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
(Updated upto August 2025 as per 24th Academic Council)

M.Tech.
(Computer Science & Engineering)

REGULATIONS 2022

CURRICULUM AND SYLLABI

(Updated upto August 2025 as per 24th Academic Council)

M.TECH.

COMPUTER SCIENCE AND ENGINEERING

(Integrated with LTIMindTree)

(with effect from academic year 2024-25)

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 modelling 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.	
MCA	
M.Sc.	Full Time
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.
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.

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
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.
13.	Commerce	M.Com	B.Com. / BBA
14.	Arabic and Islamic	M.A. Islamic Studies	B.A. in Islamic Studies / Arabic (or) Afzal-ul-Ulama (or)

Sl. No.	Name of the Department	Programmes offered	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
	Studies		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 credit 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:

❖ Onecredit 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, alter 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 assessmentshall 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 organization. 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 componentsand 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 ith course and GP_i is the Grade Point in the ith 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.

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

M.TECH. COMPUTER SCIENCE AND ENGINEERING
(Integrated with LTIMind Tree)
(with effect from academic year 2024-25)

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 6102	Algorithm Design and Implementation	3	0	2	4
3	CSE 6151	Edge Engineering	3	1	0	4
4	CSE 6152	Programming for Data Analysis	3	0	0	3
5		Professional Elective – I	3	0	0	3
6	CSE 6153	Edge Engineering Laboratory	0	0	2	1
7	CSE 6154	Programming Laboratory	0	0	4	2
8	ENE 6181	English for Career Development	1	0	2	2
		Credits				**23**

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 6203	Advanced Software Engineering and Agile Modeling	3	0	0	3
3	CSE 6161	IoT Middleware and Data Engineering	3	0	0	3
4		Professional Elective -II	3	0	0	3
5		Professional Electives -III	3	0	0	3
6	ENE 6281	Professional Skills	0	0	2	1
7	CSE 6162	IoT Middleware and Data Engineering Laboratory	0	0	2	1
8	CSE 6163	C and Embedded Programming Laboratory	0	0	2	1
		Credits				**21**

SEMESTER III

Sl. No.	Course Code	Course Title	L	T	P	C
1.		Professional Elective – IV	3	0	0	3
2.	CSE 7101	Industry Internship				3
3.	CSE 7102	Project Work - Phase I	0	0	0	9
4.		MOOC (Related to Project)				-
		Credits				**6**

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C
1	CSE 7102	Project Work - Phase II	0	0	0	12
		Credits			**9+12=**	**21**

Overall Total Credits– 71

* Industrial training will be under taken during first year summer vacation for 30 days. The credit will be awarded in the3rdSemester.

\# 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

Sl. No.	Course Code	Course Title	L	T	P	C
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
6.	CSEY 101	Java programming for IoT applications	3	0	0	3
7.	CSEY 102	.Net programming for IoT applications	3	0	0	3

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C
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 IoT	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
16.	CSEY 111	Optimization Techniques	3	0	0	3
17.	CSEY 112	C and Embedded Programming	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
13	CSEY 122	Machine Learning Engineering for Production (MLOPS)	3	0	0	3

SEMESTER I

MAE 6181 **APPLIED ALGEBRA AND DISCRETE**   L   T   P   C
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. JurajHromkovic, 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 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):	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			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 6102

SDG: 8

ALGORITHM DESIGN AND IMPLEMENTATION

L T P C

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   9
**   ALGORITHMS**

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   9
                   ALGORITHMS

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   9
                   ALGORITHMS

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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
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 6151   **EDGE ENGINEERING**   L T P C
                                                    3 1 0 4

COURSE OBJECTIVES:

COB1: To highlight the basic concepts of network types, models and security.

COB2: To learn about different IoT sensors and actuators.

COB3: To understand IoT connectivity and communication technologies, communication protocols and industry standard protocols.

COB4: To introduce a programming platform for communication between edge devices and cloud.

COB5: To explore the IoT applications and futuristic trends in market.

MODULE I   NETWORKING   12

Introduction to IoT; Network Types: Connection types - Physical topology - Network reachability; Layered Network Models: OSI Model - Internet protocol suite; TCP/IP Transport layer: Connectionless service - Connection-oriented service; Basics of Network Security: Introduction – Security - Symmetric key cryptography - Asymmetric key cryptography - Message Integrity and Authenticity - Digital signatures - Internet Security - Network layer security - Application layer security- Firewall; Predecessors of IoT: Wireless Sensor Networks - Architectural components of WSN - Machine-to-Machine Communications - Architectural components of M2M- Cyber Physical Systems.

MODULE II   IOT SENSORS AND PROCESSING   12

Emergence of IoT: IoT versus M2M - IoT versus WoT - Enabling IoT and the Complex Interdependence of Technologies - IoT Networking Components - Addressing Strategies in IoT - Address management classes - Addressing during node mobility; IoT Sensing and Actuation: Introduction – Sensors - Sensor Characteristics - Sensorial Deviations- Sensing Types - Scalar sensing - Virtual sensing - Sensing Considerations - Actuator Types - Hydraulic actuators - Pneumatic actuators - Electric actuators - Thermal or magnetic actuators - Mechanical actuators - Soft actuators - Shape memory polymers - Actuator Characteristics; IoT Processing Topologies and Types: Data Format - Structured data - Unstructured data - Importance of Processing in IoT - Processing Topologies - On-site processing - IoT Device Design and Selection Considerations

MODULE III   IOT CONNECTIVITY AND COMMUNICATION   12

IoT Connectivity Technologies: Introduction - IEEE 802.15.4 – Zigbee- Thread – Wireless HART – RFID – NFC - Z-Wave – Weightless – Sigfox – LoRa - NB-IoT - Wi-Fi – Bluetooth; IoT Communication Technologies: Introduction - Constrained nodes - Constrained networks - Types of constrained devices - Low power and lossy networks - Infrastructure Protocols - Internet protocol version 6 (IPv6) - Data Protocols – MQTT - MQTT-SN – CoAP- AMQP – XMPP – REST – WebSocket Device Management; Serial Communication Protocol: UART - I2C – SPI; Industrial Protocols: Modbus – Profibus – BACnet.

MODULE IV   PROGRAMMING EDGE AND CLOUD EDGE GATEWAY   12

Programming Edge Devices: Introduction to C - Introduction to Arduino Programming - Sensors and Actuators integration to Arduino - Introduction to Python Programming - Introduction to RaspberryPi - Sensors and Actuators integration to RaspberryPi - Implementation of IoT on Raspberrypi; Cloud Edge gateway Design & Programming: Azure edge gateway - Design & Implementation - Simulation of device data with program and usage of edge as buffer/local storage - Usage of Azure SQL & blob edge - Deployment of edge in Kubernetes - AKRI and Edge essentials - Scalability and high availability of edge gateway - Project assignment- AWS edge gateway - Design & Implementation- Simulation of device data with program and usage of edge as buffer/local storage - AWS Greengrass & IoTSitewise - Deployment of edge in Kubernetes - Scalability and high availability of edge gateway - Project assignment - Build Azure/AWS edge connecting to physical device which will be designed in lab or simulated device.

MODULE V   IOT APPLICATIONS   12

IoT Case Studies & Future Trends: Agricultural IoT - Components of an agricultural IoT - Advantages of IoT in agriculture - Vehicular IoT - Components of vehicular IoT - Advantages of vehicular IoT - Healthcare IoT - Components of healthcare IoT - Advantages and risk of healthcare IoT.

L – 45; T- 15; TOTAL HOURS – 60

REFERENCES:
1. AK Dubey, Vijayan Sugumaran, Peter Han Joo Chong (2023), Advanced IoT Sensors, Networks and Systems, Springer.
2. C. Santhiya and S. Padmavathi (2023), Perspective Chapter: A View – Cloud-Edge Computing Technology.
3. Gerardus Blokdyk (2008), IoT Communication Protocols Second Edition, 5STARCooks.

COURSEOUTCOMES:

Students who complete this course will be able to

CO1: Describe the network types, models and security.
CO2: Identify the suitable IoT sensors and actuators for real time applications.
CO3: Write programs for IoT connectivity and communication technologies using communication protocols and industry standard protocols.
CO4: Design a program for edge devices and develop cloud edge gateways.
CO5: Implement IoT applications and futuristic trends in market.

Board of Studies (BoS):   **Academic Council:**

23rd BoS of CSE held on 02.09.2024   22nd ACM held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H		L									M	H	
CO2	H		H						H			L	H	
CO3	H			H	H					M			M	
CO4		M		H		M					M			H
CO5			H		H		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 students can have productive employment and decent work in IoT based industry by learning Edge Engineering.

CSE 6152   **PROGRAMMING FOR DATA ANALYSIS**   L T P C

                                                     3 0 0 3

COURSEOBJECTIVES:

COB1: To learn the fundamentals of Big Data.

COB2: To get familiar with the NoSQL and Processing tools.

COB3: To learn advanced concepts of Spark code in depth.

COB4: To provide the methods of developing the Pyspark programs using RDD

COB5: To develop a project on Pyspark programs.

MODULE I   INTRODUCTION TO BIG DATA   9

Definition of Big data - Relational databases - Structured, Unstructured and semi-structured data - Big data tooling and technology - Scale up vs Scale out.

MODULE II   NoSQL AND PROCESSING TOOLS   9

NoSQL, Key-value stores, column-oriented stores - Document stores, Graph stores - Basics of Map Reduce - What is Spark, Spark batch, Spark Streaming, Storm - Supportive Operational tools.

MODULE III   SPARK CORE IN DEPTH   9

Big data ecosystem- RDD (Resilient Distributed Datasets) - Resource Managers - YARN, standalone mode - Deep dive - Spark internals - Accumulators, Broadcast variables - Spark streaming - Spark SQL and Data frames - Machine Learning (NLP, k-means clustering, PageRank, Shortest Path) – Graph Frames - Visualizations (Matplotlib, Google Charts, D3.js) - Advanced Performance Tuning and Debugging- Spark UI.

MODULE IV   PYSPARK - PROGRAMMING   9

PySpark coding using RDD - PySpark coding using Data Frames - Semi structured file data analysis - Structured file data analysis - Unstructured file data analysis - Distributed processing challenges - Spark performance tuning - Lazy evaluation - Spark internal execution - step by step - Spark SQL using JDBC.

MODULE V   CODE WITH US   9

Project

L – 45; TOTAL HOURS – 45

REFERENCES:

1. Tomasz Drabas, Denny Lee (2017), Learning PySpark, Packt Publishing.
2. Pedro Duarte Faria (2024), Introduction to PySpark, independently published

3. Matei Zaharia, Bill Chambers (2018), Spark: The Definitive Guide - Big Data Processing Made Simple (Greyscale Indian Edition), Shroff/O'Reilly.

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: Perform data analysis for structured, unstructured and semi-structured data sources.

CO2: Implement a model that combines NoSQL databases, Map Reduce, Spark, and operational tools in big data applications.

CO3: Demonstrate spark code in depth on RDD, spark internals, Data frames, visualizations and usage of Spark UI

CO4: Develop Pyspark programs using RDD and data frames.

CO5: Implement real time project in spark SQL using JDBC.

Board of Studies (BoS):   **Academic Council:**

23rd BoS of CSE held on 02.09.2024   22nd ACM held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1		M	M						L				M	H
CO2	M					M							H	M
CO3		H						M					M	
CO4			M			M								
CO5		L	M		L				H		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: The students can have productive employment and decent work by learning the Programming for Data Analysis course.

CSE 6153	EDGE ENGINEERING LAB	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

COB1: To understand the functional components of raspberry Pi device.

COB2: To introduce the programming features of AWS and Azure IoT.

COB3: To get familiar with the services of Power BI.

COB4: To learn installation and working procedures of Azure/AWS platform.

COB5: To explore the IoT applications using Azure/AWS services.

LIST OF EXPERIMENTS

1. Consider raspberry Pi and write python language to capture the real time data from sensors and send it to AWS IoT Core.

2. Consider raspberry Pi and write python language to capture the real time data from sensors and send it to Azure IoT hub.

3. Create asset utilization dashboard in Power BI with real time data simulated from sensors and generate actions with cloud specific services.

4. Create azure edge by installing azure edge runtime in Azure VM, write python simulator to generate device data and use Grafana dashboard to create real time monitoring insights.

5. Create AWS green grass edge run time and use awsiotsitewise edge to transfer the simulated device data to AWS IoT Core and generate real time insights using grafana dashboard.

6. Create an application to implement protocol translation in edge.

7. Simulate device data with python program in edge VM and implement local storage in edge using either Azure/AWS Services.

8. Implement Smart lightning use case with sensor data transferred from edge in Azure to Azure IoT hub and creation of grafana dashboards for real time insights with 10 KPIs. Find the right sensor for smart lightning and build small model, showcase working solution by designing edge in Azure and real time insight generation using Azure IoT hub, ADLS gen2 and PowerBi/Grafana.

P- 30; TOTAL HOURS – 30

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: Capture real time data using raspberry PI.

CO2: Communicate real time data to AWS and Azure cloud services.

CO3: Connect, visualize and analyze real time data set using Power BI

CO4: Design a system level programming that run on edge devices and s.

CO5: Develop cloud edge gateway for communication between edge and cloud platform.

Board of Studies (BoS): **Academic Council:**

23rd BoS of CSE held on 02.09.2024   22nd ACM held on 04.09.2024

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

Statement: The students can have productive employment and decent work in IoT based industry by learning programming in edge engineering.

CSE 6154	**PROGRAMMING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSEOBJECTIVES:

COB1: To understand the basic concepts of OOPS.

COB2: Toget familiar with database connectivity using JDBC with MySQL.

COB3:. Toacquire the programming features of AWS and Azure IoT.

COB4: To learn deployment of .Net application to Azure using Azure DevOps.

COB5: To explore the data transformations in PySpark with Dataframes using different spark methods and functions.

LIST OF EXPERIMENTS

1. Implement Library management system utilizing all features of Java.
2. Implement OOPs concepts.
3. Implement Generics, exception handling.
4. Implement file handling I/O and serialization.
5. Implement database connectivity using JDBC with MySQL.
6. Implement APIs using all the concepts learnt.
7. Deploy Java application to Azure using Azure DevOps.
8. Implement Library management system utilizing all features of .NET.
9. Implement OOPs concepts.
10. Implement Generics, exception handling.
11. Implement file handling I/O and serialization.
12. Implement database connectivity using JDBC with MySQL.
13. Implement APIs using all the concepts learnt.
14. Deploy the .Net application to Azure using Azure DevOps to Azure App service.
15. Implement data transformations in PySpark with Dataframes using different spark methods and functions.
16. Use semi structured dataset stored in Data Lake either in json/parquet format, implement and showcase data analysis using PySpark scripts.
17. Create visualization using Matplotlib for the semi structured dataset.
18. Implement simple algorithm with publicly available data set and spark ML libraries, visualize and show the results.
19. Implement real time analytics using spark streaming libraries.

P- 60; TOTAL HOURS – 60

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: Apply OOPs basic concepts to implement Java programs.

CO2:. Implement database connectivity using JDBC with MySQL.

CO3: Deploy the .Net application to Azure using Azure DevOps.

CO4: Design data transformations in PySpark with Dataframes using different spark methods and functions.

CO5: Develop real time analytics using spark streaming libraries.

Board of Studies (BoS):	**Academic Council:**
23rd BoS of CSE held on 02.09.2024	22nd ACM held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1		M	M						L				M	H
CO2	M					M							H	M
CO3		H						M					M	
CO4			M		M									M
CO5		L	M		L				H		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: The students will have productive employment by learning .NET programming and will be able to develop PySpark with data frames using different spark methods and functions

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| ENE 6181 | **ENGLISH FOR CAREER** | L | T | P | C |
| SDG: 4 and 8 | **DEVELOPMENT** | 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) :
15th BoS of the Department of English held on 14.6.2022

Academic Council:
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.

GEE 6201	**RESEARCH METHODOLOGY AND**	**L**	**T**	**P**	**C**
SDG: 4, 8, 9	**IPR**	**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):	**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		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 6203
SDG: 9

ADVANCED SOFTWARE ENGINEERING AND AGILE MODELLING

L	T	P	C
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):
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											M	
CO2	M	L											H	
CO3			L							L				L
CO4			M			M								L
CO5										M			H	

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.

CSE 6161	**IoT MIDDLEWARE AND DATA ENGINEERING**	**L T P C**
		3 0 0 3

COURSE OBJECTIVES:

COB1: To learn about the design and implementation of IoT solutions on the Azure platform.

COB2: To gain knowledge of the concepts of AWS IoT middleware platform to support data-driven business decisions.

COB3: To build a strong foundation in deploying IoT applications on AWS.

COB4: To equip students with the essential knowledge for designing and implementing data engineering solutions.

COB5: To provide students with data visualization principles andl experience in real-time project development.

MODULE I   AZURE IoT MIDDLEWARE   9

Azure IoT Middleware - Design & Implementation - Azure IoT hub - Azure function - Azure Kubernetes services - API implementation - Azure App Service - Azure DevOps - deploying IoT apps to Azure - Azure monitor, security & Governance services - Project assignment.

MODULE II   AWS IoT MIDDLEWARE   9

AWS IoT Middleware - Design & Implementation - AWS IoT Core - AWS Lambda functions – micro services implementation - AWS Elastic Kubernetes services - API implementation

MODULE III   DEVOPS   9

DevOps - deploying IoT apps in AWS -Monitoring, security & Governance services - Real time assignment -Case study to simulate data from edge and build Azure IOT middleware platform to show real time assets and build insights to derive business decisions.

MODULE IV   IoT DATA ENGINEERING   9

Data engineering - Design & Implementation - Data acquisition -Data Processing & Transformation – PySpark - Real time stream analysis & processing - Data Storage- Monitoring, security & Governance.

MODULE V   REAL TIME INSIGHTS GENERATION   9

Data Visualization - Visualization - Real time dashboards: Data Acquisition and Processing - Dashboard Design and Architecture- Real-Time Insights Generation - Backend Technologies for Real-Time Dashboards - Security and Data Privacy.

L – 45; - TOTAL HOURS – 45

REFERENCES:

1. Honbo Zhou (2012), The internet of things in the cloud a middleware perspective, CRC Press Inc; 1st edition (29 October 2012)

2. Gerardus Blokdyk (2018), AWS IoT Amazon The Ultimate Step-By-Step Guide, 5STARCooks

3. Joe Reis and Matt Housley (2022), Fundamentals of Data Engineering: Plan and Build Robust Data Systems (Grayscale Indian Edition), Shroff/O'Reilly.

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: Learn in-depth concepts of Azure IoT services.
CO2: Learn in-depth concepts of AWS IoT services.
CO3: Understand data engineering and real time stream processing, security and governance.
CO4: Visualize the data at real time to make efficient decisions.
CO5: Perform real time project in Azure and AWS.

Board of Studies (BoS) :
24th BoS of CSE held on 03.12.2024

Academic Council:
23th AC held on 28.02.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	M							M				H	H
CO2	H	M	M			M			M				H	H
CO3	H		M			M			M				H	H
CO4	H		M			M			M				H	H
CO5	H	H	H	H	M	H	H	L	H	L	H	H	H	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 for all

Statement: Students can integrate IoT solutions and robust data engineering practices, organizations can improve operational efficiency, create new business opportunities, and ensure sustainable economic development while fostering an inclusive workforce.

ENE 6281   **PROFESSIONAL SKILLS**   L   T   P   C

                                                       0   0   2   1

COURSE OBJECTIVES:

COB1: To develop a neutral accent by honing speech patterns, intonation, and pronunciation in order to talk more effectively and clearly.

COB2: To improve customer service skills by learning how to engage with various customers, distinguish between service and experience, practice telephone etiquette, and handle difficult situations

COB3: To develop effective problem-solving and decision-making skills through structured methods and strategies.

COB4: To master professional communication by learning effective business email etiquette and chat practices

COB5: To understand fundamental financial concepts and principles, including budgeting, financial statements, and basic investment strategies

MODULE I   ACCENT NEUTRALIZATION   6

Identifying and dealing with Mother Tongue Influence (MTI) – Pronunciation - Vowel Sounds and Consonant Sounds – Inflection – Pausing - Reducing rate of speech - Volume and tone – Pitch – Clarity - and enunciation.

MODULE II   CUSTOMER SERVICE   6

Customer Service - Different types of customers - Difference between customer service and customer experience - Telephone Etiquette - Handling difficult customers.

MODULE III   PROBLEM SOLVING AND DECISION MAKING   6

Define a Problem - Define Decision Making- Blocks in problem solving - Stereotyping and unconscious biases – The process of Problem Solving and decision making - Problem Analysis- Decision Analysis - Potential Problem / Opportunity Analysis - Creative Thinking - Problem Solving process - Implementation of the solution

MODULE IV   BUSINESS EMAIL ETIQUETTE AND CHAT   6

Emails Etiquette: Share format/ signature - Emails etiquette - dos and don'ts

MODULE V   BASICS OF FINANCE   6

Accounting systems and how transactions are recorded - Financial statements: Profit & Loss account - balance sheet - cash flow statement - Fixed assets - depreciation and the capitalization of software development expense – Working capital and cash management - Using ratio analysis to assess corporate health and performance - Funding the business: equity - debt and other aspects - Budgeting & Forecasting – capex – apex - Designing a flexible budget - Capital expenditure appraisal and approval

L – 30; TOTAL HOURS – 30

REFERENCES:

1. Lisa Mojsin, "Mastering the American Accent", Barrons Educational Services, Second Edition, 2016

2. Robert Lucas , "Customer Service: Skills for Success", McGraw Hill, Eighth Edition, 2023

3. Bob Sproull, "The Problem-Solving, Problem-Prevention, and Decision-Making Guide- Organized and Systematic Roadmaps for Managers", Productivity Press, 2018

4. Eric Butow, Kendra Losee, Kelly Noble Mirabella, "Digital Etiquette For Dummies", Wiley Publishers, 2022

5. Pamela Peterson Drake, Frank J. Fabozzi , "The Basics of Finance: An Introduction to Financial Markets, Business Finance, and Portfolio Management" John Wiley & Sons , First Edition, 2010.

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: Understand what is spoken without distortion and respond appropriately.

CO2: Behave professionally.

CO3: Participate productively in an official meeting keeping etiquette in mind.

CO4: Communicate effectively through writing.

CO5: Behave appropriately in an official environment.

CO6: Demonstrate the ability to confidently and appropriately interact with colleagues, clients, and leaders during formal and informal dining settings.

Board of Studies (BoS) :   **Academic Council:**

24th BoS of CSE held on 03.12.2024   23th AC held on 28.02.2025

	PO1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1									H	H	M		M	M
CO2						M				H		M	M	M
CO3		L		M		M				H		M	H	H
CO4	L							H	H			M	H	M
CO5										H		M	M	M

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

SDG 8: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Statement: The course aims to prepare students for professional environments where presenting information is crucial and support lifelong learning by giving individuals tools to share knowledge effectively.

CSE 6162	**IOT MIDDLEWARE AND DATA ENGINEERING LABORATROY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To learn real-time IoT data integration from various devices into Azure IoT Hub.

COB2: Toacquire knowledge on device management module integrated with Azure IoT Hub and Cosmos DB.

COB3: To gain knowledge in AWS DevOps tools to automate manual task and to manage complex environments.

COB4: To understand Azure Synapse to query and analyze data.

COB5: To explore knowledge on visualization of data analytics.

LIST OF EXPERIMENTS

1. Implement real time IoT data from devices to Azure IoT hub and generate dashboard for real time asset utilization.

2. Create device management module with Java/.NET using Azure IOT hub and store the data in Azure cosmosdb. Deploy Java/.NET in Azure App service/Azure AKS.

3. Create CI/CD pipeline for Java/.NET using Azure DevOps and deploy to Azure AppService/AKS

4. Implement real time IoT data from devices to AWS IoT Core and generate dashboard for real time asset utilization.

5. Create device management module with Java/.NET using AWS IoT Core and store the data in AWS Timeseries. Deploy Java/.NET in AWS EKS.

6. Create CI/CD pipeline for Java/.NET using AWS DevOps tools and deploy to AWS EKS.

7. Implement real time IoT data analytics with Azure synapse analytics and Pyspark scripts for data transformation.

8. Implement batch analytics with Azure synapse analytics and SQL transformation.

9. Create Power BI dashboards for Batch analytics.

10. Implement real time IoT data analytics with AWS Kinesis streams and Glue for data transformation.

11. Implement batch analytics with AWS kinesis streams and Glue for data transformation.

P- 30; TOTAL HOURS – 30

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: Design a comprehensive dashboard to monitor and analyse asset utilization in real-time.

CO2: Use the Azure SDK for .NET to handle communication with Azure IoT Hub and Cosmos DB.

CO3: Develop PySpark scripts to perform real-time data transformation and analytics.

CO4: Employ AWS kinesis to capture, process, store and real time IoT data streams.

CO5: Construct Power BI dashboard for visually immersive, and interactive insights.

Board of Studies (BoS) :
24th BoS of CSE held on 03.12.2024

Academic Council:
23th AC held on 28.02.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	M	H	L									M	H	
CO2			M				M			H	H	L	M	M
CO3			H					M					M	
CO4	H				L	M				H			L	
CO5	H					M	M	M		H	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 for all

Statement: Impactful solutions across multiple sectors are made possible by the IoT Middleware and Data Engineering lab's focus on innovation and technology, which is in line with this global goal.

CSE 6163	**C AND EMBEDDED**	**L**	**T**	**P**	**C**
SDG: 8	**PROGRAMMING LABORATORY**	0	0	2	1

COURSE OBJECTIVES:

COB1: To be familiar with C programs for File handling I/O

COB2: To provide knowledge on Structures and nested structures.

COB3: To learn pointers and linked list concepts to implement Embedded Programs

COB4: To explore the stack and queue concepts used in Embedded Programming

COB5: To expose Embedded Programming for developing real time Applications

SOFTWARE REQUIRED: UML tool – Visual Paradigm.

1. Implement C program showcasing File handling I/O
2. Implement structures and nested structures
3. Implement Pointers
4. Implement linked list.
5. Implement Stack and Queue.
6. Study of Keil software.
7. Flashing of LEDS using embedded C.
8. Mini Project – real world applications.

P- 30; TOTAL HOURS –30

COURSE OUTCOMES:

CO1: Apply File handling I/O concepts to implement C programs

CO2: Implement the concepts of structures and nested structures in programs.

CO3: Develop programs using pointer and linked list concepts.

CO4: Demonstrate the use of stack and queue concepts with the help of programs

CO5: Propose embedded Programming for real world applications.

Board of Studies (BoS) :   **Academic Council:**

24th BoS of CSE held on 03.12.2024   23th AC held on 28.02.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1			L		M	L					M			L
CO2		M	M		H							L	M	
CO3	L		M		H	L					M			M
CO4		L	M		M	L					M	M	M	

CO5			L		H					M			L

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 students can have productive employment and decent work by learning this computer fundamentals and programming course.

PROGRAMME ELECTIVE I

CSEY 001   CLOUD COMPUTING ANDTECHNOLOGY   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-Virtualizations 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-aService 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.ThamaraiSelvi, "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, ShahedLatif, "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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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   9
**   MANAGEMENT**

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   9
**   TRANSACTIONS**

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):	**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	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: Tohave a theoretical understanding of the principles underlying cryptography and cryptanalysis.

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

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

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

COB5: To 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										

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.

MODULE I DISTRIBUTED & PARELLEL DATABASES 9

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 9
DATA MODELS**

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. RamezElmasri, 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

SDG: 9

ADVANCED DATA WAREHOUSING AND DATA MINING

L	T	P	C
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 &MichelineKamber, "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 miningalgorithms 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):	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	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.

CSEY 101	**JAVA PROGRAMMING FOR IOT APPLICATIONS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To gain a comprehensive understanding of Java basics.

COB2: To acquire fundamental knowledge of object-oriented programming principles in Java.

COB3: To learn advanced Java concepts including nested classes, enums, string manipulation, wrapper classes, big numbers, date/time handling, and collections.

COB4: To understand Java's concurrency model and handle exceptions effectively.

COB5: To build Java applications for solving real-world problems through practical exercises and projects.

MODULE I   JAVA BASICS   9

Introduction to Java language: Brief history of Java -Java as a language - JDK, JRE and JVM - How does - JRE work - Java virtual machine; Datatypes and variables: Data types and variables - Non-primitive string - Primitive Data types - Implicit type casting or widening - Explicit type casting or narrowing; Operators: Operators - Arithmetic Operators - Unary Operators - Bitwise Logic Operators – Bitwise -Shift Operators - Comparison Operators - Logic operators - Assignment Operators - Ternary or Conditional Operator - Operator Precedence; Conditional flow control: If and Nested If statement - Switch case statement; Loops: For Loop - While Loop - Do While Loop - Infinite Loop - Break continue statements - Nested Loop - Labeled loop; Arrays: Arrays; Practice: Problem statement and solution; Methods: Creating Methods - Calling Methods - Method overloading - Recursive Methods.

MODULE II   OOPS IN JAVA   9

Basics of object-oriented programming: Class, Object – Constructors - Pass by reference, Pass by value - Static fields, class variables, instance variable - static methods or class methods - Static blocks. - Inheritance - Interfaces and implementation; Java packages: Packages - creating user defined packages; Encapsulation: Encapsulation; Inheritance: Inheritance; Polymorphism: Polymorphism; Abstraction: Abstraction; Composition: Composition.

MODULE III   ADVANCED CONCEPTS – I   9

Nested classes: Nested classes - Inner classes - Shadowing - Static Nested classes; Enum types: Enum types; Java string class: Java string class; Wrapper class: Wrapper class. Java Mathematics on BigInteger, Big Decimal class: Java Mathematics on BigInteger, BigDecimal class. Java Date and Time: Java Date and

Time; Formatting - Decimal, Date & Time, custom Date time formatting: Formatting - Decimal, Date & Time, custom Date time formatting; Arrays utility class: Arrays utility class; Exception handling: Exception handling; Generics: Generics; Collections: List interface – Array List – LinkedList - Vector, Stack Class - Sorting Lists - Hashset class, LinkedHashSet class – TreeSet - Queue interface - Map, HashMap, TreeMap - Immutable collections and Collection factories; Concurrency: Process and Thread Overview -Creating Threads, Pausing Thread -Thread Joins - Inter-thread communication – Deadlock – Livelock; Practice: Practice session.

MODULE IV   ADVANCED CONCEPTS – II   9

Lambda expressions; Functional Interfaces: Functional Interfaces; Streams and Generating streams: Streams and Generating streams; I/O Operations and files: I/O Operations and files; Serialization: Serialization; Network programming: Network programming; Java NIO:Java NIO; JDBC Database connectivity: JDBC Database connectivity; Garbage collector and Java Runtime: Garbage collector and Java Runtime; Reflection: Reflection; Annotations: Annotations; Regular expressions: Regular expressions.

MODULE V   CODE WITH US   9

Project for submission: Project

L – 45; TOTAL HOURS – 45

REFERENCES:

1. Kathy Sierra & Bert Bates (2003), Head First Java, Shroff/O'Reilly.

2. Joshua Bloch (2017), Effective Java, Addison-Wesley Professional.

3. D. S. Guru, K. S. Manjunatha, and M. T. Somashekara (2017) Object Oriented Programming with Java, PHI Learning.

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: Implement Java fundamentals to solve programming problems.
CO2: Demonstrate the ability to design and implement Java applications using object-oriented principles.
CO3: Develop advanced java applications to handle complex programming scenarios.
CO4: Create multi-threaded applications, manage concurrency issues, and implement exception handling to ensure application stability and performance.
CO5: Apply Java features to develop a real world application project.

Board of Studies (BoS):
23rd BoS of CSE held on 02.09.2024

Academic Council:
22nd ACM held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M	M	M	H	L				L	L	L	M	M	M
CO2	M	M	H	M	M				M	M	L	M	H	M
CO3	M	M	H	H	H				M	M	L	H	H	H
CO4	H	M	H	H	M				M	M	M	M	H	H
CO5	H	H	H	H	H				H	H	H	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: The students can tackle advanced programming scenarios by being equipped with in-demand technical skills, fostering innovation, and promoting lifelong learning through a comprehensive and structured education in Java programming.

CSEY 102 .NET PROGRAMMING FOR IOT APPLICATIONS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

COB1: To gain knowledge on .NET and SQL commands.

COB2: To study the concepts of API.

COB3: To familiarize students on SOLID principles.

COB4: To provide comprehensive knowledge on .NET in Azure.

COB5: To learn to code for the given problem statement.

MODULE I   INTRODUCTION TO .NET AND SQL   **9**

Introduction to .NET Programming: Basics of .NET – Installation of .NET in windows/mac/Linux; Basics of C#.NET: Console app creation-Variables-Data structures- Operators and conditionals-Conditional statements- Loops, Methods, scope – Practice – problem statements and solution; Intermediate concepts in C#.NET: Models – String operations – Namespaces -Connecting with Databases and database connections -Dapper – Entity framework – Config – File operations – Read and write – JSON – Model mapping; SQL Basics & Intermediate concepts: SQL Basics – SQL Intermediate – Practice - problem statements and solution

MODULE II   API BASICS AND ADVANCED CONCEPTS   9

API Basics: Basics of API development -what is startup.cs - First custom controller - API set up. -User Models and User Controller -Put & Post -DTOs -Namespaces - EF Setup, User controller and Automapper - Assignment and solution; API Intermediate: User Repository, Auth Table- Login and Registration with details- JWT token creation and validation- Helper Classes-Posts model and controller; Stored procedures: Stored procedure creation Parameters -Nullable parameters-Temp table- User upsert and delete- Posts Get, Upsert and Delete; API Advanced: API Advanced concepts -Registration set up end to end- Controller Dynamic parameters- Advanced - assignment and solution-Reusable SQL.

MODULE III   SOLID PRINCIPLES   9

SOLID Principles for C# Developers: Single Responsibility Principle- Open/Closed Principle -Liskov substitution Principle- Interface segregation Principle-Dependency inversion Principle.

MODULE IV   .NET IN AZURE   9

Azure deployment: Azure App Service -Azure SQL - Deploy .NET apps in Azure

MODULE V   CODE WITH US   9

Project for submission: Assignment1 and solution -Assignment2 and solution- Project - Problem statement and solution in Azure

L – 45; TOTAL HOURS – 45

REFERENCES:

1. Thuan L. Thai, Hoang Lam (2003), .NET Framework Essentials, 3rd Edition, O'Reilly Media, Inc.

2. Pallavi Agarwal (2021), API Fundamentals: An Easy Hands-on Workbook for Beginners, independently published.

3. AnurajParameswaran, Tamir Al Balkhi (2023), A Developer's Guide to .NET in Azure, Packt Publishing Limited.

4. https://www.udemy.com/course/net-core-with-ms-sql-beginner-to-expert/

5. https://www.pluralsight.com/courses/csharp-solid-principles

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: Apply .NET programming in IoT applications.
CO2: Learn APIs and write APIs to get data from SQL using stored procedures.
CO3: Dive deep into SOLID principles
CO4: Design .NET web application and deploy in Azure
CO5: Implement real time project in .NET, SQL and deploy in Azure

Board of Studies (BoS):   **Academic Council:**
23rd BoS of CSE held on 02.09.2024   22nd ACM held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1		M	M						L				M	H
CO2	M				M								H	M
CO3		H						M					M	
CO4		M			M									M
CO5		L	M		L				H		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: The students will have productive employment by learning .NET programming and will be able to develop IoT applications for real time problems.

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.

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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		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 MINING	L	T	P	C
SDG: 9		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.

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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.

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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

SDG: 9

ADVANCED SOFTWARE QUALITY ASSURANCE

L	T	P	C
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.

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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.

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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.

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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   9
                 SECURITY

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   9
MAINTENANCE**

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.

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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**   **9**
                           SET AND PROGRAMMING

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.

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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

SDG: 9

MOBILE AND WIRELESS NETWORK SECURITY

L	T	P	C
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   9
**   NETWORKS**

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):	**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														
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.

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	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   9
EXPERT SYSTEM

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   9   PROGRAMMING

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):	**Academic Council:**
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	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   9
**   INTELLIGENCE**

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.

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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 | | L | T | P | C |
| SDG: 9 | **DEEP LEARNING TECHNIQUES** | 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):	**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	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.

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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 Theoryll, ", 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	PO1 1	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.

CSEY 111   **OPTIMIZATION TECHNIQUES**   **L T P C**

SDG   8   **3 0 0 3**

COURSE OBJECTIVES:

COB1: To expose the linear programming type optimization problems and solutions in engineering.

COB2: To learn the optimization techniques for single-variable nonlinear problem.

COB3: To understand the multivariable nonlinear unconstrained and constrained optimization techniques.

COB4: To study the purpose of special types of mathematical optimization techniques.

COB5: To explore nature-inspired optimization techniques for solving real- world problems.

MODULE I   LINEAR OPTIMIZATION   9

Introduction to Optimization **-** Optimal problem formulation-Engineering applications of optimization- Optimization techniques- Linear programming – Graphical method - Simplex method - Duality Principle - Dual simplex method – Transportation problem – Assignment problem - Applications.

MODULE II   SINGLE-VARIABLE NONLINEAR OPTIMIZATION   9

Classical method for single-variable optimization- Exhaustive search method - Bounding phase method - Interval halving method - Fibonacci search method - Golden section search method - Bisection method – Newton Raphson method - Secant method - Successive quadratic point estimation method.

MODULE III   MULTIVARIABLE NONLINEAR OPTIMIZATION   9

Multivariable unconstrained optimization –- Evolutionary search method - Simplex search method - Hooke Jeeves pattern search method -Conjugate direction method - Steepest descent method - Multivariable constrained optimization - Kuhn – Tucker conditions - Random search method - Complex method - Sequential linear programming - Penalty function method.

MODULE IV   MATHEMATICAL OPTIMIZATION TECHNIQUES   9

Geometric Programming – Unstrained – Constrained - Dynamic Programming- Prototype - Characteristics of Dynamic Programming Problems - Deterministic Dynamic Programming - Probabilistic Dynamic Programming – Integer

Programming – Non-Linear and Linear - Applications.

MODULE V   NATURE INSPIRED OPTIMIZATIONS   9

Genetic algorithms-Neural network-based optimization-Ant colony optimization-Particle swarm optimization – Real-world applications.

L – 45; TOTAL HOURS – 45

REFERENCES:

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.

4. Kochenderfer, Mykel J., and Wheeler, Tim A. Algorithms   for Optimization. United Kingdom, MIT Press, 2019, ISBN 9780262039420.

5. Q. H. Badar, Altaf. Evolutionary Optimization Algorithms. United States, CRC Press, 2021,ISBN 9781000462166.

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: Solve the linear programming type optimization problems.

CO2: Identify the optimized solutions for single-variable nonlinear problems.

CO3: Determine the optimum algorithm to resolve multi-variable nonlinear problems.

CO4: Analyse the optimality criteria for mathematical optimization techniques

CO5:. Implement nature inspired optimization techniques for solving real- world problems.

	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	H												L	
CO2		M											L	
CO3			M											M
CO4	H		H											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

CSEY 112   **C AND EMBEDDED PROGRAMMING**   L T P C

SDG   8   3 0 0 3

COURSE OBJECTIVES:

COB1: To learn an in-depth understanding on the basic concepts in C.

COB2: To provide knowledge on the functionalities of arrays and functions in C.

COB3: To learn syntax constructs of pointers and to implement basic programs.

COB4: To study the basics of preprocessor and file handling concepts.

COB5: To impart knowledge about structures in C.

MODULE I   BASIC CONCEPTS OF C PROGRAMMING   9

Processing a High-level Language Program - Program Design - Programming in C - Basic Concepts of C Programming – Expressions – Typecasting - Simple Input and Output- Controlling the Program Flow – Functions - Storage classes - scope of variables.

MODULE II   ARRAYS & POINTERS   9

Arrays – Operation on arrays - Strings – String functions - Programming examples using strings-Multidimensional Arrays - Sorting and Searching Arrays – Pointers : Address and Dereference Operators - Passing Arguments to Functions, Pointers and Arrays - Pointer Versions of Some String Functions - Pointers to Functions - Array of Function Pointers - Function Pointers as Function Arguments.

MODULE III   PREPROCESSORS AND FILE HANDLING   9

The Comma Operator and Typed of - Type Qualifiers - The Enumeration Type - Bitwise Operations - The C Preprocessor - File Handling in C: File pointer - Opening and closing a text file - Read and write symbol to a text file.

MODULE IV   LINEAR DATA STRUCTURES   9

Defining and Using Structures - Dynamic Data Structures - Linked Lists - Creating a single-linked list - Insertion of a new node in a single-linked list - Removal of a node in a single-linked list - Double-linked list - Circular linked list – Stack – Queue.

MODULE V   DESIGN AND DEVELOPMENT OF EMBEDDED SYSTEM   9

Embedded System Vs General Computing System – Classification of Embedded System – Embedded Hardware Design and Development: OrCAD EDA tool –

Embedded Firmware Design and Development: Embedded C- Embedded System Development Environment: IDE – Simulators - Emulators and Debugging - Trends in Embedded industry.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. Ir. Sofie Beerens (3 January 2000), C for Embedded Systems, CRC Press.
2. E.A. Lee and S.A. Seshia, (2017), Introduction to Embedded Systems – A Cyber-Physical Systems Approach, Second Edition, MIT Press.
3. Thomas Mailund (2021), Pointers in C Programming: A Modern Approach to Memory Management, Recursive Data Structures, Strings, and Arrays, A press.

COURSE OUTCOMES:

Students who complete this course will be able to

CO1: Develop programs using Basic C concepts.

CO2: Apply C concepts like Arrays, functions and Pointers.

CO3: Develop concepts using preprocessors and files in C programs.

CO4: Create structures, dynamic structures and learn advanced concepts on linked list

CO5:. Design and Develop Embedded product using various tools.

Board of Studies (BoS) :	**Academic Council:**
24th BoS of CSE held on 03.12.2024	23th AC held on 28.02.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	M							M				H	H
CO2	H	M	M			M			M				H	H
CO3	H		M			M			M				H	H
CO4	H		M			M			M				H	H
CO5	H	H	H	H	M	H	H	L	H	L	H	H	H	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 for all

Statement: The students can have productive employment and decent work by learning the embedded programming course using C.

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   9
                 ANALYTICS**

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	PO1 1	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	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 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

SDG: 9

FOUNDATIONS OF BLOCK CHAIN TECHNOLOGY

L	T	P	C
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	PO1 1	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	PO1 1	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

SDG: 9

ADVANCED SOFTWARE PROJECT MANAGEMENT

L	T	P	C
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 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, 3rd 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: 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	PO1 1	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", 3rd Edition, 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

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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   9
STRUCTURE

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	PO1 1	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
SDG: 9

CELLULAR AUTOMATA AND ITS APPLICATIONS

L	T	P	C
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):	**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	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.

CSEY 122   **MACHINE LEARNING ENGINEERING FOR**   L   T   P   C
                               PRODUCTION (MLOPS)

SDG   8   **3   0   0   3**

COB1: To understand ML lifecycle, modeling, deployment, and data problem types.

COB2: To learn ML data collection, transformation, labeling, and augmentation techniques.

COB3: To optimize ML models with performance tuning.

COB4: To deploy, scale, and monitor production ML pipelines.

COB5: To monitor automated ML production workflows.

MODULE I   **INTRODUCTION TO ML IN PRODUCTION**   **9**

Overview of the ML Lifecycle and Deployment - Identify the key components of the ML lifecycle and pipeline - Compare the ML modelling iterative cycle and ML product deployment cycle - Selecting and Training a Model - Identify the key challenges in model development - Data Definition and Baseline - Compare the various types of problems- structured vs. unstructured data and big vs. small data.

MODULE II   **ML DATA LIFECYCLE**   **9**

Collecting, Labeling, and Validating data - Identify responsible data collection - building a fair ML production system, Feature Engineering, Transformation and Selection - Implement feature engineering, transformation, and selection - Encoding structured and unstructured data types and addressing class imbalances- Data Journey and Data Storage - Understand the Journey of production system's lifecycle- leverage ML metadata and enterprise schemas- Advanced Data Labeling Methods - Data Augmentation and Preprocessing Different Data Types - Combine labeled and unlabeled data - Improve ML accuracy and augment data to diversify training set

MODULE III   **ML MODELLING PIPELINES**   **9**

Neural Architecture Search- effective search for the best model, Resource Management Techniques -optimize and manage the compute, storage, and I/O resources - Production environments in its entire lifecycle, High Performance Modeling, Implement distributed processing and parallelism techniques- Use model performance analysis to debug and remediate model - Measure

robustness, fairness, and stability, Interpretability- Model interpretability – Regulatory and legal requirements for different use cases.

MODULE IV   DEPLOY ML MODELS   9

Model Serving Introduction- ML model availability to end-users and optimize the inference process- Model Serving Patterns and Infrastructures, Serve models and delivering batch and real-time inference results by building scalable and reliable infrastructure, Model Management and Delivery

MODULE V   IMPLEMENT ML MODELS   9

Implement ML processes, pipelines, and workflow automation- modern MLOps practices- manage and audit ML projects in entire lifecycle- Model Monitoring and Logging- Establish procedures to detect model decay and prevent reduced accuracy- continuous operating production system.

TOTAL HOURS – 45

TEXT BOOK:

1. Chip Huyen, Designing Machine Learning Systems: An Iterative Process for Production-Ready Applications - By Shroff/O'Reilly; 1st edition,2022.

REFERENCES:

2. M. Allam and B. Hossain, *Machine Learning Engineering with Python: Manage the Production Lifecycle of Machine Learning Models Using MLOps with Practical Examples*, 1st ed., Birmingham, U.K.: Packt Publishing, 2023.

3. A. Treveil and M. Nilsson, *Introducing MLOps: How to Scale Machine Learning in the Enterprise*, 1st ed., Sebastopol, CA, USA: O'Reilly Media, 2020.

COURSE OUTCOMES :

Students who complete this course will be able to

CO1: Identify the various components and design an ML production system end-to-end: project
scoping, data needs, modelling strategies, and deployment constraints and requirements.

CO2: Build data pipelines by gathering, cleaning, and validating datasets and assessing data quality

CO3: Build models for different serving environments.

CO4: Deliver deployment of pipelines by productionizing, scaling, and monitoring model service that require different infrastructures..

CO5: Implement and manage end-to-end MLOps.

Board of Studies (BoS) :   **Academic Council:**

25th BoS of CSE held on 07.07.2025   24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	M		L	M							M	H	
CO2	H	H		M	H				L			M	H	
CO3	M	H		H						M				H
CO4	M			H	H			L				H		H
CO5	M	M	H		M				M	H	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: This course introduces students to the end-to-end lifecycle of machine learning. Through hands-on learning and industry-relevant techniques, students gain the skills required to automate workflows, ensure model performance, and maintain continuous delivery of machine learning solutions in real-world environments.