, and dissertation phase II, which is a continuation of phase I, is to be undertaken during the IV semester. Minimum 24 credits are required to be earned to enrol on dissertation phase I.

If a student fails to earn the requisite minimum credits, the student cannot enrol for dissertation phase I. In such a case, the student can enrol for the project work in a subsequent semester after earning the minimum credits specified.

5.5 Flexibility to Add or Drop courses

5.5.1 A student 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 a student wishes, the student is permitted to earn more than the total number of credits prescribed in the curriculum of the student's programme by opting for additional courses.

5.5.2 From the II to final semesters, the student has the option to register for additional courses or drop existing courses. The total number of credits that a student can add or drop is limited to 6, subject to a maximum of 2 courses. In such cases, the attendance requirement as stated in Clause 6 is mandatory.

The courses that a student registers in a particular semester may include:

i. Courses of the current semester and

ii. Courses dropped in the lower semesters.

The maximum number of credits that can be registered in a semester is 36. However, this does not include the number of Re-appearance (RA) and Withdrawal (W) courses registered by the student for the appearance of Examination.

5.6 Reappearance Registration

5.6.1 If a student fails in a theory course, the student shall do reappearance registration for that course in the subsequent semester or when it is offered next.

5.6.2 On registration, a student may attend the classes for the reappearance registration courses if the student wishes. However, the attendance requirement (vide Clause 6) is not compulsory for such courses.

5.6.3 The student who fails in any practical/mini project or any other EEC courses shall register for the same in the subsequent semester or when offered next and **repeat** the course. In this case, the student shall attend the classes, satisfy the attendance requirements (vide Clause 6) and earn continuous assessment marks.

5.6.4 The student who fails in dissertation phase I / II shall register for the same in the subsequent semester or when offered next and **repeat** the course. In this case, the student shall attend the classes, satisfy the attendance requirements (vide Clause 6), earn continuous assessment marks and appear for the end semester examinations. Reappearance registration is not available for such courses.

5.6.5 If a student is prevented from writing the end semester examination of a course due to lack of attendance, the student has to register for that course again, when offered next, attend the classes and fulfil the attendance requirements as per Clause 6.

6. REQUIREMENTS FOR APPEARING FOR THE END SEMESTER EXAMINATION OF A COURSE

A student who has fulfilled the following conditions (vide clause 6.1 and 6.2) shall be deemed to have satisfied the attendance requirements for appearing for the End Semester Examination of a particular course.

Each semester shall normally consist of 75 working days or 540 periods of each 50 minutes duration for the full-time mode of study.

6.1 Ideally, every student is expected to attend all the periods and earn 100% attendance. However, a student shall secure not less than 80% attendance course wise taking into account the number of periods required for that course as specified in the curriculum.

6.2 If a student secures attendance between 70% and 79% in any course in the current semester due to medical reasons (prolonged hospitalisation/accident / specific illness) or participation in Institution/University/State/National/International level extra and co-curricular activities, with prior permission from the Head of the Department, shall be permitted to appear for the current semester examinations subject to the condition that the student shall submit the medical certificate/participation certificate attested by the Head of the Department. Such certificates shall be forwarded to the Controller of Examinations for verification and permission to attend the examinations.

6.3 A student shall normally be permitted to appear for the end semester examination of a course if the student has satisfied the attendance requirements (vide Clause 6.1-6.2) and has registered for the examination in those courses of that semester by paying the prescribed fee.

6.4 A student who does not satisfy clauses 6.1 and 6.2 and secures less than 70% attendance in a course will not be permitted to write the end semester examination. The student has to register and repeat this course in the subsequent semester or when it is offered next (vide clause 5.6.4).

6.5 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course to improve grades/marks.

7. FACULTY ADVISOR

To help students plan their courses of study and for general advice on the academic programme, the Head of the Department of the students will attach a certain number of students to a teacher of the department, who shall function as a faculty advisor for those students throughout their period of study. The faculty advisor shall advise the students in registration and reappearance (Arrear) registration of courses, authorise the process, monitor their attendance and progress and counsel them periodically. If necessary, the faculty advisor may also discuss with or inform the parents about the progress/performance of the students concerned.

The responsibilities of the faculty advisor shall be:

i. To inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.

ii. To guide student enrolment and registration of the courses

iii. To authorise the final registration of the courses at the beginning of each semester.

iv. To monitor the academic and general performance of the students, including attendance, and to counsel them accordingly.

v. To collect and maintain the academic and co-curricular records of the students

8. COMMITTEES

8.1 Class Committee Meeting

i. For all the courses taught, prescribed in the curriculum, a class committee meeting shall be convened twice a semester, comprising faculty members handling all the courses and two student representatives from the class.

ii. One of the faculty members (not handling any courses to that class), nominated by the Head of the Department, shall coordinate the activities of

this Committee. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to all other students.

9. ASSESSMENT AND PASSING REQUIREMENTS

9.1 Assessment

The assessment will comprise continuous assessment and end semester examination, carrying marks as specified in the scheme (Clause 15). All assessments will be done on absolute marks basis. However, to report the performance of a student, letter grades and grade points will be awarded as per Clause 9.4.

9.2 End Semester Examinations

End semester examinations will normally be conducted as per the timetable circulated by the CoE's Office. A student will be permitted to appear for the end semester examination of a semester only if he/she completes the study of that semester satisfying the requirements given in Clause 5 and 6, and registers simultaneously for the examinations of the highest semester eligible and the courses, pertaining to that semester, that needs reappearance.

9.3 Employability Enhancement Courses

Every candidate shall submit reports on industrial training / mini-project, dissertation phase I and dissertation phase II on dates announced by the institute/department through the faculty guide to the head of the department. If a candidate fails to submit the reports of any of these courses not later than the specified date, he/she is deemed to have failed in it. The reports /papers shall be orally presented by the student before a team of experts consisting of an internal examiner, usually the supervisor, and an external examiner, appointed by the Controller of the Examination.

A candidate is permitted to register for dissertation phase II only after passing dissertation phase I. A candidate who fails in industrial training / mini-project, dissertation phase I or dissertation phase II shall register for redoing the same at the beginning of a subsequent semester.

9.4 Letter Grade and Grade Point

The letter grade and the grade point are awarded based on the percentage of total marks secured by a candidate in an individual course as detailed below:

Letter Grade	**Grade Points**
O (Outstanding)	10
A + (Excellent)	9
A (Very Good)	8
B + (Good)	7
B (Above average)	6
C (Satisfactory)	5
RA (Reappearance Registration)	0
I (Incomplete)	0
W (Withdrawal)	0
AB (Absent)	0
SA(Shortage of Attendance)	0

'RA' - Reappearance registration is required for that particular course

'I' - Continuous evaluation is required for that particular course in the subsequent examinations.

After completion of the evaluation process, Semester Grade Point Average (SGPA) and Cumulative Grade Point Average is calculated using the formula:

$$SGPA/CGPA = \frac{\sum_1^n C_i * g_i}{\sum_1^n C_i}$$

where

C_i Credit allotted to the course.

g_i Grade Point secured corresponding to the course.

n number of courses successfully cleared during the particular semester in the case of SGPA and all the semesters, under consideration, in the case CGPA.

9.5 A student can apply for revaluation of his/her semester examination answer paper in a theory course, within 3 working days from the declaration of results, along with prescribed application to the Controller of Examinations through the Head of Department. Revaluation is not permitted for laboratory courses, industrial training, and project works.

9.6 Passing a Course

A candidate who secures Grade Point 6 or more in any course of study will be declared to have passed that course, provided he/she secures a minimum of 50% of the total mark in the end semester examination of that course.

If a student fails to secure a pass in theory courses and laboratory courses in the current semester examination, he/she is allowed to write arrear examinations for the next three consecutive semesters, and their internal marks shall be carried over for the above mentioned period of three consecutive semesters.

In case if he/she has not completed all the courses of the semester I at the end of semester IV, he/she shall redo the semester I courses along with regular students. The same procedure shall be followed for the subsequent semesters of II, III and IV, subject to the maximum permissible period for this programme.

9.7 If a candidate fails in the end semester examinations of Phase I, he/she has to resubmit the project report within 30 days from the date of declaration of the results. If he/she fails in the end semester examination of Phase II of M.E. / M.Tech., he/she shall resubmit the project report within 60 days from the date of declaration of the results. The resubmission of the project report and the subsequent viva voce examination will be considered as reappearance with payment of the exam fee. If a student fails to resubmit the project report within the stipulated period and fails in the subsequent viva-voce examination, the student shall register for the course again in the subsequent semester.

10. REJOINING THE PROGRAMME

A candidate who has not completed the study of any of the semesters as per Clause 6 or who is allowed to rejoin the programme after the period of discontinuance or who on his/her own request is permitted to repeat the study of any semester (break of study), may join the semester which he/she is eligible or permitted to join, only at the time of its normal commencement for a regular batch of candidates and after obtaining the approval from the Director of Technical Education and Anna University, Chennai. In such a case, earlier continuous assessment in the repeated courses will be disregarded. However, no candidate will be allowed to enrol in more than one semester at any point of time.

11. QUALIFYING FOR THE AWARD OF THE DEGREE

A candidate will be declared to have qualified for the award of the M.E. / M.Tech. Degree provided:

i. He/she has completed the course requirements and has passed all the prescribed courses of study of the respective programme listed in Clause 3 within the duration specified in Clause 2.

ii. No disciplinary action is pending against the candidate.

12. CLASSIFICATION OF THE DEGREE AWARDED

12.1 First Class with Distinction:

A student who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the four semesters in the student's First Appearance within two years (Three years in case of authorised break of study of one year (if availed)). Withdrawal from examination (vide Clause 13) will not be considered as an appearance.
- Should have secured a CGPA of not less than 8.50.
- Should NOT have been prevented from writing end Semester examination due to lack of attendance in any of the courses.

12.2 First Class:

A student who satisfies the following conditions shall be declared to have passed the examination in first-class:

- Should have passed the examination in all the courses of all four semesters within three years, including one year of authorised break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of not less than 6.50

12.3 Second Class:

All other students (not covered in clauses 12.1 and 12.2) who qualify for the award of the degree shall be declared to have passed the examination in the second class.

12.4 A student who is absent in the End Semester Examination in a course/project work after having registered for the same shall be considered to have appeared in that examination (except approved withdrawal from end semester examinations as per clause 13) for the purpose of classification.

13. WITHDRAWAL FROM EXAMINATION

13.1 A student may, for valid reasons, be granted permission by the Head of the Department to withdraw from appearing in the examination in any course(s) only once during the entire duration of the degree programme.

13.2 Withdrawal application shall be valid only if the student is eligible to write the examination as per Clause 6 and if such withdrawal request is made prior to the submission of marks of the continuous assessment of the course(s) with the recommendations from the Head of the Department.

13.3 If a student 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 examination(s)

13.4 Withdrawal shall not be considered as an appearance for deciding the eligibility of a candidate for first class with distinction or first class.

13.5 Withdrawal is permitted for the end semester examinations in the final semester only if the period of study the student concerned does not exceed 3 years for M.E. / M.Tech. as per clauses 12.1 and 12.2.

14. AUTHORISED BREAK OF STUDY FROM A PROGRAMME

14.1 A student is permitted to go on a break of study for a fixed period of one year as a single break in the entire course of study.

14.2 A student who would like to avail the break of study, on account of short term employment / medical treatment / personal reasons) shall apply to the Head of the Institution through the concerned Head of the Department (application available with the Controller of Examinations), in any case, not later than the last date for registering for the semester.

14.3 The students permitted to re-join the programme after a break of study/prevention

due to lack of attendance shall be governed by the curriculum and regulations in force at the time of re-joining. A committee constituted by the Head of the Institution shall prescribe additional/equivalent courses, if any, from the regulation in force to bridge the requirement between the curriculum in force and the old curriculum.

14.4 The total period for completion of the programme reckoned from the commencement of the first semester to which the student is admitted shall not exceed the maximum period specified in Clause 2, irrespective of the period of break of study in order that he/she may be eligible, for the award of the degree (vide Clause 11 and 12).

14.5 In case of any valid reasons for the extension of break-of-study, such extended break-of-study may be granted by the Head of the Institution for a period not more than one year in addition to the earlier authorised break of study. Such extended break-of-study shall be counted for the purpose of classification of degree (vide clause 12).

14.6 If a student does not report back to the institute, even after the extended break of study, the name of the student shall be deleted permanently from the college enrolment. Such candidates are not entitled to seek readmission under any circumstances.

15. SCHEME OF ASSESSMENT

I	**THEORY COURSES**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment: Periodical Test I (15) Periodical Test II (15) Term Paper Report (10) & Presentation (10)	
	End Semester Examination	**50**
	Total Marks	**100**
II	**THEORY COURSES WITH LAB COMPONENT**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment: Periodical Test I (15) Periodical Test II (15) Lab Examination (10) Viva-voce (10)	
	End Semester Examination (QP pattern as per (I))	**50**
	Total Marks	**100**
III	**PRACTICAL COURSES**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment: Conduct of Experiment i. Preparation (10) ii. Experiment and Analysis of Results (20) iii. Record (5) Self-Learning Experiment (15) Test - Cycle I (15) Test - Cycle II (15) Final Viva-voce (20)	
	Total Marks	**100**
IV	**DISSERTATION PHASE I**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment: Review I *Identification of topic and Justification (5)* *Literature Survey (5)* Review II *Work plan & Approach (10)* *Progress, Results and Discussion (10)* Review III *Conclusion (10)* *Implementation & Applications (10)*	

	End Semester Examination	
	Presentation (20) Report (10) Viva Voce (20)	**50**
	Total Marks	**100**

V	**DISSERTATION PHASE II**	**Marks**
	Continuous Assessment	**50**
	Distribution of marks for Continuous Assessment:	
	Review I *Work plan & Approach (10)* Review II *Progress (10)* *Results and Discussion (10)* Review II *Conclusion (10)* Implementation & Applications *(10)*	
	End Semester Examination	
	Presentation (20) Report (10) Viva Voce (20)	**50**
	Total Marks	**100**

VI	**MINI PROJECT**	**Marks**
	Continuous Assessment	**100**
	Distribution of marks for Continuous Assessment:	
	Review I	**25**
	Review II	**25**
	Presentation & Viva voce	**50**
	Total Marks	**100**

VII	**INDUSTRIAL TRAINING / INTERNSHIP**	**Marks**
	Continuous Assessment	**100**
	Presentation	**30**
	Viva-voce	**30**
	Case study / Report	**40**
	Total Marks	**100**

VIII	**VALUE ADDED COURSES / CERTIFICATE COURSES (Continuous Assessment Only)**	**Marks**
	Test I	50
	Test II	50
	Grades: Excellent (>80) / Good (61≤Marks ≤ 80) / Satisfactory (50≤Marks ≤ 60))	

Optional Test: *A student becomes eligible to appear for the one optional test conducted after the Periodical Test II, only under the following circumstances, if absent for Test I or Test II or both, on account of (i) medical reasons (hospitalisation / accident / specific illness) (ii) participation in the college/university/state / national/international level Sports events with prior permission from the Head of the Institution and (iii) on satisfying the conditions (i) or (ii), the student should have registered for the Optional Test, through the concerned faculty member who handles the course or through the respective Head of the Department, submitted to the Controller of Examinations. Such Optional Tests are not conducted for the courses under the categories III, IV, V, VI, VII and VIII listed above.*

16. DISCIPLINE

A student is expected to follow the rules and regulations laid down by the Institute and the affiliating University, as published from time to time. Any violations, if any, shall be treated as per the procedures stated thereof.

If a student indulges in malpractice in any of the end semester / continuous assessments, he/she shall be liable for punitive action as prescribed by the institution / university from time to time.

M.E. – COMPUTER SCIENCE AND ENGINEERING

VISION OF THE DEPARTMENT

To excel in the field of Computer Science and Engineering, to meet the emerging needs of the industry, society and beyond.

MISSION OF THE DEPARTMENT

1. To impart need based education to meet the requirements of the industry and society.
2. To build technologically competent individuals for industry and entrepreneurial ventures by providing infrastructure and human resources.
3. To prepare students for higher education and research oriented activities.

M.E. – COMPUTER SCIENCE AND ENGINEERING

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates will be able to

I. Analyse, design, and develop creative products and solutions for real-world problems.

II. Critically analyse the current literature in a field of study and ethically develop innovative and research-based methodologies to fill the gaps.

III. Participate in lifelong multidisciplinary learning as skilled computer engineers, including working in teams, investigating and implementing research problems, and presenting technical reports.

PROGRAMME OUTCOMES (POs)

1. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
2. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
3. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
4. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.
5. Demonstrate an ability to engage in lifelong learning for professional development and function effectively on teams to accomplish a common goal.
6. Critically analyse existing literature in an area of specialization and develop innovative and research-oriented methodologies to tackle gaps identified.

MAPPING OF PEOs AND POs

PEO(s)	Programme Outcome (s)					
	(a)	(b)	(c)	(d)	(e)	(f)
I	X	X	X	X		X
II	X	X	X	X	X	X
III			X	X	X	X

M.E.: Computer Science and Engineering
Minimum credits to be earned: 68

First Semester								
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Hours/ Week**
		PEOs	**POs**					
21CS11	Research Methodology and IPR	I,II,III	1,2,3,4,5,6	2	0	0	2	2
21CS12	Engineering Mathematics and Applications	I,II,III	1,2,3,4	3	0	0	3	3
21CS13	Applications of Data Structures	I,II,III	1,2,3,4	3	0	0	3	3
21CS14	Distributed Systems	I,II,III	1,2,3,4,5	3	0	0	3	3
	Program Elective I			3	0	0	3	3
21CS16	Applications of Data Structures Laboratory	I,II,III	1,2,3,4	0	0	4	2	3
21CS17	Distributed Systems Laboratory	I,II,III	1,2,3,4	0	0	4	2	3
	Audit course I*			2	0	0	-	2
			Total				**18**	**22**
Second Semester								
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Hours/ Week**
		PEOs	**POs**					
21CS21	Database Engineering	I,II,III	1,2,4	3	0	0	3	3
21CS22	Computer System Design	I,II,III	1,3,5,6	3	0	0	3	3
21CS23	Machine Learning Techniques	I,II,III	1,2,3,4,5	3	0	2	4	5
	Program Elective II			3	0	0	3	3
	Program Elective III			3	0	0	3	3
21CS26	Database Engineering Laboratory	I,II,III	1,2,4	0	0	4	2	4
21CS27	Mini Project		1,2,3,4,5,6	0	0	4	2	4
	Audit course II*			2	0	0	-	2
			Total				**20**	**27**
Third Semester								
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Hours/ Week**
		PEOs	**POs**					
	Program Elective IV			3	0	0	3	3
	Program Elective V			3	0	0	3	3
21CS33	Dissertation Phase I	I,II,III	1,2,3,4,5,6	0	0	20	10	20
			Total				**16**	**26**
Fourth Semester								
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Hours/ Week**
		PEOs	**POs**					
21CS41	Dissertation Phase II	I,II,III	1,2,3,4,5,6	0	0	28	14	28
			Total				**14**	**28**

LIST OF DISCIPLINE ELECTIVES

Program Electives								
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Hours/ Week**
		PEOs	**POs**					
21CS51	Agent Based Intelligent Systems	I,II,III	1,2,4,6	3	0	0	3	3
21CS52	Soft Computing	I,II,III	1,2,3,4	3	0	0	3	3
21CS53	Deep Learning Techniques	I,II,III	1,2,3,4	3	0	0	3	3
21CS54	Information Retrieval Techniques	I,II,III	1,2,3,4	3	0	0	3	3
21CS55	Data Science and Analytics	I,II,III	1,2,4	3	0	0	3	3
21CS56	Optimization Techniques	I,II,III	1,2,3,4,6	3	0	0	3	3
21CS57	Big Data Analytics	I,II,III	1,4,5	3	0	0	3	3
21CS58	Cloud Computing Technologies	I,II,III	1,2,4	3	0	0	3	3
21CS59	5G Networks	I,II,III	1,2,4	3	0	0	3	3
21CS60	High Speed Networks	I,II,III	1,2,3,4,5,6	3	0	0	3	3
21CS61	Blockchain Technology	I,II,III	1,2,4	3	0	0	3	3
21CS62	Automata Theory	I,II,III	2,4,6	3	0	0	3	3
21CS63	Programming Paradigm	I,II,III	2,4,5	3	0	0	3	3
21CS64	Digital Image Processing and Applications	I,II,III	1,2,3	3	0	0	3	3
21CS65	Agile Methodology	I,II,III	1,2,4	3	0	0	3	3

LIST OF AUDIT COURSE

List of Audit courses I & II								
Code No.	**Course**	**Objectives & Outcomes**		**L**	**T**	**P**	**C**	**Hours/ Week**
		PEOs	**POs**					
21XE01	English for Research Paper Writing	I	1,3,6	2	0	0	-	2
21XE02	Cost Management of Engineering Projects	I.II	1,3,4,6	2	0	0	-	2
21XE03	Stress Management	III	1,3,6	2	0	0	-	2
21XE04	Disaster Management	II,III	1,3,4,6	2	0	0	-	2
21XE05	Value Education	II,III	1,3,4,6	2	0	0	-	2
21XE06	Pedagogy Studies	III	1,3,4,6	2	0	0	-	2
21XE07	Business Analytics	II,III	1,2,3,4	2	0	0	-	2

21CS11 RESEARCH METHODOLOGY AND IPR 2 0 0 2

Course Objectives

- Understand the techniques for research problem formulation, analysis and solution.
- Analyze research related information and follow research ethics in technical paper writing/presentation.
- Gain knowledge about Patent drafting and filing patents.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.
e. Demonstrate an ability to engage in lifelong learning for professional development and function effectively on teams to accomplish a common goal.
f. Critically analyse existing literature in an area of specialization and develop innovative and research-oriented methodologies to tackle gaps identified.

Course Outcomes (COs)

1. Formulate the research problems and identify the approaches to solve the problems.
2. Analyze literature surveys and prepare reports based on research ethics.
3. Develop research proposals and apply assessment procedures to review.
4. Develop patents using the IPR & PCT guidelines.
5. Adapt the licensing process for patents and analyse the developments of IPR.

UNIT I **6 Hours**

INTRODUCTION TO RESEARCH PROBLEM

Meaning of research problem -Sources of research problem-criteria characteristics of a good research problem- errors in selecting a research problem-scope and objectives of research problem-Approaches of Investigations of solutions for research problem-Data collection-Analysis-Interpretation-Necessary instrumentations.

UNIT II **6 Hours**

LITERATURE REVIEW

Effective Literature studies approaches-analysis-Plagiarism-Research ethics- Review of the literature, searching the existing literature, reviewing the selected literature, developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

UNIT III **6 Hours**

TECHNICAL WRITING/PRESENTATION

Effective technical writing-how to write report-paper-Developing a research proposal-Format of Research proposal-a presentation and assessment by a review committee

UNIT IV **6 Hours**

INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS(IPR)

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: Technological research, Innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grant Patents, Patenting under Patent Cooperation Treaty(PCT).

UNIT V **6 Hours**

INTELLECTUAL PROPERTY RIGHT(IPR)

Patent Rights: Scope of Patent Rights, Licensing and transfer of Technology, Patent information and databases-Geographical Indications. New Developments in IPR: Administration of Patent system, IPR of Biological systems, Computer Software-Traditional knowledge -case studies.

Total: 30 Hours

Reference(s)

1. Wayne Goddard and Stuart Melville, Research methodology-An Introduction, 2nd Edition, Juta and Company Ltd, 2007.
2. Halbert, Resisting Intellectual Property, Taylor & Francis Ltd, 2007.
3. Robert P.Merges, Peter S.Menell, Mark.A.Lemley, Intellectual property in New technological age, 2016
4. T.Ramappa, Intellectual Property Rights under WTO, S.Chand, 2008.
5. Ranjit Kumar, 2nd Edition, Research Methodology: A Step by Step Guide for beginners, 2010.
6. C.R.Kothari, Gaurav Garg, Research Methodology, Methods and Techniques, 4th Edition, New Age International Publishers, 2018.

21CS12 ENGINEERING MATHEMATICS AND APPLICATIONS

3 0 0 3

Course Objectives

- To understand the basics of random variables, standard distributions and arrival process of various queuing and server models
- To apply testing of hypothesis to infer outcome of experiments and mathematical linear programming techniques to solve constrained problems.
- To acquire the knowledge of vector spaces and its applications.

Programme Outcomes (POs)

c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.

Course Outcomes (COs)

1. Apply the concepts of probability distributions in an appropriate place of science and engineering.
2. Analyze the data with the help of correlation and curve fitting in an appropriate place of science and engineering.
3. Identify the hypothesis to analyze the nature of data.
4. Organize a calculation for identifying the suitability of an experiment.
5. Demonstrate the properties and applications of vector spaces in computer science and Engineering.

UNIT I **9 Hours**

PROBABILITY

Axioms of probability - Addition and multiplication theorems on probability - Conditional probability - Bayes theorem (problems only) - Random variable: Continuous and discrete random variables - Discrete distributions: Binomial and Poisson - Continuous distributions: Normal, Exponential and Weibull - Simple problems and properties.

UNIT II **9 Hours**

CORRELATION AND CURVE FITTING

Correlation properties and problems - Rank correlation - Multiple and Partial Correlations Principle of least squares: Fitting of straight line, exponential curve and power curve.

UNIT III **9 Hours**

TESTING OF HYPOTHESIS

Concepts of sampling - Methods of sampling - Sampling distributions and classifications - Standard Error - Tests of hypothesis: Tests of hypothesis about proportion, mean and their differences - Chi-square distributions: Test of goodness of fit and test of independence of attributes.

UNIT IV **9 Hours**

DESIGN OF EXPERIMENTS

Basic principles of experimental designs - Analysis of variance: one-way, Two-way classifications - Latin square design - 2 Factorial Design.

UNIT V **9 Hours**

VECTOR SPACE

Definition and examples of vector space - Linear dependence and independence - Basis and Dimension - Inner product space Orthogonal and Ortho normal basis - Orthogonalization process - Gram - Schmidt process. Applications of inner product spaces.

Total: 45 Hours

Reference(s)

1. Johnson R.A., Miller & Freunds: Probability and Statistics for Engineers , Pearson Education, 8 th Edition, 2013
2. Walpole R.E , Myers R.H, Myers R.S.L and Ye K, Probability and Statistics for Engineers and Scientists , Pearsons Education, Delhi , 2002
3. Lipschutz S and Schiller J, Schaums outline Series: Introduction to Probability and Statistics, McGraw Hill Publications, New Delhi, 1998
4. Ross. S , A first Course in Probability , 8th Edition, Pearson Education , New Jersey, 2010
5. D. C. Lay, Linear Algebra and its Applications, Addison Wesley, Massachusetts, Fourth edition, 2012

21CS13 APPLICATIONS OF DATA STRUCTURES 3 0 0 3

Course Objectives

- To understand the techniques for analyzing the complexity of algorithms.
- To learn the concepts of advanced data structures and algorithm design techniques.
- To impart knowledge on choice of data structures and algorithm design for various problems.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Analyze algorithm complexity using asymptotic notations.
2. Design algorithms to perform operations using hierarchical data structures.
3. Develop solutions using graph algorithms.
4. Apply algorithm design techniques to solve computational problems.
5. Analyze the complexity classes for NP problems.

UNIT I **9 Hours**

ANALYSIS OF ALGORITHM EFFICIENCY

Role of Algorithms in Computing - Asymptotic Notations -Solving Recurrences: Recursion-Tree Method-Masters Theorem -Amortized Analysis: Aggregate Analysis- Accounting Method -Potential Method.

UNIT II **10 Hours**

HIERARCHICAL DATA STRUCTURES

Binary Heap- D-Heaps -Leftist Heaps -Skew Heaps- Binomial Queues -Splay Trees -Red-Black Trees -Multi-Way Trees 2-3-4 Trees -Priority Queues -Tries.

UNIT III **9 Hours**

GRAPH ALGORITHMS

Graph Traversals- All-To-All Shortest Path Problem -Union-Find Problem -Maximum Flows -Eulerian Graphs- Hamiltonian Graphs -Hamiltonian Cycle Problem -Graph Coloring -Vertex-Cover Problem.

UNIT IV **8 Hours**

ALGORITHM DESIGN TECHNIQUES

Dynamic Programming: Matrix-Chain Multiplication -Greedy Algorithms: Activity Selection Problem -Huffman Codes -Divide and Conquer: Maximum Sub-Array Problem-Strassen's Algorithm.

UNIT V **9 Hours**

COMPLEXITY CLASSES

Polynomial/Exponential Time -Decision Problem -Types of Complexity Classes- Relationship Between P, NP, NP Hard and NP Complete-Clique Decision Problem.

Total: 45 Hours

Reference(s)

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson, 2014.
2. Alfred V.Aho, John E.Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Third Edition, Pearson, 2015.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms, Third Edition, Prentice Hall of India, Reprint 2012.
4. Mark Allen Weiss, Data Structures and Algorithms in C++, Fourth Edition, Pearson, 2014.
5. E. Horowitz, S. Sahni and S. Rajasekaran, Computer Algorithms, University Press, 2008.
6. Adam Drozdek, Data Structures and Algorithms in C++, Fourth Edition, Cengage Learning, 2013.

21CS14 DISTRIBUTED SYSTEMS 3 0 0 3

Course Objectives

- To explore the fundamental concepts and issues underlying the design and development of distributed systems.
- To learn about the communication and interconnection architecture of multiple computer systems.
- To familiarize with the design, implementation and security issues of distributed system.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Examine the inherent characteristics of a distributed system and their impact on the design and development of distributed systems with an example.
2. Analyze the features and performance of various protocols used for communication between processes in a distributed system and examines the tradeoffs among them.
3. Analyze how middle ware is supported by operating system facilities at the nodes of distributed system.
4. Compare the common mechanisms and design aspects of flat and nested distributed transactions along with concurrency control.
5. Determine the approaches related to security system design and the security mechanisms deployed in Kerberos, TLS/SSL and 802.11 Wi-Fi.

UNIT I **8 Hours**

CHARACTERIZATION OF DISTRIBUTED SYSTEMS

Introduction - Examples of distributed systems - Trends in distributed systems - Focus on resource sharing - Challenges - System Models: Physical models - Architectural models - Fundamental models- Networking and Internetworking.

UNIT II **9 Hours**

INTERPROCESS COMMUNICATION AND REMOTE INVOCATION

Inter-Process Communication - The API for the Internet Protocols - External Data Representation and Marshalling - Client-Server Communication - Group Communication - Case Study - Distributed Objects and Remote Invocation - Communication between Distributed Objects - Remote Procedure Call.

UNIT III **10 Hours**

OPERATING SYSTEM SUPPORT

The operating system layer - Protection - Operating system architecture-Time and Global States: Clocks, Events and process states - Synchronizing physical clocks- Logical Time and Logical Clocks - Global States - Distributed debugging - Coordination and Agreement .

UNIT IV **9 Hours**

DISTRIBUTED TRANSACTION PROCESSING

Transactions - Nested Transactions - Locks - Optimistic Concurrency Control - Timestamp Ordering - Comparison - Flat and Nested Distributed Transactions - Atomic Commit Protocols - Concurrency Control

in Distributed Transactions - Distributed Deadlocks - Transaction Recovery - Overview of Replication and Distributed Multimedia Systems.

UNIT V **9 Hours**

DISTRIBUTED SYSTEM SECURITY

Overview of security techniques - Cryptographic algorithms - Digital Signatures - Cryptography pragmatics - Case studies: Needham - Schroeder, Kerberos, TLS, 802.11 Wi-Fi.

Total: 45 Hours

Reference(s)

1. Coulouris G, Dollimore J & Kindberg T, Gordon Blair, Distributed Systems Concepts and Design, Fifth edition. Addison Wesley, 2012
2. Tanenbaum S, Maarten V.S., Distributed Systems, Third Edition, Pearson Education, 2017
3. Chow R. & Johnson T., Distributed Operating Systems and Algorithms, 1st Edition, Addison Wesley, 2003
4. Ajay D. Kshemkalyani, Mukesh Singhal, Distributed Computing: Principles, Algorithms, and Systems, Cambridge University Press, 2011

21CS16 APPLICATIONS OF DATA STRUCTURES LABORATORY

0 0 4 2

Course Objectives

- To develop applications using advanced data structures.
- To enhance the knowledge on algorithmic analysis.
- To implement state-of-the-art algorithm design techniques for solving real world problems.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
2. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
3. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, and sustainability in the field of Computer Science and Engineering.
4. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science discipline.

1 **9 Hours**

EXPERIMENT 1

Implement the recurrence relation for the recursive and non-recursive problems.

a) Find the nth term of a given recurrence relation.

b) Write a program that use both recursive and non-recursive functions for implementing the following searching methods:

i) Linear search
ii) Binary search

c) Write a program to find merge sort analysis.

2 **6 Hours**

EXPERIMENT 2

Implement the following data structures:

a) Leftist heaps

b) Skew heaps

3 **3 Hours**

EXPERIMENT 3

Create two binomial queue structures and perform merging of two binomial queues

4 **3 Hours**

EXPERIMENT 4

Write a program to perform the following:

a) Create a binary tree of integers

b) Traverse the binary tree using pre-order, in-order and post-order traversals

5 **6 Hours**

EXPERIMENT 5

Write a program to perform the insertion and deletion operations in AVL Tree using

a) Single Rotation

b) Double Rotation

6 **3 Hours**

EXPERIMENT 6

a) Implement insertion, deletion and search operations in Red-Black Tree

b) Write a program to implement B-Tree operations.

7 **9 Hours**

EXPERIMENT 7

a) Implement Dijkstra's algorithm and Floyd Warshall's algorithm for solving single source shortest path problems.

b) Write a program to detect Hamiltonian cycles in a Hamiltonian graph.

8 **6 Hours**

EXPERIMENT 8

a) Write a program to implement graph coloring algorithms.

b) Write a program to find chromatic index of cyclic graphs.

9 **9 Hours**

EXPERIMENT 9

a) Solve rod cutting problem using dynamic programming technique.

b) Implement Strassen's matrix multiplication using the divide and conquer strategy.

c) Implement the Huffman coding algorithm to decode the given text.

10 **6 Hours**

EXPERIMENT 10

Simulate Tic-Tac-Toe game using backtracking strategy

Total: 60 Hours

Reference(s)

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson, 2014.
2. Alfred V.Aho, John E.Hopcroft, Jeffrey D. Ullman, Data Structures and Algorithms, Third Edition, Pearson, 2015
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest , Clifford Stein, Introduction to Algorithms, Third Edition, Prentice Hall of India, Reprint 2012.
4. Mark Allen Weiss, Data Structures and Algorithms in C++, Fourth Edition, Pearson, 2014
5. E. Horowitz, S. Sahni and S. Rajasekaran, Computer Algorithms, University Press, 2008.
6. Adam Drozdek, Data Structures and Algorithms in C++, 4th Edition, Cengage Learning, 2013.

21CS17 DISTRIBUTED SYSTEMS LABORATORY 0 0 4 2

Course Objectives

- To study and implement the various distributed system algorithms and techniques related to design and performance constraints
- To learn the basics of creating Apache Spark jobs, loading data, and working with data.
- To design and test a self contained applications of distributed systems.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.

b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.

d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Implement the distributed system algorithms and techniques using Apache Spark.
2. Design programming models for Distributed systems.
3. Develop a Spark SQL with Spark functional programming API.
4. Implement the Spark application with driver program and executes various parallel operations on a cluster.

1 **12 Hours**

EXPERIMENT 1

Implement the following Map Reduce algorithms :

Matrix vector multiplication
Power iteration (e.g. Page Rank)
Gradient descent methods
Stochastic SVD Tall skinny QR

2 **6 Hours**

EXPERIMENT 2

Create a simple PySpark app to count the degree of each vertex for a given graph

3 **6 Hours**

EXPERIMENT 3

Implementation of Resilient Execution with Bounded-Time Recovery (REBOUND)

4 **6 Hours**

EXPERIMENT 4

Implement a program to distribute the data among the multiple nodes in cluster

5 **6 Hours**

EXPERIMENT 5

Implement a program for collecting partitioning data with values

6 **6 Hours**

EXPERIMENT 6

Implement the Resilient Distributed Datasets (RDD) Operations

7 **6 Hours**

EXPERIMENT 7
Implement the machine learning example - Logistic Regression

8 **6 Hours**

EXPERIMENT 8
Implement the applications using Spark API for graphs and graph-parallel computation

9 **6 Hours**

EXPERIMENT 9
Implement the machine learning applications using Spark Machine Learning Library (MLlib)

Total: 60 Hours

Reference(s)

1. Coulouris G., Dollimore J. & Kindberg T., Gordon Blair Distributed Systems Concepts and Design, Fifth edition. Addison Wesley, 2012
2. Tanenbaum S, Maarten V.S., Distributed Systems, Third Edition, Pearson Education, 2017
3. Ajay D. Kshemkalyani, Mukesh Singhal, Distributed Computing: Principles, Algorithms, and Systems, Cambridge University Press, 2011

21CS21 DATABASE ENGINEERING 3 0 0 3

Course Objectives

- Exemplify the data models and to conceptualize a database system using ER diagrams.
- Interpret the concepts of parallel and distributed databases.
- Understand the mobile, multimedia and emerging database technologies.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Construct an ER model for a database system and apply the normalization in relational databases for removing anomalies.
2. Analyze the transaction processing, concurrency control in parallel and distributed databases.
3. Apply the real time data in object and object relational databases.
4. Apply the concepts of mobile database and implement multimedia databases.
5. Analyze the emerging database technologies in NoSQL.

UNIT I **9 Hours**

DATABASE SYSTEM CONCEPTS

Purpose of Database systems - Data Storage and Querying - Database architecture - Data models: Relational model - Entity relationship model: Constraints- Removing redundant attributes in entity sets - Entity-relationship diagrams - Reduction to relational schemas - Entity relationship design issue - Extended E-R features - Normalization and database design

UNIT II **8 Hours**

PARALLEL AND DISTRIBUTED DATABASES

Parallel databases: I/O parallelism - Inter and intra query parallelism - Inter and intra operation parallelism - Distributed databases: Homogeneous and Heterogeneous databases - Distributed data storage - Distributed transactions - Commit protocols - Concurrency control- Distributed query processing

UNIT III **9 Hours**

OBJECT AND OBJECT RELATIONAL DATABASES

Concepts for Object Databases: Object Identity - Object structure - Type Constructors - Encapsulation of Operations - Methods - Persistence - Type and Class Hierarchies - Inheritance - ODMG Model - ODL - OQL - Object Database Conceptual Design.

UNIT IV **10 Hours**

MOBILE AND MULTIMEDIA DATABASES

Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols - Multimedia Databases - Image Databases - Audio Databases - Video Databases

UNIT V **9 Hours**

EMERGING DATABASE TECHNOLOGIES

NoSQL - CAP Theorem - Sharding - Document based - MongoDB Operation: Insert, Update, Delete, Query, Indexing, Deployment - Using MongoDB with PHP / JAVA - Cassandra: Data Model, Key Space, Table Operations, CRUD Operations, CQL Types - HIVE: Data types, Database Operations, Partitioning - HiveQL - OrientDB Graph database - OrientDB Features

Total: 45 Hours

Reference(s)

1. R. Elmasri, and S. B. Navathe, Fundamentals of Database Systems. New Delhi: Pearson Education/Addison Wesley, Seventh Edition, 2016.
2. Henry F. Korth, Abraham Silberschatz, and S. Sudharshan, Database System Concepts. New Delhi: McGraw Hill, Seventh Edition, 2019.
3. C.J.Date, A.Kannan and S.Swamynathan, An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006
4. Vijay Kumar, Mobile Database Systems Wiley Series on Parallel and Distributed Computing, USA, Wiley-Interscience, 2006
5. V.S. Subramanian, Principles of Multimedia Database Systems, Elsevier Publishers, 2014
6. Brad Dayley, Teach Yourself NoSQL with MongoDB in 24 Hours, Sams Publishing, Second Edition, 2015.

21CS22 COMPUTER SYSTEM DESIGN 3 0 0 3

Course Objectives

- To introduce the fundamental techniques of pipelining and instruction level parallelism.
- To explore knowledge about the design of multiprocessors and the design of memory hierarchy in computer architecture.
- To gain knowledge about the different multicore architectures.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.

c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.

Course Outcomes (COs)

1. Explain the working principle of pipelining and Instruction Level Parallelism (ILP).
2. Classify the advanced techniques for exploiting ILP.
3. Compare the different multiprocessor architectures.
4. Utilize the advanced optimizations of cache performance and construct virtual memory.
5. Examine the different multicore architectures and their performance.

UNIT I **9 Hours**

PIPELINING AND LP

Fundamentals of computer design - Basic and intermediate concepts of pipelining - Measuring and reporting performance - Instruction level parallelism and its exploitation - Concepts and challenges - Basic compiler techniques for ILP-Reducing branch costs with prediction-Overcoming data hazards with dynamic scheduling - Dynamic branch prediction.

UNIT II **9 Hours**

ADVANCED TECHNIQUES FOR EXPLOITING ILP

Speculation - Multiple issue processors - Compiler techniques for exposing ILP -Limitations on ILP for realizable processors - Hardware versus software speculation - Multithreading: Using ILP support to exploit thread-level parallelism - Performance of advanced multiple issue processors-Efficiency in advanced multiple issue processors

UNIT III **9 Hours**

MULTIPROCESSORS

A taxonomy of parallel architectures - Models for communication and memory architecture - Symmetric and distributed shared memory architectures - Cache coherence issues - Performance issues - Synchronization issues - Models of memory consistency - Interconnection networks-Buses, Crossbar - Multi - stage switches.

UNIT IV **9 Hours**

MEMORY HIERARCHY

Introduction - Eleven advanced Optimizations of cache performance - Memory technology and Optimizations - SRAM technology-DRAM technology-Protection: Virtual memory and virtual machines-Protection via virtual memory-Protection via virtual machine-Virtual machine monitor-Design of memory hierarchies

UNIT V **9 Hours**

MULTICORE ARCHITECTURES

Homogeneous and Heterogeneous Multi-core Architectures - Intel Multicore Architectures - SUN CMP architecture - IBM Cell Architecture. Introduction to Warehouse-scale computers -Architectures - Physical Infrastructure and Costs- Cloud Computing -Case Study - Google Warehouse-Scale Computer

Total: 45 Hours

Reference(s)

1. John L. Hennessey and David A. Patterson, Computer Architecture - A quantitative approach, Morgan Kaufmann / Elsevier, 2019
2. William Stallings, Computer Organization and Architecture - Designing for Performance. New Delhi: Pearson Education, 2009 seventh edition.
3. John L.Hennessey and David A.Patterson, Computer Organization and Design:The Hardware/Software Interface, Third Edition, 2004
4. David E. Culler and Jaswinder Pal Singh, Parallel Computing Architecture:A hardware/ software approach. Noida: Morgan Kaufmann/Elsevier, 1999.
5. Multicore Application Programming: For Windows, Linux, and Oracle Solaris, Pearson,2011

21CS23 MACHINE LEARNING TECHNIQUES 3 0 2 4

Course Objectives

- To introduce the basic concepts and techniques of Machine Learning.
- To become familiar with various classification and regression methods
- To develop skills using recent machine learning techniques and solving real time problems.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.
e. Demonstrate an ability to engage in lifelong learning for professional development and function effectively on teams to accomplish a common goal.

Course Outcomes (COs)

1. Compare and Contrast the linear, binary logistic, multinomial logistic, count, and nonlinear regression methods.
2. Classify the concepts of supervised learning algorithms with patterns to predict label values on additional unlabeled data.
3. Interpret associated rules and independent component analysis in unsupervised learning algorithms.
4. Apply deep learning, Neural Network model algorithms to handle uncertainty and solve engineering problems.
5. Analyze Reinforcement learning algorithms based on behavioral approach and training models.

UNIT I **9 Hours**

INTRODUCTION TO STATISTICAL THEORY AND REGRESSION

Regression for classification: Gauss-Markov theorem - Multiple Regression - Subset selection - Ridge regression - Principal components regression - Partial least squares - Linear Discriminant analysis - Logistic regression - multi-class classification - Overfitting and regularization in linear regression and logistic regression.

UNIT II **9 Hours**

SUPERVISED LEARNING

Decision Tree Learning - Bayesian Learning- Bayes Theorem Concept Learning-Maximum Likelihood-Minimum Description Length Principle-Bayes Optimal Classifier-Gibbs Algorithm-Naive Baye's Classifier-Bayesian Belief Network-EM Algorithm

UNIT III **9 Hours**

UNSUPERVISED LEARNING

Association rules - Cluster analysis-Self organizing maps-Principal components, curves and surfaces-Non-negative matrix factorization-Independent component analysis: maximum likelihood, contrast functions - Multidimensional scaling-Ensemble learning.

UNIT IV **9 Hours**

DEEP LEARNING

Neural Network Representation - Problems - Perceptron - Multilayer Networks and Back Propagation Algorithms - Convolutional neural networks - Stochastic Gradient Descent - Recurrent neural networks - Create and deploy neural networks using TensorFlow and Keras

UNIT V **9 Hours**

REINFORCEMENT LEARNING

Introduction - Single State Case - Elements of Reinforcement Learning - Model Based Learning - Temporal Difference Learning - TD prediction, Optimality of TD(0) - SARSA - R Learning Algorithm - Q Learning Algorithm-Generalization - Partially Observable States

1 **6 Hours**

EXPERIMENT 1

House Price Prediction using Linear Regression

2 **6 Hours**

EXPERIMENT 2

Vertebrate Classification using Decision Tree Algorithm

3 **6 Hours**

EXPERIMENT 3

EM algorithm for clustering data sets

4 **6 Hours**

EXPERIMENT 4

Image Classification using SOM

5 **6 Hours**

EXPERIMENT 5

Robot Path Planning Using Q - Learning Algorithm

Total: 75 Hours

Reference(s)

1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer; Second Edition, 2009.
3. Alpaydin Ethem, Introduction to Machine Learning, MIT Press, Second Edition, 2010.
4. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning: with Applications in R, Springer; First Edition 2013
5. Daphne Koller and Nir Friedman, Probabilistic Graphical Models: Principles and Techniques, MIT Press, 2009.

21CS26 DATABASE ENGINEERING LABORATORY 0 0 4 2

Course Objectives

- To study and implement the basic SQL commands.
- To implement the database design in an Object oriented database.
- To implement distributed databases and parallel databases.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.

b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.

d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Execute the basic SQL commands in ORACLE.
2. Implement a parallel and distributed database using ORACLE.
3. Develop an object oriented database using Case tools.
4. Implement real world applications using NoSQL.

1 **12 Hours**

EXPERIMENT 1

Working basic SQL commands, Single Row and Group functions

2 **6 Hours**

EXPERIMENT 2

Implement Parallel Database of University Counselling for Engineering colleges

3 **6 Hours**

EXPERIMENT 3

Implement Distributed Database for a real time application

4 **6 Hours**

EXPERIMENT 4

Object Oriented Database - Extended Entity Relationship using case tool

5 **6 Hours**

EXPERIMENT 5

MySQL Database Creation, Table Creation, Query

6 **6 Hours**

EXPERIMENT 6

Mobile Database Query Processing using open source DB (MongoDB/MySQL etc)

7 **6 Hours**

EXPERIMENT 7

MongoDB - CRUD operations and Indexing

8 **6 Hours**

EXPERIMENT 8

Cassandra - Table Operations, CQL Types

9 **6 Hours**

EXPERIMENT 9

HIVE: Database Operations, Partitioning - HiveQL OrientDB Graph database - OrientDB Features

Total: 60 Hours

Reference(s)

1. R. Elmasri, and S. B. Navathe, Fundamentals of Database Systems. New Delhi: Pearson Education/Addison Wesley, 2016.
2. Henry F. Korth, Abraham Silberschatz, and S. Sudharshan, Database System Concepts. New Delhi: McGraw Hill, 2010.
3. Vijay Kumar, Mobile Database Systems Wiley Series on Parallel and Distributed Computing, USA, Wiley-Interscience, 2006.
4. C.J.Date, A.Kannan and S.Swamynathan, An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006.
5. Brad Dayley, Teach Yourself NoSQL with MongoDB in 24 Hours, Sams Publishing, Second Edition, 2015.

21CS27 MINI PROJECT 0 0 4 2

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.
e. Demonstrate an ability to engage in lifelong learning for professional development and function effectively on teams to accomplish a common goal.
f. Critically analyse existing literature in an area of specialization and develop innovative and research-oriented methodologies to tackle gaps identified

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify the technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations.

Total: 60 Hours

21CS33 DISSERTATION PHASE I 0 0 20 10

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.
e. Demonstrate an ability to engage in lifelong learning for professional development and function effectively on teams to accomplish a common goal.
f. Critically analyse existing literature in an area of specialization and develop innovative and research-oriented methodologies to tackle gaps identified.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify the technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations.

Total: 300 Hours

21CS41 DISSERTATION PHASE II 0 0 28 14

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.

c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.

d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

e. Demonstrate an ability to engage in lifelong learning for professional development and function effectively on teams to accomplish a common goal.

f. Critically analyse existing literature in an area of specialization and develop innovative and research-oriented methodologies to tackle gaps identified.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify the technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations.

Total: 420 Hours

21CS52 SOFT COMPUTING 3 0 0 3

Course Objectives

- To conceptualize the functioning of the human brain using neural networks.
- To summarize and apply the methodologies involved in solving problems related to Fuzzy Logic and various fuzzy systems.
- To analyze and integrate soft computing and optimization techniques in order to solve problems effectively and efficiently.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Classify the soft computing techniques and the functionalities of artificial neural networks.
2. Compare the supervised and unsupervised learning networks and illustrate the architecture and working principles of neural networks.
3. Analyze the concept of fuzzy logic and design an expert system by applying the fuzzy membership function.
4. Analyze the features and operators in genetic algorithms and apply the genetic algorithm for real time problems.
5. Apply the hybrid soft computing techniques in multi spectral image fusion modeling and optimization of traveling salesman problems.

UNIT I **9 Hours**

INTRODUCTION

Introduction to Soft Computing- Difference between soft computing and hard computing - Various types of soft computing techniques - Applications of soft computing - Biological Neuron-Nerve structure and synapse - Artificial Neuron and its model - Activation functions - Neural network architecture - single layer and multilayer feed forward networks – McCullochPitt’s neuron model.

UNIT II **9 Hours**

NEURAL NETWORKS

Supervised Learning Networks: Perceptron Networks - Adaptive Linear Neuron- Multiple Adaptive Linear Neuron - Back-propagation Network.

Unsupervised Learning Networks: Counter propagation network - architecture & functioning - Adaptive Resonance Theory - Architecture & functioning.

UNIT III **9 Hours**

FUZZY SYSTEMS

Introduction to Fuzzy logic - Crisp sets - Fuzzy sets - Crisp relations - Fuzzy relations - Fuzzy membership functions - Operations on Fuzzy sets - Fuzzification - Defuzzification techniques -Fuzzy logic controller design - Applications of Fuzzy logic.

UNIT IV **9 Hours**

GENETIC ALGORITHMS

Genetic algorithms: Basic concepts - Encoding, Fitness function, Reproduction- Encoding- Binary, Octal, Hexadecimal, Permutation, Value, Tree Encoding - Selection - Roulette wheel, Boltzmann, Random, Tournament, Rank, and Steady state selections - Crossover - Mutation- Convergence of GA - Applications of GA.

UNIT V **9 Hours**

HYBRID SOFT COMPUTING TECHNIQUES

Neuro-fuzzy hybrid systems - Genetic neuro hybrid systems - Genetic fuzzy hybrid and fuzzy genetic hybrid systems - Applications: A fusion approach of multispectral images with SAR - optimization of traveling salesman problem using genetic algorithm approach.

Total: 45 Hours

Reference(s)

1. J.S.R. Jang, C.T. Sun and E. Mizutani, Neuro-Fuzzy and Soft Computing, PHI / Pearson Education, 2015.
2. S. Rajasekaran and G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications, Prentice-Hall of India Pvt. Ltd., 2017.
3. David E. Goldberg, Genetic Algorithm in Search Optimization and Machine Learning, Pearson Education India, 2013.
4. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, 3rd Edition, Wiley Publisher, 2018.
5. Timothy J.Ross, Fuzzy Logic with Engineering Application, McGraw Hill, 2016.

21CS53 DEEP LEARNING TECHNIQUES 3 0 0 3

Course Objectives

- To understand the theoretical foundations, algorithms and methodologies of Machine Learning Algorithms.
- To provide the practical knowledge in handling and analysing real world applications.
- To provide the practical knowledge in handling and analysing real world applications.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Apply the Basic fundamentals of Machine Learning Algorithms to solve real world problems.
2. Apply the Deep Learning Architectures to classify the unstructured data.
3. Analyze the Convolutional Neural Networks and transfer learning models to obtain an optimal solution.
4. Build a Recurrent Neural Networks, Recursive Nets models and classify the given inputs with reduced cost and time.
5. Design a model using Autoencoders and Generative models for image generation.

UNIT I **9 Hours**

MACHINE LEARNING BASICS

Learning algorithms, Maximum likelihood estimation, Building machine learning algorithm, Basic Machine Learning Algorithms, Neural Networks, Multilayer Perceptron, Back-propagation algorithm and its variants stochastic gradient decent, Curse of Dimensionality.

UNIT II **9 Hours**

DEEP LEARNING ARCHITECTURES

Machine Learning and Deep Learning, Representation Learning, Width and Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders.

UNIT III **9 Hours**

CONVOLUTIONAL NEURAL NETWORKS AND TRANSFER LEARNING

Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures:ResNet, AlexNet, Applications, Transfer learning Techniques, Variants of CNN: DenseNet, PixelNet.

UNIT IV **9 Hours**

SEQUENCE MODELLING,RECURRENT AND RECURSIVE NETS

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short-Term Memory Networks.

UNIT V **9 Hours**

AUTOENCODERS AND DEEP GENERATIVE MODELS

Under complete Auto encoder, Regularized Autoencoder, stochastic Encoders and Decoders, Contractive Encoders - Deep Belief networks, Boltzmann Machines, Deep Boltzmann Machine, Generative Adversial Networks.

Total: 45 Hours

Reference(s)

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, Deep Learning, MIT Press, 2017.
2. Josh Patterson, Adam Gibson, Deep Learning: A Practitioner"""""s Approach, O"Reilly Media, 2017
3. Umberto Michelucci, Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks, Apress, 2018.
4. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, The MIT Press, 2012.
5. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy, Deep Learning with TensorFlow.
6. Explore neural networks with Python, Packt Publisher, 2017.

21CS54 INFORMATION RETRIEVAL TECHNIQUES 3 0 0 3

Course Objectives

- To gain the knowledge in information retrieval with relevance to modelling, query operations, indexing and web searching.
- To learn the retrieval modelling and retrieval evaluation and understand the various applications of IR.
- To familiarize with the concepts of web search, digital libraries and recommender systems functions.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Classify the information retrieval system and web search.
2. Analyse the classic information retrieval models and evaluate the performance of an information retrieval system.
3. Apply the concepts of index construction and compression for information retrieval and query processing in information retrieval.
4. Design an efficient search engine and analyse the web content structure in web crawler.
5. Analyse recommendation system approaches in real world problems.

UNIT I **9 Hours**

INTRODUCTION

Motivation-Information versus Data Retrieval-Basic Concepts -Past, Present, Future-Retrieval Process-Information Retrieval Systems-Architecture-Characterization of IR Model -Documents and Update-Performance Evaluation-Indexing-Web Searching-IR Versus Web Search-Components of a Search Engine.

UNIT II **9 Hours**

RETRIEVAL MODELING AND RETRIEVAL EVALUATION

Taxonomy and Characterization of IR Models-Classic Information Retrieval Model-Alternative Set Theoretic, Algebraic, Probabilistic Model-Structured Text Retrieval Model-Models for Browsing-Retrieval Evaluation-Retrieval Metrics-Retrieval Performance Evaluation-Reference Collection.

UNIT III **9 Hours**

INDEXING AND QUERY PROCESSING

Static and Dynamic Inverted Indices-Index Construction and Index Compression. Searching-Sequential Searching and Pattern Matching. Query Operations-Query Languages-Structural Query-Query Protocols-Query Processing-Automatic Local and Global Analysis.

UNIT IV **9 Hours**

WEB RETRIEVAL AND WEB CRAWLING

The Web-Search Engine Architectures-Crawling the web-Crawling Documents and Email-Document Parsing-Link Analysis -Ranking-Simple Ranking Functions-Learning to Rank-Browsing -Applications of a Web Crawler-Evaluating Search Engines-Social Search.

UNIT V **9 Hours**

RECOMMENDER SYSTEM

Recommender Systems Functions-Data and Knowledge Sources-Recommendation Techniques-Basics of Content-based Recommender Systems-High Level Architecture-Advantages and Drawbacks of Content-based Filtering-Collaborative Filtering-Matrix factorization Models-Neighborhood Models.

Total: 45 Hours

Reference(s)

1. Ricardo Baeza Yates, Berthier Ribeiro Neto, Modern Information Retrieval: The Concepts and Technology behind Search, (ACM Press Books), Second Edition, Reprint 2016.
2. Chrstopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, Introduction to Information Retrieval Cambridge University Press, First South Asian Edition, 2011.
3. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, Information Retrieval Implementing and Evaluating Search Engines, The MIT Press, Cambridge, Massachusetts London, England, 2016.
4. Bruce Croft, Donald Metzler, Trevor Strohman, Search Engines: Information Retrieval in Practice, Pearson Education, 2015.
5. Ricci, F, Rokach, L. Shapira, B.Kantor, Recommender Systems Handbook, First Edition, 2011

21CS55 DATA SCIENCE AND ANALYTICS 3 0 0 3

Course Objectives

- To understand the pre-processing and data analysis, classifications, clustering and neural networks techniques to solve the problem.
- To impart the knowledge in time series data analytics.
- To familiarize with advanced analytical techniques for unstructured web data.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Apply the different pre-processing techniques to understand the data and visualize the results.
2. Apply the classification, clustering and neural networks techniques to solve a problem in the real world and optimize the results.
3. Analyze the time series data and trends using models and predict the future.
4. Develop web analytics techniques to measure the website traffic.
5. Apply the analytic techniques to collect the visitors information from Google.

UNIT I **9 Hours**

INTRODUCTION TO DATA SCIENCE

Understanding Data Types - Data manipulation - Exploratory data analysis - Data visualization - Missing value analysis - The correction matrix - Outlier detection analysis - Linear Algebra - Statistics - correlation - Simpsons Paradox - Statistical Hypothesis Testing - Gradient Descent - Feature Extraction and Selection.

UNIT II **9 Hours**

PREDICTIVE ANALYTICS AND NEURAL NETWORKS

Descriptive statistics - Dimensionality Reduction - Semi supervised Learning - Sentiment analysis - Image recognition- Regression - Dealing with categorical data. Convolutional neural network - Artificial Neural network - Back propagation approach - algorithms - Recurrent Neural Network.

UNIT III **9 Hours**

TIME SERIES ANALYTICS

Classification of variation - Analyzing a Series Containing a Trend - Analyzing a Series Containing Seasonality - Removing Trends from a Time Series - Transformation -Stationary Time Series - Mixed ARMA Models-Integrated ARMA Model - The Fourier Transform.

UNIT IV **10 Hours**

WEB ANALYTICS

Understanding web analytics - The foundations of Web analytics :Techniques and Technologies - Data Collection : Importance and Options - Web server log files: Click stream data - User submitted information - Web analytics strategy - Content organization tools - Process measurement tools - Visitor segmentation tools - Campaign analysis tools - Commerce measurement tools.

UNIT V **8 Hours**

GOOGLE ANALYTICS

Google analytics - Omniture - Web trends - Web analytics - Key features and capabilities - Quantitative and qualitative data - Working of Google analytics - Privacy - Tracking visitor clicks, Outbound links and Non - HTML files.

Total: 45 Hours

Reference(s)

1. Joel Gurus, Data science from scratch, First principles with python, O Reilly, 2015.
2. Sayan Mukhopadhyay, Data Analytics Using Python, A press, 2018.
3. Bernard J. Jansen, Understanding User-Web Interactions via Web analytics, Morgan and Claypool, 2009.
4. Avinash Kaushik, Web Analytics 2.0, John Wiley and Sons, 2010.
5. Brian Clifton, Advanced web metrics with Google analytics, John Wiley and Sons, 2012.
6. Jerri L. Ledford, Joe Teixeira and Mary E. Tyler, Google Analytics, John Wiley and Sons, 2013.

21CS56 OPTIMIZATION TECHNIQUES 3 0 0 3

Course Objectives

- To understand the types of optimization methods.
- To impart adequate knowledge on optimization algorithms and understand the established and proposed variants of particle swarm optimization.
- To analyze the performance of particle swarm optimization in applications.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Analyze the engineering application of optimization techniques.
2. Implement the basic optimization algorithms for solving constrained and unconstrained optimization problems.
3. Apply the modern methods of optimization techniques to solve engineering problems using Matlab.
4. Analyze the established and proposed variants of particle swarm optimization techniques.
5. Examine the performance of particle swarm optimization techniques.

UNIT I **9 Hours**

INTRODUCTION TO OPTIMIZATION

Engineering application of optimization - Statement of an optimization problem - Optimal problem formulation - Classification of optimization problem. Optimum design concepts: Definition of global and local optima - Optimality criteria - Review of basic calculus concepts - Global optimality

UNIT II **9 Hours**

OPTIMIZATION ALGORITHMS

Optimization algorithms for solving unconstrained optimization problems - Gradient based method: Cauchy's steepest descent method, Newtons method, Conjugate gradient method. Optimization algorithms for solving constrained optimization problems : Direct methods - Penalty function methods - Steepest descent method

UNIT III **9 Hours**

MODERN METHODS OF OPTIMIZATION

Modern methods of Optimization: Genetic Algorithms - Simulated Annealing - Ant colony optimization - Tabu search - Neural-Network based Optimization -Fuzzy optimization techniques -Particle Swarm Optimization- Applications. Use of Matlab to solve optimization problems.

UNIT IV **9 Hours**

ESTABLISHED AND PROPOSED VARIANTS OF PSO

Unified Particle Swarm Optimization - Memetic Particle Swarm Optimization - Vector Evaluated Particle Swarm Optimization - Composite Particle Swarm Optimization A Meta-Strategy Approach - Guaranteed Convergence Particle Swarm Optimization - Cooperative Particle Swarm Optimization - Niching Particle Swarm Optimization - Tribes - Quantum Particle Swarm Optimization.

UNIT V **9 Hours**

PERFORMANCE ENHANCING TECHNIQUES

Introduction-The stretching technique for Alleviating Local Minimisers-The Deflection Technique for Detecting Several Minimisers-The Repulsion Technique-Rounding technique for Integer Optimization-Applications of Particle Swarm Optimization.

Total: 45 Hours

Reference(s)

1. DEB. K, Optimization for Engineering Design: Algorithms and Examples, India: PHI Learning, 2012.
2. Yang. X, Optimization Techniques and Applications with Examples, United States: Wiley, 2018.
3. Nayak. S, Fundamentals of Optimization Techniques with Algorithms, United Kingdom: Elsevier Science, 2020.
4. Konstantinos. E, Parsopoulos and Michael N. Vrahatis,Particle Swarm Optimization and Intelligence Advances and Applications, Information Science Reference, IGI Global, New York, 2010.

21CS57 BIG DATA ANALYTICS 3 0 0 3

Course Objectives

- To analyze the fundamental concepts of big data analytics and life cycle.
- To gain in-depth knowledge about the hadoop architecture and YARN.
- To apply the key concepts of map reduce, and hadoop ecosystem.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.

d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

e. Demonstrate an ability to engage in lifelong learning for professional development and function effectively on teams to accomplish a common goal.

Course Outcomes (COs)

1. Create competitive advantage with Big Data analytics by optimizing business decisions and Analyze the Big Data file structure and Approaches.
2. Discover the building blocks of Data Analytics Lifecycle to manage and execute the analytical projects.
3. Analyze the data on Hadoop to build and maintain reliable, scalable distributed File System.
4. Acquire and analyze the fundamental enabling technique of Map Reduce and its qualities in big data analytics.
5. Develop the applications using the programming tools Pig, Hive and Zookeeper in the Hadoop ecosystem.

UNIT I **9 Hours**

INTRODUCTION TO BIG DATA ANALYTICS

Big Data Overview, Data Structures, Analyst Perspective on Data Repositories, State of the Practice in Analytics, BI Versus Data Science, Current Analytical Architecture, Drivers of Big Data, Emerging Big Data Ecosystem and a New Approach to Analytics, Key Roles for the New Big Data Ecosystem, Examples of Big Data Analytics.

UNIT II **9 Hours**

DATA ANALYTICS LIFECYCLE

Data Analytics Lifecycle Overview, Discovery, Data Preparation, Model Planning, Model Building, Communicate Results, Operationalize, Case Study: Global Innovation Network and Analysis (GINA)

UNIT III **9 Hours**

INTRODUCTION TO HADOOP

Data format - analyzing data with Hadoop-scaling out-Hadoop streaming- Hadoop pipes,The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Sqoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures, HDFS Administering -Monitoring & Maintenance.

UNIT IV **9 Hours**

MAP REDUCE APPLICATIONS

MapReduce workflows - unit tests with MR Unit -test data and local tests - anatomy of MapReduce job run - classic Map-reduce - YARN- failures in classic Map-reduce and YARN- job scheduling -shuffle and sort - task execution - MapReduce types -input formats -output formats.

UNIT V **9 Hours**

HADOOP ECOSYSTEM

Hive Architecture and Installation, Comparison with Traditional Database, HiveQL -Querying Data -Sorting And Aggregating, Map Reduce Scripts, Joins & Subqueries, HBase concepts Advanced Usage, Schema Design, Advance Indexing - Mahout - PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

Total: 45 Hours

Reference(s)

1. David Dietrich, Data Science and Big data analytics, Discovering, Analyzing, Visualizing and Presenting Data, Wiley, 2015.
2. Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi, Big Data Principles and Paradigms, Morgan Kaufmann, 2016.
3. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, Professional Hadoop Solutions, Wiley, ISBN: 9788126551071, 2015.
4. Tom White, HADOOP: The definitive Guide, O'Reilly, 4 th edition, 2015.
5. Vignesh Prajapati, Big Data Analytics with R and Hadoop, Packet Publishing, 2013.

21CS58 CLOUD COMPUTING TECHNOLOGIES 3 0 0 3

Course Objectives

- To articulate the differences between deployment model and service model of cloud computing.
- To impart virtualization technologies, resource management techniques and scheduling schemes in cloud environments.
- To enhance knowledge on different types of programming models to deploy web applications with security in the cloud.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Elaborate the components of cloud computing to understand how business agility in an organization can be created.
2. Critique the consistency of virtualization technologies in cloud environments.
3. Evaluate the deployment of web services from cloud architecture with scheduling schemes and resource management.
4. Analyze cloud programming models to solve issues on cloud.
5. Design a secure cloud to deploy an application based on different security concerns.

UNIT I **8 Hours**

INTRODUCTION - CLOUD INFRASTRUCTURE

Cloud computing - Cloud computing delivery models and services - Ethical issues - Cloud vulnerabilities - Cloud computing at Amazon - Cloud computing the Google perspective - Microsoft Windows Azure and online services - Open-source software platforms for private clouds.

UNIT II **9 Hours**

CLOUD VIRTUALIZATION TECHNOLOGIES

Introduction - Virtualization Defined-Virtualization Benefits - Server Virtualization-Virtual Machine - Virtualization technologies-Hardware Virtualization- OS Virtualization Virtualization for x86 Architecture - Paravirtualization - Virtual Infrastructure Requirements - Server Virtualization Sustainability Assessment.

UNIT III **10 Hours**

CLOUD RESOURCE MANAGEMENT AND SCHEDULING

Policies and Mechanisms for Resource Management - Stability of a Two-Level Resource Allocation Architecture - A Utility-Based Model for Cloud-Based Web Services - Resource Bundling: Combinatorial Auctions for Cloud Resources - Scheduling Algorithms for Computing Clouds - Fair Queuing - Start -Time Fair Queuing - Borrowed Virtual Time.

UNIT IV **10 Hours**

CLOUD PROGRAMMING MODEL

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job -Developing Map Reduce Applications - Design of Hadoop file system-Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus.

UNIT V **8 Hours**

CLOUD SECURITY

Cloud Infrastructure security: network, host and application level-aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud -Cloud Security and Trust Management.

Total: 45 Hours

Reference(s)

1. Cloud Computing Theory and Practice, Dan C Marinescu, Elsevier (MK), 2013.
2. Cloud Computing, Dr Kumar Saurabh, 2 Edition, Wiley, 2012.
3. Cloud Computing Strategies, Dimitris N Chorafas, CRC Press, 2010.
4. Cloud Computing: Implementation, Management, and Security, John W. Rittinghouse and James F. Ransome, CRC Press, 2010.
5. Tim Mather, Subra Kumaraswamy, and Shahed Latif, Cloud Security and Privacy, O Reilly Media, Inc., 2009.
6. Tom White, Hadoop: The Definitive Guide, Yahoo Press, 2012.

21CS59 5G NETWORKS 3 0 0 3

Course Objectives

- To learn the fundamentals of 5G Networks and gain knowledge on 5G based mobile clouds
- To understand the concept of wireless spectrum and cognitive radio technologies in 5G.
- To learn the concept of Self Organizing Networks (SON) in 5G networks.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Summarize the evolution of 5G networks.
2. Analyze the concept of small cells and its challenges in 5G.
3. Apply the concept of cognitive radio technologies for 5G mobile clouds
4. Analyze the applications of wireless spectrum in the Unified 5G Broadcast-Broadband architecture.
5. Analyze the Security challenges and the concepts of SON in 5G networks.

UNIT I **9 Hours**

INTRODUCTION

Introduction-Historical Trend of Wireless Communications- Evolution of LTE Technology to Beyond 4G-5G Roadmap-10 Pillars of 5G-5G in Europe, North America & Asia-5G Architecture-The 5G Internet-Internet of Things and Context-Awareness-Networking Reconfiguration and Virtualisation Support-Mobility-Quality of Service Control- Emerging Approach for Resource Over-Provisioning.

UNIT II **9 Hours**

SMALL CELLS

Introduction - Small Cells - Capacity Limits and Achievable Gains with Densification - Mobile Data Demand - Demand vs Capacity - Small - Cell Challenges - Cooperative Diversity and Relaying Strategies - PHY Layer Impact on MAC Protocol Analysis

UNIT III **9 Hours**

MOBILE CLOUDS

Introduction - The Mobile Cloud - Mobile Cloud Enablers - Network Coding - Cognitive Radio for 5G Wireless Networks - Spectrum Optimisation using Cognitive Radio - Spectrum Optimisation - Cognitive Radio and Carrier Aggregation - Energy - Efficient Cognitive Radio Technology - Key Requirements and Challenges.

UNIT IV **9 Hours**

WIRELESS SPECTRUM

Background - TV White Space Technology - White Space Spectrum Opportunities and Challenges - TV White Space Applications - International Efforts - Role of WS in 5G - Unified 5G Broadcast - Broadband Architecture - Challenges - Candidate Network Architectures - Convergent Solution.

UNIT V **9 Hours**

SECURITY

Overview of a Potential 5G Communications - Security Issues and Challenges in 5G Communications - SON in UMTS and LTE - The Need for SON in 5G - Evolution towards Small - Cell Dominant HetNets.

Total: 45 Hours

Reference(s)

1. Jonathan Rodriguez, Fundamentals of 5G Mobile Networks, Wiley Publication, First Edition 2015.
2. Anwer Al-Dulaimi,5G Networks Fundamental Requirements, Enabling Technologies, and Operations Management, Wiley Publication, First Edition , 2018.
3. AfifOsseiran, Jose F. Monserrat, Patrick Marsch, 5G Mobile and Wireless Communications Technology, Cambridge University Press, First Edition ,2016
4. Devaki Chandramouli, JuhoPirskanen, Rainer Liebhart, 5G for the Connected World, Wiley Publication, First Edition, 2019.

21CS60 HIGH SPEED NETWORKS 3 0 0 3

Course Objectives

- To gain the knowledge on networking and its routing algorithms.
- To understand the fundamentals of VPN on wireless networks.
- To give adequate exposure to the emerging technologies and their potential impact.

Programme Outcomes (POs)

b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Summarize the basic functionalities of OSI model and routing algorithms.
2. Classify the operations performed on Asynchronous Transfer Mode (ATM) switching.
3. Compare the various methods for providing connection-oriented services over an advanced network with the reference to MPLS, VPN.
4. Differentiate the mechanisms involved in the 4G and Long Term Evolution (LTE) networks.
5. Analyze the importance of internetworking on WLANs and 3GWANs.

UNIT I **9 Hours**

INTRODUCTION

The OSI Reference Model-The TCP/IP Reference Model-Ethernet- Routing Algorithms: The Optimality Principle-Shortest Path-Routing-Flooding-Unicast Routing-Multicast Routing, Routing for Mobile Hosts-Uses: Network Applications-Network Types

UNIT II **10 Hours**

SWITCHING NETWORKS

Switching-Packet switching-Ethernet-Token Ring-FDDI-DQDB-Frame Relay-SMDS-Circuit Switched-SONET-DWDM-DSL-Intelligent Networks-CATV-ATM-Features-Addressing Signaling & Routing-Header Structure-ATM Adaptation layer-Management control-BISDN-Internetworking with ATM

UNIT III **9 Hours**

VIRTUAL PRIVATE NETWORK

VPN-Remote Access VPN-Site-to-Site VPN-Tunneling to PPP-Security in VPN-MPLS-Operation-Routing-Tunneling and use of Forward Error Correction-Traffic Engineering-MPLS based VPN-Overlay Networks P2P connections-IPv4 vs IPv6

UNIT IV **9 Hours**

4G AND LTE

Overview of 3G-Migration paths to UMTS-UMTS architecture-3GPP Network-4G-Features and challenges-4G technologies-Software defined radio-Cognitive Radio-IMS architecture-MVNO-LTE: System overview-Evolution from UMTS to LTE

UNIT V **8 Hours**

INTER NETWORKING BETWEEN WLANS AND 3GWANS

Internetworking-Objectives and Requirements, Schemes to Connect WLANs and 3G networks-Session Mobility-Internetworking Architecture for WLAN and GPRS-LMDS-MMDS

Total: 45 Hours

Reference(s)

1. Peter Dordal, "An Introduction to Computer Networks", Release 1.9.16, 2018.
2. J.F. Kurose, K.W. Ross, "Computer Networking-A Top Down Approach Featuring the Internet", Pearson 7th Edition, 2017.
3. Aunurag Kumar, D. Manjunath, Joy Kuri, "Communication Networking", Morgan Kaufmann Publishers, 2011.
4. Walrand J. Varatya, "High Performance Communication Network", Morgan Kaufmann-Harcourt Asia Pvt. Ltd., 2nd Edition, 2000.
5. Vijay K. Garg, "Wireless Communication and Networking", Elsevier, 2007.
6. Moray Rumney, "LTE and the Evolution to 4G Wireless Design and Measurement Challenges", Agilent Technologies, 2009.

21CS61 BLOCKCHAIN TECHNOLOGY 3 0 0 3

Course Objectives

- To gain knowledge on cryptocurrency concepts that includes bitcoin scripting and distributed consensus
- To gain insight on the architecture of hyper ledger fabric and ethereum network.
- To know the applications of blockchain technology.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Summarize the emerging abstract models for Blockchain technology.
2. Apply the concept of Bitcoin and cryptocurrency in Blockchain technology.
3. Analyze the algorithms involved in distributed consensus.
4. Develop the Block chain application using hyperledger Fabric and Etherum platform.
5. Apply the Blockchain technologies in real world problems.

UNIT I **9 Hours**

INTRODUCTION

Blockchain- Public Ledgers, Blockchain as Public Ledgers -Bitcoin, Blockchain 2.0, Smart Contracts, Block in a Blockchain, Transactions-Distributed Consensus, The Chain and the Longest Chain -Cryptocurrency to Blockchain 2.0 - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree.

UNIT II **9 Hours**

BITCOIN AND CRYPTOCURRENCY

A basic cryptocurrency, Creation of coins, Payments and double spending, FORTH: the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay, Consensus introduction, Distributed consensus in open environments-Consensus in a Bitcoin network.

UNIT III **9 Hours**

DISTRIBUTED CONSENSUS

RAFT Consensus-Byzantine general problem, Byzantine fault tolerant (BFT) system-Agreement Protocol, Lamport-Shostak-Pease BFT Algorithm-BFT over Asynchronous systems, Practical Byzantine Fault Tolerance.

UNIT IV **9 Hours**

HYPER LEDGER FABRIC

Architecture of Hyperledger fabric v1.1-Introduction to hyperledger fabric v1.1, chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity, Smart contracts, Truffle Design and issue Crypto currency.

UNIT V **9 Hours**

BLOCKCHAIN APPLICATIONS

Internet of Things-Medical Record Management System-Blockchain in Government and Blockchain Security-Blockchain Use Cases-Finance.

Total: 45 Hours

Reference(s)

1. S. Shukla, M. Dhawan, S. Sharma, S. Venkatesan, Blockchain Technology: Cryptocurrency and Applications, Oxford University Press, 2019.
2. Imran Bashir, Mastering Blockchain: Distributed Ledger technology, decentralization and smart contracts, Second edition, Packt publishing, 2018.
3. Josh Thompson, Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming, Create Space Independent Publishing Platform, 2017.
4. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, Bitcoin and cryptocurrency technologies: a comprehensive introduction, Princeton University Press, 2016.

21CS62 AUTOMATA THEORY 3 0 0 3

Course Objectives

- To understand the representations of different language in Chomsky hierarchy.
- To understand the construction of different types of Automata to recognize languages.
- To gain knowledge about Undecidable problems.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.
e. Demonstrate an ability to engage in lifelong learning for professional development and function effectively on teams to accomplish a common goal.
f. Critically analyse existing literature in an area of specialization and develop innovative and research-oriented methodologies to tackle gaps identified.

Course Outcomes (COs)

1. Construct automata for any given pattern and find its equivalent regular expressions.
2. Design Context free grammar for languages and analyze its properties.
3. Design Pushdown automata and Turing Machine to recognize languages and computation.
4. Construct linear bounded automata and prove equivalence between different language representations within the Chomsky hierarchy.
5. Analyze the undecidability of languages.

UNIT I **9 Hours**

REGULAR LANGUAGES

Finite Automata (FA)-Deterministic Finite Automata (DFA)-Non-deterministic Finite Automata (NFA) Equivalence between NFA and DFA. Regular Expression-FA and Regular Expressions-Pumping Lemma for Regular Languages-Closure Properties of Regular Languages.

UNIT II **9 Hours**

CONTEXT FREE LANGUAGES

Context-Free Grammar (CFG) -Derivation Trees-Ambiguity in Grammars and Languages -Equivalence of Parse Trees and Derivation-Simplification of Context-free Grammar-Chomsky Normal Form-Greibach Normal Form-Pumping Lemma for CFL-Closure Properties.

UNIT III **9 Hours**

PUSHDOWN AUTOMATA

Definition of the Pushdown Automata-Languages of Pushdown Automata - Equivalence of Pushdown Automata and CFG - Deterministic Pushdown Automata - Turing Machines-Language of a Turing Machine - Programming Techniques for TM -Storage in Finite Control- Multiple Tracks - Checking off symbols-Subroutines.

UNIT IV **9 Hours**

CHOMSKY HIERARCHY

Regular Grammars - Equivalence of Regular Grammar and Finite Automata - Unrestricted Grammars - Equivalence of Type 0 Grammar and Turing Machines - Context Sensitive Grammars (CSG) and Languages - Linear Bounded Automata(LBA) - Equivalence of LBA and CSG.

UNIT V **9 Hours**

UNDECIDABILITY

Properties of Recursively Enumerable (RE) and Recursive Languages - Undecidable Problems about Turing Machine - Rice Theorem - Post's Correspondence Problem (PCP) -Modified Post Correspondence Problem.

Total: 45 Hours

Reference(s)

1. John E Hopcroft, Rajeev Motwani, Jeffery D Ullman, Introduction to Automata Theory, Languages and Computations.Third Edition,Pearson Education, 2014
2. H.R. Lewis,C.H. Papadimitriou, Elements of the theory of Computation, Second Edition, Pearson Education/PHI, 2007
3. J. Martin, Introduction to Languages and the Theory of Computation, Third Edition, Tata McGraw Hill, 2007.
4. Micheal Sipser, Introduction of the Theory and Computation, Thomson Brokecole, 2005.

21CS63 PROGRAMMING PARADIGM 3 0 0 3

Course Objectives

- To understand about data types, basic statements and describe semantics of programming languages.
- To enhance object-orientation, concurrency, and event handling in programming languages.
- To develop programs in non-procedural programming paradigms.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Analyse the syntax and semantics of programming languages.
2. Design and implement the subprogram constructs.
3. Apply object-oriented, concurrency, and event handling programming constructs.
4. Analyse the functions in Lambda, LISP with its scheme.
5. Apply and adopt logic programming along with multi-paradigm languages.

UNIT I **9 Hours**

SYNTAX AND SEMANTICS AND BASIC STATEMENTS

Evolution of programming languages - describing syntax and semantics - lexical analysis - parsing - recursive- decent - bottom up parsing- primitive data types - strings -array types - associative arrays - record types -union types - pointers and references -Arithmetic expressions -relational and Boolean expressions- assignment statements - mixed mode assignments - control structures -selection - iterations - branching - guarded statements.

UNIT II **9 Hours**

SUBPROGRAMS AND IMPLEMENTATIONS

Subprograms - design issues - local referencing - parameter passing -overloaded methods - generic methods - design issues for functions - semantics of call and return -implementing simple subprograms - stack and dynamic local variables - nested subprograms - blocks -dynamic scoping.

UNIT III **9 Hours**

OBJECT - ORIENTATION, CONCURRENCY, AND EVENT HANDLING

Object-orientation - design issues for OOP languages - implementation of object - oriented constructs - concurrency - semaphores - monitors - message passing -threads - statement level concurrency - exception handling - even handling.

UNIT IV **9 Hours**

FUNCTIONAL PROGRAMMING

Introduction to lambda calculus - fundamentals of functional programming languages - Programming with Scheme - Introduction to LISP - Lists - Storage allocation for lists - Some useful functions - Error handling.

UNIT V **9 Hours**

LOGIC PROGRAMMING

Introduction to logic and logic programming - Computing with relations - Programming with Prolog - Data structures in Prolog - Programming techniques - Control in Prolog - Cuts.- multi-paradigm languages.

Total: 45 Hours

Reference(s)

1. Robert W. Sebesta, Concepts of Programming Languages, 12th Edition, Pearson Education, 2019.
2. Michael L. Scott, Programming Language Pragmatics, 4th Edition, Morgan Kaufmann, 2016.
3. R. Kent Dybvig, The Scheme programming language, 4th Edition, MIT Press, 2009
4. Richard A. O"Keefe, The craft of Prolog, MIT Press, 2009.
5. W. F. Clocksin and C. S. Mellish, Programming in Prolog: Using the ISO Standard, 5th Edition, Springer,

21CS64 DIGITAL IMAGE PROCESSING AND APPLICATIONS

3 0 0 3

Course Objectives

- To introduce the concepts of image processing and basic analytical methods to be used in image processing.
- To familiarize the concepts with image enhancement, restoration, image recognition, image segmentation and image compression techniques.
- To impart the knowledge on applying the imaging techniques on various applications.

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
c. Design a system, component, or process to meet desired needs within realistic constraints such as economic, social and ethical in the field of Computer Science and Engineering.

Course Outcomes (COs)

1. Classify the fourier transforms, histogram processing and spatial filtering.
2. Apply the techniques for image restoration in spatial filtering and multi-resolutions in wavelets.
3. Apply the mathematical modeling of morphological operation in image segmentation and patterns in object recognition.
4. Analyze the image compression standards and image representation techniques.
5. Apply image processing concepts in remote sensing & monitoring, Medical imaging and video processing.

UNIT I **9 Hours**

DIGITAL IMAGE FUNDAMENTALS

Fundamentals steps in digital image processing- Introduction to fourier transform and discrete fourier transform- Intensity transformation: Basics - Histogram processing: Histogram equalization, Histogram specification, Spatial filtering: Mechanics, correlation and convolution- Smoothing and sharpening spatial filters.

UNIT II **9 Hours**

IMAGE RESTORATION AND WAVELETS

Model of image degradation/restoration process - Noise models -Restoration in the presence of noise only spatial filtering - Estimating the degradation function-Inverse filtering -Minimum mean square error filtering -Constrained least squares filtering -Geometric mean filter- Wavelets - Sub band coding -Multi resolution expansions

UNIT III **9 Hours**

IMAGE SEGMENTATION AND RECOGNITION

Edge detection - Thresholding - Region based segmentation- Morphological processing- erosion and dilation, Segmentation by morphological watersheds - Use of Motion in Segmentation- Object Recognition: Patterns and Pattern classes- Recognition Based on Decision-Theoretic Methods - Structural methods

UNIT IV **9 Hours**

IMAGE COMPRESSION

Fundamentals, image compression models, error-free compression, image Compression Standards- Compression methods- Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Representation and Description.

UNIT V **9 Hours**

IMAGE PROCESSING APPLICATIONS

Remote sensing & monitoring applications - Medical image applications - Video processing applications

Total: 45 Hours

Reference(s)

1. Rafael C Gonzalez, Richard E Woods, Digital Image Processing, 4th Edition, Pearson Education 2018.
2. Digital Image Processing, S. Jayaraman, S. Esakkirajan, T. Veerakumar, McGraw Hill Education, 2009. Pvt Ltd, NewDelhi.
3. S Sridhar, Digital Image Processing, 2nd ed., Oxford University Press, 2016.
4. Tinku Acharya and Ajoy K. Ray-Image Processing Principles and Applications, A John Wiley & Sons, Mc., Publication 2005.
5. Ardeshir Goshtasby, 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications, John Wiley and Sons,2005.

21CS65 AGILE METHODOLOGY 3 0 0 3

Course Objectives

- Understand the software design and a set of software technologies and APIs
- Impart knowledge on Agile development and testing techniques
- Acquire knowledge on Agile based software development

Programme Outcomes (POs)

a. Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer-based systems of varying complexity.
b. Identify, formulate, critically analyse, and solve problems in the field of Computer Science and Engineering, considering recent and future trends.
d. Use current techniques, skills, and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the Computer Science and Engineering discipline.

Course Outcomes (COs)

1. Compare the software project with traditional and agile model based on customer requirements.
2. Develop the software product using Agile-based methodology.
3. Plan and execute the iterative software development process based on knowledge management.
4. Choose the better process between requirement gathering and requirement elicitation techniques.
5. Develop techniques and tools for improving team collaboration and software quality.

UNIT I **9 Hours**

AGILE METHODOLOGY

Theories for Agile Management - Agile Software Development -Traditional Model vs. Agile Model - Classification of Agile Methods -Agile Manifesto and Principles -Agile Project Management -Agile Team Interactions -Ethics in Agile Teams -Agility in Design, Testing -Agile Documentations -Agile Drivers, Capabilities and Values

UNIT II **9 Hours**

AGILE PROCESS

Lean Production -SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview -Lifecycle -Work Products, Roles and Practices

UNIT III **9 Hours**

AGILITY AND KNOWLEDGE MANAGEMENT

Agile Information Systems -Agile Decision Making -EarlS Schools of KM -Institutional Knowledge Evolution Cycle -Development, Acquisition, Refinement, Distribution, Deployment , Leveraging -KM in Software Engineering -Managing Software Knowledge -Challenges of Migrating to Agile Methodologies - Agile Knowledge Sharing -Role of Story-Cards -Story-Card Maturity Model (SMM).

UNIT IV **9 Hours**

AGILITY AND REQUIREMENTS ENGINEERING

Impact of Agile Processes in RE-Current Agile Practices -Variance -Overview of RE - Using Agile - Managing - Unstable Requirements -Requirements Elicitation -Agile Requirements Abstraction Model - Requirements Management in Agile Environment, Agile Requirements Prioritization -Agile Requirements Modeling and Generation -Concurrency in Agile Requirements Generation.

UNIT V **9 Hours**

AGILITY AND QUALITY ASSURANCE

Agile Product Development -Agile Metrics -Feature Driven Development (FDD) -Financial and Production Metrics in FDD -Agile Approach to Quality Assurance -Test Driven Development -Agile Approach in Global Software Development.

Total: 45 Hours

Reference(s)

1. Paul VII, Agile: The Complete Overview of Agile Principles and Practices (Agile Product Management), 1st Edition, 2016
2. Robert Martin, Agile Software Development, Principles, Patterns, and Practices, Pearson New International Edition,2013
3. Hazza and Dubinsky, - Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009.
4. David J. Anderson and Eli Schragenheim, - Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2009.
5. Craig Larman, Agile and iterative development: A Manager"s Guide, Addison-Wesley, 2004

21XE01 ENGLISH FOR RESEARCH PAPER WRITING 2 0 0 0

Course Objectives

- Illustrate that how to improve your writing skills and level of readability.
- Learn about what to write in each section.
- Recognize the skills needed when writing a Title.
- Ensure the good quality of paper at very first-time submission.

Course Outcomes (COs)

1. Illustrate the research ideas and writing journal papers
2. Creating research paper writing

UNIT I **6 Hours**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT II **6 Hours**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT III **6 Hours**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT IV **6 Hours**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT V **6 Hours**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

UNIT VI **6 Hours**

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

Total: 30 Hours

Reference(s)

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highmans book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

21XE02 COST MANAGEMENT OF ENGINEERING PROJECTS

2 0 0 0

Course Objectives

- To understand the cost concepts and different stages of project execution and its activities.
- To understand cost behavior, management and its quantitative techniques.

Course Outcomes (COs)

1. Apply the cost concepts in decision making.
2. Analyze the various stages of project execution and its activities.
3. Analyze the cost behavior and various types of costing.
4. Analyze the cost management and budget related decisions.
5. Analyze the quantitative techniques for cost management.

UNIT I **6 Hours**

COST CONCEPTS IN DECISION-MAKING

Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control;
Provision of data for Decision-Making.

UNIT II **6 Hours**

PROJECT

Meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and
documents Project team: Role of each member. Importance Project site: Data required with significance.

UNIT III **6 Hours**

COST BEHAVIOR AND PROFIT PLANNING MARGINAL COSTING

Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning.

UNIT IV **6 Hours**

TOTAL QUALITY MANAGEMENT AND THEORY OF CONSTRAINTS

Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V **6 Hours**

QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Total: 30 Hours

Reference(s)

1. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

21XE03 STRESS MANAGEMENT 2 0 0 0

Course Objectives

- To achieve overall health of body and mind
- To overcome stress by practicing yoga

Course Outcomes (COs)

1. Develop healthy mind in a healthy body thus improving social health also.
2. Improve Efficiency of the body by practicing breathing exercises and yoga.

UNIT I **10 Hours**

Definitions of Eight parts of yog. (Ashtanga)

UNIT II **10 Hours**

Yam and Niyam.
Do`s and Dont"s in life.
i) Ahinsa, satya, astheya, bramhacharya and aparigraha
ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III **10 Hours**

Asan and Pranayam
i) Various yog poses and their benefits for mind & body
ii)Regularization of breathing techniques and its effects-Types of pranayam

Total: 30 Hours

Reference(s)

1. Yogic Asanas for Group Training-Part-I Janardan Swami Yogabhyasi Mandal, Nagpur. Model Curriculum of Engineering & Technology PG Courses [Volume-I][47].
2. Rajayoga or conquering the Internal Nature by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

21XE04 DISASTER MANAGEMENT 2 0 0 0

Course Objectives

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Course Outcomes (COs)

1. Illustrate the key concepts in disaster risk reduction and humanitarian response
2. Interpret the strengths and weaknesses of disaster management approaches, planning and programming

UNIT I **5 Hours**

INTRODUCTION

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT II **5 Hours**

REPERCUSSIONS OF DISASTERS AND HAZARDS

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms and Cyclones, Tsunamis and Floods, Droughts and Famines, Landslides and Avalanches Man-made disaster Nuclear Reactor Meltdown, Industrial Accidents and Oil Slicks and Spills Outbreaks of Disease and Epidemics War and Conflicts.

UNIT III **5 Hours**

DISASTER PRONE AREAS IN INDIA

Study of Seismic Zones; Areas Prone to Floods And Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV **5 Hours**

DISASTER PREPAREDNESS AND MANAGEMENT

Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V **5 Hours**

RISK ASSESSMENT

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT VI **5 Hours**

DISASTER MITIGATION

Disaster Mitigation Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation In India.

Total: 30 Hours

Reference(s)

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies " , New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall Of India, New Delhi
3. Goel S. L. "Disaster Administration And Management Text and Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

21XE05 VALUE EDUCATION 2 0 0 0

Course Objectives

- Interpret value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Course Outcomes (COs)

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

UNIT I **8 Hours**

Values and self-development- Social values and individual attitudes-Work ethics- Indian vision of humanism- Moral and non- moral valuation-Standards and principles-Value judgements.

UNIT II **7 Hours**

Importance of cultivation of values- Sense of duty Devotion- Self-reliance- Confidence-Concentration-Truthfulness- Cleanliness-Honesty- Humanity- Power of faith- National Unity- Patriotism- Love for nature-Discipline.

UNIT III **8 Hours**

Personality and Behavior Development - Soul and Scientific attitude- Positive Thinking- Integrity and discipline-Punctuality- Love and Kindness- Avoid fault Thinking- Free from anger- Dignity of labour-Universal brotherhood and religious tolerance-True friendship-Happiness Vs suffering- love for truth-Aware of self-destructive habits-Association and Cooperation-Doing best for saving nature.

UNIT IV **7 Hours**

Character and Competence -Holy books vs Blind faith, Self-management and Good health. Science of reincarnation, Equality, Nonviolence ,Humility, Role of Women. All religions and same message, Mind your Mind, Self-control. Honesty, Studying effectively.

Total: 30 Hours

Reference(s)

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi.

21XE06 PEDAGOGY STUDIES 2 0 0 0

Course Objectives

- Review existing evidence on the review topic to inform programmer design and policy making undertaken by the DfID, other agencies and researchers
- Identify critical evidence gaps to guide the development.

Course Outcomes (COs)

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy overall personality?

UNIT I **8 Hours**

INTRODUCTION AND METHODOLOGY

Aims and rationale- Policy background- Conceptual framework and terminology-Theories of learning-Curriculum- Teacher education-Conceptual framework- Research questions-Overview of methodology and Searching

UNIT II **7 Hours**

THEMATIC OVERVIEW

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries, Curriculum, Teacher education.

UNIT III **8 Hours**

EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES

Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school, curriculum and guidance materials best support effective pedagogy. Theory of change, Strength and nature of the body of evidence for effective pedagogical, practices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies

UNIT IV **7 Hours**

PROFESSIONAL DEVELOPMENT

Alignment with classroom practices and follow up, Support Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Total: 30 Hours

Reference(s)

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379
3. Akyeampong K (2003) Teacher training in Ghana - does it count. Multi-site teacher education research project (MUSTER) country report 1. London: DFID
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, "learning to read" campaign

21XE07 BUSINESS ANALYTICS 2 0 0 0

Course Objectives

- Illustrate the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Use decision-making tools/Operations research techniques and Manage business process using analytical and management tools.

Course Outcomes (COs)

1. Implement the knowledge of data analytics.
2. Apply the ability of think critically in making decisions based on data and deep analytics.
3. Analyze the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Determine the ability to translate data into clear, actionable insights.
5. Analyze the decision problems in business analytics.

UNIT I **5 Hours**

BUSINESS ANALYTICS AND STATISTICAL TOOLS

Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics-Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT II **5 Hours**

TRENDINESS AND REGRESSION ANALYSIS

Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT III **5 Hours**

ORGANIZATION STRUCTURES OF BUSINESS ANALYTICS

Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT IV **5 Hours**

FORECATING TECHNIQUES

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.

UNIT V **5 Hours**

DECISION ANALYSIS

Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Total: 25 Hours

Reference(s)

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press
2. Business Analytics by James Evans, persons Education.