B.S. Abdur Rahman ™
Crescent
Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

Regulations 2022
Curriculum and Syllabi
(As approved by the 20th Academic Council)
April - 2023

M.Tech.
(Computer Science and Engineering)

B.S. Abdur Rahman ™
Crescent
Institute of Science & Technology
Deemed to be University u/s 3 of the UGC Act, 1956

REGULATIONS 2022
CURRICULUM AND SYLLABI
(As approved by the 20th Academic Council)

APRIL– 2023

M.TECH.
COMPUTER SCIENCE AND ENGINEERING

VISION AND MISSION OF THE INSTITUTION

VISION

B.S. Abdur Rahman Crescent Institute of Science and Technology aspires to be a leader in Education, Training and Research in multidisciplinary areas of importance and to play a vital role in the Socio-Economic progress of the Country in a sustainable manner.

MISSION

- To blossom into an internationally renowned Institute.
- To empower the youth through quality and value-based education.
- To promote professional leadership and entrepreneurship.
- To achieve excellence in all its endeavors to face global challenges.
- To provide excellent teaching and research ambience.
- To network with global Institutions of Excellence, Business, Industry and Research Organizations.
- To contribute to the knowledge base through Scientific enquiry, Applied Research and Innovation.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION AND MISSION

VISION

The vision of the Department of Computer Science and engineering is to impart quality education, inculcate professionalism and enhance the problem solving skills of the students in the domain of Computer Science and Engineering with a focus to make them industry ready, involve in possible areas of research, to pursue and have continual professional growth.

MISSION

- To equip the students with strong fundamental concepts, analytical capability, programming and problem solving skills.
- To create an academic environment conducive for higher learning through faculty training, self-learning, sound academic practices and research endeavors.
- To provide opportunities in order to promote organizational and leadership.
- Skills in students through various co-curricular and extra – curricular activities.
- To make the students industry ready and to enhance their employability through training and internships.
- To improve department industry collaboration through interaction including participation in professional society activities, guest lecturers and industrial visit.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M. Tech. (Computer Science and Engineering)

PROGRAMME EDUCATIONAL OBJECTIVES

- To provide advanced knowledge and skills in the field of Computer Science and Engineering.
- To provide essential skill sets needed for Software Development as per the Industry requirements.
- To instill confidence and provide necessary ambience to take up fundamental as well as applied Research in Computer related domains with social relevance.
- To impart required analytical skills and tools for solving problems with varied complexity.
- To hone necessary skills to effectively communicate, work as a team for a successful professional career.

PROGRAMME OUTCOMES

On successful completion of the programme, the graduates will be able to

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Identify, formulate, research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- Use research –based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

- Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAMME SPECIFIC OUTCOMES

PSO1 : Design, Analyze and develop essential proficiency in the areas related to algorithms, networking, web design, big data analytics, cloud computing, security, IoT and apply the knowledge to solve real world problems.

PSO2 : Apply the knowledge of computer science in various domains to identify research gaps and provide solutions in an optimized way.

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI – 600 048.

REGULATIONS 2022

M.Tech. / MCA / M.Sc. / M.Com. / M.A. DEGREE PROGRAMMES

(Under Choice Based Credit System)

1.0 PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means post graduate degree programme (M.Tech. / MCA / M.Sc. / M.Com. / M.A.)

ii) **"Branch"** means specialization or discipline of programme like M.Tech. in Structural Engineering, Food Biotechnology etc., M.Sc. in Physics, Chemistry, Actuarial Science, Biotechnology etc.

iii) **"Course"** means a theory / practical / laboratory integrated theory / mini project / seminar / internship / project and any other subject that is normally studied in a semester like Advanced Concrete Technology, Electro Optic Systems, Financial Reporting and Accounting, Analytical Chemistry, etc.

iv) **"Institution"** means B.S. Abdur Rahman Crescent Institute of Science and Technology.

v) **“Academic Council”** means the Academic Council, which is the apex body on all academic matters of this Institute.

vi) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of the Institution who is responsible for the implementation of relevant rules and regulations for all the academic activities.

vii) **"Dean (Student Affairs**)" means the Dean (Students Affairs) of the Institution who is responsible for activities related to student welfare and discipline in the campus.

viii) **"Controller of Examinations"** means the Controller of Examinations of the Institution who is responsible for the conduct of examinations and declaration of results.

ix) **“Dean of the School”** means the Dean of the School of the department concerned.

x) **“Head of the Department”** means the Head of the Department concerned.

2.0 PROGRAMMES OFFERED AND ADMISSION REQUIREMENTS

2.1 Programmes Offered

The various programmes and their mode of study are as follows:

Degree	Mode of Study
M.Tech.	Full Time
MCA	
M.Sc.	
M.Com.	
M.A.	

2.2 ADMISSION REQUIREMENTS

2.2.1 Students for admission to the first semester of the Master's Degree Programme shall be required to have passed the appropriate degree examination as specified in the clause 3.2 [Eligible entry qualifications for admission to programmes] of this Institution or any other University or authority accepted by this Institution.

2.2.2 The other conditions for admission such as class obtained, number of attempts in the qualifying examination and physical fitness will be as prescribed by the Institution from time to time.

3.0 DURATION, ELIGIBILITY AND STRUCTURE OF THE PROGRAMME

3.1. The minimum and maximum period for completion of the programmes are given below:

Programme	Min. No. of Semesters	Max. No. of Semesters
M.Tech.	4	8
MCA	4	8
M.Sc.	4	8
M.Com.	4	8
M.A.	4	8

3.1.1 Each academic semester shall normally comprise of 90 working days. Semester end examinations shall follow within 10 days of the last Instructional day.

3.1.2 Medium of instruction, examinations and project report shall be in English.

3.2 ELIGIBLE ENTRY QUALIFICATIONS FOR ADMISSION TO PROGRAMMES

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
1.	Aeronautical Engineering	M.Tech. (Avionics)	B.E. / B.Tech. in Aeronautical Engineering / Aerospace Engineering / Mechanical Engineering / Mechatronics / EEE / ECE / EIE / or Equivalent degree in relevant field.
2.	Civil Engineering	M.Tech. (Structural Engineering)	B.E. / B.Tech. in Civil Engineering / Structural Engineering or Equivalent degree in relevant field.
		M. Tech. (Construction Engineering and Project Management)	B.E. / B.Tech. in Civil Engineering / Structural Engineering / B.Arch. or Equivalent degree in relevant field.
3.	Mechanical Engineering	M.Tech. (CAD/CAM)	B.E. / B.Tech. in Mechanical / Automobile / Manufacturing / Production / Industrial / Mechatronics / Metallurgy / Aerospace / Aeronautical / Material Science / Polymer / Plastics / Marine Engineering or Equivalent degree in relevant field.
4.	Electrical and Electronics Engineering	M.Tech. (Power Systems Engineering)	B.E. / B.Tech. in EEE / ECE / EIE / ICE / Electronics / Instrumentation Engineering or Equivalent degree in relevant field.
5.	Electronics and Communication Engineering	M.Tech. (VLSI and Embedded Systems)	B.E. / B.Tech. in ECE / EIE / ICE / EEE / IT or Equivalent degree in relevant field.
6.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)	B.E. / B.Tech. in CSE / IT / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
		M.Tech. (Artificial Intelligence and Data Science)	B.E. / B.Tech. in CSE / IT / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
7.	Information Technology	M.Tech. (Information Technology)	B.E. / B.Tech. in IT / CSE / ECE / EEE / EIE / ICE / Electronics Engineering / MCA or Equivalent degree in relevant field.
8.	Computer Applications	MCA	BCA / B.Sc. Computer Science / B.E. / B.Tech. / B.Sc. Mathematics, B.Sc. Physics / Chemistry / B.Com. / BBA / B.A. with Mathematics at graduation level or at 10 + 2level or equivalent degree in relevant field.
9.	Mathematics	M.Sc. (Actuarial Science)	Any under graduate degree with Mathematics / Statistics as one of the subjects of study at 10 + 2 level.
10.	Physics	M.Sc.(Physics)	B.Sc. in Physics / Applied Science / Electronics /Electronics Science / Electronics & Instrumentation or Equivalent degree in relevant field.
11.	Chemistry	M.Sc.(Chemistry)	B.Sc. in Chemistry / Applied Science or Equivalent degree in relevant field.
12.	Life Sciences	M.Sc. Biochemistry & Molecular Biology	B.Sc. in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
		M.Sc. Biotechnology	B.Sc. in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
		M.Sc. Microbiology	B.Sc.in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
		M.Tech. Biotechnology	B.Tech. / B.E. in Biotechnology or Equivalent degree in relevant field.
		M.Tech. Food Biotechnology	B.E. / B.Tech. in Biotechnology / Food Biotechnology / Chemical Engineering / Biochemical Engineering / Industrial Biotechnology or Equivalent degree in relevant field.

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
13.	Commerce	M.Com	B.Com. / BBA
14.	Arabic and Islamic Studies	M.A. Islamic Studies	B.A. in Islamic Studies / Arabic (or) Afzal-ul-Ulama (or) Any under graduate degree with Part 1 Arabic (or) Any under graduate degree with AalimSanad / Diploma / Certificate in Arabic or Islamic Studies.

3.3. STRUCTURE OF THE PROGRAMME

3.3.1 The PG. programmes consist of the following components as prescribed in the respective curriculum:

i. Core courses
ii. Elective courses
iii. Laboratory integrated theory courses
iv. Project work
v. Laboratory courses
vi. Open elective courses
vii. Seminar
viii. Mini Project
ix. Industry Internship
x. MOOC courses (NPTEL- Swayam, Coursera etc.)
xi. Value added courses

3.3.2 The curriculum and syllabi of all programmes shall be approved by the Academic Council of this Institution.

3.3.3 For the award of the degree, the student has to earn a minimum total credits specified in the curriculum of the respective specialization of the programme.

3.3.4 The curriculum of programmes shall be so designed that the minimum prescribed credits required for the award of the degree shall be within the limits specified below:

Programme	Range of credits
M.Tech.	76 - 80
MCA	86

M.Sc.	77 - 85
M.Com.	88
M.A.	72

3.3.5 Credits will be assigned to the courses for all programmes as given below:

- ❖ One credit for one lecture period per week or 15 periods of lecture per semester.
- ❖ One credit for one tutorial period per week or 15 periods per semester.
- ❖ One credit each for seminar/practical session/project of two or three periods per week or 30 periods per semester.
- ❖ One credit for 160 hours of industry internship per semester for all programmes (except M.Com.)
- ❖ Four credits for 160 hours of industry internship per semester for M.Com.

3.3.6 The number of credits the student shall enroll in a non-project semester and project semester is as specified below to facilitate implementation of Choice Based Credit System.

Programme	Non-project semester	Project semester
M.Tech.	9 to 32	18 to 26
MCA	9 to 32	18 to 26
M.Sc.	9 to 32	10 to 26
M.Com.	9 to 32	16 to 28
M.A.	9 to 32	NA

3.3.7 The student may choose a course prescribed in the curriculum from any department offering that course without affecting regular class schedule. The attendance will be maintained course wise only.

3.3.8 The students shall choose the electives from the curriculum with the approval of the Head of the Department / Dean of School.

3.3.9 Apart from the various elective courses listed in the curriculum for each specialization of programme, the student can choose a maximum of two electives from any other similar programmes across departments, aliter to open electives, during the entire

period of study, with approval of Head of the department offering the course and parent department.

3.4. ONLINE COURSES

3.4.1 Students are permitted to undergo department approved online courses under SWAYAM up to 40% of credits of courses in a semester excluding project semester (in case of M.Tech. M.Sc. & MCA programmes) with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean Academic Affairs during his/ her period of study. The credits earned through online courses shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

3.4.2 Students shall undergo project related online course on their own with the mentoring of the project supervisor.

3.5 PROJECT WORK

3.5.1 Project work shall be carried out by the student under the supervision of a faculty member in the department with similar specialization.

3.5.2 A student may however, in certain cases, be permitted to work for the project in an Industry / Research organization, with the approval of the Head of the Department/ Dean of School. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist / Competent authority from the organization and the student shall be instructed to meet the faculty periodically and to attend the review meetings for evaluating the progress.

3.5.3 The timeline for submission of final project report / dissertation is within 30 calendar days from the last instructional day of the semester in which project is done.

3.5.4 If a student does not comply with the submission of project report / dissertation on or before the specified timeline he / she is deemed to have not completed the project work and shall re-register in the subsequent semester.

4.0 CLASS ADVISOR AND FACULTY ADVISOR

4.1 CLASS ADVISOR

A faculty member shall be nominated by the HOD/ Dean of School as Class Advisor for the class throughout their period of study.

The class advisor shall be responsible for maintaining the academic, curricular and co-curricular records of students of the class throughout their period of study.

4.2 FACULTY ADVISOR

To help the students in planning their courses of study and for general counseling, the Head of the Department / Dean of School of the students shall attach a maximum of 20 students to a faculty member of the department who shall function as faculty advisor for the students throughout their period of study. Such faculty advisor shall guide the students in taking up the elective courses for registration and enrolment in every semester and also offer advice to the students on academic and related personal matters.

5.0 COURSE COMMITTEE

5.1 Each common theory / laboratory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers handling the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers handling the common course belong to a single department or from several departments. The Course Committee shall meet as often as possible to prepare a common question paper, scheme of evaluation and ensure uniform evaluation of the assessment tests and semester end examination.

6.0 CLASS COMMITTEE

6.1 A class committee comprising faculty members handling the classes, student representatives and a senior faculty member

not handling the courses as chairman will be constituted in every semester:

6.2 The composition of the class committee will be as follows:

i) One senior faculty member preferably not handling courses for the concerned semester, appointed as chairman by the Head of the Department
ii) Faculty members of all courses of the semester
iii) All the students of the class
iv) Faculty advisor and class advisor
v) Head of the Department – Ex officio member

6.3 The class committee shall meet at least three times during the semester. The first meeting shall be held within two weeks from the date of commencement of classes, in which the nature of continuous assessment for various courses and the weightages for each component of assessment shall be decided for the first and second assessment. The second meeting shall be held within a week after the date of first assessment report, to review the students' performance and for follow up action.

6.4 During these two meetings the student members, shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process, curriculum and syllabi of courses.

6.5 The third meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

7.0 REGISTRATION AND ENROLLMENT

7.1 The students of first semester shall register and enroll at the time of admission by paying the prescribed fees. For the subsequent semesters registration for the courses shall be done

by the student one week before the last working day of the previous semester.

7.2 Change of a Course

A student can change an enrolled course within 10 working days from the commencement of the course, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

7.3 Withdrawal from a Course

A student can withdraw from an enrolled course at any time before the first continuous assessment test for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

7.4 A student can enroll for a maximum of 32 credits during a semester including Redo / Predo courses.

8.0 BREAK OF STUDY FROM PROGRAMME

8.1 A student may be allowed / enforced to take a break of study for two semesters from the programme with the approval of Dean (Academic Affairs) for the following reasons:

8.1.1 Medical or other valid grounds

8.1.2 Award of 'I' grade in all the courses in a semester due to lack of attendance

8.1.3 Debarred due to any act of indiscipline

8.2 The total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 3.1).

8.3 A student who has availed a break of study in the current semester (odd/even) can rejoin only in the subsequent corresponding (odd/even) semester in the next academic year on approval from the Dean (Academic affairs).

8.4 During the break of study, the student shall not be allowed to attend any regular classes or participate in any activities of the Institution. However, he / she shall be permitted to enroll for the 'I' grade courses and appear for the arrear examinations.

9.0 MINIMUM REQUIREMENTS TO REGISTER FOR PROJECT WORK

9.1 A student is permitted to register for project semester, if he/she has earned the minimum number of credits specified below:

Programme	Minimum no. of credits to be earned to enroll for project semester
M.Tech.	18
MCA	22
M.Sc.	18
M.Com	NA
M.A.	NA

9.2 If the student has not earned minimum number of credits specified, he/she has to earn the required credits, at least to the extent of minimum credits specified in clause 9.1 and then register for the project semester.

10.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

10.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% to become eligible to appear for the semester end examination in that course, failing which the student shall be awarded “I” grade in that course.

10.2 The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in the concerned course to the class advisor. The class advisor shall consolidate and furnish the list of students who have earned less than 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department / Dean of the School. Thereupon, the Dean (Academic Affairs) shall officially notify the names of such students prevented from writing the semester end examination in each course.

10.3 If a student secures attendance between 65% and less than 75% in any course in a semester, due to medical reasons (hospitalization / accident / specific illness) or due to participation

in the institution approved events, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the semester end examination of that course. In all such cases, the students shall submit the required documents immediately after joining the classes to the class advisor, which shall be approved by the Head of the Department / Dean of the School. The Vice Chancellor, based on the recommendation of the Dean (Academic Affairs) may approve the condonation of attendance.

10.4 A student who has obtained an “I” grade in all the courses in a semester is not permitted to move to the next higher semester. Such students shall repeat all the courses of the semester in the subsequent academic year. However, he / she is permitted to redo the courses awarded with 'I' grade / arrear in previous semesters. They shall also be permitted to write arrear examinations by paying the prescribed fee.

10.5 The student awarded “I” grade, shall enroll and repeat the course when it is offered next. In case of “I” grade in an elective course either the same elective course may be repeated or a new elective course may be taken with the approval of the Head of the Department / Dean of the School.

10.6 A student who is awarded “U” grade in a course shall have the option to either write the semester end arrear examination at the end of the subsequent semesters, or to redo the course when the course is offered by the department. Marks scored in the continuous assessment in the redo course shall be considered for grading along with the marks scored in the semester end (redo) examination. If any student obtains “U” grade in the redo course, the marks scored in the continuous assessment test (redo) for that course shall be considered as internal mark for further appearance of arrear examination.

10.7 If a student with “U” grade, who prefers to redo any particular course, fails to earn the minimum 75% attendance while doing that course, then he / she is not permitted to write the semester end examination and his / her earlier “U” grade and continuous assessment marks shall continue.

11.0 REDO COURSES

11.1 A student can register for a maximum of two redo courses per semester without affecting the regular semester classes, whenever such courses are offered by the department concerned, based on the availability of faculty members, and subject to a specified minimum number of students registering for each of such courses.

11.2 The number of contact hours and the assessment procedure for any redo course shall be the same as regular courses, except there is no provision for any substitute examination and withdrawal from a redo course.

12.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

12.1 Every theory course shall have a total of three assessments during a semester as given below:

Assessments	Weightage of Marks
Continuous Assessment 1	25%
Continuous Assessment 2	25%
Semester End Examination	50%

12.2 Theory Course

Appearing for semester end theory examination for each course is mandatory and a student shall secure a minimum of 40% marks in each course in semester end examination for the successful completion of the course.

12.3 Laboratory Course

Every practical course shall have 75% weightage for continuous assessments and 25% for semester end examination. However, a student shall have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

12.4 Laboratory Integrated Theory Courses

For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and

consolidated by assigning a weightage of 75% for theory component and 25% for practical component. Grading shall be done for this consolidated mark. Assessment of theory components shall have a total of three assessments with two continuous assessments carrying 25% weightage each and semester end examination carrying 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination. The evaluation of practical components shall be through continuous assessment.

12.5 The components of continuous assessment for theory/practical/laboratory integrated theory courses shall be finalized in the first class committee meeting.

12.6 Industry Internship

In the case of industry internship, the student shall submit a report, which shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department. The student shall also submit an internship completion certificate issued by the industry / research / academic organisation. The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively.

12.7 Project Work

In the case of project work, a committee of faculty members constituted by the Head of the Department / Dean of the School will carry out three periodic reviews. Based on the project report submitted by the students, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by the Controller of Examinations. The weightage for periodic reviews shall be 50%. Of the remaining 50%, 20% shall be for the project report and 30% for the viva voce examination.

12.8 The assessment of seminar course including its component and its weightage shall be decided by a committee of faculty members constituted by the Head of the Department. This committee shall ensure the conduct of assessment of components and award marks accordingly.

12.9 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance shall be used for grading along with the marks scored in the arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination and the internal assessment marks secured during the course of study shall become invalid.

In case of laboratory integrated theory courses, after one regular and one arrear appearance, the internal mark of theory component is invalid and full weightage shall be assigned to the marks scored in the semester end examination for theory component. There shall be no arrear or improvement examination for lab components.

13.0 SUBSTITUTE EXAMINATIONS

13.1 A student who is absent, for genuine reasons, may be permitted to write a substitute examination for any one of the two continuous assessment tests of a course by paying the prescribed substitute examination fee. However, permission to take up a substitute examination will be given under exceptional circumstances, such as accidents, admission to a hospital due to illness, etc. by a committee constituted by the Head of the Department / Dean of School for that purpose. However, there is no substitute examination for semester end examination.

13.2 A student shall apply for substitute exam in the prescribed form to the Head of the Department / Dean of School within a week from the date of assessment test. However, the substitute examination will be conducted only after the last working day of the semester and before the semester end examination.

14.0 SUPPLEMENTARY EXAMINATION

14.1 Final Year students can apply for supplementary examination for a maximum of three courses thus providing an opportunity to complete their degree programme. Likewise, students with less credit can also apply for supplementary examination for a maximum of three courses to enable them to earn minimum

credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results in both odd and even semesters.

15. PASSING, DECLARATION OF RESULTS AND GRADE SHEET

15.1 All assessments of a course shall be made on absolute marks basis. However, the Class Committee without the student members shall preferably meet within 5 days after the semester end examination and analyze the performance of students in all assessments of a course and award letter grades. The letter grades and the corresponding grade points are as follows:

Letter Grade	Grade Points
S	10
A	9
B	8
C	7
D	6
E	5
U	0
I	0

"I" denotes inadequate attendance and hence prevented from appearing for semester end examination

"U" denotes unsuccessful performance in the course.

15.2 A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course. Such a course cannot be repeated by the student for improvement of grade.

15.3 The results, after awarding of grades, shall be signed by the Chairman of the Class Committee and Head of the Department/Dean of School and it shall be declared by the Controller of Examinations.

15.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester end theory

examination answer scripts of one or more courses, on payment of prescribed fees tothe Controller of Examinations. Subsequently the Head of the Department/ Dean of School offered the course shall constitute a revaluation committee consisting of Chairman of the Class Committee as convener, the faculty member of the course and a senior faculty member knowledgeable in that course as members. The committee shall meet within a week to re-evaluate the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

15.5 After results are declared, grade sheets shall be issued to each student, which contains the following details: a) list of courses enrolled during the semester including redo courses / arrear courses, if any; b) grades scored; c) Grade Point Average (GPA) for the semester and d) Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of credits of courses registered and the grade points corresponding to the grades scored in those courses, taken for all the courses, to the sum of the number of credits of all the courses in the semester.

If C_i, is the number of credits assigned for the i^{th} course and GP_i is the Grade Point in the i^{th} course

$$GPA = \frac{\sum_{i=1}^{n}(C_i)(GPi)}{\sum_{i=1}^{n} C_i}$$

Where n = number of courses

The Cumulative Grade Point Average (CGPA) is calculated in a similar manner, considering all the courses enrolled from first semester.

“I” grade is excluded for calculating GPA.

"U" and**“I”** grades are excluded for calculating CGPA.

The formula for the conversion of CGPA to equivalent percentage of marks is as follows:

Percentage Equivalent of Marks = CGPA X 10

15.6 After successful completion of the programme, the Degree shall be awarded upon fulfillment of curriculum requirements and classification based on CGPA as follows:

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the minimum prescribed period.
First Class	6.50 and above and completing the programme within a minimum prescribed period plus two semesters.
Second Class	Others

15.6.1 Eligibility for First Class with Distinction

- A student should not have obtained 'U' or 'I' grade in any course during his/her study
- A student should have completed the PG programme within the minimum prescribed period of study (except clause 8.1.1)

15.6.2 Eligibility for First Class

A student should have passed the examination in all the courses not more than two semesters beyond the minimum prescribed period of study (except clause 8.1.1)

15.6.3 The students who do not satisfy clause 15.6.1 and clause 15.6.2 shall be classified as second class.

15.6.4 The CGPA shall be rounded to two decimal places for the purpose of classification. The CGPA shall be considered up to three decimal places for the purpose of comparison of performance of students and ranking.

16.0 DISCIPLINE

16.1 Every student is expected to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

16.2 Any act of indiscipline of a student, reported to the Dean (Student Affairs), through the HOD / Dean shall be referred to a Discipline and Welfare Committee constituted by the Registrar for taking appropriate action.

17.0 ELIGIBILITY FOR THE AWARD OF THE MASTER'S DEGREE

17.1 A student shall be declared to be eligible for the award of the Master's Degree, if he/she has:

i. Successfully acquired the required credits as specified in the curriculum corresponding to his/her programme within the stipulated time.
ii. No disciplinary action is pending against him/her.
iii. Enrolled and completed at least one value added course.
iv. Enrollment in at least one MOOC / SWAYAM course (non-credit) before the final semester.

17.2 The award of the degree must have been approved by the Institute.

18.0 POWER TO MODIFY

Notwithstanding all that have been stated above, the Academic Council has the right to modify any of the above regulations from time to time.

****

B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY

M.TECH. COMPUTER SCIENCE AND ENGINEERING
CURRICULUM & SYLLABUS, REGULATIONS 2022

SEMESTER I

Sl. No.	Course Code	Course Title	L	T	P	C
1	MAE 6181	Applied Algebra and Discrete Algorithms	3	1	0	4
2	CSE 6101	Multicore Computer Architecture	3	0	0	3
3	CSE 6102	Algorithm Design and Implementation	3	0	2	4
4	CSE 6103	Advanced Computer Networks	3	0	0	3
5	CSE 6104	Operating System	3	0	0	3
6		Professional Elective Course(s)				3
7	ENE 6181	English for Career Development	1	0	2	2
		Credits				**22**

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C
1	GEE 6201	Research Methodology and IPR	2	0	0	2
2	CSE 6201	Machine Learning Techniques	3	0	2	4
3	CSE 6202	Optimization Algorithms and Applications	3	0	0	3
4	CSE 6203	Advanced Software Engineering and Agile Modeling	3	0	0	3
5		Professional Electives Course(s)				9
		Credits				**21**

SEMESTER III

Sl. No.	Course Code	Course Title	L	T	P	C
1		Open Elective	3	0	0	3
2		Professional Elective Course(s)				6
3	CSE 7101	Industry Internship				2
4	CSE 7102	Project Work - Phase I	0	0	18	6#
5		MOOC (Related to Project)				-
		Credits				**17**

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C
1	CSE 7102	Project Work - Phase II	0	0	36	18
		Credits				**6 + 18= 24**

Overall Total Credits – 78

* Industrial training will be undertaken during first year summer vacation for 30 days. The credit will be awarded in the 3rd Semester.

Credits for Project Work Phase I to be accounted along with Project Work Phase II in IV Semester

LIST OF PROFESSIONAL ELECTIVE COURSES

Sl. No.	Course Code	Course Title	L	T	P	C
		SEMESTER I				
1.	CSEY 001	Cloud Computing and Technology	3	0	0	3
2.	CSEY 002	Pervasive Computing	3	0	0	3
3.	CSEY 003	Applied Cryptography and Network Security	3	0	0	3
4.	CSEY 004	Advanced Database Management	3	0	0	3
5.	CSEY 005	Advanced Data warehousing and Datamining	3	0	0	3
		SEMESTER II				
1.	CSEY 006	Data Science with Python	3	0	0	3
2.	CSEY 007	Social Network Analysis and Mining	3	0	0	3
3.	CSEY 008	Security Issues in Cloud Computing	3	0	0	3
4.	CSEY 009	Advanced Software Quality Assurance	3	0	0	3
5.	CSEY 010	Bigdata Analytics and loT	3	0	0	3
6.	CSEY 011	Mobile Adhoc Networks	3	0	0	3
7.	CSEY 012	Information Security	3	0	0	3
8.	CSEY 013	RFID and Microcontroller	3	0	0	3
9.	CSEY 014	Mobile and Wireless Network Security	3	0	0	3
10.	CSEY 015	Cloud Architecture and Computing	3	0	0	3
11.	CSEY 016	Knowledge Engineering and Expert Systems	3	0	0	3
12.	CSEY 017	Agent-based Intelligent Systems	3	0	0	3
13.	CSEY 018	Deep Learning Techniques	3	0	0	3
14.	CSEY 019	Distributed Systems	3	0	0	3
15.	CSEY 020	Advanced Graph Theory	3	0	0	3
		SEMESTER III				
1.	CSEY 021	Statistics for Business Analytics	3	0	0	3
2.	CSEY 022	Computer Vision and Image Processing	3	0	0	3
3.	CSEY 023	Foundations of Block Chain Technology	3	0	0	3
4.	CSEY 024	Cyber laws and Intellectual Property Rights	3	0	0	3
5.	CSEY 025	Security of E-Based Systems	3	0	0	3
6.	CSEY 026	Advanced Software Project Management	3	0	0	3
7.	CSEY 027	Statistical Natural Language Processing	3	0	0	3

8.	CSEY 028	Robotics and Intelligent Systems	3	0	0	3
9.	CSEY 029	Intelligent Information Retrieval	3	0	0	3
10.	CSEY 030	Soft Computing	3	0	0	3
11.	CSEY 031	System Simulation and Modelling Techniques	3	0	0	3
12.	CSEY 032	Cellular Automata and its Applications	3	0	0	3

LIST OF OPEN ELECTIVE COURSES – III SEMESTER

Sl. No.	Course Code	Course Title	L	T	P	C	Offering Department / School
1.	OEEY 701	Analytical Techniques	3	0	0	3	Chemistry
2.	OEEY 702	Artificial Intelligence and IoT	3	0	0	3	CSE
3.	OEEY 703	Biomaterials	3	0	0	3	Physics
4.	OEEY 704	Biomedical Instrumentation	3	0	0	3	Physics
5.	OEEY 705	Biophotonics	3	0	0	3	Physics
6.	OEEY 706	Data Science and Machine Learning	3	0	0	3	IT
7.	OEEY 707	Electric Vehicle and Battery Storage Technology	3	0	0	3	EEE
8.	OEEY 708	Green Building and Energy Management	3	0	0	3	Civil Engineering
9.	OEEY 709	Industry 4.0 and Applications	3	0	0	3	ECE
10.	OEEY 710	Nanotechnology and Catalysis	3	0	0	3	Chemistry
11.	OEEY 711	Project Management	3	0	0	3	Mechanical
12.	OEEY 712	Real Time Embedded Systems	3	0	0	3	ECE
13.	OEEY 713	Robotic Technology	3	0	0	3	Mechanical
14.	OEEY 714	Soft Computing Techniques	3	0	0	3	EEE
15.	OEEY 715	Structural Interpretation of Materials	3	0	0	3	Chemistry

SEMESTER I

		L	T	P	C
MAE 6181	**APPLIED ALGEBRA AND DISCRETE**				
SDG: 9	**ALGORITHMS**	**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: Make understand the concepts of mathematical induction and codes.

COB2: Motivate to solve the practical engineering problems applying techniques of logic.

COB3: To expose students to the concepts of Formal languages and Automata theory.

COB4: Familiarize students with graph theory.

COB5: Understand the basic foundation of Cryptography.

MODULE I INTEGERS, COMPUTER ALGEBRA AND CODES 9+3

Integers – computer algebra versus numerical analysis – sums and products – mathematical induction – Binary, Hexadecimal, Octal, ASCII, Morse, Braille, Two out of Five and Hollerith Codes.

MODULE II LOGIC 9+3

Propositional logic – logical connectives – truth tables – normal forms (conjunctive and disjunctive) – Nand, NOR – logic gates - solving word problems - predicate logic - universal and existential quantifiers - proof techniques – direct and indirect – proof by contradiction –applications.

MODULE III MODELING, COMPUTATION AND LANGUAGES 9+3

Finite state machines - deterministic and non-deterministic finite state machines - classes of grammars - phrase structure grammar - context sensitive - context-free - regular grammars - formal languages - ambiguity - Turing machines.

MODULE IV GRAPH THEORY 9+3

Multigraphs - applications of graph theory - classes of graphs - subgraphs and morphisms - Hamilton circuits – planar graphs – shortest paths and spanning trees – minimum spanning tree – fundamental cut sets and fundamental circuits - applications.

MODULE V CIPHERS 9+3

Cryptography - cryptanalysis - substitution and permutation ciphers – block cipher – the play fair cipher – hill cipher - unbreakable ciphers – applications.

L – 45; T – 15; TOTAL HOURS - 60

TEXT BOOKS:

1. Darel W. Hardy, Fred Richman, Carol L. Walker, Applied Algebra: Codes, Ciphers, and Discrete Algorithms, 2nd edition, CRC Press, Newyork, 2009.
2. Hopcraft, J. E, R. Motwani and Ullman, J. D, 'Introduction to Automata theory, Languages and Computation', Narosa publishing House, 4th edition 2006.
3. Kenneth H. Rosen, "Discrete Mathematics and its Applications", 7th edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2015.
4. J.P. Tremblay and R. Manohar, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill, 1997.

REFERENCES:

1. Juraj Hromkovic, Theoretical Computer Science: Introduction to Automata, Computability, Complexity, Algorithmics, Randomization, Communication and Cryptography, Springer, 2003.
2. Darel W. Hardy, Fred Richman, Carol L. Walker, Applied Algebra: Codes, Ciphers and Discrete Algorithms, Second Edition (Discrete Mathematics and Its Applications), CRC Press, Newyork, 2009.
3. David Gries and Fred B. Schneider, A Logical Approach to Discrete Math, Springer, Edition 3,1993.

COURSE OUTCOMES:

CO1: Authenticate the correctness of the a given statement using mathematical induction.

CO2: Test and analyze the logic of a program

CO3: Use the concept of finite state machines in their courses and to generate languages.

CO4: Solve problems in engineering using the concepts of graph theory.

CO5: Apply encryption and decryption techniques to send messages securely.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2		L											L	
CO3		M												M
CO4			M										M	
CO5				M										M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Sustainable Industry, innovation and Infrastructure.

Statement: Learning of various techniques in applied algebra and discrete algorithms will lead to knowledge required for applying in Computer Science projects.

CSE 6101	MULTICORE COMPUTER ARCHITECTURE	L	T	P	C
SDG: 8		3	0	0	3

COURSE OBJECTIVES:

COB1: To get familiar with the principles of parallel computing

COB2: To learn the fundamentals of multicore system architecture.

COB3: To provide the methods of developing programming for parallel systems.

COB4: To comprehend the multicore software development concepts.

COB5: To educate case studies using three mainstream parallelisms approaches – Open MPP, MPI and Open CL

MODULE I PARALLEL COMPUTING 9

Concurrency Vs Parallelism – Symmetric and Asymmetric multiprocessing – Parallelism saves power – Key challenges of parallel computing - Need for parallel programming – History of parallel computing, systems and programming – Modeling parallel computation.

MODULE II MULTICORE SYSTEM ARCHITECTURE 9

Origin of the multicore architecture – Parallel computers – Shared memory multicore systems – Cache coherency –Shared data synchronization – Distributed memory – Symmetric multiprocessing – Asymmetric multiprocessing – Hybrid approaches – Graphical Processing Units (GPU).

MODULE III PARALLEL PROGRAMMING 9

Limits on parallel program performance – Parallel programming models – Shared memory parallel programming – Steps in parallel programming – Dependence Analysis – Identifying parallel tasks in loop structures – Parallel programming for linked data structures – Programming multicore and shared memory multiprocessors using OpenMP.

MODULE IV MULTI CORE SOFTWARE ARCHITECTURES 9

Multicore software architectures – Decision tree approach to select multicore architecture – Multicore programming models – A Case study of Multicore development – Multicore virtualization – Performance and Optimization of multicore systems – Sequential to parallel migration of software applications.

MODULE V CONCURRENCY ABSTRACTIONS 9

Language Extension Example: Open MP – Framework Example: Open CL -

Libraries Example: Thread building examples – Thread safety – Message passing Multicore Models: MPI and MCAPI- Language support – Parallel computation of the number π : Open MP,MPI and OpenCL.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Roman Trobec, Boštjan Slivnik, Patricio Bulić, Borut Robič , "Introduction to Parallel Computing", Springer International Publishing, ISBN: 9783319988337,2018.
2. Robert Oshana," Multicore Software Development Techniques", Elsevier Science, ISBN: 9780128010372,2015.

REFERENCES:

1. Yan Solihin, "Fundamentals of Parallel Multicore Architecture", CRC Press, ISBN: 9781482211191, 2015.
2. Pranabananda Chakraborty, "Computer Organisation and Architecture", CRC Press, ISBN: 9781000190380, 2020.

COURSE OUTCOMES:

CO1: Describe the fundamentals of parallel systems.

CO2: Develop parallel program for the software applications.

CO3: Analyze the need for parallel computing through case studies.

CO4: Identify the method to design the multi-core programming models.

CO5: Solve the problems using three mainstream parallelisms approaches Open MPP, MPI and Open CL.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2		L											L	
CO3			M										L	
CO4			M											M
CO5				M										M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: By learning “Multicore Architecture”, the students are able to gain knowledge on Advance architecture design concepts and able to develop parallel programming using parallelism approaches for various applications which leads to productive employment opportunities.

CSE 6102	ALGORITHM DESIGN AND	L	T	P	C
SDG: 8	IMPLEMENTATION	3	0	2	4

COURSE OBJECTIVES:

COB1: To discuss various algorithm design techniques for developing algorithms.

COB2: To study the basic techniques for designing algorithms, including the techniques of recursion, divide-and-conquer, and greedy.

COB3: To provide the basic knowledge of computational complexity, approximation and randomized algorithms.

COB4: To Learn the advanced techniques for designing algorithms, including dynamic programming, network flow and problem reduction.

COB5: To determine the time and space complexity of simple algorithms and recursively defined algorithms.

MODULEI INTRODUCTION 9

Introduction and Motivation - Lower Bound - Asymptotic Notations-Mathematical Induction-Mathematical models - Formulating the Equations-Solving the equations - Homogeneous Linear Recurrence with Constant Coefficients - Non-homogeneous Equations-Transformations.

MODULE II GRAPH ALGORITHMS 9

Elementary Graph Algorithms Breadth-first search – Depth-first search - Topological sort- Minimum Spanning Trees -The algorithms of Kruskal and Prim – Single-Source Shortest Paths - The Bellman-Ford algorithm – Single-source shortest paths in directed acyclic graphs -Dijkstra's algorithm – All-Pairs Shortest Paths -The Floyd-Warshall algorithm -Johnson's algorithm for sparse graphs- Maximum Flow- Flow network- The Ford-Fulkerson method- Maximum bipartite matching-Push-relabel algorithms-The relabel-to-front algorithm.

MODULE III DIVIDE-AND-CONQUERANDRANDOMIZED ALGORITHMS 9

The maximum-sub array problem- Strassen's algorithm for matrix multiplication- The substitution method for solving recurrences-The recursion-tree method for solving recurrences-The master method for solving recurrences-Proof of the master theorem-The hiring problem- Indicator random variables-Randomized algorithms-Probabilistic analysis and further

uses of indicator random variables.

MODULE IV MULTITHREADED AND NUMBER - THEORETIC ALGORITHMS 9

The basics of dynamic multithreading - Multithreaded matrix multiplication - Multithreaded merge sort - Elementary number-theoretic notions - Greatest common divisor -Modular arithmetic -Solving modular linear equations - The Chinese remainder theorem - Powers of an element- The RSA public-key cryptosystem- Primality testing - Integer factorization.

MODULE V NP - COMPLETENESS AND APPROXIMATION ALGORITHMS 9

Polynomial time - Polynomial - time verification-NP-completeness and reducibility-NP-completeness proofs-NP-complete problems.

Approximation Algorithms-The vertex-cover problem-The traveling-salesman problem-The set-covering problem-Randomization and linear programming-The subset-sum problem.

L – 45; P - 30 ; TOTAL HOURS – 75

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, 3rd Edition MIT Press, 978-0262033848,2009.
2. Robert Sedgewick, Kevin Wayne, “Algorithms”, 4th Edition, Addison Wesley, ISBN-13: 978-0321573513, 2011.
3. Alfred V Aho, John E Hopcrof,” The Design and Analysis of Computer Algorithms”, Pearon Education,4th Edition, ISBN:978813170205,2009.
4. Mark Allen Weiss,” Data Structures and Algorithm Analysis in C++”, Addison-Wesley, 3rd edition, ISBN: 978-0132847377,2013.

COURSE OUTCOMES:

CO1: Analyze randomized algorithms with respect to expected running time, probability of error using tail inequalities

CO2: Classify problems into different complexity classes corresponding to both deterministic and randomized algorithms

CO3: Analyze approximation algorithms including algorithms that are PTAS and FPTAS.

CO4: Implement both a greedy and a divide-and-conquer algorithm to solve problems.

CO5: Design the techniques of proof by contradiction, mathematical induction and recurrence relation, and apply them to prove the

correctness and to analyze the running time of algorithms.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	M												M	
CO2			M											M
CO3				M									H	
CO4			M										M	
CO5		H												M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: By learning Algorithm design, students can apply algorithms in order to take actions in complex decision-making environment, which in turn leads to sustainable economic growth and enormous employment opportunities

CSE 6103	ADVANCED COMPUTER NETWORKS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the students to the understanding of Computer networks with OSI Reference Model, Protocol at different layers.

COB2: To special emphasis on IP, TCP & UDP and Routing algorithms

COB3: To Identify the different types of network devices and their functions within a network.

COB4: To study major topics such are TCP/IP implementation, LANs/WANs, internetworking technologies, Routing and Addressing.

COB5: To analyze the identified research work in building Computer Networks.

MODULE I INTRODUCTION, PROTOCOLS AND STANDARDS 9

Definition and Uses of Computer Network, Classification of Computer network, Network Architecture, Internet Standards, Internet Administration; Overview of reference models: The OSI model, The OSI Reference Model, TCP/IP protocol Suite, The TCP/IP Reference Model, Comparison of the OSI & the TCP/IP Reference Models, Addressing, IP versions.

MODULE II MULTIPLEXING AND LOCAL AREA NETWORKS 9

Multiplexing - Types of Multiplexing- FDM, TDM, SM – Ethernet - token ring – FDDI - switching - circuit switching - packet switching - multicasting. Connectors - Transceivers and Media converters - Network interface cards and PC cards – Repeaters – Hubs – Bridges – Switches - Routers and Gateways H/W selection - Telephone networks - networking principles.

MODULE III PACKET SWITCHING PROTOCOL AND ROUTING PROTOCOL 9

X.25, theory of Operation and Network Layer functions, X.75, Internetworking protocols, SMDS, Subscriber Interface and Access Protocol, Addressing and Traffic Control Common Protocols, Routing Protocols: RIP, OSPF, BGP; Multicast Routing Protocols: MOSPF, DVMRP, Drawbacks of traditional routing methods, Idea of TE, TE and Different Traffic classes.

MODULE IV WEB SECURITY AND TRAFFIC MANAGEMENT BASICS **9**

Introduction, Web Security Requirements, Secure Socket Layer (SSL), Traffic Management, Quality characteristics and requirements. Introduction, Applications and Quality of service, Queue Analysis, Queue Management Algorithms.

MODULE V ENTERPRISE NETWORK SECURITY **9**

DMZ – NAT – SNAT – DNAT - Port Forwarding – Proxy - Transparent Proxy - Packet Filtering and Layer 7 Filtering - Backbone Network Design - Backbone Requirements - Network Capacities Topologies - Topologies Strategies - Tuning Network.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. L. Peterson and B. Davie, Morgan Kaufman, "Computer Networks, A Systems Approach", Fifth Edition,2012.

REFERENCES:

1. A. Tanenbaum and David Wetherall, “Computer Networks”, Fifth Edition, Pearson Prentice-Hall, 2011.
2. W.S. Stallings, "Data and Computer Communications", Ninth Edition, Pearson Prentice-Hall, 2011.
3. J. Kurose and K. Ross, “Computer Networking, A Top-Down Approach”, Addison Wesley, 2010.
4. Y-D. Lin, R-H. Hwang and F. Baker, “Computer Networks, An Open-Source Approach", McGraw Hill, 2012.
5. Morgan Kaufman, “The Illustrated Network, How TCP Works in a Modern Network”, 2009.

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: Illustrate reference models with layers, protocols and interfaces.

CO2: Describe and Analysis of basic protocols of computer networks,

and how they can be used to assist in network design and implementation.

CO3: Describe Subnetting and Addressing of IP V4.

CO4: Identify the different types of network devices and their functions within a network.

CO5: Conducting experiments to analyze the identified research work
in building Computer Networks.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2
CO1	M				L									
CO2			M											
CO3		H						M						M
CO4													H	
CO5										H				M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement:
By learning “Advanced Computer Networks” the students will be able to analyze the identified research work in building Computer Networks with guidelines and frameworks for various real time applications which leads to sustainable economic growth and provide productive employment.

CSE 6104	OPERATING SYSTEM	L	T	P	C
SDG: 8		3	0	0	3

COURSE OBJECTIVES:

COB1: To know the objectives, functions and architecture of operating systems and the process management concepts.

COB2: To provide a knowledge about how the memory management is done with the help of operating systems.

COB3: To understand the foundation of virtualization and its importance.

COB4: To learn the essentials required to build virtualization.

COB5: To identify security implications in virtualization.

MODULE I OPERATING SYSTEMS&PROCESS SYNCHRONIZATION 9

Operating System Introduction, Structures - Simple Batch, Multi programmed, time-shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, System components, Operating-System services, System Calls, Virtual Machines, System Design and Implementation. Process and CPU Scheduling - Process concepts and scheduling, Operation on processes, Cooperating Processes, Threads, and Interposes Communication Scheduling Criteria, Scheduling Algorithm, Multiple -Processor Scheduling.

MODULE II MEMORY MANAGEMENT&I/O MANAGEMENT 9

Memory Management and Virtual Memory - Logical versus Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging. Demand Paging, Performance of Demanding Paging, Page Replacement, Page Replacement Algorithm, Allocation of Frames, Thrashing. File System Interface and Implementation -Access methods, Directory Structure, Protection, File System Structure, Allocation methods, Free-space Management, Directory Management, Directory Implementation, Efficiency and Performance.

MODULE III REAL-TIME SCHEDULING 9

Multiprocessor and Real-Time Scheduling: Multiprocessor Scheduling, Real-Time Scheduling, Linux Scheduling, UNIX Precls Scheduling, Windows Vista Hours Scheduling, Process Migration, Distributed Global States, Distributed Mutual Exclusion, Distributed Deadlock.

MODULE IV DISTRIBUTED SYSTEMS 9

Introduction to Distributed systems: Goals of distributed system, hardware and software Concepts, design issues. Elementary introduction to the terminologies within Modern Oss: Parallel, Distributed, Embedded & Real Time, Mobile, Cloud and Other Operating System Models.

MODULE V EMBEDDED OPERATING SYSTEMS 9

Embedded Systems, Characteristics of Embedded Operating Systems, eCOS, TinyOS, Computer Security Concepts, Threats, Attacks, and Assets, Intruders, Malicious Software Overview, Viruses, Worms, and Bots, Rootkits.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Abraham Silberschatz, Peter B galvin, Greg Gagne, "Operating System Concepts", 7th Edition, John Wiley & Sons Inc, 2008.
2. Matthew Portnoy, “Virtualization Essentials”, Wiley, Second edition, ISBN: 9788126564668, 2016.

REFERENCES:

1. Dhamdhere D M, "Operating Systems", 1st reprint, Tata McGraw Hill, New Delhi, 2006.
2. Daniel Kusnetzky, "Virtualization: A Manager's Guide", O'Reilly Media, Illustrated, 9781449306458 2012.
3. Dave Shackleford, “Virtualization security- Protecting Virtualized Environments”, Sybex Publishers, First Edition, ISBN: 978118288122, 2012.
4. Norman E-Fentor and Share Lawrence Pflieger,-Software Metrics‖,International Thomson Computer Press,2nd Edition,ISBN: 9781850322757, 1997.

COURSE OUTCOMES:

CO1: Compare the performance of various process scheduling algorithms.

CO2: Analyze the implementation of processes and problems related

to process synchronization.

CO3: Analysis virtualization concepts and their role in elastic computing.

CO4: Articulate the main concepts, architecture, taxonomy, key technologies, strengths, and limitations of Virtualization.

CO5: Analyze the constraints and techniques in setting up virtualization through its enabling technologies.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2
CO1		H			M			L					H	
CO2	H				M	M								L
CO3		H		M				L		M				M
CO4		H							M					
CO5			H							M	M	M	L	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: The individual is aware of innovative opportunities and markets for industrial growth, resilient virtual infrastructure, and innovation.

Statement: The holistic understanding of the concepts, core structure of Operating Systems, virtual machines and environment leads to construction of virtualized infrastructure and sustainable industrialization.

ENE 6181	ENGLISH FOR CAREER DEVELOPMENT	L	T	P	C
SDG: 4 and 8		1	0	2	2

COURSE OBJECTIVES:

COB1: To enable students to learn about the job search, application, and interview process

COB2: To give them an opportunity to explore their global career path, build vocabulary and improve language skills to achieve professional goals

COB3: To produce a professional-looking resume

COB4: To understand networking and interview skills

COB5: To understand the key skills and behaviours required to facilitate a group discussion

MODULE I ENTERING THE JOB MARKET 3+6

(This module focuses more on the practical aspects of communication for career development.)

Introduction to the Career Development - Job Search Overview - Identifying Your Interests and Skills

Language Focus: Vocabulary and Word Forms Related to Jobs - Choosing the Job that's the Best Fit

Language Focus: Verb Tenses (Present vs. Present Progressive)

Understanding Job Descriptions: Reading a Job Advertisement

Language Focus: Phrases to Compare Similarities

Online Learning Opportunities to Extend Your Skills

MODULE II RESUMES 3+2

What is a resume? Why do you need one?

Parts of a Resume-Writing a Resume, Part 1: Name and Contact Information

Listening: Connecting Employers with Job Seekers in Today's Economy

Language Focus: Key Words

Writing a Resume, Part 2: Headline and Summary

Writing a Resume, Part 3: Work Experience

Writing a Resume, Part 4: Education

Language Focus: Action Verbs

Writing a Resume, Part 5: Complete your Resume

MODULE III WRITING A COVER LETTER 3+2

What is a Cover Letter?

Professional Writing: Letter Format

Cover Letter: Paragraph 1- Introducing Yourself
Cover Letter: Paragraph 2- Highlighting Your Skills in the Cover letter
Cover Letter: Paragraph 3- Closing
Language Focus – Present Perfect vs. Past Tense
Professional Writing: Level of Formality
Language Focus: Using Modal Verbs to Write politely
Writing a Cover Letter for a Specific Job

MODULE IV INTERVIEWING FOR A JOB 3+10

(This module focuses more on the practical aspects of communication for career development.)
Overview of the Job Interview: Answering Typical Interview Questions
Language Focus: Asking for Clarification in an Interview-
Sample Interview: Do's and Don'ts Part 1
Sample Interview: Do's and Don'ts Part 2
Sample Video: Responding to an Interview Question

MODULE V GROUP DISCUSSION 3+10

(This module focuses more on the practical aspects of communication for career development.)
Introduction to Group Discussion - Participating in group discussions – understanding group dynamics - brainstorming the topic - questioning and clarifying - GD strategies - activities to improve GD skills

L-15, P-30; TOTAL HOURS - 45

REFERENCES:

1. R. Byrne, D. *Teaching Oral Skill.* London: Longman. 1975.
2. Byrne, D. *Teaching Writing*, London: Longman. 1975.
3. Rani Asoka, Devi Vimala. *English for Career development: A Course in Functional English.* Orient Longman Pvt. Ltd., India, 2004.
4. Anderson, K., Maclean, J. & Lynch, T. *Study speaking: A Course in Spoken English for Academic Purposes*. Cambridge University Press, UK, 2004.
5. Withrow, J., Brookes, G. & Cummings, M.C. *Inspired to write. Reading and Tasks to Develop Writing Skills*. Cambridge University Press, U.K., 2004.

COURSE OUTCOMES:

CO1: Identify the steps in the job search process

CO2: Describe themselves and their experiences in a résumé

CO3: Build their job-related vocabulary

CO4: Write a clear cover letter that tells employers why they are the right person for the job

CO5: Take part in Group discussion confidently.

Board of Studies (BoS) :	**Academic Council:**
15th BoS of the Department of English held on 14.6.2022	19th Meeting of the Academic Council held on 29.09.2022

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

Statement: This course ensures that the students acquire quality education and are also made eligible to obtain productive and decent employment.

SEMESTER II

GEE 6201	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
SDG: 4, 8, 9		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To apply a perspective on research

COB2: To analyze the research design, information retrieval and problem formulation techniques.

COB3: To select the appropriate statistical techniques for hypothesis construction and methods of data analysis and interpretation

COB4: To execute the effective communications of research findings and apply the ethics in research.

COB5: To describe the research findings as research reports, publications, copyrights Patenting and Intellectual Property Rights.

PREREQUISITES:

- Basics of core engineering, probability and statistics.
- Basics of flowchart and algorithm techniques.

MODULE I **RESEARCH PROBLEM FORMULATION AND RESEARCH DESIGN** **6**

Research - objectives – types - Research process, solving engineering problems- Identification of research topic - Formulation of research problem, literature survey and review. Research design - meaning and need - basic concepts - Different research designs, Experimental design - principle, Design of experimental setup, Mathematical modeling - Simulation, validation and experimentation.

MODULE II **DATA COLLECTION, ANALYSIS AND INTERPRETATION OF DATA** **8**

Sources of Data, Use of Internet in Research, Types of Data - Research Data Processing and analysis - Interpretation of results- Correlation with scientific facts - repeatability and reproducibility of results - Accuracy and precision –limitations, Application of Computer in Research- Spreadsheet tool-Basic principles of Statistical Computation. Importance of statistics in research - Concept of probability - Popular distributions - Sample design. Hypothesis testing, ANOVA, Design of experiments - Factorial designs - Orthogonal arrays.

MODULE III OPTIMIZATION TECHNIQUES 8

Use of optimization techniques - Traditional methods – Evolutionary Optimization Techniques. Multivariate analysis Techniques, Classifications, Characteristics, Applications - correlation and regression, Curve fitting.

MODULE IV INTELLECTUAL PROPERTY RIGHTS 8

The Research Report - Purpose of written report - Synopsis writing - preparing papers for International Journals, Software for paper formatting like LaTeX/MS Office, Reference Management Software, Software for detection of Plagiarism – Thesis writing, - Organization of contents - style of writing- graphs, charts and Presentation tool - Referencing, Oral presentation and defense - Ethics in research - Patenting, Intellectual Property Rights - Patents, Industrial Designs, Copyrights, Trade Marks, Geographical Indications-Validity of IPR, Method of Patenting, procedures, Patent Search.

L – 30 ; TOTAL HOURS – 30

TEXT BOOKS:

1. Ganesan R., “Research Methodology for Engineers”, MJP Publishers, Chennai, 2011.
2. George E. Dieter., “Engineering Design”, McGraw Hill – International edition, 2020.
3. Kothari C.R., “Research Methodology” – Methods and Techniques, New Age International (P) Ltd, New Delhi, 2020.
4. Kalyanmoy Deb., “Genetic Algorithms for optimization”, Kangal report, No.2001002.
5. Rajkumar S. Adukia, “Handbook on Intellectual Property Rights in India”, TMH Publishers, 2020.
6. Prabhuddha Ganguli. ”Intellectual Property Rights”. 1st Edition, TMH Publishers, 2012.

REFERENCES:

1. Holeman, J.P., ”Experimental methods for Engineers, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2017.
2. Govt. of India, ”Intellectual Property Laws; Acts, Rules & Regulations”, Universal Law Publishing Co. Pvt. Ltd., New Delhi 2020.
3. R Radha Krishnan & S Balasubramanian, ”Intellectual Property Rights”. 1st Edition, Excel Books, 2012.
4. Derek Bosworth and Elizabeth Webster. ”The Management of Intellectual Property”, Edward Elgar Publishing Ltd., 2013.

COURSE OUTCOMES:

At the end of the course, the student should be able to:

CO1: Formulate the research problem

CO2: Design and Analyze the research methodology

CO3: Apply statistical techniques for hypothesis construction

CO4: Analyze and interpret the data to construct and optimize the research hypothesis

CO5: Report the research findings as publications, copyright, trademarks and IPR

Board of Studies (BoS) :
23rd BOS of ECE held on 13.07.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H	M	L	L	L	L	L	L	L	H	H	H
CO2	H	H	H	H	M	-	-	-	-	-	-	-	H	H	H
CO3	H	H	H	H	M	L	L	L	L	L	L	-	H	H	H
CO4	H	H	H	H	M	-	M	M	M	M	M	-	H	H	H
CO5	H	H	H	H	M	-	M	M	M	M	M	-	H	H	H

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Analysis and design of core field design promotes engineering skills and quality education.

Statement: This course enables the student to analyze the existing technology for further solution and its qualitative measures in terms of societal requirements.

SDG 8: Development of new technologies with core field design provides sustainable economic growth and productive employment.

Statement: To apply the hybrid techniques and concepts for different applications provides sustainable economic growth and productive employment.

SDG 9: Creative and curiosity of core field design fosters innovation and sustainable industrialization.

Statement: This course plays major roles through innovative ideas in industry towards modern infrastructures and sustainability.

CSE 6201	MACHINE LEARNING TECHNIQUES	L	T	P	C
SDG: 9		3	0	2	4

COURSE OBJECTIVES:

COB1: To expose the applications of machine learning.

COB2: To study the various algorithms related to supervised and unsupervised learning.

COB3: To recognize the different types of machine learning models and how to use them.

COB4: To acquire the knowledge of various classification techniques.

COB5: To learn the various neural network algorithms.

MODULE I INTRODUCTION 8

Introduction – Classic and Adaptive Machines – Types of Learning – Elements – Data Formats – Learnability – Statistical Learning Approaches.

MODULE II FEATURE SELECTION AND CLASSIFICATION 10

Feature Selection and Feature Engineering – Linear Regression – Logistic Regression – Naïve Bayes – Support Vector Machines – Decision Trees – Ensemble Learning.

MODULE III CLUSTERING 9

Clustering Basics – K-Means – DBSCAN – Spectral Clustering - Evaluation Methods –Hierarchical Clustering - Hierarchical Strategies – Agglomerative Clustering.

MODULE IV RECOMMENDATION SYSTEM AND NLP 9

Introduction to NLP – NLTK and Built-in Corpora – BoW Strategy – Topic Modeling – Latent Semantic Analysis –Probabilistic Latent Semantic Analysis – Latent Dirichlet Allocation - Sentiment Analysis in NLP – VADER Sentiment Analysis with NLTK.

MODULE V DEEP LEARNING 9

Introduction to Deep Learning –ANN – Deep Architectures - Fully Connected Layers – Convolutional Layers – Drop out Layers – Recurrent Neural Networks - Tensor Flow –Computing Gradients – Logistic Regression – Classification with Multilayer Perceptron – Creating Machine Learning Architectures.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Giuseppe Bonaccorso, “Machine Learning Algorithms”,Packt, ISBN:9781785889622, 2017.
2. EthemAlpaydin, “Introduction to Machine Learning”, 3rd Edition, MITPress, ISBN: 9780262028189, 2014.
3. Kevin Patrick Murphy, “Machine Learning: a Probabilistic Perspective”, 4th edition, MIT Press, ISBN:9780262018029, 2013.
4. Ian H. Witten, Eibe Frank, Mark A. Hall, “Data Mining: Practical Machine Learning Tools and Techniques”, 3rd Edition, Morgan Kaufmann,2011.

COURSE OUTCOMES:

CO1: Design and implement algorithms for supervised and unsupervised learning.

CO2: Develop skills of using recent machine learning software for solving practical problems.

CO3: Analyze the efficient clustering techniques for solving real world problems.

CO4: Implement deep learning algorithms for an application and analyze the results.

CO5: Apply the appropriate algorithms for Sentiment analysis and Recommendation Systems.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2	L													L
CO3		M												M
CO4		M											M	
CO5			H										H	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9:Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: The students will play a key role in driving technological and societal progress through research, discovery, knowledge creation and dissemination. They educate and equip young people with the knowledge, acquired by building various models and real-time implementations.

CSE 6202	OPTIMIZATION ALGORITHMS AND APPLICATIONS	L	T	P	C
SDG: 8		3	0	0	3

COURSE OBJECTIVES:

COB1: To present students with knowledge of the state-of-the-art in the theory and practice of solving network flow problems.

COB2: To learn Operation research models using optimization techniques based upon the fundamentals of engineering mathematics (minimization and Maximization of objective function).

COB3: To help each student develop his or her own intuition about optimization algorithm development and algorithm analysis.

COB4: To learn about the fundamentals of optimization and non-optimization algorithms

COB5: To provide students with a rigorous analysis of network flow algorithms.

MODULE I INTRODUCTION TO OPTIMIZATION 9

Optimal problem formulation-Engineering applications of optimization-Optimization techniques- Linear optimization- Nonlinear optimization - Application.

MODULE II NETWORK OPTIMIZATION MODELS 9

Network Optimization Models- Prototype Example -The Terminology of Networks -The Shortest-Path Problem -The Minimum Spanning Tree Problem - The Maximum Flow Problem - The Minimum Cost Flow Problem -The Network Simplex Method -The Transportation Problem -A Streamlined Simplex Method for the Transportation Problem.

MODULE III DYNAMIC PROGRAMMING 9

A Prototype Example for Dynamic Programming- Characteristics of Dynamic Programming Problems -Deterministic Dynamic Programming -Probabilistic Dynamic Programming – Application.

MODULE IV INTEGER PROGRAMMING AND MULTIOBJECTIVE OPTIMIZATION 9

Integer linear programming-Integer nonlinear programming- Global criterion method-Ultity function method-Inverted utility method-Bounded objective function method-lexicographic model-Goal programming method- application.

MODULE V NATURE INSPIRED OPTIMIZATIONS 9

Genetic algorithms-Neural network-based optimization-Ant colony optimization-Particle swarm optimization - Application.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Nayak, Sukanta. Fundamentals of Optimization Techniques with Algorithms. Netherlands, Elsevier Science, 2020.
2. Arora, Rajesh Kumar. Optimization: Algorithms and Applications. United Kingdom, CRC Press, 2015.
3. Hillier, Frederick S., and Lieberman, Gerald J.. Introduction to Operations Research. United Kingdom, McGraw-Hill Education, 2021.

REFERENCES:

1. Kochenderfer, Mykel J., and Wheeler, Tim A.. Algorithms for Optimization. United Kingdom, MIT Press, 2019,ISBN 9780262039420.
2. Q. H. Badar, Altaf. Evolutionary Optimization Algorithms. United States, CRC Press, 2021,ISBN 9781000462166.

COURSE OUTCOMES:

CO1: Solve several transportation network problems (shortest path, minimum spanning tree, maximum flow, and minimum cost network flow problems).

CO2: Formulate and solve linear and non-linear programming problems.

CO3: Determine the optimum solution to constrained and unconstrained optimization problems.

CO4: Apply convex optimization methods and game theory to analyze and design communication networks

CO5: Apply the different numerical methods for solving optimization problems.

Board of Studies (BoS):	**Academic Council:**
20th BoS of Department of CSE held on 16.08.2022	19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2		L											L	
CO3			M											M
CO4			L											M
CO5				M									M	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: By learning optimization algorithm design, students can apply algorithms in order to take actions in complex decision-making environment, which in turn leads to sustainable economic growth and enormous employment opportunities

CSE 6203	ADVANCED SOFTWARE ENGINEERING AND AGILE MODELLING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand Software Engineering Lifecycle Models.

COB2: To do project management and cost estimation.

COB3: To gain knowledge of the System Analysis and Design concepts.

COB4: To understand software testing and DevOps approaches.

COB5: To be familiar with agile software development practices.

MODULE I INTRODUCTION 8

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary – Spiral.

MODULE II SOFTWARE REQUIREMENT SPECIFICATION 9

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram.

MODULE III ARCHITECTURE AND DESIGN 10

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles - Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking.

MODULE IV DEVOPS 9

DevOps: Motivation - Cloud as a platform-Operations- Deployment Pipeline: Overall Architecture - Building and Testing-Deployment- Case study: Migrating to Microservices.

MODULE V AGILE METHODOLOGY & PROCESSES 9

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 - Lean production - SCRUM, Crystal, Feature Driven Development, Adaptive Software Development, and Extreme Programming: Method overview – lifecycle – work products, roles and practices.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Len Bass, Ingo Weber and Liming Zhu, - DevOps: A Software Architect‘s Perspective‖, Pearson Education, 2016.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt. Ltd., 2010.
3. Rajib Mall, Fundamentals of Software Engineering, 3 rd edition, PHI Learning Pvt. Ltd., 2009.
4. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.) - Agile Software Development, Current Research and Future Directions‖, Springer-Verlag Berlin Heidelberg, 2010.
5. Craig Larman, - Agile and Iterative Development: A managers Guide‖, Addison-Wesley, 2004

COURSE OUTCOMES:

CO1: Understand the advantages of various Software Development Lifecycle Models

CO2: Gain knowledge on project management approaches as well as cost and schedule estimation strategies.

CO3: Understand the Mutual Exclusion and Deadlock detection algorithms in distributed systems

CO4: Apply software testing and DevOps practices.

CO5: They know importance of interacting with business stakeholders in determining the requirements for a software system.

Board of Studies (BoS):	**Academic Council:**
20th BoS of Department of CSE held on 16.08.2022	19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	M	L											M	
CO2	M	L											H	
CO3			L							L				L
CO4			M			M								L
CO5										M			H	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: Able to understand iterative software development process and impact of social aspects on software development success.

PROGRAMME ELECTIVE I

CSEY 001	CLOUD COMPUTING AND TECHNOLOGY	L	T	P	C
SDG: 8		3	0	0	3

COURSE OBJECTIVES:

COB1: To gain understanding of the basic concepts of cloud computing.

COB2: To learn various types of cloud services, technologies and service providers.

COB3: To gain the knowledge about different programming models and cloud software.

COB4: To understand the privacy and security issues in cloud environments.

COB5: To illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon.

MODULE I CLOUD COMPUTING BASICS 9

Introduction to Cloud Computing – Cloud computing reference model- Essential Characteristics - Benefits and challenges of cloud computing- Cloud Delivery Models - Deployment models -Cloud computing vendors.

MODULE II CLOUD COMPUTING TECHNOLOGY 8

Virtualization-Types of virtualizations - Virtualization and cloud computing- Clientthin, thick, mobile clients- Cloud Providers and Consumers-Various Cloud Services- Accessing the Cloud- Frameworks- Web Hosting Services- Web Applications- Web API‟s and Web Browsers.

MODULE III CLOUD INFRASTRUCTURE 10

Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development– Design Challenges - Inter Cloud Resource Management – Resource Provisioning and Platform Deployment – Global Exchange of Cloud Resources.

MODULE IV PROGRAMMING MODEL 10

Map Reduce programming model - Map reduce and extensions - Relational operations – Parallel Efficiency of Map Reduce- Cloud File Systems - GFS and HDFS –Cloud platforms in Industry – Google App Engine, Amazon AWS- Cloud Software Environments -Eucalyptus, Open Nebula.

MODULE V SECURITY IN CLOUD 8

Cloud security fundamentals- Privacy and Security in cloud - Software-as-a Service Security Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, McGraw-Hill,2010.
2. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, “Mastering Cloud Computing”, McGraw-Hill Education Private Ltd., 2013.
3. John W.Rittinghouse and James F.Ransome, “Cloud Computing: Implementation, Management, and Security”, CRC Press, 2010.
4. RajkumarBuyya, James Broberg, Andrzej Goscinski, “Cloud Computing Principles and Paradigms” John Wiley & Sons, Inc Publications, 2011.
5. Tim Malhar, S.Kumaraswammy, Shahed Latif, “Cloud Security & Privacy”, O‟Reilly media, 2009.

COURSE OUTCOMES:

CO1: Articulate the main concepts, key technologies, strengths and limitations of cloud computing.

CO2: Identify the architecture, infrastructure and delivery models of cloud computing.

CO3: Discuss the cloud technologies including virtualization and web based technologies.

CO4: Work with online cloud services and collaborate with online documents and web-based applications.

CO5: Explain the core issues of cloud computing such as security, privacy and interoperability.

Board of Studies (BoS):	**Academic Council:**
20th BoS of Department of CSE held on 16.08.2022	19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	M	L	L										L	
CO2	M		M	M										M
CO3	M	L	H	M										M
CO4	M	L	M	M									M	
CO5	M	L	H	H										M

Note: L- Low Correlation M - Medium Correlation H - High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: By learning “Cloud Computing and Technology”, the students will be able to discuss economic models and future visions of economy and society critically and to communicate them in public spheres.

CSEY 002	PERVASIVE COMPUTING	L	T	P	C
SDG: 8		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the relationship, basic concepts and structures in pervasive computing.

COB2: To learn about Human-Computer Interface and Mobile Transactions in pervasive computing environment.

COB3: To highlight the role of sensor networks, wireless protocols in the design of pervasive applications.

COB4: To illustrate architecture and protocols in pervasive computing and to identify the trends and latest development of the technologies in the area.

COB5: To design successful mobile and pervasive computing applications and services.

MODULE I BASIC CONCEPTS AND STRUCTURE 9

Relationship of Wireless Computing - Ubiquitous Computing - Internet Computing –Perspectives of pervasive computing – Challenges – Technology – Infrastructure and Devices – Middleware for Pervasive Computing Systems: Resource Management – User Tracking – Context Management – Service Management – Data Management – Security Management–Pervasive Computing Environments.

MODULE II CONTEXT COLLECTION AND RESOURCE MANAGEMENT 9

Context Collection and Wireless Sensor Networks – User Tracking – Context Reasoning: Evidence Theory – DSCR Model – Propagating Evidence in Sensors Layer and Object Layer – Recognizing User Activity – Evidence Selection Strategy – Performance – Resource Management in Pervasive Computing: Efficient Resource location – Transparent Task Migration.

MODULE III HUMAN-COMPUTER INTERFACE AND MOBILE TRANSACTIONS 9

Overview –HCI Service and Interaction Migration – Context-Driven HCI Service Selection – A web service-based HCI Migration Framework – Mobile Transaction Framework – Context-aware Pervasive Transaction model – Dynamic Transaction Management – Format Transaction Verification.

MODULE IV LOCAL AND WIDE AREA TECHNOLOGIES 9

Local area wireless networks: IEEE 802.11 technologies - Mobile IP- Infrared technologies. Bluetooth networks (OBEX Protocol) - Messaging Systems - Personal Area Networks - Network Management - Quality of Service - Wireless protocols - Establishing Wide area wireless networks: Concept and structure of "cell"- Call establishment and maintenance.

MODULE V PROTOCOLS 9

Protocols: Networking protocols - Packet switched protocols - Routing Protocols for Sensor Networks - Data Centric Protocols - Hierarchical Protocols Location-based protocols - Multimedia Messaging Service (MMS) Protocols Wireless Application Protocol (WAP)- Applications: Mobile access to patient information in a hospital, sales support, retailing.

L – 45; TOTAL HOURS –45

REFERENCES:

1. MinyiGuo, Jingyu Zhou, Feilong Tang, Yao Shen, "Pervasive Computing Concepts, Technologies and Applications", 1st Edition, CRC Press, 2016.
2. CiprianDobre and FatosXhafa, "Pervasive Computing-Next Generation Platforms for Intelligent Data Collection", 1st Edition, Elsevier Publication, 2016. ISBN:978-0-12-803663-1.
3. Natalia Silvis-Cividjian, "Pervasive Computing: Engineering Smart Systems", Springer Publishing, 2017. ISBN: 978-3-319-51655-4.

COURSE OUTCOMES:

CO1: Analyze the pervasive computing from normal computing applications.

CO2: Describe how the devices (sensors and RFIDs) operate in a pervasive computing environment.

CO3: Analyze the performance of different sensor data management and routing algorithms for sensor networks.

CO4: Apply the basic techniques, algorithms, protocols of different types of networks for designing pervasive computing system.

CO5: Identify the performance of various data dissemination techniques for mobile real-time applications.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2		L												L
CO3			M										M	
CO4				L										
CO5		M												M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: By learning “Pervasive Computing”, the students will be able to discuss economic models and future visions of economy and society critically and to communicate them in public spheres.

CSEY 003	APPLIED CRYPTOGRAPHY AND	L	T	P	C
SDG: 4	NETWORK SECURITY	3	0	0	3

COURSE OBJECTIVES:

COB1:have a theoretical understanding of the principles underlying cryptography and cryptanalysis.

COB2:have a fundamental understanding of symmetric and asymmetric encryption, hashing, and digital signatures.

COB3: learn the basic concepts in networking and wireless security, applied cryptography, as well as ethical, legal, social and economic facets of security.

COB4: become familiar with the cryptographic techniques that provide
information and network security.

COB5: be able to evaluate the security of communication systems, networks and protocols based on a multitude of security metrics.

MODULE I CRYPTOGRAPHY AND ENCRYPTION TECHNIQUES **9**

Overview – Principles-Concepts –Symmetric and Asymmetric Encryption– AES – Block Cipher Operations– RSA Algorithm – Diffie Hellman Key Exchange.

MODULE II DATA INTEGRITY ALGORITHMS AND MUTUAL TRUST **10**

Hash Functions – SHA – Message Authentication Codes – Digital Signatures- Key Management and Distribution – X.509 Certificates – Kerberos.

MODULE III NETWORK SECURITY **8**

Vulnerabilities - Security Assessment, Analysis, and Assurance-Disaster Management – Access Control and Authentication – Authorization.

MODULE IV WIRELESS NETWORK SECURITY **8**

Wireless Security – Wireless LAN - Smart Phones – PDA – Bluetooth-Broadband Security.

MODULE V SECURITY IN EMERGING TECHNOLOGIES **9**

Next Generation Mobile Networks – Wireless Sensor Networks – Adhoc Networks – IP based Mobile Networks.

L – 45; TOTAL HOURS –45

REFERENCES:

1. William Stallings, “Cryptography and Network Security – Principles

and Practice" 7th Edition, Pearson Education, ISBN No. 978-0134444284,2016.
2. Joseph MiggaKizza, "Guide to Computer Network Security" 3rd Edition, Springer Publishers, ISBN No 978-1447166535,2015.
3. Wolfgang Osterhage, "Wireless Security", CRC Press, ISBN No. 978-1578087686,2011.
4. William Stallings, "Network Security Essentials, Applications and Standards",5th Edition, Pearson Education, ISBN No.978-0133370430,2013.
5. John R.Vacca , "Network and System Security",2nd Edition, Elsevier Publishers, ISBN No.978-0124166899,2014.

COURSE OUTCOMES:

CO1: have a technical understanding of the main cryptographic concepts and technologies available today.

CO2: understand the requirements and techniques for security management, including security policies, risk analysis, and physical threats and controls.

CO3: illustrate how cryptography and its application can maintain privacy and security in electronic communications and computer networks.

CO4: describe the vulnerabilities brought about by modern web-based application and services, and discuss countermeasures.

CO5: innovate techniques for enforcing computer and network security and developing secure e-commerce protocols.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1		L												
CO2		L												
CO3	M													
CO4			M											
CO5				M										

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Quality Education Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Statement: The students will play a key role in cryptography network algorithms and societal progress through research, discovery, knowledge creation and dissemination. They educate and equip young people with the knowledge, acquired by building various application models.

CSEY 004	ADVANCED DATABASE	L	T	P	C
SDG: 9	MANAGEMENT	3	0	0	3

COURSE OBJECTIVES:

COB1: To learn about design of databases.

COB2: Toattain knowledge on parallel and distributed databases and their applications.

COB3: Toconquer information on object and deductive databases.

COB4: Tolearn intelligent databases and various data models.

COB5: Toacquire data mining and data warehousing concepts.

DISTRIBUTED & PARELLEL DATABASES 9

MODULE I

Introduction to Distributed Databases – Types of Distributed Databases – Distributed DBMS Architectures –Storing Data in a Distributed DBMS – Distributed Catalog Management –Distributed Query Processing –Updating Distributed Data – Distributed Transactions – Distributed Concurrency Control –Distributed Recovery – Architectures for Parallel Databases – Parallel Query Evaluation – Parallelizing Individual Operations –Parallel Query Optimization.

MODULE II OBJECT & DEDUCTIVE DATABASES 9

Structured Data Types – Operations on Structured Data – Encapsulation and ADTs – Objects, aIDs, and Reference Types – Database Design for an ORDBMS –ORDBMS Implementation Challenges – OODBMS – Comparing RDBMS, OODBMS, and ORDBMS: Deductive Databases: Introduction to Recursive Queries – Theoretical Foundations – Recursive Queries with Negation – Evaluating Recursive Queries.

MODULE III SPATIAL DATA MANAGEMENT & ENHANCED DATA MODELS 9

Types of Spatial Data and Queries – Applications Involving Spatial Data – Introduction to Spatial Indexes, – Indexing Based on Space – Filling Curves – Grid Files – R Trees – Point and Region Data: Active Database concepts and triggers –Temporal Database concepts – Spatial Database concepts – Multimedia database concepts.

MODULE IV NOSQL IN DATABASE MANAGEMENT 9

Introduction, Big Data, Scalability, Key/Value Stores, Hello NoSQL: Getting

Initial Hands-On Experience, Working with Language Bindings, MongoDB's Drivers, Interfacing And Interacting With NoSQL, Storing and Accessing Data, Storing Data In and Accessing Data from MongoDB, Querying MongoDB, Storing Data In and Accessing Data from Redis.

MODULE V DATABASES & DATA MINING 9

Active Databases – Syntax and Semantics of Active Databases –Application of Active Databases – Design Principles for Active Rules – Temporal Databases – Time Domain – Time Data types – Associating Facts with time – Overview of Data mining technology – Association rules – Classification – Clustering – Data mining techniques – Data mining process – Data mining tools.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. R. Ramakrishnan, J. Gehrke, Database Management Systems, McGraw Hill, 2004.
2. Henry F Korth, Abraham Silberschatz, S. Sudharshan, - Database System Concepts‖, Sixth Edition, McGraw Hill, 2011.
3. Ramez Elmasri, Shamkant B. Navathe, - Fundamentals of Database Systems‖, Sixth Edition, Pearson, 2011
4. Thomas Cannolly and Carolyn Begg, - Database Systems, A Practical Approach to Design, Implementation and Management‖, Fourth Edition, Pearson Education, 2008.

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, - An Introduction to Database Systems‖, Eighth Edition, Pearson Education, 2006.
2. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T.Snodgrass, V.S.Subrahmanian, Roberto Zicari, -Advanced Database Systems‖, Morgan Kaufmann publishers,2006.

COURSE OUTCOMES:

CO1: Develop in-depth understanding of parallel and distributed databases and to optimize database performance.

CO2: Attain and evaluate on each type of databases.

CO3: Learn database models for practical database problems.

CO4: Exposure to learn concepts and design of Data warehouse

CO5: Ability to solve real time problems using various databases.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2		M												L
CO3			M										L	
CO4			L											M
CO5		H											M	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation.

Statement: To comprehend and evaluate the role of database management systems, with an emphasis on how to organize, maintain and retrieve information from a DBMS efficiently, and effectively in information technology applications within organizations.

CSEY 005	ADVANCED DATA WAREHOUSING	L	T	P	C
SDG: 9	AND DATAMINING	3	0	0	3

COURSE OBJECTIVES:

COB1: To provide students with basic knowledge of tools used for data mining.

COB2: To explore the technologies for storing and mining large databases.

COB3: To assess the concepts and methods used for mining the data.

COB4: To explore the strength and weakness of data mining algorithms.

COB5: To explain the application of data warehousing and data mining in real time scenario.

MODULE I DATA WAREHOUSING 8

Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing – Parallel DBMS Vendors - Multidimensional Data Model – Data Warehouse Schemas for Decision Support, Concept Hierarchies -Characteristics of OLAP Systems – Typical OLAP Operations, OLAP and OLTP.

MODULE II DATA MINING TOOLS 9

Introduction to Data Mining Tools – Weka, R – Preparing Data Set – Working with Data Set – Data Preprocessing – Need for Data Preprocessing – Data Preprocessing Methods – Data Cleaning – Data Integration- Data Transformation – Data Reduction.

MODULE III CLASSIFICATION AND CLUSTERING 11

Introduction – Types of Classification- Input and Output Attributes – Guidelines – Size and Quality of Training data set – Decision Tree Classifier – Naïve Bayes Method – Metrics – Quality of Classifiers – Applications of Cluster Analysis – Desired Features of Clustering – Distance Metrics – Clustering Algorithms – Partitioning Clustering – Hierarchical Clustering Algorithms.

MODULE IV ASSOCIATION MINING AND WEB MINING 8

Introduction – Association Rule Mining – Metrics – Apriori Algorithm –Web Content Mining – Web Usage Mining – Web Structure Mining –Page Rank Algorithm – Precision and Recall.

MODULE V DATA QUALITY AND WAREHOUSE 9

Data quality – Types of quality analysis - Data Warehouse – Data Marts – Data Warehouse Schema –Online Analytical Processing – Knowledge of Big data and NoSQL.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. Parteek Bhatia, “Data Mining and Data Warehousing Principles and Practical Techniques”, 1stEdittion, Cambridge University Press, 2019, ISBN: 9781108727747.
2. Jiawei Han & Micheline Kamber, “Data Mining – Concepts and Techniques”, 3rdEdition, ISBN 978-0-12-381479- Morgan Kaufmann Publishers, Elsevier, 2012.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, “Introduction to Data Mining”, 1st Edition, ISBN: 1-892095-02-5, Pearson education,2006.

COURSE OUTCOMES:

CO1: Design appropriate data warehouse multi-dimensional model.

CO2: Perform basic data mining operations and apply standard data mining algorithms to solve real time problems.

CO3: Correlate data mining techniques to current scenarios in various

fields and inculcate the ability to apply tools for mining and analysis.

CO4: Review the various latest research activities going on in the field

of Data Mining, thereby creating an interest for research

CO5: Able to mine the data and perform predictive analysis.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2			L										L	
CO3				L										M
CO4			M										M	
CO5		M												M

Note: L- Low Correlation M - Medium Correlation H - High Correlation

SDG: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: The various industrial standards data of technical drawing and the application of orthographic projections to draw simple solids helps to innovate a new design for sustainable industrialization.

PROGRAMME ELECTIVE II

CSEY 006	DATA SCIENCE WITH PYTHON	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: Toprovide computational environments for data scientists using python.

COB2: To features the data-frame for efficient storage and manipulation of labeled/columnar data in python.

COB3: To includes capabilities for a flexible range of data visualizations in Python.

COB4: To make decisions using applied and practical machine learning techniques.

COB5: To learn the efficient and clean Python implementations of the most important and established machine learning algorithms.

MODULE I IPYTHON: BEYOND NORMAL PYTHON 7

Shell Or Notebook - IPython Shell - IPython Magic Commands – Input and Output History - IPython and Shell Commands – Shell Related Magic Commands - Errors and Debugging - Profiling and Timing Code.

MODULE II INTRODUCTION TO NUMPY 9

Understanding Data Types - The Basics Of Numpy Arrays - Computation On Numpy Arrays -Universal Functions –Aggregations - Min, Max, computation On Arrays: Broadcasting - Comparisons, Masks, And Boolean Logic - Fancy Indexing - Sorting Arrays - Structured Data: Numpy's Structured Arrays.

MODULE III DATA MANIPULATION WITH PANDA 9

Installing And Using Pandas - Introducing Pandas Objects - Data Indexing And Selection - Operating On Data In Pandas - Handling Missing Data - Hierarchical Indexing - Combining Datasets: Concat And Append - Combining Datasets: Merge And Join - Aggregation And Grouping - Pivot Tables - Vectorized String Operations - Working With Time Series - High-Performance Pandas: Eval() And Query().

MODULE IV VISUALIZATION WITH MATPLOTLIB 11

General Matplotlib Tips - Two Interfaces For The Price Of One - Simple Line Plots - Simple Scatter Plots - Visualizing Errors - Density And Contour Plots -

Histograms, Binnings, And Density - Customizing Plot Legends - Customizing Colorbars - Multiple Subplots - Text And Annotation - Customizing Ticks - Customizing Matplotlib: Configurations And Stylesheets - Three-Dimensional Plotting In Matplotlib - Geographic Data With Basemap - Visualization With Seaborn.

MODULE V MACHINE LEARNING 9

Machine Learning - Introducing Scikit-Learn - Hyperparameters And Model Validation - Feature Engineering - Naive Bayes Classification - Linear Regression -Support Vector Machines -Manifold Learning - K-Means Clustering - Gaussian Mixture Models.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Jake VanderPlas, “Python Data Science Handbook”Jake. Published by O’Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol,Copyright © 2017, ISBN-13:978-1491912050.
2. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016, ISBN-13:978-1491939369.

COURSE OUTCOMES:

CO1: Perform powerful libraries for Machine learning applications and other scientific computations.

CO2: Describe about numpy and deal with feature like linear algebra,

fourier transforms and advanced random number capabilities.

CO3: Implement the pandas help us with munging and preparing data

and also it is great for operating on and maintaining structured data,manipulating, transforming, and cleaning data.

CO4: Apply the matplotlib will let you plot different kinds of graphs and visualizing different types of data

CO5: Describe the concepts and model of machine learning.

Board of Studies (BoS):	**Academic Council:**
20th BoS of Department of CSE held on 16.08.2022	19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1		L											L	
CO2			M											L
CO3		M											M	
CO4			M											M
CO5				M										M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: By learning the concepts of python program, the students are able to apply the concepts to design real time application which can improve productive employment.

CSEY 007	SOCIAL NETWORK ANALYSIS AND	L	T	P	C
SDG: 9	MINING	3	0	0	3

COURSE OBJECTIVES:

COB1: To familiarize the basic concepts of social network analysis.

COB2: To learn the various methods of social network analysis.

COB3: To get the knowledge of sentimental analysis in social network using R.

COB4: To have the knowledge on Facebook analytics using python.

COB5: To acquire essential knowledge on applications of social network analysis.

MODULE I INTRODUCTION TO SOCIAL NETWORK ANALYSIS 9

Introduction to Social network Analysis – Social Network - History of Social network analysis – Sociogram – Sociometry – Matrices and Cliques – Data collection.

MODULE II SOCIAL NETWORK ANALYSIS METHODS 9

Descriptive methods of social network analysis – Graphs and Matrix representation –Density – Centrality, Centralization and Prestige – Cliques – Structural Equivalence – Inferential Methods in Social network analysis.

MODULE III SENTIMANTAL ANALYSIS 9

Sentimental Analysis in Social Networks – Key concepts of sentimental analysis - Level of analysis – Semantic Aspects - Twitter analytics – Sentimental analysis using R.

MODULE IV FACEBOOK ANALYTICS- PYTHON 9

Facebook analytics – Parsing API outputs – Uncovering Brand Activity, Popularity and Emotions on Facebook.

MODULE V NO SQL IN SOCIAL NETWORKS 9

Advantages of No SQL – Applications of No SQL – SQL vs No SQL – Types of No SQL – Micro services and No SQL database – No SQL in social networks – Case study.

L – 45; TOTAL HOURS –45

REFERENCES:

1. John Scott," Social Network Analysis",4th Edition, SAGE

Publication,2017.
2. Reda Alhajj, Jon Rokne, “Encyclopedia of Social Network Analysis and Mining”, 2nd Edition, Springer New York,2018.
3. Song Yang, Franziska B. Keller, Lu Zheng, “Social Network Analysis: Methods and Examples”, 1st Edition, SAGE Publication, 2016.
4. Siddhartha Chatterjee, Michal Krystyanczuk, “Python Social Media Analytics”,1st Edition, Packt Publishing Ltd, 2017.
5. Raghav Bali, Dipanjan Sarkar, TusharSharm, “Learning Social Media Analytics with R”,1st Edition, Packt Publishing Ltd, 2017.
6. Federico Alberto Pozzi, ElisabettaFersini, Enza Messina, Bing Liu,” Sentiment Analysis in Social Networks”, Morgan Kaufmann Publication,2016.

COURSE OUTCOMES:

CO1: Analyze the terminologies used in social network analysis.

CO2: Apply the various methods of social network analysis.

CO3: Analyze the sentimental concept of any social network.

CO4: Test the sentimental analysis of twitter characters using R tool

CO5: Identify the various field of applications of social network analysis.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1		L											M	
CO2			L											L
CO3	L												M	
CO4		M												M
CO5			M										M	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Social network information retrieval can provide organizations with immediate value-while it's important to try to figure out ways to capture tacit knowledge, information retrieval provides a means to get the information that already exists in electronic formats.

CSEY 008	SECURITY ISSUES IN CLOUD	L	T	P	C
SDG: 8	COMPUTING	3	0	0	3

COURSE OBJECTIVES:

COB1: To expose fundamental concepts of cloud security.

COB2: To analyze the different attacks of cloud computing.

COB3: Relate current trends of risk management in cloud computing.

COB4: Recognize the requirements of cloud security and provide various solutions to vendors.

COB5: Illustrate the advanced security of cloud computing and demonstrate their use.

MODULE I INTRODUCTION 9

An Overview of Computer Security – Vulnerabilities and attacks-Security Mechanisms – Data Security – Digital Signature – Virtualization Security.

MODULE II CLOUD STORAGE SERVICES 9

Cloud Data Protection Models – Enforcing Access Cloud Control Policy – Data Leakage in the Cloud – Privacy and Security in Multi-clouds– Desired Security and Privacy Properties – Ensuring Security, Privacy and Reliability.

MODULE III RISK ANALYSIS AND CLOUD INFRASTRUCTURE 9

Risk and Trust Assessment Schemes – Managing Risk – Cloud Security Risk Management – Cloud Risk Mitigation Methods –Distributed Access Control – Cloud User Controls – Secure Cloud Architecture

MODULE IV CLOUD SECURITY REQUIREMENTS 9

Negotiating Cloud Security– Vendors – Legal Compliance Risk – Personal Data Protection Requirements – Integrity Assurance – Locking Down Cloud Servers – Third-Party Providers Integrity Secure Computing – Secure Cloud Architecture.

MODULE V ADVANCED CLOUD COMPUTING SECURITY 9

Advanced Security Architectures– Side-Channel Attacks – Trusted Computing Technology – Trusted Cloud Security – Defenses on Cloud Traffic – Clouds Are Evil – Future Directions in Cloud Computing Security.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. John vacca, “Cloud Computing Security: Foundations and Challenges”, CRC Press Publisher,1st Edition, ISBN: 978-1-4822-6094-6,1st Edition,2016.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, “Cloud Security and Privacy”, O’Reilly Media, Inc, ISBN: 978-0-596-80276-9, 1st edition, September 2009.
3. Russell Dean Vines Ronald L., “Cloud Security: A Comprehensive Guide to Secure Cloud Computing”, Wiley India; 1st edition, January 1, 2010.

COURSE OUTCOMES:

CO1: Analyze the solutions for vulnerabilities and attacks in cloud security.

CO2: Describe the platform architectures that are suitable for cloud security.

CO3: Brief upon cloud security requirements prevailing across the globe.

CO4: Categorize the different risk management and responsibilities in secure-cloud.

CO5: Apply the concept of defenses on cloud security in real time applications.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2	M													L
CO3		M												M
CO4			M										M	
CO5			H											M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: By learning “Security Issues in Cloud Computing”, the students will be able to discuss economic models and future visions of economy and society critically and to communicate them in public spheres.

CSEY 009	ADVANCED SOFTWARE	L	T	P	C
SDG: 9	QUALITY ASSURANCE	3	0	0	3

COURSE OBJECTIVES:

COB1: Understand the automation testing using various tools.

COB2: Explore the object repository functionality using in testing phase.

COB3: Analyze different techniques to synchronize the tests

COB4: Gain knowledge on actions and functional Library.

COB5: Introduction of parameterized test and check points.

MODULE I AUTOMATION 9

Automation testing and benefits - Manual VS Automated testing - Automation testing tools and tool selection criteria - Introduction, overview to Quick Test Pro (QTP), QTP10.0, 11.5 QTP, and QTP commands - understanding and executing a test. Non-functional testing- Objectives of Non-functional testing - Characteristics of Non-functional testing - Non-functional testing Parameters- Non Functional Testing Types - Example Test Cases Non-Functional Testing – Performance Testing and smoke testing.

MODULE II OBJECT REPOSITORY 9

Working on test objects and object repository - Configuring Object Identification - Managing object repository - Merging shared object repository - Associating hared object repository to a test.

MODULE III SCRIPT ENHANCEMENT 9

Synchronization of tests - Options to synchronize tests - Adding comments to scripts - Working and introduction of data tables - Recovery scenarios: introduction, definition, usage, managing, recovering scenarios - Associating recovery scenarios to test - Importing and exporting data from a text file, spreadsheet, database.

MODULE IV ACTIONS AND FUNCTIONAL LIB 9

Introduction, benefits and working with actions - Creating tests with multiple actions - Creating user-defined functions, its advantages, splitting actions functions, creating generic functions.

MODULE V CHECK POINT AND OUTPUT VALUES 9

Introduction to checkpoints, adding a checkpoint to test, while recording, while editing. Types of checkpoints - Parameterization: Introduction to parameterizing tests, parameterizing a test manually and using data table - Output values: Introduction to output values, creating, storing and viewing output values, Categories of output values.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Hiren Dand, Vilas Mahajan., “Software Quality Assurance”, StarEdu Solutions India Pvt Ltd, 2019. (ISBN 13: 978-9386765611)

REFERENCES:

1. Stephan Goericke, “The Future of Software Quality Assurance”, Saint Philip Street Press, 2020. (ISBN 13: 978-1013274671)
2. Claude Y. Laporte, Alain April, “Software Quality Assurance, First Edition”, IEEE Computer Society, 2017.

COURSE OUTCOMES:

CO1: Fundamental knowledge on Automation testing and the tools.

CO2: Understand the various operation on object repository.

CO3: Analyze the working of data tables and recovery scenarios.

CO4: Create tests with multiple actions.

CO5: Comprehend the categories of output values.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L													
CO2		M												
CO3	L													
CO4				M									M	
CO5				M										L

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

CSEY 010	BIG DATA ANALYTICS AND IOT	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To provide the students with different concepts and applications behind big data analytics.

COB2: To expose big data computing technologies, machine learning techniques, and scaling up machine learning approaches.

COB3: Understand the key issues in big data management and its associated applications in intelligent business and scientific computing.

COB4: To realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.

COB5: To introduce the tools required to manage and analyze big data like Hadoop, Spark SQL etc.

MODULE I DATA TO BIG DATA 9

Data to Big Data – Analytics Techniques – Building Data Analyitcs a compilation – Building and Understanding – Why Data analytics – Data Analytics Process.

MODULE II DATA ANALYTICS AND MACHINE LEARNING 9

Basics of Machine Learning – Supervised and Unsupervised Algorithms – Applications and Examples – Data visualization.

MODULE III INTERNET OF THINGS 9

Introduction – Concepts – Framework – Technology Infrastructure - Derived Qualities – Challenges – Factors – Architecture.

MODULE IV COMPUTING IN IOT 9

Cloud and Fog Computing – RFID – IoT Design and Prototyping – Security Mechanisms.

MODULE V TOOLS AND APPLICATIONS 9

Case Study - Hadoop – Spark, Spark SQL - Deep Dive in Apache spark – IoT and Applications.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Soraya Sedkaoui, “Data Analytics and Big Data”, First Edition, Wiley

Publications, 2018. ISBN 978-1-78630-326-4.
2. Rajat Mehta, “Big Data Analytics with Java”, Pact Publishing, First Edition, 2017. ISBN :978-1-78728-898-0.
3. Qusay F. Hassan, “Internet of Things A to Z: Technologies and Applications”, Wiley Publications, Second Edition,2018. ISBN: 978-1-111-945674-2.
4. VenkatAnkam, “Big Data Analytics”, Pact Publishing, First Edition, 2016. ISBN: 978-1-78588-496-6.
5. NilanjanDey, Aboul Ella Hassanien, Chintan Bhatt, Amira S. Ashour, Suresh Chandra Satapathy, “Internet of Things and Big Data Analytics Toward Next-Generation Intelligence”, First Edition, Springer, 2017.

COURSE OUTCOMES:

CO1: select and implement machine learning techniques and computing environment that are suitable for the applications under consideration

CO2: Identify the technology and standards related to IoT.

CO3: Integrate computer-based systems to the physical world.

CO4: Design IoT based prototypes using big Data.

CO5: Familiarize with tools and techniques with Apache spark, with Hadoop platform.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1														
CO2														
CO3														
CO4														
CO5														

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Promoting sustainable industries, and investing in scientific research and innovation, are all important ways to facilitate sustainable development
Statement: Small and medium-sized enterprises can use data analytics to improve production; create new goods and services, improve processes and marketing strategies.

CSEY 011	MOBILE ADHOC NETWORKS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To provide a broad overview of the state of wireless and mobile
ad hoc networking.

COB2: To discuss physical, networking and architectural issues of mobile ad hoc networks.

COB3: To elaborate the functions of various routing protocols under unicast, multicast and transport layer protocols.

COB4: To give a knowledge about issues in QoS, energy management
of mobile ad hoc networks

COB5: To study the current technology trends for the implementation and deployment of mobile ad hoc networks.

MODULE I INTRODUCTION 9

Introduction – Fundamentals of wireless communication technology – The Electromagnetic spectrum – Radio propagation mechanisms – Characteristics of the wireless channel – IEEE 802.11a,b standard – Origin of Ad hoc: Packet radio networks – Technical challenges – Architecture of PRNETs – Components of packet radios – Adhoc wireless networks – Heterogeneity in mobile devices– Wireless sensor networks – Traffic profiles – Types of Ad hoc mobile communications – Types of mobile host movements – Challenges facing Ad hoc mobile networks – Ad hoc wireless internet.

MODULE II ROUTING PROTOCOLS 9

Introduction – Issues in designing a routing protocol for Ad hoc wireless networks – Classifications of routing protocols – Table-Driven routing protocols– Destination Sequenced Distance Vector (DSDV) – Source-Initiated On-Demand approaches – Ad hoc On-Demand Distance Vector Routing (AODV)– Dynamic Source Routing (DSR) –Temporally Ordered Routing Algorithm (TORA) –Location–Aided Routing (LAR) – Power-Aware Routing (PAR) – Zone Routing Protocol (ZRP).

MODULE III MULTICASTING AND SECURITY PROTOCOLS 9

Introduction – Issues in designing a multicast routing protocol – Operation of

multicast routing protocols –Classifications of multicast routing protocols – Tree-Based multicast routing protocols – Mesh-based multicast routing protocols. Security in Ad hoc wireless networks – Network security requirements – Issues and challenges in security provisioning – Network security attacks – Key management – Secure routing in Ad hoc wireless networks.

MODULE IV TRANSPORT LAYER PROTOCOLS 9

Introduction – Issues in designing a transport layer protocol for Ad hoc wireless networks – Design goals of a transport layer protocol for Ad hoc wireless networks –Classification of transport layer solutions – TCP over Ad hoc wireless networks – Other transport layer protocols for Ad Hoc wireless networks.

MODULE V QOS AND ENERGY MANAGEMENT 9

Introduction – Issues and challenges in providing QoS in Ad hoc wireless networks –Classifications of QoS solutions – MAC layer solutions – Network layer solutions–Introduction – Need for energy management in Ad hoc wireless networks – Classification of energy management schemes – Battery management schemes – Transmission power management schemes – System power management schemes.

L – 45; TOTAL HOURS –45

REFERENCES:

1. C.Siva Ram Murthy and B.S.Manoj,"Ad hoc Wireless Networks Architectures and Protocols", 2nd Edition, Pearson Education, ISBN-13: 9780133007060, 2012.
2. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic" Mobile Ad Hoc Networking: The Cutting Edge Directions",2nd Edition, Wiley-IEEE Press, ISBN: 978-1-118-08728-2,2013.
3. Jonathan Loo, Jaime LloretMauri, Jesús Hamilton Ortiz,"Mobile Ad Hoc Networks: Current Status and Future Trends" CRC Press, ISBN 9781439856505,2012.

COURSE OUTCOMES:

CO1: Identify the issues in wireless networks and how they can be addressed. Assess the platform architectures that are suitable for Mobile Adhoc networks.

CO2: An ability to understand and analyze the routing concept of mobile ad hoc network

CO3: Examine the various security threats to ad hoc networks and propose the solutions.

CO4: Analyze the issues in designing the multicasting and security protocols for Mobile Adhoc networks

CO5: An ability to understand the solutions to improve the quality of service in mobile Adhoc network.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2	L													L
CO3		L												M
CO4		M											M	
CO5				M										M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: Design and develop the various industrial projects using Mobile Adhoc Network.

CSEY 012	INFORMATION SECURITY	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To provide an understanding of principal concepts, major issues, technologies and basic approaches in information security.

COB2: To know the legal, ethical and professional issues in Information Security.

COB3: To know the technological aspects of implementation of Information Security.

COB4: To focus on physical security and understand the access models.

COB5: To highlight the salient features of implementation and maintenance of security.

MODULE I INTRODUCTION 9

Introduction - History of Information Security - Need for security - CNSS security model - Components of an information system - Balancing information security and access - System development life cycle - security systems development life cycle - threats - attacks - secure software development-software attacks - Technical hardware failure or errors.

MODULE II PLANNING FOR SECURITY 9

Introduction-Information security planning and governance- Information security policy, standards and practices -Cryptographic tools-protocols for secure communications - Attacks on cryptosystems - Legal, Ethical and Professional issues in Information Security -Laws and Ethics in Information Security.

MODULE III RISK MANAGEMENT 9

Introduction- Risk identification – assessment- control strategies- selecting a risk control strategy – quantitative versus qualitative risk control practices.

MODULE IV SECURITY TECHNOLOGY AND PHYSICAL SECURITY 9

Security Technology - Access Controls, Firewalls and VPNs- Intrusion Detection and prevention systems. Physical Security – Introduction-Physical access controls-Fire Security and safety-Failure of supporting utilities and

structural collapse-Interception of Data-Remote computing security.

MODULE V INFORMATION SECURITY IMPLEMENTATION AND MAINTENANCE **9**

Information security project management-technical aspects of implementation-non technical aspects of implementation- Positioning and staffing the security function. Security Management Maintenance Models-Digital Forensics.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Michael E. Whitman and Herbert J. Mattor., "Principles of Information Security: 6thEdition, Cengage Learning, 2017.
2. John R.Vacca, "Computer and Information Security Handbook**"**, 3rd Edition, Morgan Kaufmann Publishers,2017.
3. Jason Andress,"The Basics of Information Security", 2nd edition, Syngress Press, Elsevier Publications, 2014.

COURSE OUTCOMES:

CO1: Identify the major types of threats to information security and the associated attacks.

CO2: Describe the major components of security and analyze planning, governance, legal and ethical issues of information security.

CO3: Describe firewall technology and the various approaches to firewall implementation.

CO4: Emphasize the relationship between information security and physical security.

CO5: Enumerate the organizational considerations to be addressed in a project plan and describe the maintenance issues of security.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1		L											L	
CO2	L													L
CO3		M											M	
CO4		M												M
CO5				M									H	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Sustainable Industry, innovation and Infrastructure.

Statement: Learning of various information techniques in applied real time application will lead to knowledge required for applying in Computer Science projects.

CSEY 013	RFID AND MICROCONTROLLER	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To Understand the basic building blocks of RFID.

COB2: Familiarize the different kinds of RFID, usage, and deployment details.

COB3: Understand the key factors for RFID deployment.

COB4: To develop real time applications based on microcontrollers

COB5: Analyze different case studies.

MODULE I INTRODUCTION OF RFID 9

Automatic Identification Systems – A Classification of ID systems – Components of an RFID System- Features of RFID systems - Layer by Layer-OSI Model and the RFID Interface.

MODULE II RFID APPLICATIONS 9

Short range RFID applications- access control - personal identification - Transportation ticketing- blood, tissue and organ identification- fleet management- personal identification- car body production-passport security. Long range RFID applications- supply chain management- Mail and shipping- Clothing Tags.

MODULE III MICROCONTROLLERS 8051 9

Intel 8051 - architecture- memory organization- special function registers timing and control- port operation- memory interfacing - I/O interfacing Programming the 8051 resources- interrupts- Measurement of frequency, period and pulse width of a signal- power down operation.

MODULE IV INTEL 8051 MICROCONTROLLER - INSTRUCTION SET AND PROGRAMMING 9

Programmers model of Intel-Operand types- Operand addressing- Data transfer instructions- Arithmetic Instructions - Logic instructions- Control transfer instructions- 8051 Interfacing and applications.

MODULE V CASE STUDIES 9

Reading RFID cards using 8051- RFID in the supply chain- Vehicles parking using RFID- library management system- electronic toll payment smart

shipping containers- fleet monitoring and management.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Ali Miri, “Advanced Security and Privacy for RFID Technologies”, 1st Edition, IGI Global Publisher, 2013.
2. Klaus Finkenzeller, “RFID Handbook”, 3rd Edition, John Wiley & Sons, 2010.
3. Ajit Pal, "Microcontrollers- principles and applications", Prentice Hall of India, 2011.
4. Dennis E. Brown, “RFID implementation” Tata McGraw - Hill, 2007.
5. Syed Ashon Mohammed Ilyas, “RFIDHAND BOOK Applications, Technology”, Security, and Privacy, CRC Press 2008.
6. Steven Shepard, "RFID: Radio frequency and Identification", Tata McGraw - Hill.
7. Krishna Kant. " Microprocessors and Microcontrollers", Prentice hall of India,2011.
8. www.circuitstoday.com/interfacing-rfid-module-to-8051.

COURSE OUTCOMES:

CO1: Understand the basic components and applications of RFID systems.

CO2: Identify how to evaluate a RFID project and create estimation with deployment plans.

CO3: Describe Interfacing mechanism and frequency ranges of RFID systems.

CO4: Explore the data transformation procedure with microcontroller.

CO5: Evaluate the key factors for RFID deployment and business process adaption.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2	L													L
CO3		L												L
CO4			M										M	
CO5				M										M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation.

Statement: By learning RFID and Microcontroller the students are able to design the architecture of a system refers to its structure in terms of separately specified components of that system and their interrelationships.

CSEY 014	MOBILE AND WIRELESS NETWORK	L	T	P	C
SDG: 9	SECURITY	3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the concepts of wireless and mobile network security.

COB2: To Provide security for mobile telecommunication networks

COB3: To learn the security issues in IP based mobile networks

COB4: To discuss the security mechanism followed in adhoc and sensor networks.

COB5: To expose students to emerging technologies of mobile and wireless networks.

MODULE I INTRODUCTION 9

Introduction to Mobile and Wireless Networks - Mobile cellular networks - IEEE wireless networks - Mobile Internet networks - Vulnerabilities of Wired and Wireless Networks-Security in the digital age -Threats and risks to telecommunications systems-From wireline vulnerabilities to vulnerabilities in wireless communications.

MODULE II WIFI AND BLUE TOOTH SECURITY 9

Wi-Fi Security Dedicated Architectures-Hot spot architecture: captive portals - Wireless intrusion detection systems (WIDS)- Wireless honeypots-Bluetooth Security-Bluetooth technical specification - Bluetooth security - Wi-Fi Security-Attacks on wireless networks-Security in the IEEE 802.11 standard. Security in 802.1x-Security in 802.11i-Authentication in wireless networks - WiMAX Security.

MODULE III SECURITY IN MOBILE TELECOMMUNICATION NETWORKS 9

Signaling - Security in the GSM-GPRS security-3G security - Network interconnection - Security of Downloadable Applications.

MODULE IV EMERGING TECHNOLOGIES 9

Security in Next Generation Mobile Networks-SIP- VoIP-IP Multimedia Subsystem (IMS)- 4G security – Confidentiality-Security of IP-Based Mobile Networks - Security in Ad Hoc Networks- Wireless Sensor Network Security.

MODULE V **RESEARCH DIRECTIONS IN SECURITY AND PRIVACY FOR MOBILEAND WIRELESS NETWORKS** **9**

Security and Privacy in 4G/LTE Network-Security for 5G Mobile Wireless Networks-Attacks and Security Services in 5G Wireless Networks-Security Services in 5G Wireless Networks -State-of-the-Art Solutions in 5G Wireless Security-Security for Technologies Applied to 5G Wireless Network Systems-Challenges and Future Directions for 5G Wireless Security.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. Georgios Kambourakis, Felix Gomez Marmoland GuojunWang, Security and Privacy in Wireless and Mobile Networks, Future Internet,MDPI, 2018.
2. Dongfeng Fang, Yi Qian,,RoseQingyang Hu,, Security for 5G Mobile Wireless Networks-IEEE Access, 2017.
3. HakimaChaouchiMaryline Laurent-Maknavicius, “Wireless and Mobile Network Security Security Basics, Security in On-the-shelf and Emerging Technologies”, Wiley, 2009.
4. S. Kami Makki,Peter Reiher,Kia Makki,Niki Pissinou,ShamilaMakki, “Mobile and Wireless Network Security and Privacy”, Springer, 2007.
5. Lei Chen Jiahuang Ji Zihong Zhang, Wireless Network Security Theories and Applications, Springer, 2013.
6. NourMoustafa, JiankunHu,Security and Privacy in 4G/LTE Network, Research Gate, 2018.

COURSE OUTCOMES:

CO1: Gain knowledge on the concepts of wireless and mobile network
security.

CO2: Analyze the different security threats in Wifi, Bluetooth and wimax.

CO3: Identify the various security risks in mobile telecommunication networks.

CO4: Investigate the solutions for security threats to ad hoc networks and sensor networks.

CO5: Get the knowledge on different attacks and security services in future generation mobile wireless and mobile networks.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1														
CO2														
CO3														
CO4														
CO5														

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation.

Statement: By learning mobile and wireless technology for the students are able to design the architecture of a system refers to its structure in terms of separately specified components of that system and their interrelationships.

CSEY 015	CLOUD ARCHITECTURE AND	L	T	P	C
SDG: 8	COMPUTING	3	0	0	3

COURSE OBJECTIVES:

COB1: To teach about the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges.

COB2: To List type of cloud services and Cite Application of Cloud strategies for SaaS, PaaS, IaaS, DBaaS and Xaas. Discuss functional implementation of each of the above-mentioned cloud delivery model.

COB3: To Recognize steps and processes used to perform an audit assessment of a cloud computing environment.

COB4: To Compare and contrast the economic benefits delivered by various cloud models based on application requirements, economic constraints and business requirements.

COB5: To Analyze the components of cloud computing showing how business agility in an organization can be created.

MODULE I INTRODUCTION 9

Recent trends in Computing- Evolution of cloud computing - Business driver for adopting cloud computing-Introduction to Cloud Computing (NIST Model) - Cloud service providers - Benefits of Cloud Computing-Cloud Computing Architecture -Cloud computing stack -Role of Networks in Cloud Computing-Service Models -Deployment Models.

MODULE II CLOUD SERVICE MODELS 9

Introduction to IaaS-Resource Virtualization: Server, Storage, Network-Data storage in cloud computing (storage as a service)-Platform as a Service (PaaS)-What is PaaS, Service Oriented Architecture (SOA)-Cloud Platform and Management-Software as a Service (PaaS) -Web services.

MODULE III CLOUD SERVICE MANAGEMENT 9

Service Level Agreements (SLAs)-Billing & Accounting-Comparing Scaling Hardware: Traditional vs. Cloud-Economics of scaling: Benefitting Enormously-Managing Large Scale Data Processing.

MODULE IV CLOUD SECURITY 9

Infrastructure Security-Network level security, Host level security, Application

level security -Data privacy and security Issues, Jurisdictional issues raised by Data Location-Trust, Reputation, Risk-Authentication in cloud computing-Cloud contracting Model, Commercial and business considerations.

MODULE V DESIGN OF EXPERIMENTS 9

Analysis of Case Studies when deciding to adopt cloud computing architecture. How to decide if the cloud is right for your requirements. Cloud based service, applications and development platform deployment so as to improve the total cost of ownership (TCO).

L – 45; TOTAL HOURS –45

REFERENCES:

1. Barrie Sosinsky“Cloud Computing Bible”,1st Edition, Wiley-India, 2010ISBN-13: 978-0470903568.
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski” Cloud Computing: Principles and Paradigms “first edition, Wiley, 2011.
3. Nikos Antonopoulos, Lee Gillam“Cloud Computing: Principles, Systems and Applications” Springer, 2012.
4. Ronald L. Krutz, Russell Dean Vines“Cloud Security: A Comprehensive Guide to Secure Cloud Computing” Wiley-India, 2010.

COURSE OUTCOMES:

CO1: Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure

CO2: Classify security and privacy issues in cloud computing.

CO3: Investigate the performance, scalability, and availability of the underlying cloud technologies and software.

CO4: Design & develop backup strategies for cloud data based on features.

CO5: Recognize the importance of protocols and standards in management for cloud services.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2
CO1			L											L
CO2		L											L	
CO3			M										L	
CO4	M												M	
CO5		M												M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: By learning “cloud architecture and computing”, the students will be able to discuss economic models and future visions of economy and society critically and to communicate them in public spheres.

CSEY 016	KNOWLEDGE ENGINEERING AND	L	T	P	C
SDG: 4	EXPERT SYSTEMS	3	0	0	3

COURSE OBJECTIVES:

COB1: To Identify the knowledge of engineering.

COB2: To learn the concepts of knowledge base and information management.

COB3: To discuss the expert systems.

COB4: To explaining architecture of expert system.

COB5: To understanding the programming language with expert systems.

MODULE I INTRODUCTION OF KNOWLEDGE ENGINEERING 9

Trends in Knowledge of Engineering: Introduction to knowledge engineering - Limitations and Possibilities of knowledge engineering - Business Management Styles - Management Styles and Information Technology - Management Source of Information - Information Processing - Multidimensional Management Systems (MMS) – Computer-Aided Decision-Making (CAD) - Organization Marketing - Virtual Management - Computer-Aided Management and Communications.

MODULE II ISSUES IN KNOWLEDGE ENGINEERING AND EXPERT SYSTEM 9

Problem solving strategies - Knowledge Information Engineering Workbench - The Systematic-Intuitive Approach - Information Engineering Workbench - Language and Perceptual Models - Standards of expert system - Inference-Reasoning and Knowledge Acquisition.

MODULE III PROBLEM SOLVING PROCESS 9

Rule Based Systems – Heuristic Classifications – Constructive Problem Solving.

MODULE IV EXPERT SYSTEMS 9

Tools for Building Expert Systems - Case Based Reasoning – Semantic of Expert Systems – Modeling of Uncertain Reasoning – Applications of Semiotic Theory - Designing for Explanation.

MODULE V EXPERT SYSTEM ARCHITECTURE AND PROGRAMMING 9

Expert System Architectures - High Level Programming Languages – Logic Programming for Expert Systems.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. By Thomas B. Cross, “Knowledge Engineering 2017 The Uses of Artificial Intelligence in Business”, TECHtionary Corporation, 2017.
2. Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education 2007.
3. Jean-Louis Ermine, “Expert Systems: Theory and Practice”, 4th printing, Prentice-Hall of India, 2001.
4. Padhy N.P, “Artificial Intelligence and Intelligent Systems”, 4th impression, Oxford University Press, 2007.
5. Robert I. Levine, Diane E. Drang, Barry Edelson: “AI and Expert Systems: a comprehensive guide, C language”, 2nd edition, McGraw-Hill 1990.

COURSE OUTCOMES:

CO1: Apply knowledge in logical form and construct ontology for different domains.

CO2: Identified the knowledge engineering issues and implement the workbench process.

CO3: Analyze the classification and constructive problem solution.

CO4: Tools identification of expert system.

CO5: Understand the flow of expert system architecture and programming logic in expert system.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1			M											L
CO2		M											L	
CO3	L													M
CO4		M											L	
CO5			M											M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 4: Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Statement: The real-world problems persist and different types of data sets help in understanding the nature of the problems at a profounder level. By observing the problems in depth, it helps to come up with a feasible solution thereby providing way for lifetime learning opportunities for everyone.

CSEY 017	AGENT-BASED	L	T	P	C
SDG: 9	INTELLIGENTSYSTEMS	3	0	0	3

COURSE OBJECTIVES:

COB1: To provide basic knowledge of employing intelligent agents in solving complex problems.

COB2: To give the awareness of the building blocks of agents and working of different types of agents.

COB3: To analyze the reasons for uncertainty and ability to design agents to handle them.

COB4: To represent knowledge in first order and predicate logic.

COB5: To study the employment of artificial intelligence in recent technologies.

MODULE I INTRODUCTION 9

Introduction to agent based intelligent systems – structure – Environment – Basic problem solving agents – Formulating – Search strategy – Intelligent search – Game playing as search.

MODULE II INTELLIGENT AGENT 9

Intelligent Agent – rational agent – task environment and its properties – Types of Agent – Constraint Satisfaction Problem – Backtracking search for CSP – Forward checking – Intelligent backtracking.

MODULE III KNOWLEDGE BASED AGENTS 9

Knowledge Representation – Logic – Propositional logic – Predicate logic - First Order Logic – Unification and lifting – Representation of knowledge using rules – Uncertain knowledge and reasoning – Probabilistic reasoning

MODULE IV PLANNING AND LEARNING 9

Planning Problem – Planning Agent – Planning language – Hierarchical Planning – Knowledge based planning – Multi agent planning – Learning – Scope of Machine learning – Learning Methods and models – Artificial Neural Network based learning – Multi agent-based Learning.

MODULE V RECENT TRENDS WITH ARTIFICIAL INTELLIGENCE 9

Architecture of expert system – Knowledge Acquisition – Natural Language Processing – Fuzzy and hybrid Intelligence system –Cloud Computing and

Intelligent agents – Business Intelligence and analytics – Big Data and sensory Processing.

L – 45; TOTAL HOURS –45

REFERENCES:

1. ParagKulkarni, Prachi Joshi, “Artificial Intelligence: Building Intelligent Systems, 1st Edition, PHI,2015.
2. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Prentice Hall, 2010.
3. NgoocThanhNguyaaen, Lakhmi C. Jain, “Intelligent Agents in the Evolution of Web and Applications”, 4th Edition, Springer, 2009.
4. ZiliZhang,Chengqi Zhang, “Agent-Based Hybrid Intelligent Systems: An Agent-Based Framework for Complex Problem Solving”, 1st Edition, Springer-Verlag New York, LLC , 2004.

COURSE OUTCOMES:

CO1: Differentiate the types of agents and learn how to apply them in different problem based on requirements.

CO2: Explain the basic knowledge representation, problem solving, and learning methods of Artificial Intelligence

CO3: Explore the scenarios of uncertainty and design planning agents
to handle them.

CO4: Aability to apply knowledge representation, reasoning, and machine learning techniques to real-world problems

CO5: ApplyArtificial Intelligence techniques in the cuttingedge technologies such as cloud computing and Big data.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1			L											L
CO2	L												L	
CO3	M												M	
CO4		M												M
CO5			M										M	

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: The various industrial standards intelligence system used for technical drawing and the application of orthographic projections to draw simple solids helps to innovate a new design for sustainable industrialization

CSEY 018	DEEP LEARNING TECHNIQUES	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the basic architecture and statistical approaches for spoken language processing.

COB2: To illustrate how these models are applied to speech recognition and speaker verification.

COB3: To provide knowledge on training the networks constructed based on the mathematical models.

COB4: To introduce Deep Neural Network for modeling complex patterns of speech.

COB5: To provide an overview on advanced deep models for speech recognition.

MODULE I INTRODUCTION 9

Introduction–Deep learning – Advantages of deep Learning – Types of deep learning techniques – Machine learning vs Deep learning – Deep learning algorithms – Convolution Neural Network.

MODULE II TRANING NETWORK 9

Neural Networks – Architecture -Parameter Estimation – Practical Considerations Restricted Boltzmann Techniques - ODeep Belief Network – Discriminative Pretraining-Hybrid and Dropout Pretraining.

MODULE III NETWORK MODEL 9

DNN-HMM Hybrid System -Key components – Training and Decoding Speedup Sequence Discriminative Training Criteria-Practical Considerations -Noise Estimation.

MODULE IV REPRESENTATION OF LEARNING NETWORK 9

Feature Representation Learning in Deep Neural Network –Deep Neural Network Fuse Deep Neural Network -Gaussian Mixture Model Systems-Adaptation of Deep Neural Networks.

MODULE V ADVANCED DEEP MODELS 9

Representation Sharing and Transfer – Multiobjective Training of Neural Network for speech recognition-Multilingual and Cross Lingual Speech Recognition-Robust Speech Recognition Exploiting – Recurrent Neural Network-Related Models – Computational Network.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. Dong Yu, Li Deng, “Automatic Speech Recognition: A Deep Learning Approach”, Springer, ISBN: 978-1-4471-5778-6, 2015.
2. Jack Hollingum, Graham Cassford, “Speech Technology at Work”, Springer, ISBN: 978-3-662-13012-4, 2013.
3. Tuomas Virtanen, Rita Singh, Bhiksha Raj, “Techniques for Noise Robustness in Automatic Speech Recognition”, Wiley, ISBN: 978-1-11997088-0, 2013.

COURSE OUTCOMES:

CO1: Apply appropriate mathematical model for the processing the speech.

CO2: Build a complete speech recognition system using the various techniques.

CO3: Apply speech recognition system in areas like military, healthcare, etc.

CO4: Resolve the issues in speech recognition using the various methods.

CO5: Authenticate the identity of the speaker using deep neural network models.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2		M												M
CO3	L												M	
CO4		L												L
CO5			L										M	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: Design and develop the various industrial projects using Convolutional Neural Network and Recurrent Neural Network.

CSEY 019	DISTRIBUTED SYSTEMS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the foundations of distributed systems.

COB2: To learn issues related to clock Synchronization and the need for
global state in distributed systems.

COB3: To learn distributed mutual exclusion and deadlock detection algorithms.

COB4: To understand the significance of agreement, fault tolerance and
recovery protocols in Distributed Systems.

COB5: To learn the characteristics of peer-to-peer and distributed shared memory systems.

MODULE I INTRODUCTION 9

Introduction: Relation to computer system components –Motivation –Relation to parallel systems – Message-passing systems versus shared memory systems –Primitives for distributed communication –Synchronous versus asynchronous executions –Design issues and challenges. A model of distributed computations: A distributed program –A model of distributed executions –Models of communication networks –Global state – Cuts –Past and future cones of an event –Models of process communications. Logical Time: A framework for a system of logical clocks –Scalar time –Vector time – Physical clock synchronization: NTP.

MODULE II MESSAGE ORDERING & SNAPSHOTS 9

Message ordering and group communication: Message ordering paradigms – Asynchronous execution with synchronous communication –Synchronous program order on an asynchronous system –Group communication – Causal order (CO) - Total order. Global state and snapshot recording algorithms: Introduction –System model and definitions –Snapshot algorithms for FIFO channels.

MODULE III DISTRIBUTED MUTEX & DEADLOCK 9

Distributed mutual exclusion algorithms: Introduction – Preliminaries – Lamport‘s algorithm – RicartAgrawala algorithm – Maekawa‘s algorithm – Suzuki–Kasami‘s broadcast algorithm. Deadlock detection in distributed

systems: Introduction – System model – Preliminaries – Models of deadlocks – Knapp‘s classification – Algorithms for the single resource model, the AND model and the OR model.

MODULE IV RECOVERY & CONSENSUS 9

Checkpointing and rollback recovery: Introduction – Background and definitions – Issues in failure recovery – Checkpoint-based recovery – Log-based rollback recovery – Coordinated checkpointing algorithm – Algorithm for asynchronous checkpointing and recovery. Consensus and agreement algorithms: Problem definition – Overview of results – Agreement in a failure – free system – Agreement in synchronous systems with failures.

MODULE V P2P & DISTRIBUTED SHARED MEMORY 9

Peer-to-peer computing and overlay graphs: Introduction – Data indexing and overlays – Chord – Content addressable networks – Tapestry. Distributed shared memory: Abstraction and advantages – Memory consistency models – Shared memory Mutual Exclusion.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. Kshemkalyani, Ajay D., and Mukesh Singhal. Distributed computing: principles, algorithms, and systems. Cambridge University Press, 2011.
2. George Coulouris, Jean Dollimore and Tim Kindberg, ―Distributed Systems Concepts and Design‖, Fifth Edition, Pearson Education, 2012
3. Pradeep K Sinha, “Distributed Operating Systems: Concepts and Design”, Prentice Hall of India, 2007.

COURSE OUTCOMES:

CO1: Elucidate the foundations and issues of distributed systems

CO2: Understand the various synchronization issues and global state for distributed systems.

CO3: Understand the Mutual Exclusion and Deadlock detection algorithms in distributed systems

CO4: Describe the agreement protocols and fault tolerance mechanisms in distributed systems.

CO5: Describe the features of peer to peer and distributed shared memory systems.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	M	L											M	
CO2	M	L											H	
CO3	H	M	L	L									H	L
CO4	H	M	L	L									H	L
CO5	H	M	L	L									H	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Able to apply and Understand foundations of Distributed Systems, peer to peer services and file system.

CSEY 020	ADVANCED GRAPH THEORY	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the students to graphs and their properties.

COB2: To comprehend graphs as modelling and analysis tool

COB3: To explore modern applications of graph theory.

COB4: To introduce various data structures with graph theory

COB5: To investigate the applications of graphs in solving engineering problems.

MODULE I ALGEBRAIC GRAPH THEORY 9

Linear Recurrences for Graph -Coefficient Interpretation – Hoffman Theorem – Counting Directed Spanning Trees.

MODULE II LABELLING 9

Predecessor and Successor – Algorithm – Graceful Labeling Sequential functions - Magic graphs – Conservative graphs**.**

MODULE III EXPONENTIAL ALGORITHMS 9

Domatic Partition – Inclusion and exclusion- Set Cover – Dominating Set – Subset Sum- Three coloring problem.

MODULE IV GRAPH CLASSES 9

Perfect Graph – Cographs – Distance Hereditary Graphs –Chordal Graphs – Interval Graphs – Permutation Graphs.

MODULE V MATCHING AND COVERING: 9

Matching in bipartite graphs - Konig's theorem, Hall's marriage theorem. Matching in general graphs - Tutte's theorem. Path covers - Gallai-Milgram theorem - Dilworth theorem.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Ping Zhang, Jay Yellen, Jonathan L. Gross," Handbook of Graph Theory‖, ", Chapman and Hall/CRC, 2nd Edition, ISBN: 9781439880197, 2015.

REFERENCES:

1. Michel Rigo," Advanced Graph Theory and Combinatorics", Wiley & Sons, ISBN: 9781848216167, 2016.
2. Martin Charles, "Algorithmic Graph Theory and Perfect Graphs", North Holland, 2nd Edition, ISBN: 9780444515308, 2004.

COURSE OUTCOMES:

CO1: Formulate real time problems in terms of graphs.

CO2: Apply concepts of graph theory in real time problems.

CO3: Integrate core theoretical knowledge of graph theory to solve problems.

CO4: Analyze new networks using the main concepts of graph theory.

CO5: Apply theories and concepts to test and validate independent mathematical thinking in problem solving.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1														
CO2		H	H										H	
CO3													H	
CO4														
CO5				H										M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Intelligent use of graph theory concepts in real time applications can utilize the power of data to provide optimized solution.

PROGRAMME ELECTIVE (SEMESTER III)

CSEY 021	STATISTICS FOR BUSINESS ANALYTICS	L	T	P	C
SDG: 8		3	0	0	3

COURSE OBJECTIVES:

COB1: To elucidate the theoretical aspects of Business Analytics Process.

COB2: To expose to the importance of resource considerations to support Business Analytics.

COB3: To accumulate knowledge of aligning resources to support Business Analytics within an organization.

COB4: To demonstrate the necessary visualizing and exploring data.

COB5: To develop the ability to design implement and validate the forecasting Models.

MODULE I INTRODUCTION 9

Business Analytics Process–Relationship of BA Process and Organization Decision-Making Process – Importance of Business Analytics – Business Analytics Personnel- Business Analytics Data.

MODULE II ORGANIZATION STRUCTURES AND DESCRIPTIVE ANALYTICS 9

Organization Structures Aligning Business Analytics– Management Issues – Descriptive Statistics– Sampling and Estimation- Probability Distributions- Descriptive Analytics Step in the BA Process.

MODULE III PREDICTIVE ANALYTICS 9

Predictive Modeling– Logic-Driven Models- Data-Driven Models-Data Mining – Data Mining Methodologies– Predictive Analytics Analysis- Case Study.

MODULE IV PRESCRIPTIVE ANALYTICS 9

Prescriptive Modeling– Nonlinear Optimization- Marketing/Planning Case Study- Prescriptive Analysis.

MODULE V BUSINESS ANALYTICS CASE PROBLEM 9

Descriptive Analytics Analysis– Developing the Forecasting Models– Selecting and Developing an Optimization Shipping Model– Business Performance Improvement– Statistical Testing- Duality and Sensitivity Analysis in Linear Programming- Simple Regression Model- Decision Theory.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson,“Essentials of Business Analytics”, Cenage Learning, 2nd Edition, ISBN-13: 978-1-305-62773-4, 2016.
2. Marc J. Schniederjans Dara G. Schniederjans Christopher M. Starkey, “Business Analytics Principles, Concepts, and Applications”, Pearson Education Inc, 2014, ISBN-13: 978-0-13-355218-8.
3. Kush R Varshney, “Introduction to Business Analytics”, Business Analytics and Mathematical Sciences Department, IBM Thomas J Watson Research Center,IBM Corporation, 2012.

COURSE OUTCOMES:

CO1: Comprehend and compare the differentconcepts of business analytics.

CO2: Design models to reflect alignment of resources to support business analytics within an organization.

CO3: apply the various business analytics models.

CO4: Evaluate research articles and thus be aware of the research front in predictive analytics.

CO5: Explore and use an appropriate forecasting model for real time case studies.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2			L											M
CO3		L												L
CO4			M											M
CO5				M									M	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: By learning “Business Analysis”, the students are able to develop and evaluate ideas for sustainability-driven innovation and entrepreneurship.

CSEY 022	COMPUTER VISION AND IMAGE	L	T	P	C
SDG: 9	PROCESSING	3	0	0	3

COURSE OBJECTIVES:

COB1: Know the fundamental techniques for image processing, video processing, and computer vision.

COB2: Understand the basics camera processing techniques.

COB3: Acquire the basic skill of designing image transformation

COB4: Familiarize himself/herself with image/video compression standards.

COB5: Understand the computer vision modelling techniques**.**

MODULE I IMAGE PROCESSING OVERVIEW 9

Digital Image Formation and low-level processing: Overview and State-of-the-art, Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, etc. Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

MODULE II CAMERA PROCESSING 9

Depth estimation and Multi-camera views, Multiple View Geometry Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

MODULE III IMAGE TRANSFORMATION 9

Feature Extraction Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.

MODULE IV COMPUTER VISIONS 9

Image Segmentation Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection. Pattern Analysis Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

MODULE V COMPUTER VISION MODELING 9

Motion Analysis Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation. Shape from X Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 4th Edition, Pearson, 2018.
2. William K. Pratt, Digital Image Processing, 4th Edition, John Wiley, 2007.
3. Maria Petrou and Panagiota Bosdogianni, “Image Processing: The Fundamentals”, 2nd edition, John Wiley, 2010.
4. Kenneth R. Castleman, “Digital Image Processing”, 2nd Edition, Pearson, 2010.
5. Forsyth and Ponce, “Computer Vision – A Modern Approach”, Second Edition, Prentice Hall, 2011.
6. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011.
7. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis and Machine Vision”, Third Edition, CL Engineering, 2013.

COURSE OUTCOMES:

CO1: Describe the basic concepts of image processing with mathematical interpretation.

CO2: Apply the knowledge of different image enhancement, and image registration techniques.

CO3: Demonstrate the various image segmentation and morphological operations for partition of objects.

CO4: Describe the fundamental concepts of various feature extraction techniques and recognize the image scene from image feature.

CO5: Analyze and implement image processing techniques for various real-time applications such as industry, medicine and defense.

Board of Studies (BoS):	**Academic Council:**
20th BoS of Department of CSE held on 16.08.2022	19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2		L											L	
CO3			M											L
CO4			M											M
CO5				M										M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Intelligent use of computer visions and image processing concepts in real time applications can utilize the power of real time data to provide optimized solution.

CSEY 023	FOUNDATIONS OF BLOCK CHAIN	L	T	P	C
SDG: 9	TECHNOLOGY	3	0	0	3

COURSE OBJECTIVES:

COB1: To learn the block chain basic technologies work.

COB2: To identify the block chain networking mechanisms.

COB3: ToDesign, build, and deploy smart contracts and distributed applications

COB4: To understand the cryptocurrency technology and its mechanism.

COB5: Integrate ideas from block chain technology into their own projects.

MODULE I INTRODUCTION 9

Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

MODULE II BLOCKCHAIN TECHNOLOGY 9

Introduction, Advantage over conventional distributed database, Block chain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Block chain application, Soft & Hard Fork, Private and Public block chain.

MODULE III DISTRIBUTED CONSENSUS

Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

MODULE IV CRYPTOCURRENCY TECHNOLOGIES

History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin.

MODULE V REGULATIONS OF CRYPTOCURRENCY AND APPLICATIONS

Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical

Record Management System, Domain Name Service and future of Block chain.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

REFERENCES:

1. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
2. D. Drescher, Blockchain Basics. Apress, 2017.

COURSE OUTCOMES:

CO1: Understand and explore the working of Blockchain technology.
CO2: Analyze the working of Smart Contracts.
CO3: Understand and analyze the working of Cryptocurrency.
CO4: Evaluate security, privacy, and efficiency of a given blockchain system.
CO5: Create a real time application using blockchain technology.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2		L												L
CO3			L											L
CO4		M											M	
CO5			M										M	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.
Statement: Intelligent use of blockchain concepts in real time applications can utilize the power of real time data to provide optimized solution.

CSEY 024	CYBER LAWS AND INTELLECTUAL	L	T	P	C
SDG: 9	PROPERTY RIGHTS	3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the origin and development of cyber laws.

COB2: To understand the various rules and procedures for the applicability of the cyber laws with reference and domestic and international laws.

COB3: To understand the contemporary issues and challenges in cyber laws.

COB4: To learn the intellectual property rights.

COB5: To identify the real time software intellectual property rights.

MODULE I INTRODUCTION 9

Conceptual and theoretical perspective of Cyber Law - Computer and Web Technology - Development of Cyber Law – National and International Perspective Cyber Law - Legal Issues and Challenges in India, USA and EU Data Protection - Cyber Security.

MODULE II INTERNATIONAL PERSPECTIVES 9

International Perspectives - Budapest Convention on Cybercrime - ICANN's core principles and the domain names disputes - Net neutrality - EU electronic communications regulatory framework - Web Content Accessibility Guidelines (WCAG).

MODULE III SOFTWARE - IPR 9

Copyrights- Software – Copyrights vs Patents debate - Authorship and Assignment Issues - Copyright in Internet - Multimedia and Copyright issues - Software Piracy - Trademarks - Trademarks in Internet – Copyright and Trademark cases.

MODULE IV CYBER LAW AND IPR

Cyber Law and IPRs - Understanding Copy Right in Information Technology - Software - Copyrights Vs Patents debate- Authorship and Assignment Issues - Copyright in Internet - Multimedia and Copyright issues - Software Piracy – Patents - Understanding Patents - European Position on Computer related Patents - Legal position of U.S. on Computer related Patents - Indian Position on Computer related Patents –Trademarks - Trademarks in Internet - Domain name registration - Domain Name Disputes & WIPO - Databases in Information Technology - Protection of databases - Position in USA, EU and

India.

MODULE V E-COMMERCE 9

E-Commerce - UNCITRAL Model - Legal aspects of E-Commerce - Digital Signatures - Technical and Legal issues - E-Commerce, Trends and Prospects - Etaxation, E-banking, online publishing and online credit card payment - Employment Contracts – Non-Disclosure Agreements - Shrink Wrap Contract -Source Code - Escrow Agreements, etc.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing, UP, 2016.
2. Farouq Ahmed, Cyber Law in India, Allahabad Law Agency, 2015.
3. Karnika Seth, Computers, Internet and New Technology Laws-A Comprehensive Reference Work with Special Focus On Developments In India, LexisNexis, Nagpur, 2016.
4. Kamath Nandan: Law relating to Computer, Internet and E-Commerce, Universal Law Publishing, UP, 2007.
5. N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property (2009), Eastern Book Company, Lucknow.

COURSE OUTCOMES:

CO1: Learn the conceptual and theoretical perspective of cyber laws.
CO2: Understand the international development of cyber laws.
CO3: Understand the legalities through analysis of IT Act.
CO4: Understand the relation between IPR laws.
CO5: Understand the importance of E-commerce.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1		L											L	
CO2	L													L
CO3			M										M	
CO4				M										M
CO5			M										H	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Identify, design and development of various industrial laws using IPR.

CSEY 025	SECURITY OF E-BASED SYSTEMS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To discuss the basic security principles and standards particular to E-based applications.

COB2: To introduce the technology and principles for the design and implementation of secure E-based system.

COB3: To enable to evaluate the security and performance of security
algorithms in E-commerce systems.

COB4: To learn the E-payment transaction technologies.

COB5: To understand the E-learning security.

MODULE I E-System and E-Healthcare 9

Evolution of Commerce -Payment Modes and Methods - Distributed Computing Environment Cloud Security- Mobile Commerce Vs. E – Commerce- Web Commerce Security Requirements - E-Commerce Security -Risk Driven Security- Scalable Security Securing Transactions. E-Healthcare - Information Breaches of Privacy and Confidentiality in E-Healthcare Utilization Challenge - Legal Protection Challenge.

MODULE II E-Payments 7

Electronic Payments: Overview, SET Protocol, Payment Gateway, Certificates, Digital Token, Smart Cards, Credit Cards, Magnetic Strip Cards, E-Checks, Credit/ Debit Card EPS, Dash. Online Payments: Mobile Payments, Online Banking, Emerging Financial Instruments - Application in Business, E-Commerce Laws, Forms of Agreement, Government Policies and Agenda, Secured Online Shopping and Payment - Threats and Attacks Certification and Accreditation Process for Web Commerce Applications.

MODULE III Privacy And Confidentiality 8

Anonymization and Pseudo-Anonymization Secure E-Healthcare Information Systems Elements Security and Privacy Provisions Electronic Personal Health Care Records Clinical Decision Support Systems.

MODULE IV E-Governance Security 9

Introduction - Secure and Interoperable e-Government Services- Trust Models Dos Attacks on E-Government Services- Certificate Management - Interoperability- Privacy Enabled Identity Management- E-Government

Architecture- Anonymous and Accurate E-Polling- Secure Multiparty/Multi Candidate Electronic Elections.

MODULE V E-Learning Security 12

Introduction Security Attacks in E-Learning Modeling Security Services Real E-Learning Scenarios Secure Learning Management Systems Security in Collaborative Learning, Mobile Learning, Massive Open Online Courses (MOOC) - Trustworthiness for Secure Collaborative Learning Model Factors and Rules - Assessment Case Study.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. H. Nahari and R. L. Krutz, Web Commerce Security: Design and Development. Indianapolis: Wiley, John Sons, 2011. (ISBN No. : 978-0-470-62446-3)
2. A. Shoniregun, K. Dube, and F. Mtenzi, Electronic Healthcare Information Security. New York: Seacaucs, New Jersey, U.S.A.: Springer-Verlag New York, 2010. (ISBN No. : 978-0-387-84817-4)
3. A. Mitrakas, P. Hengeveld, and D. Polemi, Eds., Secure e-Government Web Services. United States: IGI Global, United States, 2006. (ISBN No. : 978-1-59-904138-4)
4. M. Jorge, S. Caballe, and F. Xhafa, Intelligent Data Analysis for e-Learning: Enhancing Security and Trustworthiness in Online Learning Systems. United States: Morgan Kaufmann Publishers In, 2016. (ISBN No. : 978-0-12-804535-0)

REFERENCES:

1. M. S. Obaidat and N. A. Boudriga, Security of E-Systems and Computer Networks. Cambridge: Cambridge University Press, 2007. (ISBN No.: 978-3-66-244787-1)
2. K. Stanoevska-Slabeva, Towardsthe e-Society: e-Commerce, e-Business, and e-Government. Kluwer Academic Publishers, 2001. (ISBN No. : 978-0-306-47009-7)

COURSE OUTCOMES:

CO1: Describe security features needed for an e-based system.

CO2: Understand the security breaches and possible solutions for a robust e-based system.

CO3: Identify the inner-workings of payment protocols, file transfer protocols, and related algorithms

CO4: Understand the E-governance security and its terminologies.

CO5: Identify the E-learning security and implementation levels.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2	L												L	
CO3		L												M
CO4			L											M
CO5				L									M	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Identify, design and development of various industrial law-based E-Learning, E-Security and E-Transactions system.

CSEY 026	ADVANCED SOFTWARE PROJECT MANAGEMENT	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand Software Engineering Lifecycle Models

COB2: To do project management and cost estimation.

COB3: To gain knowledge of the System Analysis and Design concepts.

COB4: To understand software testing and DevOps approaches.

COB5: To be familiar with agile software development practices.

MODULE I INTRODUCTION 9

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

MODULE II SOFTWARE REQUIREMENT SPECIFICATION 9

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modeling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modeling – Data Flow Diagram.

MODULE III ARCHITECTURE AND DESIGN 9

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered – Client- server - Tiered - Pipe and filter- User interface design.

MODULE IV TESTING & DEVOPS 9

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking - DevOps: Motivation- Cloud as a platform - Operations- Deployment Pipeline: Overall Architecture - Building and Testing-Deployment- Case study: Migrating to Microservices.

MODULE V AGILE METHODOLOGY & PROCESSES 9

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 documentation – agile drivers, capabilities and values - Lean production - SCRUM, Crystal, Feature Driven Development, Adaptive Software Development, and Extreme Programming: Method overview – lifecycle – work products, roles and practices.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. Len Bass, Ingo Weber and Liming Zhu, DevOps: A Software Architect's Perspectiveǁ, Pearson Education, 2016
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2nd edition, PHI Learning Pvt. Ltd., 2010.
3. Rajib Mall, Fundamentals of Software Engineering, 3rd edition, PHI Learning Pvt. Ltd., 2009.
4. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), -Agile Software Development, Current Research and Future Directionsǁ, Springer-Verlag Berlin Heidelberg, 2010.
5. Craig Larman, - Agile and Iterative Development: A managers Guideǁ, Addison-Wesley, 2004.

COURSE OUTCOMES:

CO1: Understand the advantages of various Software Development Lifecycle Models

CO2: Gain knowledge on project management approaches as well as cost

and schedule estimation strategies.

CO3: Understand the Mutual Exclusion and Deadlock detection algorithms in distributed systems

CO4: Apply software testing and DevOps practices

CO5: Theknow importance of interacting with business stakeholders in determining the requirements for a software system.

Board of Studies (BoS):	**Academic Council:**
20th BoS of Department of CSE held on 16.08.2022	19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	M	L											M	
CO2	M	L											H	
CO3			L							L				L
CO4			M			M								L
CO5										M			H	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Able to understand iterative software development process and impact of social aspects on software development success.

CSEY 027	STATISTICAL NATURAL LANGUAGE	L	T	P	C
SDG: 8	PROCESSING	3	0	0	3

COURSE OBJECTIVES:

COB1: To learn the concepts of speech processing and synthesis.

COB2: To gain knowledge on syntax and semantics in NLP.

COB3: To explain various statistical methods for language processing.

COB4: To explore the language processing in real world application.

COB5: To trace the statistical approaches used in natural language processing.

MODULE I WORD AND SPEECH 9

Regular Expressions and Automata - Words and Transducers - N-grams – Partof-Speech Tagging - Hidden Markov and Maximum Entropy Models.

MODULE II SYNTAX, SEMANTICS AND PRAGMATICS 9

Formal Grammars of English - Syntactic Parsing - Statistical Parsing – Features and Unification - Language and Complexity - The Representation of Meaning -Computational Semantics - Lexical Semantics- Computational Lexical Semantics.

MODULE III N-GRAMS 9

N-grams Models of Syntax – Counting Words - Unsmoothed N-grams – Smoothing Backoff - Deleted Interpolation – Entropy - English Word Classes – Tagsets for English - Part of Speech Tagging - Rule-Based Part of Speech Tagging -Stochastic Part of Speech Tagging - Transformation-Based Tagging.

MODULE IV STATISTICAL ALIGNMENT AND MACHINE 9

Text Alignment-Word Alignment – Statistical Machine Translation.

MODULE V APPLICATIONS of NLP 9

NLP – Types of application – Tools study – NLP in engineering – Healthcare – Data analytics – Smart Assistance – Business.

L – 45; TOTAL HOURS –45

REFERENCES:

1. NitinIndurkhya, Fred J. Damerau, “Handbook of Natural Language

Processing", 2nd Edition", CRC Press, ISBN: 9781420085921,2010.
2. Daniel Jurafsky and James H.Martin, "Speech and Language Processing", 2nd Edition, Prentice Hall, ISBN: 100131873210, ISBN: 9780262133609,2009.
3. Christopher D. Manning and Hinrich Schütze, "Foundations of StatisticalNatural Language Processing", MIT Press. Cambridge, 1999.
4. Imed Zitouni, "Natural language processing of semantic language", Springer, ISBN :97836424535588, 2014.

COURSE OUTCOMES:

CO1: Identify the different linguistics components of given sentences.
CO2: Design a tagger to semantically tag words using word tag.
CO3: Implement a parser by providing suitable grammar and words.
CO4: Analyze the statistical machine translation techniques.
CO5: Apply the NLP techniques to real world problems.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2	L												L	
CO3		M												M
CO4		M												M
CO5	H												H	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: By learning "Statistical Language Processing", the students will be able to design and develop various applications using methods for language translation into machine language and hence develop the economics sustainable and enormous employment opportunities.

CSEY 028	ROBOTICS AND INTELLIGENT	L	T	P	C
SDG: 9	SYSTEMS	3	0	0	3

COURSE OBJECTIVES:

COB1: To impart knowledge on setting software and hardware construction of the robot.

COB2: To introduce the concepts Robot design process.

COB3: To educate on various path planning techniques.

COB4: To Learn about planning and reasoning artificial intelligence.

COB5: To Solve the risk in artificial intelligence.

MODULE I INRTODUCTION 9

Principle of robotics and AI – Advanced robotics techniques – Development environment – System and decision-making framework – The robot control system.

MODULE II SETTING UP ROBOTS 9

Robot Anatomy – Subsumption architecture – software setup – Hardware – Use case – Story board.

MODULE III ROBOT DESIGN PROCESS 9

Image recognition process – Neural network – Picking up the toys: Task Analysis, Teaching the robot arm - Other robot arm machine learning approaches – Teaching a Robot to listen: Robot Speech recognition.

MODULE IV ALGORITHM 9

Decision trees – Entropy - Random forest - Grid searching and A* algorithm - GPS path finding.

MODULE V AI IN ROBOTICS 9

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Francis X. Govers, “Artificial Intelligence for robotics”, 1st Edition, Packt publishing Ltd, UK, ISBN :978-1-78883-544-2, 2018.
2. Peter Sincak, Pitoyo Hartono, Maria Vircikova, Jan Vascak, Rudolf

Jaksa, “Emerging Trends in Robotics and Intelligent Systems”, 1st Edition, Springer Cham Heidelberg New York Dordrecht London, 2015, ISBN: 978-3-319-10783-7.

3. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rdEdition, Pearson, ISBN: 9780136042594, 2010.

COURSE OUTCOMES:

CO1: Ability to understand basic concept of robotics.

CO2: To analyze Instrumentation systems and their applications to various.

CO3: To know about the various path planning techniques.

CO4: Implement basic AI algorithms.

CO5: Design and carry out an empirical evaluation of different algorithms on problem formalization.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2		L												M
CO3			L										M	
CO4				M									L	
CO5			M											M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: To gain overall knowledge in Applying robotics modeling and data analysis techniques to the real time problems.

CSEY 029	INTELLIGENT INFORMATION	L	T	P	C
SDG: 4	RETRIEVAL	3	0	0	3

COURSE OBJECTIVES:

COB1: To teach about the information retrieval systems.

COB2: To introduce the students to design, implementation, and evaluation of information retrieval systems, such as Web search engines.

COB3: To expose the students to emerging technologies to build the next generation of intelligent and personalized search tools and Web information systems.

COB4: To describe the students to underlying retrieval models, algorithms, and system implementations, such as vector-space and probabilistic retrieval models, as well as the PageRank algorithm used by Google.

COB5: To expose the students to intelligent information retrieval and filtering, particularly on the World Wide Web, including techniques for document categorization, automatic concept discovery, recommender systems, discovery and analysis of online communities and social networks, and personalized search.

MODULE I OVERVIEW AND BACKGROUND 9

Overview of Information Retrieval Systems – Boolean Retrieval Dictionaries - Indexes.

MODULE II COMPUTING SCORES IN A SEARCH SYSTEM 9

Efficient scoring and ranking - Inexact top K document retrieval - Index elimination - Champion lists -- Static quality scores and ordering - Impact ordering - Cluster pruning - Components of an information retrieval system- Tiered indexes - Query-term proximity - Designing parsing and scoring functions - Vector space scoring and query operator interaction.

MODULE III EVALUATION IN INFORMATION RETRIEVAL 9

Information retrieval system evaluation- Standard test collections - Evaluation of unranked retrieval sets - Evaluation of ranked retrieval results - Assessing relevance- Critiques and justifications of the concept of relevance.

MODULE IV RETRIEVAL MODELS AND CLUSTERING 9

Similarity Measures and Ranking – Boolean Matching – Vector Space

Models- Probabilistic Models. Relevance Feedback – User Profiles – Collaborative Filtering –Document and Term Clustering – Document Categorization.

MODULE V FILTERING TECHNIQUES AND CLUSTERING 9

Information Retrieval Systems and the WWW – PageRank and Hyperlink Analysis – Search Personalization – Web Mining and Its Applications.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Christopher Manning, Prabhakar Raghavan and Hinrich Schutze, “Introduction to Information Retrieval” ,Cambridge University Press, 2009.[Available online: https://nlp.stanford.edu/IR-book/]
2. Grossman, David A., Frieder, and Ophir, “Information Retrieval”, Algorithms and Heuristics, ISBN:978-1-4020-3005-5, 2004.
3. Online course material: http://facweb.cs.depaul.edu/mobasher/classes /csc575/lecture.html.
4. https://nlp.stanford.edu/IR-book/pdf/irbookonlinereading.pdf.

COURSE OUTCOMES:

CO1: Apply the basic concepts and techniques of Information Retrieval
in various related fields.

CO2: Apply document indexing to real world problems by learning the indexing models.

CO3: Analyze different information retrieval techniques in various application areas.

CO4: Evaluate the use of filtering techniques and clustering in various applications areas.

CO5: Illustrate the use of information retrieval techniques in World Wide Web.

Board of Studies (BoS):	**Academic Council:**
20th BoS of Department of CSE held on 16.08.2022	19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO 12	PSO 1	PSO 2
CO1		M											L	
CO2				L									L	
CO3			L											M
CO4				M										L
CO5			M										H	

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Statement: Beyond work-specific skills, emphasis must be placed on developing high-level cognitive and non-cognitive/transferable skills, such as problem solving, critical thinking, creativity, teamwork, communication skills and conflict resolution, which can be used across a range of occupational fields.

CSEY 030	SOFT COMPUTING	L	T	P	C
SDG: 8		3	0	0	3

COURSE OBJECTIVES:

COB1: Enumerate the strengths and weakness of soft computing.

COB2: Illustrate soft computing methods with other logic driven and statistical method driven approaches.

COB3: Focus on the basics of neural networks, fuzzy systems, and evolutionary computing.

COB4: Emphasize the role of euro-fuzzy and hybrid modeling methods.

COB5: Trace the basis and need for Genetic Algorithms and its Operators.

MODULE I BASICS 6

Soft computing – Hard Computing – Artificial Intelligence as the basis of soft computing – Relation with logic driven and statistical method driven approaches-Expert systems – Types of problems: Classification, Functional approximation, Optimizations – Modeling the problem – Machine Learning – Hazards of Soft Computing – Current and future areas of research.

MODULE II ARTIFICIAL NEURAL NETWORK 12

Artificial Neuron – Multilayer perceptron – Supervised learning – Back propagation network –Types of Artificial Neural Network: Supervised Vs Un Supervised Network – Radial basis function Network – Self Organizing Maps – Recurrent Network – Hopfield Neural Network – Adaptive Resonance Theory – Issues in Artificial Neural Network – Applications.

MODULE III FUZZY SYSTEMS 9

Fuzzy Logic – Membership functions – Operators – Fuzzy Inference systems – Other sets: Rough sets, Vague Sets – Fuzzy controllers – Applications.

MODULE IV NEURO FUZZY SYSTEMS 9

Cooperative Neuro fuzzy systems – Neural network driven fuzzy reasoning – Hybrid Neuro fuzzy systems – Construction of Neuro Fuzzy systems: Structure Identification phase, Parameter learning phase – Applications.

MODULE V GENETIC ALGORITHMS 9

Genetic Algorithms and optimization – Genetic Algorithm operators -

Encoding - Crossover Selection etc - Genetic algorithms with Neural/Fuzzy systems – Basic GA framework - Variants of Genetic Algorithms– Population based incremental learning.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Samir Roy, “Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms”, Pearson, 2013.
2. S.Rajasekaran, G.A.VijayalakshmiPai, “Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications “, PHI Learning Pvt. Ltd., 2017.
3. N.P.Padhy, S.P.Simon, “Soft Computing with MATLAB Programming”, Oxford University Press, 2015.
4. S.N.Sivanandam , S.N.Deepa, “Principles of Soft Computing”, Wiley India Pvt. Ltd., 2nd Edition, 2011.
5. Asa Bensten ,” Genetic Algorithms in Applications “,Scitus Academics LLC, 2016.

COURSE OUTCOMES:

CO1: Apply neural networks to pattern classification and regression problems.

CO2: Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.

CO3: Demonstrate some applications of Genetic Algorithms.

CO4: Discuss the neural networks and supervised and unsupervised learning networks.

CO5: Evaluate and compare solutions by various soft computing approaches for a given problem.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L													M
CO2		L												M
CO3			L										L	
CO4			M										H	
CO5				M										M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: By learning the course, the students are able to design soft computing system applications thereby promote sustainable economic growth and productive employment.

CSEY 031	SYSTEM SIMULATION AND	L	T	P	C
SDG: 9	MODELLING TECHNIQUES	3	0	0	3

COURSE OBJECTIVES:

COB1: Introduce the concepts of Modeling and Simulation that are used as an essential tool for engineers for optimum design.

COB2: Students will use MATLAB to explore a range of programming and modeling concepts while acquiring those skills.

COB3: Understand the modeling through different approaches, optimization and simulation.

COB4: Students will use simulation tools and conduct studies to address current research issues for complex systems

COB5: Learn modeling approaches with a focus on continuous and discrete simulation, and surveys applications for complex systems across a variety of engineering domains.

MODULE I INTRODUCTION 9

System – environment - input and output variables - State variables - Static and Dynamic systems - Hierarchy of knowledge about a system - Modeling Strategy. Physical Modeling: Dimensions analysis - Dimensionless grouping of input and output variables of find empirical relations - similarity criteria and their application to physical models.

MODULE II MODELING OF SYSTEM WITH KNOWN STRUCTURE 9

Review of conservation laws and the governing equation for heat, mass and momentum transfer - Deterministic model: - distributed parameter models in terms of partial identification and their solutions and - lumped parameter models in terms of differential and difference equations - state space model - transfer functions block diagram and sub systems - stability of transfer functions -modelling for control.

MODULE III OPTIMIZATIONS AND DESIGN OF SYSTEMS 9

The gradient-based techniques - Non-traditional Optimizations techniques - genetic Algorithm (GA)- coding - GA operations elitism - Application using MATLAB -Simulated Annealing.

MODULE IV NEURAL NETWORK MODELING OF SYSTEMS 9

Neural Network Modeling of Systems only with Input-output Database:

Neurons - architecture of neural networks - knowledge representation - learning algorithm. Multilayer feed forward network and its back propagation learning algorithm - Application to complex engineering systems and strategy for optimum output.

MODULE V SIMULATION OF ENGINEERING SYSTEMS 9

Monte-Carlo simulation, Simulation of continuous and discrete processes with suitable examples from engineering problems – Case study.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Banks, J., J.S. Carson, B.L. Nelson, and D.M. Nicol (2005), Discrete-Event System Simulation, Fourth Edition, Prentice-Hall, Upper Saddle River, NJ.
2. Birta, L. G., and Arbez, G. (2013), Modelling and Simulation. Springer.
3. Cantot, P., and Luzeaux, D., Eds. (2013), Simulation and Modeling of Systems of Systems. John Wiley and Sons.
4. Choi, B. K., and Kang, D. (2013), Modeling and Simulation of Discrete Event Systems. John Wiley and Sons.
5. Rubinstein, R. Y., and Kroese, D. P. (2016), Simulation and the Monte Carlo Method (3rd edition), John Wiley and Sons.
6. Muzy, A., Kofman, E. (2018), Theory of Modeling and Simulation (3rd Edition), Academic Press.
7. Murray-Smith, D. J. (2012), Modelling and Simulation of Integrated Systems in Engineering: Issues of Methodology, Quality, Testing and Application. Elsevier.

COURSE OUTCOMES:

CO1: Understand the techniques of modeling in the context of hierarchy of knowledge about a system and develop the capability to apply the same to study systems through available software.

CO2: Learn different types of simulation techniques and simulate the models for the purpose of optimum control by using software.

CO3: Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.

CO4: Model and simulate systems and environments through the use

of computers.

CO5: Conduct experiments with discrete dynamic, stochastic system models on a computer.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1			L										L	
CO2		L												M
CO3				M										L
CO4			M											M
CO5				H									H	

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Design and develop the various industrial projects using simulation modelling technique.

CSEY 032	CELLULAR AUTOMATA AND ITS	L	T	P	C
SDG: 9	APPLICATIONS	3	0	0	3

COURSE OBJECTIVES:

COB1: Impart knowledge on Cellular automata and its applications.

COB2: Understand the Cellular Automata which provides a potential solution and is probably the most popular technique to model the dynamics of many processes.

COB3: Learn the computational programs and their remarkable ability to create complex behavior from simple rules by using cellular automata.

COB4: Examine a number of these simple programs in order to draw conclusions about the nature of complexity seen in the world.

COB5: Understand the applications of cellular automata in real world problems.

MODULE I INTRODUCTION 9

Introduction to Cellular Automata (CA) - Computing model – Neighborhood and radius – Moore and VonNeumann Architecture – Advantages over conventional machine.

MODULE II STRUCTURE AND TYPES 9

Structure of CA- one, two, multi-dimensional, their neighborhood - rule of CA. Different classes of CA–class I, II, III, IV. Difference between order, complex, chaos. Types of CA–linear, non-linear, multi-valued, probabilistic, fuzzy.

MODULE III LINEAR AND NON-LINEAR CA 9

Linear CA–characteristic polynomial – matrix algebra – analysis and synthesis – Quasi linear CA. Non-linear CA–characterization – synthesis and analysis of probabilistic – fuzzy – multivalued CA.

MODULE IV CA WITH VECTOR FIELD 9

Relation of CA with vector space -field – Galois field – Concept of Hierarchical CA – Concept of GF(2) and GF(2)CA.

MODULE V GENETIC ALGORITHM

Cellular automata and evolutionary algorithm - Genetic Algorithm(GA) - Concept of CAGA – Parallel GA - co-evolution – Embedded GA.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. H S Behera et.al., “Formal Languages and Automata Theory” January 1, 2014, ISBN-10: 9325978598.
2. Allen Downey, “Think Complexity: Complexity Science and Computational Modeling”, 2nd Edition, ISBN-13: 978-1492040200.
3. Dexter C. Kozen, “Automata and Computability”, March 12, 2014, Springer, ISBN-13: 978-3642857072.
4. Lakshmana Phaneendra Maguluri, Maganti Syamala and V. Naga Bushanam, “The Art of Automata Theory and Formal Languages”, August 14, 2018, LAP LAMBERT Academic Publishing, ISBN-13 : 978-6135840049.
5. V. Aladjev, M. Shishakov, V. Vaganov, “Selected problems in the theory of classical cellular automata”, USA, Lulu Press, 2018, 410 p., ISBN 978–9949–9876–2–7.
6. Aladjev V.Z., “Classical Cellular Automata: Mathematical Theory and Applications”, Germany, Saarbrucken, Scholar`s Press, 2014, ISBN 9783639713459, 517.

COURSE OUTCOMES:

CO1: Apply the working of cellular automation process.

CO2: Develop the essentials of the working of the cellular units and trace the operation.

CO3: Identify the various elements of cellular architecture.

CO4: implement the cellular automation techniques in real time protect.

CO5: Develop a real time application using genetic algorithm.

Board of Studies (BoS):
20th BoS of Department of CSE held on 16.08.2022

Academic Council:
19th Academic Council held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	L												L	
CO2		L												M
CO3		L												M
CO4			M										H	
CO5		H											H	

Note: L- Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Implementing automation system in small and medium-sized enterprises can improve production, create new goods and services, and improve processes and marketing strategies.

OPEN ELECTIVE COURSES

OEEY 701	ANALYTICAL TECHNIQUES	L	T	P	C
SDG: 6, 7		3	0	0	3

COURSE OBJECTIVES:

To make the students to understand the

COB1: basics in data analysis

COB2: basics and principles in volumetric and gravimetric analysis

COB3: types and principles of electro analytical methods

COB4: principles and analysis of spectroscopic techniques

COB5: the principle and methods in chromatography and thermal analysis

MODULE I DATA ANALYSIS 9

Precision and accuracy, Classification of errors, methods of minimization and elimination of errors Mean and standard deviation; absolute and relative errors; students t-test, F-test, linear regression for deriving calibration plots, covariance and correlation coefficient

Statistics for analytical experimentation: Probability, Regression analysis, Data analysis and signal enhancement.

MODULE II VOLUMETRIC METHODS OF ANALYSIS 9

Different methods of expressing concentration terms, Difference between titrimetic and volumetric analysis, Types and roles of indicators - Principle and reactions involved in neutralization, precipitation, complexometric and redox titrations, calculations involving stoichiometry – for all types of systems - Gravimetric analysis (volatilisation and precipitation methods)

MODULE III ELECTROANALYTICAL METHODS 9

Types of electrodes - Conductometric Titrations - Potentiometric titrations - pH-metry and ion-selective electrodes - Amperometric titrations - Coulometric Titrations, DM Electrode - polarography - electrogravimetry - voltammetry, cyclic voltammetry, impedance studies - Electrochemical sensors, ISFETs, CHEMFETs.

MODULE IV SPECTROPHOTOMETRIC TECHNIQUES 9

Quantitative applications of Colorimetric analysis – UV-Visible spectrophotometry – *Atomic absorption spectroscopy* (*AAS*) - atomic

emission spectroscopy (AES), *Flame photometry*, ICP-AES - Fluorescence spectroscopy, Stern Volmer Equation and quantum yield calculation.

MODULE V CHROMATOGRAPHIC TECHNIQUES AND THERMAL METHODS 9

Chromatography**:** Paper, TLC and column Chromatography – Detectors in Chromatography - GC, HPLC, (hyphenated techniques GC/MS, LC/MS) and GPC -– ion exchange chromatography – Electrochromatography**:** Capillary electrophoresis and gel electrophoresis

Thermal analytical techniques: TGA, DTA, DSC, DMA – Chemisorption Techniques – TPD, TPO, TPR, TPS.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Skoog D.A., West D.M., Holler F.J. and Crouch S.R., Fundamentals of Analytical Chemistry, 8th Edition, Thomson Brooks/Cole Publication., Singapore, 2004.
2. Willard H.H., Merritt L.L., Dean J.A. and Settle F.A., Instrumental Methods of Analysis, 7th Edition, CBS Publication, New Delhi Reprint, 2004.
3. Skoog D.A., Holler F.J. and Nieman T.A., Principles of Instrumental Analysis, 5th Edition, Harcourt College Publication., Singapore, 1998.
4. Christian G.D., Analytical Chemistry, 6th Edition, John Wiley, Singapore, 2003.
5. Fifield F.W. and Kealey D., Principles and Practice of Analytical Chemistry, 5th Edition, Blackwell Publication, London, 2000.
6. Settle F. (Editor), Handbook of Instrumental Techniques for Analytical Chemistry, Pearson Education, Singapore, 2004.

COURSE OUTCOMES:

The student will be able to

CO1: analyse the numerical data without error

CO2: perform the volumetric and gravimetric analysis of chemical compounds and interpret the result

CO3: perform the electro analytical titrations and analyse the result

CO4: identify the appropriate spectral technique and do the spectral analysis

and interpret the data

CO5: perform the chromatographic techniques and separate the compounds

Board of Studies (BoS):
12th BoS of Chemistry held on 22.07.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M		M											
CO2	H	M		M											
CO3	H	M		M		H									
CO4	H	M		M	M	H									
CO5	H	M		M	M	H									

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 6: Clean Water & Sanitation
SDG 7: Affordable and Clean Energy

Statement: Through various analytical methods, innovative, cheap and affordable materials can be developed and can be employed in the area of clean water, sanitation and energy

OEEY 702 ARTIFICIAL INTELLIGENCE AND IOT L T P C

SDG: 8 3 0 0 3

COURSE OBJECTIVES:

COB1: To learn the working of intelligent agents.

COB2: To study the various search techniques and optimization of search.

COB3: To represent knowledge in first order logic**.**

COB4: To know the fundamentals of IoT.

COB5: To learn the IoT architecture and protocol stack.

MODULE I ARTIFICIAL INTELLIGENCE INTRODUCTION 9

Artificial Intelligence Foundations - Artificial Intelligence History - Agents and Environments - Structure of Agents - Problem-Solving Agents - Search Algorithms - Uninformed Search Strategies - Informed (Heuristic) Search Strategies - Heuristic Functions.

MODULE II SEARCH OPTIMIZATIONS 9

Local Search and Optimization Problem - Continuous Spaces - Nondeterministic Actions - Partially Observable Environments - Online Search Agents and Unknown Environments - Constraint Satisfaction Problems – Backtracking Search – Adversarial Search and Games - Alpha Beta Search.

MODULE III KNOWLEDGE REPRESENTATION 9

Knowledge Based Agents – Propositional Logic – First Order Logic – Inference in First Order Logic – Forward Chaining – Backward Chaining.

MODULE IV IOT FUNDAMENTALS 9

Fundamentals of IoT – Characteristics of IoT – IoT architecture and Components – Logical Design of IoT – Communication Models – IoT Communication APIs.

MODULE V IOT ARCHITECTURE AND PROTOCOLS 9

Structure – Objectives – Three layer and Five Layer Architecture – Cloud and Fog based Architecture – IoT Network Protocol Stack - IoT Technology Stack – Case Study – Applications of AI in IoT.

L – 45; TOTAL HOURS –45

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson, Fourth Edition, 2020. ISBN: 978-0134610993.

2. Dr Kamlesh Lakhwani, Dr Hemant Kumar Gianey, Joseph Kofi Wireko, Kamal Kant Hiran, Internet of Things (IoT): Principles, Paradigms and Applications of IoT, BPB Publications, First Edition, 2020, ISBN: ISBN: 978-9389423365.

REFERENCES:

1. S. Kanimozhi Suguna, M. Dhivya, Sara Paiva, Artificial Intelligence (AI): Recent Trends and Applications, CRC Press, 2021, ISBN: 978-0-367-43136-5.
2. Vlasios Tsiatsis, Stamatis Karnouskos, Jan, Internet of Things: Technologies and Applications for a New Age of Intelligence, 2nd Edition, Academic Press, 2019, ISBN: 978-0-12-814435-0

COURSE OUTCOMES: The student will be able to

- Identify the suitable search algorithms for solving problems.
- Employ AI adversarial game search techniques while evaluating the application of more real world problems.
- Use first order logic for wide variety of applications, from planning and diagnosis to knowledge representation and reasoning.
- Apply the technologies, standards, and protocols that are best suited for low-level sensor nodes.
- Determine the most appropriate IoT Devices and Sensors based on case Studies.

Board of Studies (BoS) :
21st BoS of CSE held on 27.02.2023

Academic Council:
20th AC held on 13.04.2023

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2
CO1	H	M	H	L	M	-	L	-	-	L	-	M	H	M
CO2	H	H	H	L	M	-	L	-	-	L	-	H	M	H
CO3	H	H	H	L	L	-	-	-	-	L	-	L	M	H
CO4	H	M	H	L	L	-	-	-	-	-	-	M	M	H
CO5	H	H	H	L	L	-	-	-	M	-	M	M	H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
Statement: The objective of AIoT is to improve human-machine interactions, IoT operations and data management and analytics.

OEEY 703	BIOMATERIALS	L	T	P	C
SDG: 4		3	0	0	3

COURSE OBJECTIVES:

COB1: To enable the students understand importance of and properties of Biomaterials

COB2: To familiarize the students with different orthopaedic materials.

COB3: To understand different cardiovascular materials.

COB4: To help students study about materials in opthalmology

COB5: To make the students understand applications of various biomaterials

MODULE I BIOLOGICAL PERFORMANCE OF MATERIALS 9

Biocompatibility- Introduction to the biological environment – Material response: swelling and leaching, corrosion and dissolution, deformation and failure, friction and wear – Host response: the inflammatory process - coagulation and hemolysis- approaches to thrombo- resistant materials development.

MODULE II ORTHOPAEDIC MATERIALS 9

Bone composition and properties - temporary fixation devices - joint replacement – Biomaterials used in bone and joint replacement: metals and alloys – Stainless steel, cobalt based alloys, titanium based materials – Ceramics: carbon, alumina, zirconia, bioactive calcium phosphates, bioglass and glass ceramics – polymers: PMMA, UHMWPE/HDPE, PTFE – Bone cement – Composites.

MODULE III CARDIOVASCULAR MATERIALS 9

Blood clotting – Blood rheology – Blood vessels – The heart – Aorta and valves – Geometry of blood circulation – The lungs - Vascular implants: vascular graft, cardiac valve prostheses, cardiac pacemakers – Blood substitutes – Extracorporeal blood circulation devices.

probability-internal conversion- nuclear isomerism.

MODULE IV DENTAL MATERIALS 9

Teeth composition and mechanical properties – Impression materials – Bases, liners and varnishes for cavities – Fillings and restoration materials – Materials for oral and maxillofacial surgery – Dental cements and dental amalgams – Dental adhesives.

MODULE V MATERIALS IN OPTHALMOLOGY 9

Biomaterials in ophthalmology – Viscoelastic solutions, contact lenses, intraocular lens materials – Tissue grafts – Skin grafts – Connective tissue grafts – Suture materials – Tissue adhesives – Drug delivery: methods and materials – Selection, performance and adhesion of polymeric encapsulants for implantable sensors- biomemtic materials-Technology from nature.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Sujata V. Bhat. Biomaterials, Narosa Publication House, New Delhi, 2002.
2. Jonathn Black. Biological Performance of Materials: Fundamentals of biocompatibility, Marcel Dekker Inc, New York, 1992.
3. D.F.Williams (editor). Materials Science and Technology: A comprehensive treatment, Volume 14. Medical and Dental Materials, VCH Publishers Inc, New York, 1992.
4. F.Silver and C.Doillon. Biocompatibility: Interactions of Biological and implantable materials. Volume I Polymers, VCH Publishers Inc, New York, 1989.
5. L.L.Hench and E.C.Ethridge. Biomaterials: An Interfacial Approach, Academic Press, 1982.
6. Joon Park, R. S. Lakes, Biomaterials. An Introduction, Springer, third edition, 2010. Springer

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: importance and properties of biomaterial..

CO2: different classes of orthopaedic materials

CO3: different types of cardiovascular materials.

CO4: various types of materials used in ophthalmology.

CO5: applications of various biomaterials

Board of Studies (BoS) :	**Academic Council:**
BOS of Physics was held on 30.6.22	19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L	L	M	M	M	L	L	L	M	M	M	M	M
CO2	H	M	M	L	L	M	L	L	L	L	L	M	M	M	M
CO3	H	M	M	L	L	L	L	L	L	L	L	M	M	M	M
CO4	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M
CO5	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 4 : Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement : The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

OEEY 704	BIOMEDICAL INSTRUMENTATION	L	T	P	C
SDG: 4		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the human physiological systems.

COB2: To know the different aspects of biosignal acquisition.

COB3: To understand the basics in biopotential recorders.

COB4: To know the importance methods, instruments available for biomedical field.

COB5: To analyze the special biomedical instrumentation systems.

MODULE I HUMAN PHYSIOLOGICAL SYSTEMS 9

Cells and their structure – Nature of Cancer cells – Transport of ions through the cell membrane – Resting and action potentials – Bio-electric potentials – Nerve tissues and organs – Different systems of human body. Biopotential Electrodes and Transducers Design of Medical instruments – components of the biomedical instrument system – Electrodes – Transducers.

MODULE II BIOSIGNAL ACQUISITION 9

Physiological signal amplifiers – Isolation amplifiers – Medical preamplifier design – Bridge amplifiers – Line driving amplifier – Current amplifier – Chopper amplifier – Biosignal analysis – Signal recovery and data acquisition – Drift Compensation in operational amplifier – Pattern recognition – Physiological Assist Devices. Pacemakers – Pacemakers batteries – Artificial heart valves – Defibrillators – nerve and muscle stimulators Heart – Lung machine – Kidney machine.

MODULE III BIOPOTENTIAL RECORDERS 9

Characteristics of the recording system – Electrocardiography (ECG) – Electroencephalography (EEG) – Electromyography (EMG) – Electroethinogrphy (ERG) and Electroculography (EOG) – Recorders with high accuracy – recorders for OFF line analysis.

MODULE IV OPERATION THEATRE EQUIPMENT 9

urgical diathermy- shortwave diathermy – Microwave diathermy – Ultrasonic disathermy – Therapeutic effect of heat – Range and area of irritation of different techniques – Ventilators – Anesthesia machine – Blood flowmeter –

Cardiac Output measurements – Pulmonary function analyzers – Gas analyzers – Blood gas analyzers – Oximeters – Elements of intensive care monitoring.

MODULE V SPECIALISED MEDICAL EQUIPMENTS 9

Blood Cell counter – Electron microscope – Radiation detectors – Photometers and colorimeters – digital thermometer – audiometers – X-rays tube – X-ray machine – image intensifiers – Angiography – Application of X-ray examination. Safety instrumentation: Radiation safety instrumentation – Physiological effects due to 50Hz current passage – Microshock and macroshock – electrical accident Hospitals – Devices to protect against electrical hazards – Hospitals architecture.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Arumugam M., Biomedical Instrumentation, Anurada Agencies Publishers, 1992.
2. Khandpur R.S., Handbook of Biomedical Instrumentation, Third Edition, Tata McGraw-Hill Education, 2014.
3. Shakti Chatterjee and Aubert Miller, Biomedical Instrumentation Systems, Cengage Learning Publisher, 2010.
4. Gromwell L., Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Second Edition, Prentice Hall, 1980.

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: the human physiological systems.

CO2: the different aspects of biosignal acquisition.

CO3: different biopotential recorders such as EEG, ECG, EMG, EOG

CO4: biomedical instruments involved in advanced operation theatres

CO5: the application of biomaterials towards specialized medical equipment such as electron microscope and radiation detectors

Board of Studies (BoS) :
BOS of Physics was held on 30.6.22

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L	L	M	M	M	L	L	L	M	M	M	M	M
CO2	H	M	M	L	L	M	L	L	L	L	L	M	M	M	M
CO3	H	M	M	L	L	L	L	L	L	L	L	M	M	M	M
CO4	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M
CO5	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 4 : Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement : The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

OEEY 705	BIOPHOTONICS	L	T	P	C
SDG: 4		3	0	0	3

COURSE OBJECTIVES:

COB1: To know the role of light and its interaction in the cells and tissues.

COB2: To understand the different imaging techniques for the biological systems.

COB3: To know the concepts of spectroscopy in biological applications.

COB4: To understand the optical force spectroscopy.

COB5: To understand the role of Biophotonic materials in applications.

MODULE I INTERACTION OF LIGHT WITH BIOLOGICAL SYSTEMS **9**

Interaction of light with cells, tissues, nonlinear optical processes with intense laser beams, photo-induced effects in biological systems.

MODULE II IMAGING TECHNIQUES **9**

Imaging techniques: Light microscopy, wide-field, laser scanning - confocal, multiphoton, fluorescence lifetime imaging, FRET imaging - Frequency-Domain lifetime imaging. Cellular Imaging - Imaging of soft and hard tissues and other biological structures.

MODULE III SINGLE MOLECULE SPECTROSCOPY **9**

Single molecule spectroscopy: UV-VIS spectroscopy of biological systems, single molecule spectra and characteristics – IR and Raman spectroscopy and Surface Enhanced Raman Spectroscopy for single molecule applications.

MODULE IV OPTICAL FORCE SPECTROSCOPY **9**

Optical Force Spectroscopy: Generation optical forces – Optical trapping and manipulation of single molecules and cells in optical confinement - Laser trapping and dissection for biological systems - single molecule biophysics, DNA protein interactions.

MODULE V BIOSENSORS **9**

Biosensors, Principles- DNA based biosensors – Protein based biosensors–

materials for biosensor applications- fabrication of biosensors.

L – 45; TOTAL HOURS –45

REFERENCES:

1. Prasad. P.N., Introduction to Biophotonics, John Wiley & Sons, 2003
2. Michael P. Sheetz, Laser Tweezers in Cell Biology (Methods in Cell Biology), Vol.55, Academic Press Publishers, 1997.
3. Ranier .W, Nanoelectronics and Information Technology, Wiley Publishers, 2012.
4. Drexler. K.E., Nanosystems: Molecular Machinery, Manufacturing and Computation, Wiley Publishers, 1992.

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Make clear insights into the applications of light interaction with biological systems.

CO2: Compare different imaging techniques

CO3: Understand and analyse the various spectroscopic techniques used in biological system.

CO4: Effectively grasp the usage of the optical force spectroscopy.

CO5: Get clear ideas and communicate about the importance of use of spectroscopy in design of bio-photonic devices.

Board of Studies (BoS) : BOS of Physics was held on 30.6.22

Academic Council: 19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	M	L	L	M	M	M	L	L	L	M	M	M	M	M
CO2	H	M	M	L	L	M	L	L	L	L	L	M	M	M	M
CO3	H	M	M	L	L	L	L	L	L	L	L	M	M	M	M
CO4	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M
CO5	H	M	M	L	M	M	M	L	L	L	M	M	M	M	M

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 4 : Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.

Statement : The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

OEEY 706	DATA SCIENCE AND MACHINE LEARNING	L	T	P	C
SDG: 8		3	0	0	3

COURSE OBJECTIVES:

CO1: To understand the needs of machine learning in Real Time.

CO2: To acquire knowledge about the data science in machine learning.

CO3: To study the Monte Carlo Sampling and processing.

CO4: To explore knowledge about real-time data analysis using various models.

CO5: To understand the deep learning.

MODULE I INTRODUCTION 9

Introduction to Artificial Intelligence - Machine Learning – Types of Machine Learning - Data preprocessing - Noise Removal - Data Transformation - Normalization - Importing, Summarizingand Visualizing Data – Statistics-Visualizing Data-Plotting Qualitative Variables and Quantitative Variables- Data Visualization in a Bivariate Setting

MODULE II MACHINE LEARNING ALGORITHMS 9

Introduction to Supervised and Unsupervised Learning-Linear Regression - Single Variable – Multivariate –Logistic - Naive Bayes - Decision Tree - Neural Network - Single Layer Perceptron - Multilayer BPN- Training and Test Loss-Statistical Learning-Estimating Risk-Modeling Data-Multivariate Normal Models-Bayesian Learning

MODULE III SAMPLING AND UNSUPERVISED LEARNING 9

Unsupervised Learning Algorithm -Clustering - Monte Carlo Sampling-Resampling-Markov Chain Monte Carlo-Monte Carlo Estimation-Monte Carlo for Optimization-Simulated Annealing – Cross-Entropy Method-Splitting for Optimization -Noisy Optimization-Risk and Loss in Unsupervised Learning – Expectation-Maximization (EM) Algorithm-EM Algorithm for Mixture Models-K-Means – KNN - Hierarchical

MODULE IV REGRESSION ANALYSIS AND REGULARIZATION 9

Linear Regression-Analysis via Linear Models-Model Selection and Prediction – Cross-Validation and Predictive Residual Sum of Squares-In-Sample Risk and Akaike Information Criterion-Inference for Normal Linear Models -Nonlinear Regression Models-Modeling Regularization-Reproducing Kernel Hilbert Spaces- Smoothing Cubic Splines- Gaussian Process Regression - Graphical Models - Bayesian Networks

MODULE V ADVANCED LEARNING 9

Semi-supervisory Learning - Reinforcement Learning Algorithm – Feed-Forward Neural Networks -Back-Propagation – QLearning-Methods for Training- Steepest Descent- Levenberg–Marquardt Method - Limited-Memory BFGS Method- Adaptive Gradient Methods-Simple Polynomial Regression -Image Classification

L – 45 ; TOTAL HOURS – 45

REFERENCES:

1. Alex Smola, S.V.N. Vishwanathan, Introduction to Machine Learning, Cambridge University Press, 2008.
2. Stephen Marsland, Machine Learning: An Algorithmic Perspective, Second Edition, Chapman & Hall/CRC, 2014.
3. Kroese, Dirk P., et al. Data science and machine learning: mathematical and statistical methods. Chapman and Hall/CRC, 2019.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1: pre process the data

CO2: identify the suitable machine learning algorithm and apply the same to solve the given problem.

CO3: explain risk analysis and optimization algorithms.

CO4: apply the suitable regression method and regularization of data.

CO5: explore the applications of advanced learning.

Board of Studies (BoS): 17th BoS of IT held on 28.02.2023

Academic Council: 20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5
CO1	M	L			L
CO2	M	L		M	
CO3	L	L	L		L
CO4	M	L	L	H	
CO5	L	H	L		H

Note: L - Low Correlation M -Medium Correlation H -High Correlation

SDG 8: Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work.

Statement: The Learning algorithms helps to design and develop solutions for solving real world application in any engineering domain.

OEEY 707	ELECTRIC VEHICLE AND BATTERY STORAGE TECHNOLOGY	L	T	P	C
SDG:8,9		3	0	0	3

COURSE OBJECTIVES:

COB 1: To study the concept of electric vehicles

COB2: To get familiarized with EV and PHEV Energy Storage Systems

COB3: To learn the basics of various electric drive trains

COB4: To study about sensors and electric vehicle control

COB5: To study about electric vehicle and its environmental impact.

MODULE I INTRODUCTION TO ELECTRIC VEHICLE (EV) 9

A Brief History -Technology, benefits and challenges in comparison with IC engine - EV classification and electrification levels - degree of hybridization - Concept of Hybrid Electric Vehicle (HEV) – Working Principle of an HEV drive train - concept of electric, hybrid electric and plug-in hybrid electric vehicles – HEV drive train topologies - plug-in HEV drive train topologies.

MODULE II EV AND PHEV ENERGY STORAGE SYSTEMS 8

Battery parameters - Types of Battery : Lithium – Nickel – Sodium – Zinc – Lead Acid - Coin cell - Rechargeable Battery sealing – Ideal model, Linear model, Thevenin model – Battery Cell Voltage Equalization – Onboard power electronics battery management – Equalizer chaining method. Electrical Modeling of Ultra capacitors, Flywheel Energy Storage Systems and Renewable Fuel Cell Power Sources.

MODULE III FUEL CELL AND HYBRID ELECTRIC VEHICLE DRIVE TRAIN 10

Component Stage Based Efficiency Analysis of Series and Parallel HEV Drive Trains - Varied Driving Patterns and Regenerative Braking Efficiency Analysis - Overall Electric Drive Train Efficiency Analysis - Fuel Cell HEV: Modeling and Control - Power Electronics Interface of Fuel Cell and Traction System - Concept of Fuel Cell Plug-in HEV (FC-PHEV).

MODULE IV SENSORS AND VEHICLE CONTROL 11

Introduction, Basic Sensor Arrangement, Types of Sensors, Oxygen Sensor, Cranking Sensor, Position Sensor, Engine Oil Pressure Sensor, Linear and Angle Sensor, Flow Sensor, Temperature and Humidity Sensor, Gas Sensor, Speed and Acceleration Sensor, Knock Sensor, Torque Sensor, Yaw Rate Sensors, Tire Pressure Sensor, Actuators.

Protocols: In vehicle Networking (IVN) - Local Interconnect Network(LIN) – Control Area Network (CAN) – Media Oriented System Transport (MOST) and FlexRay - Wireless Access in Vehicular Environment (WAVE).

MODULE V ENVIRONMENTAL IMPACT AND ENERGY MANAGEMENT 6

Vehicle pollution in context - alternative and sustainable energy used via the grid hybridization - V2G, G2V, V2B, V2H - energy consumption in braking and regeneration - brake system of EVs and HEVs.

L – 45; TOTAL HOURS:45

TEXT BOOKS:

1. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013.
2. James Larminie and John Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons Ltd, 2nd edition, 2015.
3. M. Ehsani, Y. Gao, Stefano Lango, K.M.Ebrahimi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 3rd Edition,2018.

REFERENCES:

1. Tariq Muneer and Irene Illescas García, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017.
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition, CRC Press, 2016.
3. Tom Denton, “Electric and Hybrid Vehicles” Routledge Publishers, 1st edition, March 2016.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: identify the opportunities and challenges of advances in electric vehicles

CO2 : model battery system for any EV

CO3: model and choose a suitable drive scheme suitable for developing an EV

CO4: compute the performance parameter of sensors, actuators and to apply suitable technique for automotive communication

CO5: choose proper energy consumption method to integrate with grid

Board of Studies (BoS) : 18th BoS of EEE held on 10.02.2023

Academic Council: 20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO 1	PSO 2
CO1	L	H	L	L	M	L	L	H	L	M	M	L	H	L
CO2	H	L	L	L	L	L	H	L	L	L	L	L	L	H
CO3	L	H	M	L	M	L	L	L	M	L	M	L	M	M
CO4	M	L	H	L	L	L	M	L	H	L	L	H	L	L
CO5	L	L	L	L	H	L	L	L	L	L	H	L	L	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas to promote economic growth.

SDG No. 9 Industry, innovation and infrastructure

Statement:

The development of zero emission electric vehicles will meet out the desired needs such as new innovative systems for industry and establishing advanced infrastructure.

OEEY 708	GREEN BUILDING AND ENERGY	L	T	P	C
SDG: 11	MANAGEMENT	3	0	0	3

COURSE OBJECTIVES:

The objectives of the course are to impart knowledge on

COB1: the concept of green design

COB2: the basics of green design strategies

COB3: the elements of green building

COB4: the concept of green building materials

COB5: the concept of energy management.

MODULE I BASIC CONCEPTS 8

Green Design concepts and definitions - sustainability begins with climate - recent upsurge in the green building movement -incentives for building green - incentives and tax deductions-green building programs -defining sustainable communities-emerging directions- liability - spectacular landmarks

MODULE II DESIGN STRATEGIES 9

Conventional versus Green Delivery Systems- green design strategies- The Integrated Design Process (IDP) -the green-building project delivery process- the integrated multidisciplinary project team - design process for high-performance buildings -sustainable site selection-general considerations- site selection - development density and community connectivity –brown field redevelopment - alternative transportation -site development storm water design-heat-island effect - light-pollution reduction

MODULE III ELEMENTS OF GREEN BUILDING 9

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency- Commissioning process – fundamental commissioning –retro commissioning -enhanced commissioning

MODULE IV GREEN COMPOSITES FOR BUILDINGS 9

Concepts of Green Composites-low-emitting materials -adhesives, finishes, and sealants -paints and coatings- flooring systems- earthen building materials- building reuse -materials reuse- construction waste management-recycled materials regional materials- rapidly renewable materials- bamboo-cork - insulation- linoleum straw-bale construction-wheat board - use and selection of green office equipment -certified wood- life-cycle assessment of building materials and products

MODULE V ENERGY MANAGEMENT 10

Energy Management – Definitions and significance – objectives – Characterising of energy usage – Energy Management program – Energy strategies and energy planning Energy Audit – Types and Procedure – Optimum performance of existing facilities – Energy management control systems- Low Energy Approaches to Water Management. Management of Solid Wastes.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Osman Attmann., “Green Architecture Advanced Technologies and Materials”, McGraw Hill, 2010.
2. Charles Kibert, J., “Sustainable Construction: Green Building Design and Delivery”, 2nd Edition, John Wiley and sons, 2007.
3. Moncef Krarti, “Energy Audit of Building Systems: an Engineering approach” CRC Press, LLC, Florida 2000.
4. “Alternative Building Materials and Technologies”. K.S.Jagadish, B.U. Venkataramareddy and K. S. Nanjundarao New Age International, 2007.

REFERENCES:

1. Doty S. and W. C. Turner, “Energy Management Hand book”, Fairmont Press, 2009.
2. LEED - Practices, Certification and Accreditation Handbook”. Sam Kubba, Butterworth-Heinemann, 2009.

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1: describe the basics of green design concept.

CO2: explain the concepts of green design strategies.

CO3: illustrate the elements of green building.

CO4: summarize the different green building materials.

CO5: describe the concept of energy management.

Board of Studies (BoS) : Academic Council:

17th BOS of CE held on 10.08.2022 20th AC held on 13.04.2023

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	-	L	-	-	L	H	-	-	-	-	-	L	-	M
CO2	-	-	L	-	-	L	H	-	-	-	-	L	L	-	M
CO3	-	-	L	-	-	L	H	-	-	-	-	-	L	-	M
CO4	-	-	M	-	-	L	H	-	-	-	-	L	L	-	M
CO5	-	-	L	-	-	M	H	-	-	-	-	-	L	-	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Statement : The understanding of basics of green concepts, materials, energy management and leads to the development of sustainable building

OEEY 709	INDUSTRY 4.0 AND APPLICATIONS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To describe the concepts, trends and the paradigm of Industry 4.0

COB2:To analyze the IoT technologies for practical IoT applications

COB3: To develop the ability to use Internet of Things related protocols and connectivity methods

COB4:. To elaborate the business issues in Industry 4.0.

COB5: To select the appropriate design concepts of Industrial IoT systems for various application

PREREQUISITES: Basic concepts in automation

MODULE I INTRODUCTION TO INDUSTRY 4.0 9

The Various Industrial Revolutions, Digitalization and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0, The Journey so far: Developments in USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

MODULE II ROAD TO INDUSTRY 4.0 & RELATED DISCIPLINES 9

Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Smart Manufacturing, Smart Devices and Products, Smart Logistics, Smart Cities, Predictive Analytics, Cyber physical Systems, Robotic Automation and Collaborative Robots, Support System for Industry 4.0, Support System for Industry 4.0, Cyber Security.

MODULE III DATA INFORMATION AND COLLABORATION 9

Resource-based view of a firm, Data as a new resource for organizations, Harnessing and sharing knowledge in organizations, Cloud Computing Basics, Cloud Computing and Industry 4.0

MODULE IV BUSINESS ISSUES IN INDUSTRY 4.0 9

Opportunities and Challenges, Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

MODULE V INDUSTRY 4.0 APPLICATIONS 9

Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security, Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Alp Ustundag and Emre Cevikcan, “Industry 4.0: Managing the Digital Transformation”, Springer, 2017.
2. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things" A press, 2017.
3. Deepak Gupta, Victor Hugo C. de Albuquerque, Ashish Khanna, Purnima Lala Mehta, "Smart Sensors for Industrial Internet of Things: Challenges, Solutions and Applications", Springer, 1st Edition, 2021.
4. Francis daCosta, “Rethinking the Internet of things: A Scalable Approach to Connecting Everything”, Apress, 2014.

REFERENCES:

1. Christoph Jan Bartodziej, "The Concept Industry 4.0: An Empirical Analysis of Technologies and Applications in Production Logistics", Springer, 2016.
2. Gary Smart, "Practical Python Programming for IoT: Build advanced IoT projects using a Raspberry Pi 4, MQTT, RESTful APIs, Web Sockets, and Python 3", Pckt Publishing, 2020

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: apply the basic concepts and principles of Industry 4.0

CO2:identify, formulate and solve engineering problems using Industrial IoT

CO3:describe basics of cloud computing with IoT capability

CO4:discuss the challenges of the industry through IoT techniques

CO5:develop a domain specific IoT system

Board of Studies (BoS) :
24th BOS of ECE held on 08.02.2023.

Academic Council:
20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO1	PSO2	PSO3
CO1	H	H	M	M	L	L	L	L	L	L	L	L	H	H	H
CO2	M	H	M	M	L	L	L	L	L	L	L	L	H	H	H
CO3	M	M	L	M	L	L	L	L	L	L	L	L	H	H	H
CO4	H	M	M	M	L	L	L	L	L	L	L	L	H	H	H
CO5	H	H	M	M	L	L	L	L	L	L	L	L	H	H	H

Note: L- Low Correlation M -Medium Correlation H -High Correlation

SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation,

Statement: Able to apply the theoretical concepts for the various application in Industry 4.0

OEEY 710 NANOTECHNOLOGY AND CATALYSIS L T P C
SDG: 6,7,9,15 3 0 0 3

COURSE OBJECTIVES:

To make the student conversant with

COB1: basic knowledge on nanoscience and nanotechnology which includes the exotic properties of materials at nanoscale including various techniques for the processing of nanomaterials

COB2: various techniques available for the characterization of nanostructured materials

COB3: applications in selected fields and impacts of nanotechnology in ecosystem

COB4: Impart the basic concepts involved in catalytic processes.

COB5: Understand the importance of heterogeneous catalysis.

MODULE I INTRODUCTION AND PREPARATION OF NANOMATERIALS 9

Introduction to nanomaterials, Properties of nanomaterials, Nanostructures: Zero-, One-, Two- and Three-dimensional structures, Surface Plasmon Resonance, Change of bandgap; Methods of preparation of nanomaterials, top-down approach and bottom-up: Chemical precipitation and coprecipitation; Sol-gel synthesis; Ball milling synthesis; lithography, Plasma Laser deposition (PLD) techniques, Thermolysis routes (Solvothermal, Hydrothermal and pyrolysis), Microwave assisted synthesis; Sonochemical synthesis; Electrochemical synthesis.

MODULE II CHARACTERIZATION TECHNIQUES 9

Structural Characterization: X-ray diffraction, Scanning Electron Microscopy (SEM/HR-SEM/FE-SEM) with EDS, TEM (HR-TEM) and SAED analysis, Atomic force Microscopy (AFM). X-ray Photoelectron spectroscopy (XPS), Raman analysis. Introduction to advanced Scanning Probe Microscopy Techniques Scanning Tunnelling Mode (STM), Piezoelectric force microscopy (PFM). DLS and zeta potential analysis. BET surface area analysis, CHNSO micro analysis.

MODULE III APPLICATIONS AND ENVIRONMENTAL IMPACTS 9

Current applications - Short-term Applications - Long - term Applications – Energy filed - solar cells, military battle suits. Biomedical applications –

Photodynamic therapy in targeted drugs - quantum dot technology in cancer treatment, MRI applications. Nanosensors: pH, heat, humidity, gas, toxic chemicals sensors and sensors for aerospace and defence – biosensors – water remediation - Environmental Impacts: toxicological health effects, relevant parameters in nanoparticles toxicology, integrated concept of risk assessment of nanoparticles.

MODULE IV CONCEPTS OF CATALYSIS 9

Acid-base catalysis – catalysis by transition metal ions and their complexes – supported transition metal complexes as catalysts – catalysis by enzymes – phase transfer catalysis - photocatalysis – adsorption – chemisorption on metals, metal oxides and semiconductors - kinetics of unimolecular and bimolecular surface reactions - Contact time - WHSV - time on stream - Catalyst deactivation and regeneration, TOF, TON.

MODULE V HETEROGENEOUS CATALYSTS 9

Metals, metal oxides, mixed metal oxides, supported metals, spinels, perovskites, super acids, hydrotalcites, zeolites and zeotypes (small, medium, large), shape selective catalysts, mesoporous materials (SBA, MCM, KIT, AlPOs, MOFs, COFs) Hydrothermal synthesis, sol-gel process, impregnation method, ion-exchange method - Operations in catalyst manufacture - drying, calcination, spray drying, Reactors- fixed bed and flow reactors.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. T. Pradeep, Nano: The Essentials, Tata McGraw-Hill, New Delhi, 2007.
2. G. Cao, Nanostructures and Nanomaterials –Synthesis, Properties and Applications, Imperial College Press, London, 2004.
3. C. N. R. Rao, A. Muller and A. K. Cheetham, The Chemistry of Nanomaterials, Volume 1, Wiley –VCH Verlag GmbH & Co. KgaA, Weinheim, 2004.
4. G. A. Ozin, A. C. Aresnault, L. Cadematriri, Nanochemistry: A chemical approach to nanomaterials, RSC Publishing, 2008
5. J. Rajaram and J.C. Kuriacose, Kinetics and Mechanisms of Chemical Transformations, Macmillan Publishers India Limited, 2000.
6. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy (Editors), Catalysis

COURSE OUTCOMES:

The students will be able to

CO1: differentiate the nanomaterials based on their dimensions and acquire knowledge of various synthetic methods

CO2: understand the components of instrumental techniques of and characterization techniques for structural and properties of nanomaterials

CO3: select the appropriate nanomaterials for specific applications in the interested arena

CO4: Find the fundamentals of catalysis

CO5: Evaluate significance of heterogeneous catalysts.

Board of Studies (BoS): 12th BoS of Chemistry held on 22.07.2022

Academic Council: 19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		L		M	H	H									
CO2	M			H	M	H									
CO3					H	M									
CO4															
CO5															

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 6: Clean Water and Sanitation

SDG 7: Affordable & Clean Energy

SDG 9 : Industry and Innovation

SDG 15 : Life on Land

Statement:

SDG 6, 7 & 9: Foundation to work in R&D of renewable energy and sensors sector and for teaching career.

SDG 15: R&D labs in API labs in the production novel materials for various applications

OEEY 711	PROJECT MANAGEMENT	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn the concepts of organizational project management.

COB2: To acquire knowledge on leadership in project management.

COB3: To gain knowledge in stakeholder management and program management

COB4: To familiarize with the project scope and time management

COB5: To be conversant with project execution, monitoring and closing.

MODULE I INTRODUCTION – ORGANIZATIONAL PROJECT MANAGEMENT L:9

Introduction to Organizational Project Management- Organizational Project Management Framework- Project Linkages to Strategic Management - Relationships between Portfolio, Program, and Project Management - Organizational Issues and Project Management.

MODULE II PROJECT MANAGEMENT - LEADERSHIP L:9

Importance of Leadership in Project Management-Roles and Responsibilities of a Project Manager-Leadership vs. Management-Project Management Leader's Portfolio-Technical Management skills -Project Entrepreneurship skills- Project Leadership skills

MODULE III PROJECT STAKE HOLDER MANAGEMENT AND PROGRAM MANAGEMENT L:9

Project Stakeholder Management-Stakeholders Identification and Assessment - Stakeholders vs. Project Lifecycle - Stakeholders and Interested Parties- Program Management - Program Characteristics - Programs vs Projects - Programs vs Portfolios

MODULE IV PROJECT SCOPEAND TIME MANAGEMENT L:9

Project Scope: Planning, Defining, Verification and Change control -Project Activity sequencing -Precedence diagram method- Arrow diagram method – Project Activity Time Estimation -Tools for Activity Time Estimation -Schedule development – Resource levelling heuristics

MODULE V PROJECT EXECUTION,MONITORING AND CLOSING L:9

Execution phase overview-Delegating tasks -Assessing project status - Foreseeing future challenges - Managing progress and timeline adjustments Project execution guidelines - Monitoring phase overview - Key Performance Indicators -Evaluating progress-Assessing work quality -Setting quality assurance procedures -Monitoring risks -Closing phase overview -Obstacles in the closing phase -Evaluating project performance-Final reports and managing records -Project closing guidelines

L – 45; TOTAL HOURS – 45

TEXTBOOKS:

1. Projects: Planning, Analysis, Financing, Implementation and Review,

   Prasanna Chandra, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
2. Jack. R. Meredith, Samuel. J. Mantel & Scott. M. Shafer, Project

   Management in Practice, Fifth Edition, Bangalore: Wiley, 2015

REFERENCES:

1. Project Management and Control, Narendra Singh, Himalaya Publishing, New Delhi, 2015.
2. Bob Hughes, Mike Cotterrel “Software Project Management”, Tata

   McGraw-Hill, 2009
3. A Guide to the Project Management Body of Knowledge (PMBOK® Guide)–Sixth Edition, Author& publisher - Project Management Institute 2017
4. Lean Project Management: Philip Small, Arkham Publishing Limited, March 2020

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1:Explain the concepts of organizational project management

CO2: Discuss the leadership in project management.

CO3: Elucidate the stakeholder management and program management

CO4: Explain project scope and time management

CO5: Describe project execution, monitoring and closing

Board of Studies (BoS) :
21st BOS of Mechanical Engg. held on 10.02.2023.

Academic Council:
20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	L		L	M		H							M	L
CO2	L		M	L		L							L	H
CO3	M		M	H		L							H	M
CO4	L		L	L		M							L	M
CO5	L		M	L		L							H	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The comprehensive understanding of Project management principles and techniques brings prosperity, create jobs, and build prosperous equitable societies across the country

OEEY 712	REAL TIME EMBEDDED SYSTEMS	L	T	P	C
SDG: 4,9		3	0	0	3

COURSE OBJECTIVES:

COB1: To define the fundamental concepts of real time systems

COB2: To analyze the various uniprocessor and multiprocessor scheduling mechanisms

COB3: To develop knowledge on programming languages and tools for real time systems.

COB4: To discuss the overview of real time data bases

COB5: To classify the fault tolerance and evaluation techniques in real time systems.

PREREQUISITES: Embedded Systems, Operating Systems

MODULE I INTRODUCTION : EMBEDDED SYSTEMS & REAL TIME SYSTEMS **9**

Introduction –Embedded system - characterizing real time system -Performance Measures for Real Time Systems – Estimating Program Run Times – Task Assignment and Scheduling.

MODULE II PROGRAMMING LANGUAGES AND TOOLS **9**

Desired language characteristics – ADA language - Data typing – Control structures – Facilitating Hierarchical Decomposition- Packages- Run time Error handling – Overloading and Generics – Multitasking – Timing Specifications – Programming Environments – Run time support.

MODULE III REAL TIME DATABASES **9**

Basic Definition, Real time Vs General Purpose Databases- Main Memory Databases- Transaction priorities-Transaction Aborts-Concurrency control issues-Disk Scheduling Algorithms-Two – phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

MODULE IV REAL TIME COMMUNICATION 9

Communications media, Network Topologies, Protocols- contention based, Token based, Stop-and-Go multihop, Polled Bus, Hierarchical Round Robin Protocol, Deadline-Based Protocols, Fault Tolerant Routing.

MODULE V FAULT TOLERANT AND EVALUATION TECHNIQUES 9

Fault Tolerance Techniques – Fault Types – Fault Detection-Fault and Error containment- Redundancy- Reliability Evaluation Techniques – Software error models.

L –45 ; TOTAL HOURS –45

TEXT BOOKS:

1. C.M. Krishna, Kang G. Shin, “Real – Time Systems”, McGraw – Hill International Editions, 2010.
2. Rajib Mall,”Real-time systems: theory and practice”, Pearson Education, 2007.

REFERENCES:

1. Xiaocong Fan, “Real-Time Embedded Systems: Design Principles and Engineering Practices”, Elsevier, 2015.
2. Albert M. K. Cheng, “Real-Time Systems: Scheduling, Analysis, and Verification“, Wiley publishers, 2003.
3. P. A. Laplante," Real-Time Systems Design & Analysis", Willey, 2011.
4. Qing Li, "Real Time Concepts for Embedded Systems", Elsevier, 2011.

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1: describe the characteristics of real time system.

CO2: apply scheduling algorithms based on the application.

CO3: discuss about the programming language characteristics and tools of real time systems.

CO4: choose the appropriate real time communication protocols.

CO5: analyze the fault tolerance and evaluation techniques in real time systems.

Board of Studies (BoS) : 24th BOS of ECE held on 08.02.2023.

Academic Council: 20th AC held on 13.04.2023

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H
CO2	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H
CO3	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H
CO4	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H
CO5	H	H	H	H	H	H	M	M	M	M	M	M	H	H	H

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Statement: Understanding of the real time systems will bring practical knowledge on quality education.

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

Statement: capable of promoting industrialization through the application of real-time system design principles.

OEEY 713	ROBOTIC TECHNOLOGY	L	T	P	C
SDG: 9		3	0	0	3

OBJECTIVES:

COB1: To study the basics of robotics technology.

COB2: To acquire knowledge about robot operating system.

COB3: To familiarize with robot assembly and aerial robots.

COB4: To learn about futuristic robots.

COB5: To know about the application of robots in various fields.

MODULE I INTRODUCTION L:6

Robot – Definition – Robot Anatomy – Co-ordinate Systems - Work envelope: Types and classification – Specifications – Pitch, Yaw, Roll, and Joint notations - Speed of motion - Pay load – Robot Parts and their functions – Need for robots.

MODULE II ROBOT OPERATING SYSTEM L:10

Master – Node – Topic – Messages – Subscriber – Publisher – Robot Operating System (ROS) packages – ROS file system – Services and actions – Custom publisher – Custom subscriber – ROS topic list and ROS topic information -ROS topic echo – ROS topic pub – Custom messages.

MODULE III ROBOT ASSEMBLY AND AERIAL ROBOTS L:12

Robotic assembly automation - Parts presentation methods - Assembly operations - Assembly system configurations - Design for robot assembly - Basics of aerial robots - Modelling and control of small Unmanned Aerial vehicles - Guidance and navigation of small range aerial robots.

MODULE IV FUTURE TECHNOLOGY L:9

Wheeled and legged Robot – Legged locomotion and balance – Arm movement, Gaze and auditory orientation control – Facial expression – Hands and manipulation – Sound and speech generation – Motion capture/Learning from demonstration.

MODULE V APPLICATIONS L:8

Implementation of Robots in Industries - Industrial application for material handling: machine loading and unloading, assembly, and inspection– Applications of robot in Arc welding, Spot welding, and Spray painting - Robots

in Assembly operation, Cleaning and underwater applications –Applications of Robots in Agriculture, Mining, Defense, Nuclear, Medical, and Space.

L – 45; TOTAL HOURS – 45

TEXTBOOKS:

1. Robert J. Schilling, “Fundamentals of Robotics Analysis and Control”, PHI Learning.,2009.
2. Richard D. Klafter, Thomas. A, ChriElewski, Michael Negin, “Robotics Engineering an Integrated Approach”, Phi Learning.,2009
3. YoonSeokPyo, HanCheol Cho, RyuWoon Jung, TaeHoon Lim, ROS Robot Programming.
4. M.P.Groover, “Industrial Robotics – Technology, Programming and Applications”, McGraw Hill, 2001.

REFERENCES:

1. Bernard Hodges, “Industrial Robotics”, Second Edition, Jaico Publishing house, 1993.
2. Tsuneo Yohikwa, “Foundations of Robotics Analysis and Control”, MIT Press., 2003.
3. John J. Craig, “Introduction to Robotics Mechanics and Control”, Third Edition, Pearson,2008.
4. Craig.J. J, “Introduction to Robotics Mechanics and Control”, Addison-Wesley, 1999.Robotics Lab manual, 2007.

COURSEOUTCOMES:

After completion of the course, students should be able to

CO1: Explain the basics of robots.

CO2: Elucidate robot operating system.

CO3: Discuss about robot assembly and aerial robots.

CO4: Describe the future robot technology.

CO5: Explain the applications of robots.

Board of Studies (BoS) :
21st BOS of Mechanical Engg. held on 10.02.2023.

Academic Council:
20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M		M			M					L	L	H	M
CO2	M		M			M					L	L	H	M
CO3	M		M			M					L	L	H	M
CO4	M		M			M					L	L	H	M
CO5	M		M			M					L	L	H	M

Note: L - Low Correlation M - Medium Correlation H - High Correlation

SDG 9: Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation.

The holistic knowledge of robot technology, its operating system, and future robot helps in developing robots for various applications.

OEEY 714 SOFT COMPUTING TECHNIQUES L T P C
SDG:8,9 3 0 0 3

COURSE OBJECTIVES:

COB 1: To enumerate the strengths and weakness of soft computing
COB2 To focus on the basics of neural networks
COB3: To learn the basics of fuzzy systems and hybrid Neurofuzzy systems
COB4: To emphasize the role of evolutionary computing algorithms
COB5: To learn the ANN, FIS and GA tool boxes for various soft computing applications.

MODULE I BASICS OF SOFT COMPUTING 8

Soft computing – Hard Computing – Artificial Intelligence as the basis of soft computing – Relation with logic driven and statistical method driven approaches- Expert systems – Types of problems: Classification, Functional approximation, Optimizations – Modeling the problem – Machine Learning – Hazards of Soft Computing – Current and future areas of research.

MODULE II ARTIFICIAL NEURAL NETWORK 10

Artificial Neuron – Multilayer perceptron – Supervised learning – Back propagation network –Types of Artificial Neural Network: Supervised Vs Un Supervised Network – Radial basis function Network – Self Organizing Maps – Recurrent Network – Hopfield Neural Network – Adaptive Resonance Theory – Issues in Artificial Neural Network – Applications.

MODULE III FUZZY SYSTEMS 10

Fuzzy Logic – Membership functions – Operators – Fuzzy Inference systems – Other sets: Rough sets, Vague Sets – Fuzzy controllers - Cooperative Neuro fuzzy systems – Neural network driven fuzzy reasoning – Hybrid Neuro fuzzy systems – Construction of Neuro Fuzzy systems: Structure Identification phase, Parameter learning phase – Applications.

MODULE IV EVOLUTIONARY COMPUTING & ALGORITHMS 7

Overview of evolutionary computing – Genetic Algorithms and optimization – Genetic Algorithm operators – Genetic algorithms with Neural/Fuzzy systems – Variants of Genetic Algorithms– Population based incremental learning – Meta heuristic algorithms - Evolutionary strategies and applications.

MODULE V MATLAB TOOL BOX FOR SOFT COMPUTING 10

Artificial Neural Network (ANN) Toolbox - training and testing with different activation

functions- controller design using ANN toolbox Fuzzy Inference System (FIS) Editor and tool box- fuzzy controller design - Genetic Algorithm Toolbox - Application of ANN, FIS and GA tool box to various power system and control applications.

L – 45; TOTAL HOURS – 45

TEXT BOOK:

1. Samir Roy, “Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms”, Pearson, 2013

REFERENCES:

1. Anupam Shukla, Ritu Tiwari and Rahul Kala, “Real life applications of Soft Computing”, CRC press, 2010.
2. Fakhreddine O. Karray, “Soft Computing and Intelligent Systems Design: Theory, Tools and Applications”, Pearson, 2009
3. Matlab Simulink Manual

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1: enumerate the theoretical basis of soft computing

CO2 : explain the Neural network architecture and different learning rules

CO3: apply the fuzzy systems and hybrid Neurofuzzy systems

CO4: demonstrate the different evolutionary and metaheuristic algorithms

CO5: demonstrate the most appropriate soft computing technique for a given situation using MATLAB tool box.

Board of Studies (BoS) :
18th BoS of EEE held on 10.02.2023

Academic Council:
20th AC held on 13.04.2023

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO 1	PSO 2
CO1	L	H	L	L	M	L	L	H	L	M	M	L	H	L
CO2	H	L	L	L	L	L	H	L	L	L	L	L	L	H
CO3	L	H	M	L	M	L	L	L	M	L	M	L	M	M
CO4	M	L	H	L	L	L	M	L	H	L	L	H	L	L
CO5	L	L	L	L	H	L	L	L	L	L	H	L	L	M

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 8: Decent work and economic growth

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas to promote economic growth.

SDG No. 9 Industry, innovation and infrastructure

Statement:

The development of soft computing techniques will meet out the desired needs such as new innovative systems for industry and establishing advanced infrastructure.

OEEY 715	STRUCTURAL INTERPRETATION OF	L	T	P	C
SDG: 4, 9	MATERIALS	3	0	0	3

COURSE OBJECTIVES:

To use the concepts (basic and advanced level) of analytical methods for structure elucidation of materials and the students will be trained for the

COB1: Interpretation of electronic spectral data of materials

COB2: Interpretation of magnetic spectral data of materials

COB3: Interpretation of structural and morphological data of materials

COB4: Interpretation of thermoanalytical data of materials

COB5: Interpretation of electrochemical and XPS data of materials

MODULE I ELECTRONIC DATA 9

UV-visible, fluorescence and phosphorescence: Characteristic absorption of simple chromophoric groups, conjugated/ aromatic/ ligand systems, metal complexes and materials. FT-IR and Raman: Characteristic group frequencies of organic, inorganic molecules and various materials (polymer, nano, semiconducting) Interpretation of organic and inorganic and hybrid materials using combination of the spectral data.

MODULE II MAGNETIC AND MASS DATA 9

Solid-state nuclear magnetic resonance spectroscopy: Compounds containing ^{1}H, ^{13}C, ^{19}F,^{27}Al, ^{29}Si, and ^{31}P nuclei. Electron spin resonance (ESR): Simulation of ESR spectra of paramagnetic species, spin dynamics in solid and liquid. Mass spectrometry: The production and analysis of positive ions, molecular ions, application of isotopic abundance measurements, fragmentation modes and rearrangement of ions. Interpretation of organic, inorganic compounds and materials using combination of the spectral data.

MODULE III STRUCTURAL AND MORPHOLOGICAL DATA 9

Fundamental theoretical framework for diffraction (XRD) and imaging methods (SEM, TEM and AFM) used in structural and compositional characterization of materials in solid, film state etc.

MODULE IV THERMOANALYTICAL DATA AND SURFACE AREA 9

Interpretation of Differential Thermal Analysis (DTA), Thermo-gravimetric Analysis (TGA), Differential Scanning Calorimetry (DSC) data of various materials including inorganic complex, organic polymeric materials, composite, nano-composites etc; Surface area analysis; isotherms, types, BET surface area, pore dimensions, pore volume, etc.

MODULE V ELECTROCHEMICAL AND XPS DATA 9

Cyclic voltammetry for oxidation and reduction potentials, TAFEL polarization and Impedance spectroscopy for corrosion inhibitor behavior, chronoamperometry for charge or discharge of battery. X-ray photoelectron spectroscopy: Study the chemical composition and oxidation state of elements at the surface and interface. Applications of XPS in various arenas.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. R. S. Drago, Physical Methods for Chemists, W. B. Saunders,1992.
2. R. M. Silverstein, C. G. Bassler and T. C. Morril, Spectrophotometric Identification of Organic Compounds, 5th edition, Wiley, 1991.
3. D. H. Williams and I. Fleming, Spectroscopic Methods in Organic Chemistry, 3rd edition, McGraw Hill, 1980.
4. W. Kemp, Organic Spectroscopy, ELBS, 1979.
5. W. L. Jolly, The synthesis and characterization of inorganic compounds, Prentice-Hall, 1970.
6. John Wertz, Electron Spin Resonance: Elementary Theory and Practical Applications, Springer Science & Business Media, 2012.
7. R. F. Speyer, Thermal Analysis of Materials, CRC Press, 1994.
8. P.J. Goodhew, J. Humphreys and R. Beanland, Electron Microscopy and Analysis, Taylor & Francis, 2001.
9. John F Watts, John Woistenhoime, An introduction to surface analysis by XPS and AES, John Wiley and Sons, 2nd edition, 2003.
10. James, B. Condon, Surface Area and Porosity Determinations by Physisorption Measurement and Theory, Elsevier, 1st edition, 2006.

COURSE OUTCOMES:

The students will be able to

CO1: Interpret electronic spectral data of materials

CO2: Interpret magnetic spectral data of materials

CO3: Interpret structural and morphological data of materials

CO4: Interpret thermo analytical data and porous nature of materials

CO5: Interpret electrochemical and XPS data of materials

Board of Studies (BoS):	**Academic Council:**
12th BoS of Chemistry held on 2207.2022	19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	H	M		H	M	H									
CO2	H	M		H	M	L									
CO3	H	L		H	M	M									
CO4	H	L		H	M	H									
CO5	H	L		H	M	L									

Note: L- Low Correlation M - Medium Correlation H -High Correlation

SDG 4: Quality Education
SDG 9: Industry and Innovation

Statement:
SDG9: Foundation to work in R&D laboratory, chemical industry, independent researcher and for teaching career.
SDG4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities.