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

Regulations 2025
Curriculum and
Syllabi (I & II Semester)
(As approved by the 24th Academic Council)
August - 2025

M.Tech. (Computer Science & Engineering)

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

REGULATIONS 2025

CURRICULUM AND SYLLABI (I & II Semesters)

(As approved by 24th Academic Council)

August - 2025

M.TECH. COMPUTER SCIENCE AND ENGINEERING

VISION AND MISSION OF THE INSTITUTION

VISION

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

MISSION

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

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

VISION AND MISSION

VISION

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

MISSION

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

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M. Tech. (Computer Science and Engineering)

PROGRAMME EDUCATIONAL OBJECTIVES

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

PROGRAMME OUTCOMES

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

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

- Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and 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 2025

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, conduct of co-curricular, extra-curricular events 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 ADMISSION REQUIREMENTS

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 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 BRANCHES OF STUDY

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

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

3.2 Programmes offered

S. No.	Name of the Department	Programmes offered
1.	Aeronautical Engineering	M.Tech. (Avionics)
2.	Civil Engineering	M.Tech. (Structural Engineering)
		M. Tech. (Construction Engineering and Project Management)
3.	Mechanical Engineering	M.Tech. (CAD/CAM)

S. No.	Name of the Department	Programmes offered
4.	Electrical and Electronics Engineering	M.Tech. (Power Systems Engineering)
5.	Electronics and Communication Engineering	M.Tech. (VLSI and Embedded Systems)
6.	Computer Science and Engineering	M.Tech. (Computer Science and Engineering)
		M.Tech. (Artificial Intelligence and Data Science)
7.	Information Technology	M.Tech. (Information Technology)
8.	Computer Applications	MCA
9.	Mathematics	M.Sc. (Actuarial Science)
10.	Physics	M.Sc.(Physics)
11.	Chemistry	M.Sc.(Chemistry)
12.	Life Sciences	M.Sc. Biochemistry & Molecular Biology
		M.Sc. Biotechnology
		M.Sc. Microbiology
		M.Sc. Stem Cell Technology
		M.Sc. Clinical Embryology
		M.Tech. Biotechnology
		M.Tech. Food Biotechnology
13.	Commerce	M.Com
14.	Arabic and Islamic Studies	M.A. Islamic Studies

3.3 Eligible entry qualifications for admission to programmes

Sl. No.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
1.	M.Tech. (Avionics)	B.E. / B.Tech. in Aeronautical Engineering / Aerospace Engineering / Mechanical

Sl. No.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
		Engineering / Mechatronics / EEE / ECE / EIE / or Equivalent degree in relevant field.
2.	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.Tech. in Mechanical / Civil / Electrical and Electronics / Geo Informatics / B Plan / B. Des, and B.Arch.
3.	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.	M.Tech. (Power Systems Engineering)	B.E. / B.Tech. in EEE / ECE / EIE / ICE / Electronics / Instrumentation Engineering or Equivalent degree in relevant field.
5.	M.Tech. (VLSI and Embedded Systems)	B.E. / B.Tech. in ECE / EIE / ICE / EEE / IT or Equivalent degree in relevant field.
6.	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.	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.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
8.	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.	M.Sc. (Actuarial Science)	Any under graduate degree with Mathematics / Statistics as one of the subjects of study at 10 + 2 level.
10.	M.Sc.(Physics)	B.Sc. in Physics / Applied Science / Electronics /Electronics Science / Electronics & Instrumentation or Equivalent degree in relevant field.
11.	M.Sc.(Chemistry)	B.Sc. in Chemistry / Applied Science or Equivalent degree in relevant field.
12.	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.Sc. Stem Cell Technology	B.Sc.in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology / Genetics or Equivalent degree in relevant field.
	M.Sc. Clinical Embryology	B.Sc.in Biotechnology / Biochemistry / Botany / Zoology / Microbiology / Molecular Biology /

Sl. No.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
		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. .	M.Com	B.Com. / BBA
14. .	M.A. Islamic Studies	B.A. in Islamic Studies / Arabic (or) Afzal-ul-Ulama (or) Any under graduate degree with Part 1 Arabic (or) Any under graduate degree with Aalim Sanad / Diploma / Certificate in Arabic or Islamic Studies.

4.0. STRUCTURE OF THE PROGRAMME

4.1. 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

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

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

4.1.3. 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.	80 - 86
MCA	80 - 86
M.Sc.	80 - 85
M.Com.	80 - 88
M.A.	80 - 84

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

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

4.1.5. 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

4.1.6 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.

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

4.1.8 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.

4.1.9. Online courses

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.

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.

5.0 DURATION OF THE PROGRAMME

5.1. 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

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

5.3 Medium of instruction, examinations and project report shall be in

English.

6.0 REGISTRATION AND ENROLLMENT

6.1 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.

6.2 Change of a Elective Course

A student can change an enrolled elective 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.

6.3 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.

6.4 A student can enroll for a maximum of 36 credits during a semester including Redo / Predo courses.

7.0 BREAK OF STUDY FROM PROGRAMME

7.1 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:

7.1.1 Medical or other valid grounds

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

7.1.3 Debarred due to any act of indiscipline

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

7.3 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).

7.4 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.

8.0 CLASS ADVISOR AND FACULTY ADVISOR

8.1 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.

8.2 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.

9.0 COURSE COMMITTEE

9.1 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.

10.0 CLASS COMMITTEE

10.1 A class committee comprising faculty members handling the courses, student representatives and a senior faculty member not handling any courses for that class as chairman will be constituted in every semester:

10.2 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

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

10.4 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.

10.5 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.

11.0 CREDIT REQUIREMENTS TO REGISTER FOR PROJECT WORK

11.1 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

11.2 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.

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 (LIT) 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 (for a 4 credit LIT Course). 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.

Component	Maximum Marks	Weightage for Final Grade	Mode of Assessment
Theory Component	100	75%	CAT1 (25%) + CAT2 (25%) + SEE (50%)
Practical Component	100	25%	Continuous assessment only
Final Grade Basis	Consolidated	100%	75% Theory + 25% Practical

Pass Requirement	-	-	Minimum 40% in Semester-End Theory Exam (SEE)

Note:

1. Proportionate weightage shall be assigned to LIT courses based on their credit value, whether 2 or 3 credits.
2. In Lab-Integrated Professional Elective courses, the laboratory component shall be assessed by the course faculty.

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

12.6 Industry Internship

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

12.7 Project Work

Mini project work, shall be carried out individually or as a group activity involving a maximum of three students.

Each group shall identify a suitable topic within their domain, either disciplinary or interdisciplinary, based on the students' abilities and in consultation with the faculty mentor. The topic must lead to the development of a small-scale system or application.

The progress of the mini project shall be evaluated through three periodic reviews: two interim reviews and one final review. A project report shall be submitted by the end of the semester. The reviews shall be conducted by a committee of faculty members constituted by the Head of the Department / Dean of the School.

An oral examination (viva voce) shall be conducted as the semester-

end examination by an internal examiner approved by the Controller of Examinations, based on the project report.

The weightage for assessment shall be as follows:

• Periodic Reviews: 50%

- 25% by the Project Guide
- 25% by the Review Committee

• Project Report: 20%

• Viva Voce Examination: 30%

The Project shall be carried out individually or as a group activity, involving a maximum of two or three students.

A committee of faculty members, constituted by the Head of the Department / Dean of the School, shall conduct three periodic reviews during the semester to monitor and assess the progress of the project.

At the end of the semester, students shall submit a project report, based on which a semester-end oral examination (viva voce) shall be conducted by an external examiner approved by the Controller of Examinations.

The assessment weightage shall be as follows:

• Periodic Reviews – 50%

- 25% by the Project Guide
- 25% by the Review Committee

• Project Report – 20%

• Viva Voce Examination – 30%

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

12.9 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance shall be used for grading along with the marks scored in the arrear examination. From the subsequent appearance onwards, full weightage shall be

assigned to the marks scored in the semester end examination and the internal assessment marks secured during the course of study shall become invalid.

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

13.0 SUBSTITUTE EXAMINATIONS

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

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

14.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

14.1 A student shall earn 100% attendance in the scheduled contact hours (such as lectures, tutorials, labs, etc.) for that course. However, a relaxation of up to 25% in attendance may be granted to account for valid reasons such as medical emergencies, participation in co-curricular or extracurricular activities with prior approval, or other genuine circumstances.

If a student's attendance falls below 75% in a particular course, even after considering the permissible relaxation, they will not be allowed to appear for the semester-end examination in that course. Instead, the student will be awarded an “I” grade (Incomplete) for the course

14.2 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.

14.3 If a student’s attendance in any course falls between 65% and 75% due to medical reasons (e.g., hospitalization, illness) or participation in institution-approved events, they may be granted exemption from the minimum attendance requirement and allowed to appear for the semester-end exam. The student must submit valid documents to the class advisor upon rejoining, with approval from the HoD/Dean. Final approval for **condonation** will be granted by the Vice Chancellor based on the Dean (Academic Affairs)’s recommendation.

14.4 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.

14.5 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.

14.6 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.

14.7 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.

15.0 REDO / PRE-DO COURSES

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

15.2 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**.

15.3 A student shall be permitted to pre-do a course offered by the concerned department, provided it does not affect the regular semester class schedule. Such permission shall be granted based on the availability of faculty members, the maximum permissible credit limit of the semester, and the student's fulfillment of the necessary prerequisites for the course. The proposal shall be recommended by the Dean of the School and the Head of the Department, and shall require final approval from the Dean (Academic Affairs).

16.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

16.1 All assessments of a course shall be made on absolute marks basis. The class committee without the student members shall meet to analyse the performance of students in all assessments of a course and award letter grades following the relative grading system. 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
W	-
I	-
PA	-
FA	-

"W"- denotes withdrawal from the course

"I" - denotes "Incomplete" ie. inadequate attendance in the course and prevention from appearance of semester end examination

"U" - denotes unsuccessful performance in the course.

"PA" - denotes the 'Pass' of the zero credit courses.

"FA" - denotes the 'Fail' of the zero credit courses.

16.2 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**.

16.3 Upon awarding grades, the results shall be endorsed by the chairman

of the class committee and Head of the Department / Dean of the School. The Controller of Examinations shall further approve and declare the results.

16.4 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 fee, through proper application to the Controller of Examinations. Subsequently, the Head of the Department / Dean of the 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 having expertise in that course as members. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

16.5 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 the first semester onwards.

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

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

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

Where n = number of courses

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

“I”, "W", “PA” and **“FA”** grades are excluded for calculating GPA.

"U", "I", "W", "PA" and **"FA"** grades are excluded for calculating CGPA.

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

Percentage equivalent of marks = CGPA X 10

16.6 After successful completion of the programme, the degree shall be awarded to the students with the following classifications based on CGPA.

Classification	CGPA
First Class with Distinction	8.50 and above and passing all the courses in first appearance and completing the programme within the prescribed period of 8 semesters for all students (except lateral entry students) and 6 semesters for lateral entry students
First Class	6.50 and above and completing the programme within a maximum of 10 semesters for all students (except lateral entry students) and 8 semesters for lateral entry students
Second Class	Others

16.6.1 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 UG programme within the minimum prescribed period of study (except clause 7.1.1)

16.6.2 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 7.1.1)

16.6.3 The students who do not satisfy clause 16.6.1 and clause 16.6.2 shall be classified as second class.

16.6.4 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.

17.0 SUPPLEMENTARY EXAMINATION

Final year students and passed out 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.

18.0 DISCIPLINE

18.1 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.

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

19.0 MULTI ENTRY AND MULTI EXIT (MEME) FRAMEWORK *

In accordance with the provisions of the National Education Policy (NEP) 2020, the programme shall support a Multi Entry – Multi Exit (ME-ME) framework to provide flexibility in the academic pathway of students.

*** At present (AY 2025-26), it is applicable only for all M.Tech.**

Programmes.

19.1. Exit Option:

19.1.1 Credit Requirement for Award of M.Tech. Degree

To qualify for the award of a M.Tech. degree from the Institute, a student must successfully complete the total credit requirements as prescribed in the approved curriculum of the respective programme. The specific credit requirements are determined by the programme curriculum.

19.1.2 Provision for Multiple Exit

In alignment with NEP 2020 guidelines, the Institute provides students enrolled in postgraduate programmes with the option of multiple exits, subject to the following conditions:

a. Exit at the End of First Year

Students may choose to exit the programme at the end of the first year, provided they have fulfilled the prescribed academic requirements.

b. Application for Exit

A student intending to exit must submit a formal written application in the prescribed format at least **eight weeks prior to the scheduled end of the academic year.**

c. Departmental Recommendation

1. Upon receipt of the application, the concerned Department shall evaluate the academic record of the student and recommend the award of a **Post Graduate Diploma**, based on the credits earned.
2. In the case of arrear courses, the post graduate diploma will be conferred only after successful clearance of all pending arrears.

d. Notification of Completion

Once a student has fulfilled the requirements for the award of post graduate diploma, the Department shall notify the same to controller of examinations for further processing and issuance.

19.1.3 Award of Qualifications under Multiple Exit Scheme

Post graduate diploma: Awarded after successful completion of the first year, subject to earning the prescribed cumulative credits as per the respective programme curriculum (e.g., 44 credits from the first year) along with 3 credits of Skill Based Courses.

19.1.4 Conditions Governing Exit

1. The multiple exit facility is intended strictly for **genuine and exceptional circumstances,** such as prolonged illness, or securing an employment opportunity necessitating a temporary withdrawal from the programme.
2. Students opting for a temporary exit after the first year must obtain **prior approval from the Registrar through Dean (Academics),** based on the recommendation of the respective Head of the Department.

19.1.5 Expectation of Programme Continuity

While the option for multiple exits exists, it is generally expected that students admitted to a post graduate programme shall pursue their studies continuously until completion of the final degree requirements.

19.2. Entry Option:

Students seeking re-entry into the programme (multi-entry) must submit an application through the proper channel at the beginning of the odd semester. Admission shall be subject to fulfilment of institutional guidelines, credit mapping, and availability of seats.

19.3. Credits Requirement for the Certifications

Name of the Certificate Programme	Required Credits
Post graduate Diploma (Level 6.5 as per NEP 2020)	40* - 45

* The minimum number of credits that a student must earn (as per the respective curriculum) in order to get the above certification program

20.0 ELIGIBILITY FOR THE AWARD OF THE MASTER'S DEGREE

20.1 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 maximum period of 8 semesters from the date of admission, including break of study.
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.

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

21.0 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

REGULATIONS 2025

CURRICULUM & SYLLABI FOR

M. TECH. (COMPUTER SCIENCE AND ENGINEERING)

SEMESTER I

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MAF 6181	Algebraic Structures and Discrete Algorithms	3	1	0	4
2.	CSF 6101	Algorithm Design and Implementation	3	0	0	3
3.	CSF 6102	Computer Networks and Secure Systems	3	0	0	3
4.	CSF 6103	Advanced Database Systems and Technologies	3	0	0	3
5.		Professional Elective – I	3	0	0	3
6.	CSF 6104	Algorithm Design Laboratory	0	0	2	1
7.	CSF 6105	Networks and Security Laboratory	0	0	2	1
		Credits				**18**

SEMESTER II

Sl. No.	Course Code	Course Title	L	T	P	C
1.	GEF 6201	Research Methodology and IPR for Engineers	2	0	0	2
2.	CSF 6201	Advanced Machine Learning	3	0	0	3
3.	CSF 6202	Agile and DevOps Engineering	3	0	0	3
4.	CSF 6203	Operating system and Virtualization	3	0	0	3
5.		Professional Elective -II	3	0	0	3
6.		Professional Electives –III	3	0	0	3
7.	ENF 6281	Professional communication	0	0	2	1
8.	CSF 6204	Machine Learning Laboratory	0	0	2	1
9.	CSF 6205	Mini Project	0	0	6	3
		Credits				**22**

SEMESTER III

Sl. No.	Course Code	Course Title	L	T	P	C
1.	OEC	Open Elective	3	0	0	3
2.	CSF 7101	Cloud Infrastructure and Services	3	0	0	3
3.		Professional Elective – IV	3	0	0	3
4.		Professional Elective – V	3	0	0	3
5.	CSF 7102	Industry Internship	0	0	4	2
6.	CSF 7103	Project Work - Phase I	0	0	16	8
7.	MOOC	MOOC (Related to Project)				-
		Credits				**14**

SEMESTER IV

Sl. No.	Course Code	Course Title	L	T	P	C
1.	CSF 7103	Project Work - Phase II	0	0	36	18
		Credits				**(8+18) = 26**

Overall Total Credits – 80

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

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

LIST OF PROFESSIONAL ELECTIVE COURSES

Sl. No.	Course Code	Course Title	L	T	P	C
		SEMESTER I				
1.	CSFY 01	Advanced Software Defined Networks	3	0	0	3
2.	CSFY 02	Advanced Java programming	3	0	0	3
3.	CSFY 03	Optimization Techniques	3	0	0	3
4.	CSFY 04	Python for Data Science	3	0	0	3
5.	CSFY 05	Software Testing and Quality Assurance	3	0	0	3
		SEMESTER II				
1.	CSFY 06	Advanced Data warehousing and Data mining	3	0	0	3
2.	CSFY 07	High Performance Computer Architecture	3	0	0	3
3.	CSFY 08	Social Network Analysis	3	0	0	3
4.	CSFY 09	Security Issues in Cloud Computing	3	0	0	3
5.	CSFY 10	Image Processing and Analysis	3	0	0	3
6.	CSFY 11	Advanced Full Stack Development for Front-End	3	0	0	3
7.	CSFY 12	Embedded Programming	3	0	0	3
8.	CSFY 13	Advanced Graph Theory	3	0	0	3
9.	CSFY 14	Quantum computing	3	0	0	3
10	CSFY 15	Statistics for Business Analytics	3	0	0	3
		SEMESTER III				
1.	CSFY 16	Computer Vision and Pattern Recognition	3	0	0	3
2.	CSFY 17	Wireless Sensor Networks	3	0	0	3
3.	CSFY 18	Cyber laws and Intellectual Property Rights	3	0	0	3
4.	CSFY 19	Natural Language Processing	3	0	0	3
5.	CSFY 20	Robotics and Intelligent Systems	3	0	0	3
6.	CSFY 21	Intelligent Information Retrieval	3	0	0	3
7.	CSFY 22	Cellular Automata and its Applications	3	0	0	3
8.	CSFY 23	Deep Learning Techniques	3	0	0	3
9.	CSFY 24	Advanced Full Stack Development for Back-End	3	0	0	3
10.	CSFY 25	Block chain Technology	3	0	0	3

SEMESTER I

		L	T	P	C
MAF 6181	**ALGEBRAIC STRUCTURES AND**				
SDG: 4	**DISCRETE ALGORITHMS**	**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To develop a foundational understanding of logic and proof techniques for solving problems in computer science.

COB2: To introduce algebraic structures and their applications in coding theory and error correction.

COB3: To study various types of graphs and their applications in solving real-world problems.

COB4: To understand the foundations of automata, grammars, and formal languages in computation.

COB5: To explore classical cryptographic techniques and their applications in secure communication.

MODULE I LOGIC AND PREDICATE CALCULUS 9+3

Propositional logic – Logical connectives – Truth tables – Normal forms (conjunctive and disjunctive) – Predicate logic – Universal and existential quantifiers – Proof techniques – Direct and indirect – Proof by contradiction – Theory of Inference - Applications.

MODULE II ALGEBRAIC STRUCTURES 9+3

Set theory – Semigroup, monoid, groups, cyclic groups, subgroups, cosets – Lagrange's theorem – Normal subgroups.

MODULE III GRAPH THEORY 9+3

Basic definitions – Types of graphs – Adjacency and incidence matrices of graphs – Paths and circuits – Eulerian and Hamiltonian circuits – Weighted graph, network flow – Travelling salesman problem – Trees – Rooted trees, spanning trees – Prim's algorithm – Tree traversal – Expression trees.

MODULE IV FORMAL LANGUAGES 9+3

Finite state machines – Deterministic and non-deterministic finite state machines – Classes of grammars – Phrase structure, context sensitive, context free, regular grammars – Formal languages – Ambiguity – Turing machines.

MODULE V CIPHERS 9+3

Cryptography – Substitution and permutation ciphers – Block cipher – The play fair cipher – Transposition ciphers – Columnar, row, double transposition – Hill cipher – 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, New York, 2009.
2. John E. Hopcraft, Rajeev Motwani and Jeffrey D. Ullman,, “Introduction to Automata Theory, Languages and Computation”, Pearson, 3rd Edition, 2006.
3. Kenneth H. Rosen, “Discrete Mathematics and Its Applications”, 8th Edition, McGraw-Hill, 2018.
4. J.P. Tremblay and R. Manohar, “Discrete Mathematical Structures with Applications to Computer Science”, 2nd Edition, McGraw Hill, 1987.

REFERENCES:

1. Juraj Hromkovič, “Theoretical Computer Science: Introduction to Automata, Computability, Complexity, Algorithmics, Randomization, Communication and Cryptography”, Springer, 2011.
2. Darel W. Hardy, Fred Richman, Carol L. Walker, “Applied Algebra: Codes, Ciphers and Discrete Algorithms”, 2nd Edition (Discrete Mathematics and Its Applications), CRC Press (Chapman & Hall), New York, 2009.
3. David Gries and Fred B. Schneider, “A Logical Approach to Discrete Math”, Springer-Verlag, 3rd Edition,1993.

COURSE OUTCOMES: At the end of the course students will be able to

CO1: pertain propositional and predicate logic, and use proof methods to validate logical arguments.

CO2: apply group theory concepts to design and analyze error-correcting codes.

CO3: model problems using graphs and apply algorithms to find optimal solutions.

CO4: analyze and classify languages using finite automata and Turing machines.

CO5: implement basic cipher techniques and analyze their effectiveness in data security.

Board of Studies (BOS):
17th BOS of Department of Mathematics and Actuarial Science held on 23.06.2025.

Academic Council:
24th AC held on 26.08.2025

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

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

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

Statement Learning Applied Algebra and Discrete Algorithms equips students with essential skills and knowledge applicable in Computer Science and IT.

CSF 6101	ALGORITHM DESIGN AND	L	T	P	C
SDG: 9	IMPLEMENTATION	3	0	0	3

COURSE OBJECTIVES:

COB1: To familiarize students with fundamental algorithmic strategies.

COB2: To impart comprehensive knowledge on various algorithm design techniques.

COB3: To understand hash tables, collision resolution strategies and performance analysis.

COB4: To explore complex graph algorithms and network flow techniques.

COB5: To understand computational complexity and approximation algorithms for NP-complete problems.

MODULE I ALGORITHMIC FUNDAMENTALS 9

Algorithm analysis techniques - Asymptotic complexity - Amortized analysis - Recurrences and Master's theorem - Algorithmic paradigms - Brute force techniques - Probabilistic analysis - Randomized algorithms.

MODULE II ALGORITHM DESIGN TECHNIQUES 9

Divide and conquer - Merge Sort, Quick Sort, Binary Search - Dynamic programming: Matrix Chain Multiplication, Longest Common Subsequence - Greedy algorithms: Huffman coding- Activity selection- Fractional knapsack.

MODULE III HASHING,TREES AND HEAPS 9

Hash Tables - Advanced trees: AVL trees- Red-Black trees- B+-trees - Heaps and Priority Queues - Disjoint sets - Union-Find Algorithms - Fibonacci heaps - Skip lists.

MODULE IV GRAPH AND NETWORK FLOW ALGORITHMS 9

Graph representation - Graph Traversals: DFS - BFS - Topological sorting - Shortest paths: Dijkstra's, Bellman-Ford- Floyd-Warshall's algorithms - Minimum Spanning Trees: Prim's- Kruskal's algorithms - Network Flow Algorithms: Ford-Fulkerson - Edmond-Karp.

MODULE V COMPLEXITY THEORY AND APPROXIMATION ALGORITHMS **9**

Complexity Classes - Polynomial reductions - Cook-Levin theorem - Approximation algorithms: Vertex cover - Travelling salesman problem - Basics of Randomized algorithms.

L – 45; Total Hours: 45

TEXT BOOK:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms," 4th edition, MIT Press, ISBN, 026204630X, 9780262046305, 2022.

REFERENCES:

1. Douglas R. Stinson," Techniques for designing and Analyzing Algorithms", CRC Press, ISBN:9781000403695, 2021.
2. Steven S. Skiena, "The Algorithm Design Manual," 3rd edition, Springer, ISBN 10: 3030542556 .2020.

COURSE OUTCOMES:

CO1: Analyze the efficiency of algorithms through advanced complexity analysis techniques.

CO2: Apply algorithmic techniques to design efficient solutions for complex problems.

CO3: Implement data structures to optimize algorithm performance.

CO4: Develop and evaluate graph algorithms for solving complex network problems.

CO5: Evaluate the effectiveness of approximation algorithms for NP-hard problems.

Board of Studies (BoS):	**Academic Council:**
25th BOS of CSE held on 07.07.2025	24th AC held on 26.08.2025

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	H	-	M	-	L	-	-	-	M	-	H	H	M
CO2	L	-	H	-	M	-	L	-	M	-	-	H	H	H
CO3		H	-	H	M	-	-	L	-	-	L	H	-	H
CO4	-	-	H	-	H	-	-	L	-	-	L		H	H
CO5	H	H	M	-		L	-	M	-	M	L	H	M	H

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

SDG 9: Strengthen infrastructure, encourage sustainable and inclusive industrial growth, and support innovation.

The students learn key algorithm design techniques and complexity analysis. The course helps students build problem-solving skills and design efficient algorithms for real-world problems.

CSF 6102	COMPUTER NETWORKS AND SECURE SYSTEMS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn the network models and datalink layer functions.

COB2: To understand routing in the network layer.

COB3: To explore methods of communication and congestion control by the transport layer.

COB4: To study the network security services and mechanisms.

COB5: To focus on the different network security tools and applications.

MODULE I NETWORK MODELS AND DATALINK LAYER 9

Overview of Networks and its Attributes – Network Models – OSI model- TCP/IP model - Addressing – Introduction to Datalink Layer – Error Detection and Correction – Ethernet (802.3)- Wireless LAN – IEEE 802.11- Bluetooth – Flow and Error Control Protocols – HDLC – Point-to-Point Protocol.

MODULE II NETWORK LAYER PROTOCOLS 9

Network Layer – IPv4 Addressing – Network Layer Protocols (IP,ICMP and Mobile IP) Unicast and Multicast Routing – Intradomain and Interdomain Routing Protocols – IPv6 Addresses – IPv6 – Datagram Format - Transition from IPv4 to IPv6.

MODULE III TRANSPORT AND APPLICATION LAYERS 9

Transport Layer Protocols – UDP and TCP Connection and State Transition Diagram – Congestion Control and Avoidance (DEC bit and RED)- QoS - Application Layer Paradigms – Client-server Programming –Domain Name System – World Wide Web- HTTP- Electronic Mail.

MODULE IV NETWORK SECURITY 9

OSI Security Architecture – Attacks – Security Services and Mechanisms – Encryption – Advanced Encryption Standard – Public Key Cryptosystems – RSA Algorithm – Hash Functions – Secure Hash Algorithm – Digital Signature Algorithm.

MODULE V AUTHENTICATION APPLICATION 9

Kerberos - X.509 Authentication Service – Key Management and distribution – Symmetric Key Distribution using Symmetric Distribution – Public Key infrastructure - Email Security - Pretty Good Privacy and Secure / Multipurpose Internet Mail Extensions.

L – 45; Total Hours: 45

TEXT BOOKS:

1. Forouzan, B. A." Data communications and networking",5th edition, McGraw Hill Education, ISBN: 9781259064753, 2023.
2. Kurose, J. F., & Ross, K. W. "Computer networking: A top-down approach", 6th edition, Pearson, ISBN: 9780133594144,2023.

REFERENCES:

1. Stallings, W. "Cryptography and network security: Principles and practice", 8th edition, Pearson, ISBN: 9780138167381,2023.
2. Schneier, B, "Applied cryptography: Protocols, algorithms, and source code in C", 2nd edition, John Wiley & Son, ISBN: 9781119096726,2023.

COURSE OUTCOMES:

CO1: Utilize the Network Models, layers and functions.

CO2: Categorize and classify the routing protocols.

CO3: Apply the functions of the transport and application layer.

CO4: Analyze various network security mechanisms and select appropriate solutions based on security requirements, threats, and system architecture.

CO5: Simulate the different tools in the domain of computer networks and security.

Board of Studies (BoS): 25th BOS of CSE held on 07.07.2025

Academic Council: 24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	H	-	H	M	H	-	M	-	-	L	M	L	H	H
CO2	M	-	H	-	H	-	M	-	-	L	L	L	H	H
CO3	-	H	M	M	M	-	H	-	-	L	M	L	H	M
CO4	H	H	M	L	H	-	M	-	-	L	L	L	H	H
CO5	M	H	M	M	H	-	H		-	L	M	L	M	M

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

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

Statement: The students learn network models, protocols and apply security techniques to build reliable, secure, and innovative communication infrastructure.

CSF 6103	ADVANCED DATABASE SYSTEMS AND	L	T	P	C
SDG: 9	TECHNOLOGIES	3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce fundamental database concepts and relational data modeling techniques.

COB2: To explore SQL features and query execution strategies for performance enhancement.

COB3: To understand transaction principles, concurrency issues, and recovery mechanisms in databases.

COB4: To examine the architecture and functioning of distributed and parallel database systems.

COB5: To introduce NoSQL models and big data technologies in modern database ecosystems.

MODULE I INTRODUCTION TO DATABASES AND THE RELATIONAL MODEL **9**

Database Introduction- DBMS vs. File System- Entity-Relationship (ER) Model- Relational Data Model: Tables, Tuples, Attributes- Mapping ER Model to Relational Model- Introduction to SQL - Relational Algebra -Basic Data Normalization.

MODULE II SQL AND QUERY PROCESSING **9**

SQL: Joins – Views - Nested Queries- Simple Triggers and Stored Procedures - Query Processing Steps- Query Execution Plan - Performance Influencing Factors- Introduction to Indexing: bit-map- hash- B+ Trees.

MODULE III TRANSACTION MANAGEMENT AND CONCURRENCY CONTROL **9**

Transactions and ACID Properties- Serializability and Conflict Serializability -Basic Locking Mechanisms- Deadlocks: Avoidance Techniques- Recovery Concepts : Checkpoints and Logging -Tool: DB Browser for SQLite.

MODULE IV DISTRIBUTED AND PARALLEL DATABASE **9**

Distributed Database Architecture -Data Fragmentation and Replication - Distributed

Query Processing -Heterogeneous Distributed Databases-Cloud-based Distributed Databases - Parallel Databases- Types of Parallelism: Inter-query and Intra-query- Data Partitioning Techniques.

MODULE V NoSQL DATABASES AND BIG DATA SYSTEMS 9

NoSQL- Comparative Study of NoSQL Systems-Types of NoSQL Databases: Key-Value stores, Document-oriented Databases - CAP Theorem - SQL vs. NoSQL- Big Data: Hadoop and Spark- Case Study-Smart Healthcare Record and Monitoring System.

Total Hours: 45

TEXT BOOKS:

1. M. Kleppmann, “Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems”, Reprint edition, Sebastopol, CA, USA: O’Reilly Media, ISBN: 1449373321, 2024.
2. M. Winand, “SQL Performance Explained”, 3rd edition, Vienna, Austria: Self-published, ISBN: 9783950307821,2022.
3. D. Sullivan, “Fundamentals of Data Engineering”, 1st edition, Sebastopol, CA, USA: O’Reilly Media, ISBN: 1098108302, 2022.
4. A. Petrov, Database Internals: A Deep Dive into How Distributed Data Systems Work, 1st edition, Sebastopol, CA, USA: O’Reilly Media, ISBN: 9781492040347,2021.
5. P. J. Sadalage and M. Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, Reprint edition, Boston, MA, USA: Addison-Wesley, 2021.

REFERENCES:

1. T. Drabas and D. Lee, “Learning Apache Spark with Python”, 1st edition, Birmingham, UK: Packt Publishing, ISBN: 9781800562809, 2023.
2. R. Elmasri and S. B. Navathe, “Fundamentals of Database Systems”, 7th edition, Boston, MA, USA: Pearson, ISBN:9780133970777, 2021.
3. M. Barai and Y. Reddy, “Distributed Systems for Practitioners”, 1st edition, New Delhi, India: BPB Publications, ISBN: 9789355510525, 2022.

COURSE OUTCOMES:

CO1: Design relational schemas and write basic SQL queries.

CO2: Develop efficient SQL queries and interpret query plans.

CO3: Apply ACID properties and handle concurrent transaction issues using locks and

logs.

CO4: Demonstrate the understanding of distributed database components and types of query parallelism.

CO5: Implement the SQL and NoSQL databases, along with fundamental concepts of Hadoop and Spark.

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

	PO 1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	H	M			M					M		L	H	M
CO2	H	H	M		H							L	H	M
CO3	H	H	M	M	M			L		L		M	H	M
CO4	H	M	H	H	H					M	M	H	H	H
CO5	M	M	H	M	H		M			M		M	H	H

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

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

Statement: The course imparts understanding of relational databases, SQL, and transaction management. In order to manage scalability, flexibility, and real-time processing, it also encompasses contemporary technologies like distributed databases, NoSQL models, and big data frameworks. With these abilities, students may create durable and creative digital solutions that support smart infrastructure and sustainable manufacturing.

CSF 6104	ALGORITHM DESIGN LABORATORY	L	T	P	C
SDG: 9		0	0	2	1

COURSE OBJECTIVES:

COB1: To introduce algorithm analysis techniques through empirical testing and asymptotic complexity evaluation.

COB2: To provide practical experience with diverse algorithm design techniques.

COB3: To study data structures like AVL trees, hash tables, and disjoint sets.

COB4: To equip students with the skills to solve problems using graphs and shortest path algorithms.

COB5: To understand the core principles of computational complexity and explore fundamental strategies for approximating solutions to complex problems.

SOFTWARE REQUIRED: Python/C++/Java

List of Experiments

1. Implement and compare the time complexity of bubble sort, merge sort, and quick sort. Analyze their performance using asymptotic notations.
2. Design and implement a brute-force algorithm and a randomized algorithm (e.g., Randomized Quick Sort or Closest Pair Problem) and compare their execution times.
3. Implement the Matrix Chain Multiplication problem using Dynamic Programming. Display the optimal order of multiplication and the minimum number of scalar operations required.
4. Implement the Longest Common Subsequence (LCS) algorithm using Dynamic Programming and display both the length and the actual subsequence.
5. Implement Huffman Coding for a given set of characters and their frequencies. Generate the prefix codes and display the encoded string.
6. Implement AVL Tree insertion and display the tree structure after each operation, ensuring the balance property is maintained throughout.
7. Implement the Union-Find algorithm with path compression. Apply it to find the Minimum Spanning Tree using Kruskal's algorithm.
8. Implement Breadth-First Search (BFS), Depth-First Search (DFS), and Topological Sort for a directed graph. Demonstrate on a sample input graph.

9. Implement Dijkstra's algorithm for finding the shortest path from a source node to all other nodes in a weighted graph. Display the shortest paths.
10. Implement a Greedy approximation algorithm for the Vertex Cover problem.

P – 30; Total Hours: 30

COURSE OUTCOMES:

CO1: Compare algorithm complexities through experimental testing.

CO2: Gain experience in implementing diverse algorithm design techniques.

CO3: Apply advanced data structures in algorithmic solutions.

CO4: Solve real-world problems using key graph algorithms.

CO5: Apply complexity concepts and approximation algorithms to NP problems.

Board of Studies (BoS): 25th BOS of CSE held on 07.07.2025

Academic Council: 24th AC held on 26.08.2025

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

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

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

Statement: The promotes a strong foundation in apply algorithm design strategies for solving real-world challenges efficiently.

CSF 6105	NETWORKS AND SECURITY LABORATORY	L	T	P	C
SDG: 9		0	0	2	1

COURSE OBJECTIVES:

COB1: To enable reliable and transparent data framing at the data link layer.

COB2: To learn data transmission with Automatic Repeat reQuest (ARQ) protocols for reliable communication.

COB3: To explore various routing protocols and assess their effectiveness in simulated networking scenarios

COB4: To understand encryption techniques for secure data encryption and decryption.

COB5: To gain hands-on experience in creating network-based applications.

PRACTICALS

List of Experiments

1. Implement the Data Link Layer framing methods,
   i) Bit stuffing, (ii) Character stuffing
2. Design and implement error detection and correction techniques
   i) LRC, (ii) CRC, (iii) Hamming code
3. Implement Stop and Wait, Sliding Window Protocols.
4. Simulation of Go-Back-N and Selective Repeat protocols.
5. Implementation of Distance Vector Routing algorithm (Routing Information Protocol).
6. Develop a Link State Routing algorithm (OSPF) for 5 nodes using Dijkstra's algorithm.
7. Perform data encryption and decryption with the Data Encryption Standard (DES) algorithm.
8. Data encryption and decryption using RSA (Rivest, Shamir and Adleman) algorithm.
9. Implement Client Server model using FTP protocol.
10. Explore different network security tools and applications.

P – 30; Total Hours:30

TEXT BOOKS:

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach",

Pearson, ISBN**:** 978-0136681557,6 th Edition, 2023.

REFERENCES:

1. Schneier, B. . “Applied cryptography: Protocols, algorithms, and source code in C”, 2nd edition, John Wiley & Sons, ISBN: 9781119096726, 2023.
2. Stallings, W. “ Cryptography and network security: Principles and practice”, 8 th edition, Pearson, ISBN: 9780138167381, 2023.
3. Behrouz A. Forouzan, “Data Communications and Networking”, McGraw-Hill Education, ISBN: 978-0073374226, 5th Edition,2013.

COURSE OUTCOMES:

CO1: Demonstrate the ability to implement framing methods and error detection/correction techniques for reliable communication.

CO2: Analyze the operation and performance of flow control and error recovery protocols in data transmission.

CO3: Simulate dynamic routing protocols to understand shortest-path calculation and route updates.

CO4: Implement encryption and decryption using cryptographic algorithms like DES and RSA for secure data transmission.

CO5: Apply essential cybersecurity tools to ensure the confidentiality, integrity, and availability of network resources.

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

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

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

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

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

SEMESTER II

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

COURSE OBJECTIVES:

COB1: To apply a perspective on research

COB2: To select the appropriate statistical techniques for hypothesis construction and methods of data analysis and interpretation

COB3: To analyze the research design by using optimization techniques.

COB4: To describe the research findings as research reports, publications, copyrights Patenting and Intellectual Property Rights.

MODULE I RESEARCH PROBLEM FORMULATION AND RESEARCH DESIGN **8**

Research - objectives – types - Research process, solving engineering problems -Identification of research topic - Formulation of the 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 the 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- Importance of statistics in research - Sample design. Hypothesis testing, ANOVA, Design of experiments - Factorial designs - Orthogonal arrays.

MODULE III OPTIMIZATION TECHNIQUES **6**

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 the 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.

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:

COB1: Formulate the research problem

COB2: Design and Analyse the research methodology

COB3: Analyse and interpret the data to construct and optimize the research hypothesis

Board of Studies (BoS) : 20th BoS of Civil held on 08.07.2025

Academic Council: 24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	3	**I**	**2**	**1**
CO2	2	3	**3**	**2**
CO3	3	2	2	3
CO4	**1**	3	2	**2**

Legend: L – Low (1), M – Medium (2), H – High (3).

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.

CSF 6201	ADVANCED MACHINE LEARNING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the fundamental concepts of machine learning.

COB2: To understand the knowledge of supervised learning methods.

COB3: To equip with foundational knowledge of unsupervised learning methods.

COB4: To impart the understanding of neural networks with deep learning model.

COB5: To develop skills in advanced machine learning techniques, real-world application domains.

MODULE I INTRODUCTION TO MACHINE LEARNING 9

Introduction - Different types of learning - Steps in ML process - Performance metrics - Training and test sets - cross validation - Concept of overfitting and under fitting - Data preprocessing - Normalization - Missing values - Feature selection.

MODULE II SUPERVISED LEARNING TECHNIQUES 9

Regression Algorithms - Linear Regression - Polynomial Regression - Ridge and Lasso Regression - Classification Algorithms - Logistic Regression - k-Nearest Neighbors - Decision Trees - Support Vector Machines - Naive Bayes Classifier.

MODULE III UNSUPERVISED LEARNING AND CLUSTERING 9

k-Means Clustering - Hierarchical Clustering – DBSCAN - Principal Component Analysis - Dimensionality Reduction Techniques - Association Rule Mining- Apriori - FP-Growth.

MODULE IV NEURAL NETWORKS AND DEEP LEARNING 9

Introduction to Neural Networks – Perceptron - Multi-layer Perceptron - Activation functions - ReLU - Sigmoid –Tanh - Backpropagation Algorithm - Convolutional Neural Networks - Recurrent Neural Networks - Overview of Deep Learning Frameworks: TensorFlow - PyTorch.

MODULE V MACHINE LEARNING PARADIGMS AND APPLICATION DOMAINS 9

Ensemble Learning - Bagging and Boosting - Reinforcement Learning - Q-learning -

Policy Gradient - Time Series Forecasting - Natural Language Processing – Tokenization – Embedding– Transformers Ethical issues in ML – Fairness – Interpretability – Bias.

L – 45; Total Hours: 45

TEXT BOOKS:

1. J. Winn, “Model-Based Machine Learning”, 1st edition Boca Raton, FL, USA: Chapman & Hall/CRC, ISBN: 978-1-4987-5681-5,2024.
2. A. Jung, “Machine Learning: The Basics”, Singapore, Springer, ISBN: 978-981-16-8192-9 (print), 978-981-16-8193-6 (e-book), 2022.
3. G. Friedland, “Information-Driven Machine Learning. Cham, Switzerland”, Springer International Publishing, ISBN: 978-3-031-39476-8 (print), 978-3-031-39477-5 (e-book), 2024.

REFERENCES:

1. M. Khurana et al. (Eds.), “Machine Learning Algorithms”, Proc. ICMLA 2024. Cham, Switzerland: Springer, ISBN: 978-3-031-75860-7, 2025.
2. C. C. Aggarwal, “Probability and Statistics for Machine Learning: A Textbook Cswitzerland”, Springer, ISBN: 978-3-031-53281-8, 2024.
3. I. Goodfellow, Y. Bengio, and A. Courville, “Deep Learning”, Cambridge, MA, USA, MIT Press, ISBN: 978-0-262-03561-3, 2019.

COURSE OUTCOMES:

CO1: Analyze the key steps in the machine learning pipeline.

CO2: Apply supervised learning algorithms to solve real-world predictive modeling tasks.

CO3: Implement unsupervised learning algorithms to extract meaningful structures.

CO4: Evaluate deep learning models using modern neural network techniques and tools.

CO5: Build advanced machine learning methods and assess their ethical implications across diverse application domains.

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	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	-	M	M	L	L	-	M	M	M	L	H	M
CO2	M	H	-	L	L	-	-	-	-	M	L	-	M	H
CO3	M	L	H	M	M	M	-	M	-	H	M	-	H	M
CO4	M	M	-	H	H	-	-	-	-	H	-	M	M	M
CO5	L	M	-	-	H	-	L	-	-	M	L	M	M	H

*

Legend: L – Low (1), M – Medium (2), H – High

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

Statement:

Students will be able to apply advanced machine learning techniques and critically assess their ethical implications in varied real-world application domains including time series analysis, natural language processing, and reinforcement learning.

CSF 6202	AGILE AND DEVOPS ENGINEERING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand and apply Agile and Scrum fundamentals.

COB2: To apply fundamental Agile projects with tools.

COB3: To learn DevOps tools for efficient software delivery.

COB4: To develop skills for managing builds using Maven and Gradle.

COB5: To learn basic Docker, Ansible automation and how to build DevOps pipelines on AWS.

MODULE I FOUNDATIONS AND PRACTICES OF AGILE SOFTWARE DEVELOPMENT **9**

Agile and Lean Software Development: Basics and Fundamentals - Extreme Programming – Scrum - Agile and Scrum Principles - Agile Manifesto - Twelve Practices of XP - Agile Estimation - Planning - Agile Requirements - User Stories - Backlog Management - Agile Architecture.

MODULE II PRACTICAL ASPECTS OF AGILE PROJECT MANAGEMENT **9**

Tracking Agile Projects - Lean Software Development - Agile Risk management - Agile Project Tools - Continuous Integration - Agile Testing - Scaling Agile for Large Projects.

MODULE III DEVOPS FUNDAMENTALS **9**

DevOps Overview - DevOps in the Software Lifecycle - Git Basics and Practice - Intermediate Git Commands - GitHub Management - Introduction to Jenkins - Basic Jenkins Job - Plugins in Jenkins and Build Pipelines.

MODULE IV BUILD AND CONTINUOUS INTEGRATION **9**

Build Tools Overview - Maven Basics - Maven Repositories - Maven Plugins & Profiles - Dependency management - Artifacts & Build Output - Gradle Setup - Gradle Build Concepts.

MODULE V CONFIGURATION MANAGEMENT AND CONTAINERIZATION 9

Understand basic Docker functionality - Docker usage and orchestration basics - Configure and automate with Ansible - Ansible Playbooks and Roles - Building DevOps Pipeline on AWS - build a sample code - Modify AWS-pipelines.

L – 45; Total Hours: 45

TEXT BOOKS:

1. Sibylle Peter, Martin Kropp, Ademar Aguiar, Craig Anslow, Maria Ilaria Lunesu, Andrea Pinna, “Agile Processes in Software Engineering and Extreme Programming”, Springer Cham, ISBN: 978-3-031-94543-4, 2025.
2. Susheela Hooda, Vandana Mohindru Sood, Yashwant Singh, Sandeep Dalal, Manu Sood, “Agile Software Development: Trends, Challenges and Applications”, Wiley-Scrivener (an imprint of John Wiley & Sons), ISBN 978-1119896395, 2023.
3. Dr. Mark T. Peters II, “Confident DevOps: The Essential Skills and Insights for DevOps Success”, Kogan Page Ltd, ISBN:978-1398616592, 2024.

REFERENCES:

1. Hugh Beyer, “User-Centered Agile Methods”, Springer Cham, ISBN: 978-3-032-03973-6, 2025.
2. Peter Wlodarczak, “Agile Software Development”, CRC Press, ISBN : 978-1032294643, 2023.
3. Robert Benefield, “Lean DevOps: A Practical Guide to On-Demand Service Delivery”, Addison-Wesley Professional, ISBN: 978-0133847505, 2022.

COURSE OUTCOMES:

CO1: Describe the basics of agile and lean software development.

CO2: Apply how to track and test agile projects and use lean and CI methods to grow projects.

CO3: Use Git and GitHub for coding and Jenkins for automating builds.

CO4: Demonstrate the ability to manage project builds and dependencies using Maven and Gradle.

CO5: Analyze automation and deployment workflows using Docker, Ansible, and AWS.

Board of Studies (BoS):

25th BOS of CSE held on 07.07.2025

Academic Council:

24th AC held on 26.08.2025

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

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement: Students Learn Agile principles and DevOps tools to efficiently manage software development, automate builds, ensure integration, and streamline continuous delivery pipelines.

CSF 6203 OPERATING SYSTEM AND VIRTUALIZATION L T P C

SDG: 9 3 0 0 3

COURSE OBJECTIVES:

COB1: To explore the basic structure, functionalities and services of operating systems.

COB2: To develop knowledge of process management and synchronization.

COB3: To understand the functions and techniques of memory management.

COB4: To provide knowledge about storage and file system structure.

COB5: To learn the concepts of virtual machine structure and access.

MODULE I OPERATING SYSTEMS STRUCTURES 9

Introduction-Computer System Architecture -Operating System Operations, Structures, Services, Design and Implementation- User and Operating System Interface-Debugging-Security and Protection-Building and Booting-Free and Open-Source Operating Systems.

MODULE II PROCESS MANAGEMENT AND SYNCHRONIZATION 9

Process Concept- Process Scheduling-Inter Process Communication-Client Server Communication-Threads and Concurrency- Multithreading Models- Threading Issues-CPU Scheduling- Synchronization The Critical-Section Problem- Synchronization within the Kernel- Deadlocks-Deadlock Avoidance, Detection, Recovery.

MODULE III MEMORY MANAGEMENT 9

Main Memory- Contiguous Memory Allocation- Paging- Swapping- Virtual Memory-Demand Paging-Page Replacement –Thrashing- Memory Compression- Allocating Kernel Memory.

MODULE IV STORAGE MANAGEMENT AND FILE SYSTEM 9

Overview of Mass Storage Structure-HDD Scheduling- NVM Scheduling-RAID Structure-I/O Systems-I/O Hardware-Application I/O Interface-Kernel I/O Subsystem-File System Interface- Structure and Implementation- Partitions and Mounting-Consistency Semantics.

MODULE V VIRTUALIZATION **9**

Virtual Machines- Requirement for Virtualization- Types of virtual machines and Implementations- Techniques for Efficient Virtualization- Memory Virtualization- I/O Virtualization- Virtual Machines on Multicore CPUs- Licensing Issues- Case Study- VMWARE.

L – 45; Total Hours: 45

TEXT BOOKS:

1. N. Maltare, M. Goyani, and S. Vahora, “Principles of Operating System Design and Virtualization Technologies”, Deep Science Publishing, ISBN-13: 978-93-49307-37-7, 2025.
2. Abraham SilberSchatz, Peter B Galvin, Greg Gagne, "Operating System Concepts", 10th edition, John Wiley & Sons Inc, ISBN:978-1-119- 32091-3, 2018.

REFERENCES:

1. A. Silberschatz, P. B. Galvin, and G. Gagne, “Operating System Concepts”, 10th edition, Wiley, ISBN: 978-1-119-80475-3, 2023.
2. Andrew S. Tanenbaum, Herbert Bos,"Morden Operating System", 4th edition, Pearson Education.Inc, ISBN:978-0-13-359162-0, 2015.
3. Remzi H. Arpaci-Dusseau Andrea C. Arpaci-Dusseau, "Operating Systems", 4th edition, Arpaci-Dusseau Books, ISBN: 978-1105979125, 2014.

COURSE OUTCOMES:

CO1: Identify the operating system structure, services and the evolution of operating systems.

CO2: Compare the performance of various process scheduling algorithms and analyse inter-process communication.

CO3: Evaluate process synchronization and identify issues related to critical sections, deadlocks, and recovery mechanisms.

CO4: Apply appropriate storage management techniques and file allocation to handle memory-related problems.

CO5: Analyze the implementation methods and techniques used in virtualization.

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	H	M	-	M	-	-	-	-	-	-	-	-	M	-
CO 2	H	-	M	-	-	M	-	-	L	-	-	-	M	-
CO 3	-	H	M	-	-	-	-	-	-	L	M		H	-
CO 4	M	M	L	-	-	-	M	-	-	-	-	L		M
CO 5	-	H		L	M	-	-	-	-	M	-	-	L	-

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement:

The students learn efficient system-level design (scheduling, memory management, synchronization), preparing them to innovate in computing systems and digital infrastructure.

CSF 6204	MACHINE LEARNING LABORATORY	L	T	P	C
SDG: 9		0	0	2	1

COURSE OBJECTIVES:

COB1: To implement and experiment with supervised learning models.

COB2: To build neural networks using Tensor Flow and from-scratch.

COB3: To apply cross-validation, data augmentation, and model regularization.

COB4: To explore unsupervised learning, anomaly detection, and recommender systems.

COB 5: To deploy recommendation models using collaborative, content-based, and reinforcement learning approaches.

PRACTICALS

List of Experiments:

1. Linear Regression and Learning Curve:Implement multiple linear regression with feature engineering.
2. Logistic Regression with Regularization: Apply logistic regression on binary classification dataset including overfitting control using L2 regularization.
3. Model Evaluation and Cross-validation: Perform k-fold cross-validation for different models and visualize variance and bias tradeoff.
4. Tree-based Models – Random Forest and XGBoost: Classify datasets using ensemble methods and analyze feature importance.
5. K-Means and Anomaly Detection: Cluster high-dimensional data and highlight outliers.
6. Collaborative Filtering with Matrix Factorization: Implement basic recommender using user-item matrix.
7. Outlier Detection with Distance & Density-based Approaches: Use z-score, DBSCAN and isolation forest to detect anomalies.
8. Build a basic feedforward neural network with backpropagation from scratch.
9. Multi-class Classification with Activation Functions: Use ReLU, Sigmoid, SoftMax; compare their effects on performance.
10. Ensemble Learning: Implement a Random Forest classifier on the UCI dataset.
11. Reinforcement Learning: Implement a basic REINFORCE algorithm.

P – 30; Total Hours: 30

TEXT BOOKS:

1. Hang Li, “Machine Learning Methods”, Springer Nature, ISBN: 978-981-99-0196-7, 2023.
2. Dr. R. Nageswara Rao, “Machine Learning in Data Science Using Python”, Dreamtech Press, ISBN: 978-93-5468-055-5, 2022.

REFERENCES:

1. C. C. Aggarwal, “Probability and Statistics for Machine Learning”, Springer, ISBN: 978-3-031-53281-8, 2024.
2. M. Khurana et al. (Eds.), Machine Learning Algorithms, Proc. ICMLA 2024. Cham, Switzerland: Springer, ISBN: 978-3-031-75860-7, 2025.

COURSE OUTCOMES:

CO1: Apply linear and logistic regression to real-world data.

CO2: Train basic neural networks using real-world data.

CO3: Use simple techniques to improve model performance.

CO4: Implement clustering and outlier detection.

CO5: Build basic recommender systems using similarity measures..

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	H	M	H	H	M	M	-	-	L	M	H	H	L	H
CO2	M	M	L	L	L	-	-	-	M	M	H	L	H	M
CO3	M	L	M	L	L	M	-	-	M	L	L	H	H	L
CO4	M	L	M	M	H		-	-	M	L	M	M	H	H
CO5	M	M	M	L	L	H	-	-	L	H	M	L	M	H

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement:

The course equips students with practical skills in machine learning to develop intelligent, data-driven systems. It enables innovation in domains like healthcare, transportation, and industry.

ENF 6281	PROFESSIONAL COMMUNICATION	L	T	P	C
SDG: 4 & 8		0	0	2	1

COURSE OBJECTIVES:

COB1: To introduce the fundamentals of professional communication in workplace contexts.

COB2: To develop structured presentation and public speaking skills.

COB3: To develop students' proficiency in written correspondence, including emails, and reports.

COB4: To enhance awareness and use of body language in professional settings

COB5: To instil appropriate workplace etiquette and digital professionalism.

MODULE I COMMUNICATION AT THE WORKPLACE P: 6

Language and communication fundamentals, Types of workplace communication, Formal and informal Communication, Direction and flow of Communication-Organizational communication and interpersonal dynamics, 7 Cs of Communication - Ethical use of AI assisted communication tools

MODULE II PRESENTATION & PUBLIC SPEAKING SKILLS P: 6

Importance of presentation skills, Managing public speaking anxiety, Structured planning and delivery of presentations, Use of visual aids and technology - Interactive tools

MODULE III CORRESPONDENCE AT WORK P: 9

Digital correspondence - Email Writing and Etiquette, Report Writing: Incident Reports, Feasibility Reports, and Executive Summaries

MODULE IV BODY LANGUAGE P: 5

Fundamentals of body language in professional communication, Types of non-verbal cues, posture -Interpreting and responding to non-verbal signals in interpersonal and group contexts, Cultural variations in body language and their implications in global communication

MODULE V WORKPLACE ETIQUETTE P: 4

Workplace etiquette, Cultural sensitivity in globalized work environments, Gender sensitivity and inclusivity, DEI, Netiquette and digital professionalism - video conferencing, Professional networking (Social media, LinkedIn, etc.), Virtual team dynamics

P – 30; Total Hours:30

TEXT BOOKS:

1. Course material by the Department of English

REFERENCES:

1. Bovee, C. L., & Thill, J. V. *Business Communication Today* (14th ed.). Pearson, 2021.
2. Cardon, P. W., & Marshall, B. The hype and reality of social media use for work collaboration and team communication. *International Journal of Business Communication*, 52(3), 2015, 273–293.
3. Guffey, M. E., & Loewy, D. *Essentials of Business Communication* (11th ed.). Cengage Learning, 2020.
4. Jones, D. A., & Pittman, M. The digital professionalism paradox: Workplace norms and expectations in the era of online communication. *Journal of Applied Communication Research*, 49(3), 2021, 283–301.
5. Keyton, J., & Smith, F. L. M. Communication practices of work teams: Task, social, and identity functions. *Journal of Business Communication*, 46(4), 2009, 402–426.
6. Krizan, A. C., Merrier, P., Logan, J., & Williams, K. *Business Communication* (9th ed.). Cengage Learning, 2016.
7. Lesikar, R. V., Flatley, M. E., Rentz, K., & Lentz, P. *Lesikar's Business Communication: Connecting in a Digital World* (13th ed.). McGraw-Hill Education, 2019.
8. Madlock, P. E. The link between leadership style, communicator competence, and employee satisfaction. *Journal of Business Communication*, 45(1), 2008, 61–78.
9. Raman, M., & Sharma, S. Technical communication: Principles and practice (3rd ed.). Oxford University Press, 2015.
10. Robles, M. M. Executive perceptions of the top 10 soft skills needed in today's workplace. *Business Communication Quarterly*, 75(4), 2012, 453–465. https://doi.org/10.1177/1080569912460400

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Demonstrate clarity in professional communication by selecting appropriate modes and formats for workplace interactions.

CO2: Deliver structured presentations with confidence, using relevant verbal and visual communication techniques.

CO3: Produce clear and effective written correspondence, including emails, and formal reports.

CO4: Interpret and apply non-verbal communication cues appropriately in professional contexts.

CO5: Exhibit workplace etiquette, digital conduct, and cultural sensitivity in professional environments.

Board of Studies (BoS):

18th BoS of the Department of English held on 04.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1														
CO2														
CO3														
CO4														
CO5														

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

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

Statement: This course equips students with the competencies required for employment in a dynamic global workforce.

CSF 6205	MINI PROJECT	L	T	P	C
SDG: 9		0	0	6	3

COURSE OBJECTIVE:

COB1: To enhance knowledge in the design, development and evaluation of computational systems.

COB2: To ascertain Computer Science and Engineering problems through a comprehensive literature review.

GENERAL GUIDELINES:

The Mini Project will feature a mid-semester presentation and an end-semester presentation. The mid-semester presentation will cover the identification of a problem statement based on current trends in Computer Science and Engineering, along with a brief literature review and analysis of existing methods and algorithms using different techniques.

Students can select minor issues in the Computer Science and engineering domain for their mini project. The work may include creating or improving algorithms, building software applications, exploring and analyzing data, experimenting with machine learning models, evaluating how well a system performs, studying security aspects, understanding and using existing tools and frameworks to solve real-world computing problems.

The end-semester presentation must be accompanied by a project report that includes the identification of the topic for the work and the methodology used for the analysis / design and detailing of the complete system.

The departmental committee will monitor the continuous assessment of the Design Project.

COURSE OUTCOMES:

At the end of the mini project, the students will be able to

CO1: Identify issues in emerging areas of Computer Science and Engineering.

CO2: Apply appropriate analytical and experimental methods to solve identified problems.

CO3: Design, implement and evaluate computational solutions using modern software tools and platforms.

CO4: Exhibit proficient communication and report writing skills.

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4
CO1	2	3	-	-
CO2	2	3	-	3
CO3	-	2	3	2
CO4	-	-	-	2

-

Note: 1 - Low Correlation 2 - Medium Correlation 3 - High Correlation

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

Statement: Encouraging students to identify real-world computing problems through literature review and develop innovative, efficient, and scalable software solutions that contribute to technological advancement, digital infrastructure, and sustainable industrial growth.

SEMESTER III

CSF 7101	CLOUD INFRASTRUCTURE AND SERVICES	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the fundamentals of traditional computing.

COB2: To introduce the concept of virtualization and storage services in cloud computing.

COB3: To impart the various cloud computing service models.

COB4: To explore the key security threats in cloud environments, authentication protocols and encryption techniques for secure data access.

COB5: To infer a real-world problems and develop a cloud-based software solution.

MODULE I OVERVIEW OF COMPUTING PARADIGM 9

Recent trends in Computing Grid Computing-Cluster Computing - Distributed Computing-Utility Computing - Cloud Computing Evolution of Cloud computing - Business driver for adopting Cloud computing - Introduction to Cloud Computing (NIST Model) - Cloud Service providers - Pros and Cons, Properties, and Characteristics of Cloud Computing.

MODULE II VIRTUALISATION TECHNIQUES AND STORAGE 9

Introduction to Virtualization- Different approaches to Virtualization-Hypervisors, Machine Image- Virtual Machine (VM) - Resource Virtualization Server - Network Virtual Machine - Resource Provisioning and Manageability - Storage as Service

MODULE III CLOUD SERVICE MODELS 9

Cloud computing Stack -Traditional computing architecture - Cloud Computing Works, Role of Networking protocol in Cloud computing - Role of web services - Infrastructure as a Service (IaaS) - Platform as a Service (PaaS)-Software as a Service (SaaS) - Deployment Models.

MODULE IV CLOUD SECURITY ISSUES **9**

Infrastructure Security - Network Level Security - Host Level Security - Application-Level Security - Data Security and Storage - Data Privacy and Security Issues-Jurisdictional issues raised by Data Location Identity & Access Management- Access Control- Trust-Reputation- Risk-Authentication in Cloud Computing- Cloud contracting Model - Commercial and Business Considerations-Cloud Security Threats -Authentication & Identity Management - Quality Assurance.

MODULE V CLOUD APPLICATIONS **9**

Build and deploy cloud app.- Application integrating with third party API - Authentication - security, awareness - Case Studies: Salesforce - Basecamp - Xero.com - Dropbox - Overview of interconnectivity in Cloud Ecosystems - Working with Twitter API - Flickr API - Google Maps API - Advanced use of JSON and REST.

L – 45; Total Hours: 45

TEXT BOOKS:

1. Sr. Shravan Chandra Geerlapally, “Cloud Computing: A Practical Approach”, 2nd Edition, ISBN 979-8338119730, 2024.
2. D. Gupta, “The Cloud Computing Journey, 1st ed. Birmingham”, UK: Packt Publishing, ISBN 978-1-80512-228-9, 2024.
3. R. Buyya, A. V. Dastjerdi, and S. Thamarai Selvi, “Cloud Computing:Principles and Paradigms”, 2nd Edition, Wiley, ISBN: 978 0 470 88799 8, 2023.

REFERENCES:

1. J.C. Andersson, “Learning Microsoft Azure: Cloud Computing and Development Fundamentals”, 1st edition, O’Reilly,Media, ISBN 978 1 09811 332 2, 2023,
2. D. Comer, The Cloud Computing Book: The Future of Computing Explained, 1st edition, CRC Press, ISBN 978 0 36770 684 5, 2023
3. T. Erl, Z. Mahmood, and R. Puttini, “Cloud Computing: Concepts, Technology, Security, and Architecture”, 2nd edition, Pearson, ISBN 978 0 13 805225 6, 2023.

COURSE OUTCOMES:

CO1: Analyze the basics of cloud computing fundamentals.

CO2: Explore the select suitable type of virtualization.

CO3: Identify various cloud service models.

CO4: Articulate the various security threats in cloud environment.

CO5: Design, implement and evaluate a cloud-based real time applications.

Board of Studies (BoS):

25th BOS of CSE held on 07.07.2025

Academic Council:

24th AC held on 26.08.2025

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

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement:

The course introduces core principles and techniques of cloud computing, with a focus on analysis and hands-on experience in building real-time cloud applications.

CSF 7102	INDUSTRY INTERNSHIP	L	T	P	C
SDG: 9		0	0	4	2

COURSE OBJECTIVE:

COB1: To expose the students to an industrial environment and make them industry ready.

COURSE DESCRIPTION:

1. To earn credits for this course, industrial training for a period of 15 days, in a single slot, is mandatory. The course has to be undertaken during the first year summer vacation and the credits will be awarded in the third semester.
2. If the student is not able to complete the internship during the first year summer vacation, he/she can complete the course in a single slot between 2th and 4th semester vacation.
3. For effective implementation of the course Industry Internship, a teaching faculty is appointed as the coordinator by the Head of the department.
4. The students will be allowed to undergo training only in reputed companies /research labs/design centres. The coordinator identifies the companies related to core engineering for internship during second semester. He/she assists the students in every process of getting into the companies as an intern.
5. To enable the students to focus on the internship, no two students are allowed to be in the same site.
6. Interacting with the respective industries, where the students do their internship, the Coordinator continuously monitors the performance of the students during the internship.
7. After completion of the internship, the students are required to submit a detailed report and present what they had learned through the internship, in the form of posters. The students should submit the industry certificate at the time of giving the presentation.
8. The performance of the student will be evaluated by the industry as well as the University. Both the evaluations will be considered and aggregated to award the final grade. 50% weightage is given to the evaluation by the industry and remaining 50% weightage to the evaluation by the committee appointed by the Head of the Department.

9. The 50 % weightage of evaluation done at the department comprises of (a) 20/50 for viva-voce, (b) 20/50 for the Intern report and (c) 10/50 for poster presentation.

COURSE OUTCOMES:

At the end of the internship, the student will be able to:

CO1: Solve problems typically encountered by engineers in industry.

CO2: Identify and address social, economic, and safety issues in an engineering problem and develop a solution that addresses this.

CO3: Learn new concepts and apply them to the solution of engineering problems.

CO4: Function effectively on a multidisciplinary team and interface effectively with other areas of the organization.

CO5: Clearly communicate their ideas orally and in writing.

CO6: Prepare for a lifelong productive career as an engineer.

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	2	2	3	2	2	2	2	-	3	2	2	2
CO2	2	2	2	2	2	2	2	2	2	-	2	2	2	2
CO3	2	2	2	2	2	2	2	2	2	-	2	2	2	2
CO4	2	2	2	2	2	2	2	2	2	-	3	2	3	3
CO5	2	2	2	2	3	3	3	3	3	-	3	2	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

CSF 7103	**Project Work– Phase I (III Sem)**	**L**	**T**	**P**	**C**
		0	**0**	**16**	**8**
	Project Work– Phase II (IV Sem)	**L**	**T**	**P**	**C**
SDG: 9		**0**	**0**	**36**	**18**

COURSE OBJECTIVES:

COB1: To enable students to undertake independent research or development work relevant to their specialization.

COB2: To apply advanced knowledge, techniques, and tools in solving real-world or research problems.

COB3: To enhance project planning, execution, and management skills.

COB4: To develop skills in technical documentation and effective communication.

COB5: To cultivate innovation, ethical practice, and lifelong learning in professional work.

COURSE DESCRIPTION

Project work shall be carried out by each and every individual student under the supervision of a faculty of this department. A student may however, in certain cases, be permitted to work for the project in association with other departments or in an Industrial/Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and the faculty of the other department of the University or an Engineer / Scientist from the organization. The student shall meet the faculty periodically and attend the periodic reviews for evaluating the progress.

There will be three reviews for continuous assessment and one final review and viva voce at the end of the semesters. The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department. The research findings have to be published in conference/Journal.

COURSE OUTCOMES:

At the end of the project work, the student will be able to:

CO1: Identify and define a research or application-oriented problem relevant to

Power System Engineering, and apply appropriate methodologies, tools, and technologies to analyze and solve it.

CO2: Design, implement, and evaluate power system models, components, or solutions that meet specified performance and functional objectives.

CO3: Exhibit critical thinking, creativity, and independence in addressing complex engineering challenges.

CO4: Prepare comprehensive technical documentation and effectively communicate the project outcomes through written reports, presentations, and academic publications.

CO5: Demonstrate ethical conduct, project management skills, and contribute to professional knowledge by presenting findings at conferences or publishing in journals.

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1	-	-	-	1	2	3	3	3
CO2	2	3	3	3	3	1	-	-	-	1	2	3	3	3
CO3	2	3	3	3	3	1	-	-	-	2	2	3	3	3
CO4	1	1	1	1	1	1	-	-	3	1	2	3	3	3
CO5	1	1	1	1	1	2	3	2		2	2	3	3	3

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

PROFESSIONAL ELECTIVES - SEMESTER I

		L	T	P	C
CSFY 01	**ADVANCED SOFTWARE DEFINED NETWORKS**				
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the packet switching and the evolution of switch architectures for designing scalable network infrastructures.

COB2: To explore the transition from legacy networks to SDN, including interoperability, open-source contributions, and virtualization.

COB3: To grasp the fundamental characteristics, components, and operation of SDN, including controllers, devices, and applications.

COB4: To interpret SDN in data centers, covering tunneling, path technologies, use cases, and real implementations..

COB5: To study emerging SDN applications in areas like SD-WAN, mobile networks, security, and energy-efficient network management.

MODULE I INTRODUCTION **9**

Basic Packet Switching Terminology-Historical Background-The Modern Data Center-Traditional Switch Architecture-Autonomous and Dynamic Forwarding Tables-Evolution of Switches and Control Planes-SDN Implications for Research and Innovation-Data Center Innovation-Data Center Needs.

MODULE II DESIGN PARADIGM OF SDN **9**

The Evolution of Networking Technology-Forerunners of SDN-Legacy Mechanisms Evolve Toward SDN-Software Defined Networking-Sustaining SDN Interoperability-Network Operating System-Protocols: OpenFlow, NETCONF, REST APIs.

MODULE III WORKING OF SDN **9**

Fundamental Characteristics of SDN-SDN Operation-SDN Devices-SDN Controller-SDN Applications-Alternate SDN Methods-Centralized Network Control-Open source contributions in SDN-Network Virtualization.

MODULE IV SDN IN THE DATA CENTRE **9**

Data Center Demands-Tunneling Technologies for the Data Center-Path Technologies in the Data Center-Ethernet Fabrics in the Data Center-SDN Use Cases in the Data Center-Comparison of Open SDN, and APIs-Real World Data Center Implementations.

MODULE V SDN FUTURES 9

Current State of Affairs SD-WAN -Potential Novel Applications of Open SDN-Managing Nontraditional Physical Layers Links-Applying Programming Techniques to Networks-Security Applications-Roaming in Mobile Networks-Traffic Engineering in Mobile Networks-Energy Savings.

L – 45; Total Hours: 45

TEXT BOOKS:

1. Y. Li, “Software-Defined Networking for Intelligent Transport Systems”, Wiley-IEEE Press, ISBN: 978-11-1987-6248, 2023.
2. J. Kaur, “Software Defined Networking: Concepts, Techniques, and Applications”. Springer, ISBN: 978-30-3084-3275, 2022
3. N. McKeown and T. Anderson, “Software Defined Networking: The New Norm for Networks”, 2nd edition, Addison-Wesley Professional, ISBN: 978-01-3609-9755, 2021.
4. S. Jain and M. Samaka, “Security in Software Defined Networks: Challenges and Solutions”. Springer, ISBN: 978-30-3070-9568, 2021
5. M. M. Hassan, “Software-Defined Networking and Network Functions Virtualization: Technologies, Applications, and Research Directions”. Springer, ISBN: 978-30-3037-6318, 2020.

REFERENCES:

1. M. Amanowicz, S. Szwaczyk, and K. Wrona, “Data-Centric Security in Software Defined Networks (SDN)”, vol. 149, Springer, pp. 66–91, ISBN: 978-3-031-55516-9, 2024.
2. Ž. Bojović, “Application of Network Function Virtualization in Modern Computer Environments”, ISBN: 978-1638283584, 2024.
3. B. B. Gupta, “SDN and NFV: A New Dimension to Virtualization,World Scientific”, ISBN: 978-981-16-0385-3, 2024.

4. A. Nayyar, B. Singla, and P. Nagrath, “Software Defined Networks: Architecture and Applications”, Wiley-Scrivener, ISBN: 978-1119857303, 2022.

COURSE OUTCOMES:

CO1: Analyze packet switching and switch architectures to design scalable networks.

CO2: Apply SDN and virtualization concepts to modern network design.

CO3: Evaluate SDN components and apply them in network solutions.

CO4: Design efficient data center networks using SDN technologies.

CO5: Develop SDN in areas like SD-WAN, mobility, security, and energy efficiency.

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

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

*** Legend: L – Low (1), M – Medium (2), H – High (3).**

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

Statement:

Understanding the various architectural standards of Software Defined Networks and the application of network virtualization techniques to design flexible and programmable infrastructures contributes to the innovation of scalable and sustainable digital connectivity.

CSFY 02	ADVANCED JAVA PROGRAMMING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn advanced Java programming concepts like interface, threads, swings.

COB2: To introduce network programs in Java.

COB3: To understand the concepts needed for distributed and multi-tier applications.

COB4: To gain knowledge of distributed systems and multitier enterprise applications with performance considerations.

COB5: To impart foundational knowledge on server-side programming with focus on database access and session management.

MODULE I INTRODUCTION 9

Basic Java – Java designing goals – Features of Java language – JVM the heart of Java– role of Java programmer in industry– Extending classes and Inheritance – Packages – Exception handling and Event handling – Threads - Graphical User Interface – Creating Windows – Dialog Boxes – Layout Managers – AWT Component classes – Swing Component classes – AWT graphics classes – Other Swing controls.

MODULE II NETWORKING AND JAVA DATABASE CONNECTIVITY 9

Networking: Basics – Networking in Java – Socket Programming using TCP/IP – Socket Programming using UDP – URL and InetAddress Classes. Database Connectivity: Types of drivers – JDBC Architecture – JDBC Classes and Interfaces – Basic steps in developing JDBC application – Creating a new database and table with JDBC – Working with Database metadata

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MODULE III SERVLETS AND APPLETS 9

Servlets: Basics – Advantages – Servlet alternatives – strengths – Architectures – Servlet Life Cycle – Generic Servlet – HTTP Servlet – Passing parameters – Retrieving parameters – server side include – Cookies – Filters. Applets: Applet Fundamentals – Applet Class – Applet Life Cycle – Steps for developing an Applet Program – Passing values through Parameters – Graphics in an Applet.

MODULE IV JAVA SERVER PAGES **9**

Java Server Pages: Overview – JSP and HTTP – JSP Engines – JSP Architecture and lifecycle - Working of JSP – Anatomy of JSP – JSP Syntax – Creating simple JSP page – Components of JSP – Implicit objects and scopes – JDBC Integration and CRUD operations - Database Integration via JSP – MVC Architecture - Java Beans and custom tags.

MODULE V WEB PROGRAMMING - CLIENT AND SERVER SIDE PROGRAMMING **9**

Web Programming – Client Side Programming: Client Side Programming technologies – Form design with HTML and CSS – Client side Validation using JavaScript – Content Structuring using XML – Adding interactivity with AJAX - Web Programming – Server Side Programming: Web Servers – Handling Request and Response – Database Access – Session Management.

L – 45; Total Hours: 45

TEXT BOOKS:

1. Sagayaraj, Denis, Karthik and Gajalakshmi, “Java Programming for Core and Advanced Learners”, University Press, ISBN 978-9386235329, 2024.

2. Maydene Fisher, Jon Ellis, Jonathan Bruce JDBC API Tutorial and Reference, Third Edition, Addison Wesley, ISBN : 321-17384-8, 2003.

REFERENCES:

1. Subrahmanyam Allamaraju,.” Professional Java Server Programming” Cedric Buest Wiley Publication,ISBN: 978-1861005373, 2001.

COURSE OUTCOMES:

CO1: Develop the components of J2EE Architecture, MVC Framework and Multi-tier Application and Various Network Protocol.

CO2: Make use of Servlet and JSP API in the process of enterprise application deployment

CO3: Implement components such as Session, Filters, JSTL, Beans

CO4: Distinguish Application Server, Web Container, JDBC and ORM tools.

CO5: Design and Development of web application having collaboration of Servlets

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

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

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement:

This course builds a strong foundation and enable the students in the design and development of scalable, secure, and innovative web-based enterprise solutions aligned with modern digital infrastructure needs.

CSFY 03	OPTIMIZATION TECHNIQUES	L	T	P	C
SDG: 9		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

TEXT BOOKS:

1. D. Samanta and S. Kumar, “Classical and Modern Optimization Techniques: Theory and Applications”, 2nd edition, Singapore: Springer, 2024. ISBN: 978-98-1991-1868.
2. Hillier, Frederick S., and Lieberman, Gerald J, “Introduction to Operations Research”, McGraw-Hill Education, ISBN: 9781259872990, 2021.
3. Nayak, Sukanta, “Fundamentals of Optimization Techniques with Algorithms”, Elsevier Science, ISBN: 9780128211267, 2020.
4. Arora, Rajesh Kumar, “Optimization: Algorithms and Applications”, CRC Press, ISBN: 978149872112, 2015.

REFERENCES:

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

COURSE OUTCOMES:

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.

Board of Studies (BoS): 25th BOS of CSE held on 07.07.2025

Academic Council: 24th AC held on 26.08.2025

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

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement: Build digitally enhanced manufacturing by combining industrial practices with the latest smart technologies.

CSFY 04	PYTHON FOR DATA SCIENCE	L	T	P	C
SDG: 8		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand data science fundamentals and its links to ML and BI.

COB2: To learn Python for data handling and visualization

COB3: To study statistics to analyze and interpret data..

COB4: To interpret and assess ML models on real datasets..

COB5: To explore NLP and clustering for data insights

MODULE I FOUNDATIONS OF DATA SCIENCE AND PYTHON 9

Historical evolution and foundational concepts of Data Science - Core tools – competencies - interdisciplinary skill sets essential for data science practice - Specializations and adjacent domains - Data Engineering - Machine Learning - Business Intelligence - Methodologies for conducting data science projects - CRISP-DM - Agile workflow - Introduction to the Python programming environment using Anaconda distribution - Fundamentals of Python - syntax - data types - control structures – functions

MODULE II DATA WRANGLING AND VISUALIZATION TECHNIQUES 9

File operations in Python - loading - reading - writing text and structured files using built-in modules - Introduction to SQL and SQLite for structured data storage and querying - Data manipulation with Pandas and NumPy – cleaning – transforming - filtering real-world datasets - Exploratory Data Analysis - detecting anomalies.

MODULE III APPLIED STATISTICS FOR DATA SCIENCE 9

Fundamentals of probability: concepts, rules, and probability distributions - Sampling techniques and estimation theory - Statistical inference and hypothesis testing - Parametric tests – t-test - z-test - Outlier detection – Generalized ESD test - Correlation and association – Pearson correlation coefficient - Application of statistical tests to real-world datasets for data-driven decision making.

MODULE IV MACHINE LEARNING TECHNIQUES 9

Data preparation for machine learning - Feature engineering - dimensionality reduction and

selection techniques - Supervised learning - Classification models - logistic regression - decision trees- Regression models - linear regression and its extensions - AUC and cross-validation - Introduction to automated machine learning and model optimization - Tree-based learning models - random forests - gradient boosting.

MODULE V TEXT ANALYTICS AND INSIGHTS REPORTING 9

Unsupervised learning and clustering algorithms - Introduction to Natural Language Processing (NLP) - Text preprocessing tokenization – stemming - lemmatization - Basic text analysis and vectorization techniques - Text classification using supervised learning models.

Total Hours: 45

TEXT BOOKS:

1. Song Yang, “Social Network Analysis in Action: Basic Methods and Applications”, University of Arkansas, Springer, Cham, ISBN 978-3-031-66660-5, December 2024.
2. Dr. Gohar F. Khan, “Creating Value with Social Media Analytics”, Create Space Independent Publishing, ISBN 978-1977543974, 2024.
3. Tang & Li, “Semantic Mining of Social Networks”, Springer - Nature New York Inc, ISBN 978-3-031-794629, 2022.

REFERENCES:

1. Stephen Borgatti P, Martin G Everett, Jeffrey C Johnson, Filip Agneessens, “Analyzing Social Networks”, SAGE Publications, ISBN 978-1529609165, February 22, 2024.
2. Jiang Wu, “Social Network Computing”, Springer - Nature New York Inc, ISBN 978-981-9740-83-3, 2024.
3. Mehmet Kaya, Sleiman Alhajj, Kashfia Sailunaz, Min-Yuh Day, “Social Network Analysis and Mining Applications in Healthcare and Anomaly Detection”, Springer, ISBN 978-3-031-75203-2, 2024..

COURSE OUTCOMES:

CO1: Analyze the evolution of data science, tools, CRISP-DM, Agile, and interdisciplinary roles.

CO2: Interpret the file operations and perform data wrangling with NumPy, Pandas, and

SQL.

CO3: Apply EDA and visualize data using Matplotlib and Seaborn.

CO4: Use probability and statistical tests (t-test, z-test, etc.) for data analysis.

CO5: Analyze classification and regression models with proper evaluation metrics.

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

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

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement: By learning the concepts of Data Science using Python, Graduates will be able to write the code to manipulate, analyze, visualize data and be able to discover hidden patterns which in turn improve economic growth.

CSFY 05	SOFTWARE TESTING AND QUALITY	L	T	P	C
SDG: 9	ASSURANCE	3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the fundamental concept of software quality.

COB2: To learn the components of software quality assurance.

COB3: To impart software development and quality plans.

COB4: To gain knowledge on various software testing strategies.

COB5: To study test automation and configuration management.

MODULE I INTRODUCTION TO SOFTWARE QUALITY 9

Introduction to Software quality-Software quality factors-classification of software requirements- Product operation software quality factors- Product transition software quality factors- Software compliance with quality factors.

MODULE II COMPONENTS OF SOFTWARE QUALITY ASSURANCE 9

SQA system- Software project life cycle components- Infrastructure components: error prevention ,improvement- SQA standards-System certification and assessment components- Pre-project software quality components: Contract review objectives and Contract review subjects.

MODULE III QUALITY PLANS 9

Development plan and quality plan objectives- Elements of the development plan-Elements of the quality plan- SQA components in the project life cycle: Factors affecting quality assurance : Verification-Validation - Qualification.

MODULE IV SOFTWARE TESTING STRATEGIES 9

Testing Strategies – White Box and Black Box Approach – Integration Testing – System and Acceptance Testing – Performance Testing – Regression Testing - Internationalization Testing – Alpha and beta site testing – Website Testing – Usability Testing – Accessibility Testing..

MODULE V TEST AUTOMATION AND MANAGEMENT 9

Test plan – Management – Execution and Reporting – Software Test Automation – Automated Testing tools - Hierarchical Models of Software Quality – Configuration Management – Documentation Control.

Total Hours: 45

TEXT BOOKS:

1. Stephan Goericke, “The Future of Software Quality Assurance”, Saint Philip Street Press, ISBN 978-1013274671, 2020.

REFERENCES:

1. Hiren Dand, Vilas Mahajan., “Software Quality Assurance”, Star Edu Solutions India Pvt Ltd, ISBN 13: 978-9386765611,2019.
2. Claude Y. Laporte, Alain April, “Software Quality Assurance, First Edition”, IEEE Computer Society, 2017.
3. Daniel Galin, “Software Quality Assurance – from Theory to Implementation” Pearson Education, 2009.

COURSE OUTCOMES:

CO1: Identify key quality factors and requirement classifications.

CO2: Describe the components of an SQA system.

CO3: Evaluate the effectiveness of verification, validation, and qualification techniques.

CO4: Compare and apply white box and black box testing approaches

CO5: Understand the importance of documentation control in quality assurance.

Board of Studies (BoS): 25th BOS of CSE held on 07.07.2025

Academic Council: 24th AC held on 26.08.2025

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

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement: This course on Software Quality Assurance supports fostering innovation and enhancing software infrastructure through reliable, high-quality, and efficient software systems.

PROFESSIONAL ELECTIVES - SEMESTER II

CSFY 06	**ADVANCED DATA WAREHOUSING**	**L**	**T**	**P**	**C**
SDG: 9	**AND DATA MINING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the evolution and need for data warehousing.

COB2: To explore the architectural components and implementation strategies of data warehouses.

COB3: To introduce core concepts in data mining and machine learning.

COB4: To study data-driven techniques for problem understanding and pattern discovery.

COB5: To impart the knowledge of predictive models for classification and regression.

MODULE I INTRODUCTION TO DATA WAREHOUSING 9

Decision support system-Operational versus Decision-Support Systems-Data Warehousing- definitions, features of Data warehouse-Data Marts-Metadata-Planning Data warehouse-project team-project management considerations- Information packages & requirements gathering methods and Requirements definition: Scope and Content.

MODULE II ARCHITECTURAL COMPONENTS 9

Objectives, Data Warehouse Architecture, Distinguishing Characteristics, Architectural Framework. Infrastructure: Operational & Physical-Implementation of Data warehouse- ETL- Physical design-Data lake vs Data warehouse.

MODULE III DATA MINING TOOLS 9

Basic Data Mining Tasks, Data Mining versus Knowledge Discovery in Databases, Applications of Machine Learning. 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 IV ASSOCIATION MINING AND WEB MINING 9

Unbalanced data, Unsupervised Learning: Association rules-Apriori algorithm- FP tree algorithm- Market Basket Analysis and Association Analysis -Clustering- Concept of other clustering algorithms: Hierarchical clustering and DBSCAN –Web Content Mining – Web Usage Mining – Web Structure Mining –Page Rank Algorithm – Precision and Recall.

MODULE V CLASSIFICATION & PREDICTION 9

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.

L – 45; Total Hours: 45

TEXT BOOKS:

1. J. Han, J. Pei, and H. Tong, “Data Mining: Concepts and Techniques”, 4th ed., The Morgan Kaufmann Series in Data Management Systems. San Francisco, CA, USA: Morgan Kaufmann, ISBN: 978-0-12-811761-3, 2022.
2. P. Ponniah, “Data Warehousing Fundamentals for IT Professionals”, 2nd ed. Hoboken, NJ, USA: Wiley, ISBN: 978-0470462072, 2010.

REFERENCES:

1. R. Kimball, M. Ross, W. Thornthwaite, J. Mundy, and B. Becker, “The Data Warehouse Lifecycle Toolkit”, 2nd ed. Hoboken, NJ, USA: Wiley, ISBN 978-0470149775, 2008.
2. S. Yazdani and S. S. Wong, “Data Warehousing with Oracle: An Administrator’s Handbook”, Upper Saddle River, NJ, USA: Prentice Hall, 1997.

COURSE OUTCOMES:

CO1: Analyze the need for data warehousing and distinguish it from operational databases.

CO2: Design and describe the architecture and physical implementation of a data warehouse.

CO3: Apply data preprocessing techniques and use tools like Weka and R for

mining tasks.

CO4: Evaluate unsupervised learning tasks such as clustering and association rule mining.

CO5: Build and evaluate classification and regression models using statistical and ML techniques.

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

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

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	-	M	-	-	H	-	-	M	-	-	-	H	-
CO2	M	L	M	L	-	-	-	-	-	-	M	-	H	-
CO3	H	H	M	-	-	M	-	L	-	H	-	H	-	M
CO4	H	L	-	L	M	-	-	L	-	-	-	-	M	-
CO5	L	-	-	M	-	-	M	-	-	L	L	-	L	M

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

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

CSFY 07	HIGH PERFORMANCE COMPUTER	L	T	P	C
SDG: 9	ARCHITECTURE	3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the theoretical foundations and types of parallel processing.

COB2: To explore hardware technologies supporting parallelism, including memory hierarchies and interconnects.

COB3: To study scalable parallel architectures and evaluate their performance.

COB4: To learn software approaches for parallel programming, including paradigms, tools, and runtimes.

COB5: To gain knowledge of instruction-level and system-level parallelism to enhance execution performance.

MODULE I THEORY OF PARALLELISM 9

Parallel Computer models – The state of Computing- - PRAM and VLSI models- Architectural development tracks- Program and network properties - Conditions of parallelism – program partitioning- scheduling and flow mechanisms- System interconnect architectures – Principles of Scalable Performance- Performance metrics and measures – parallel processing applications.

MODULE II HARDWARE TECHNOLOGIES 9

Processors and memory hierarchy- Advanced processor technology- superscalar and vector processors- Memory Hierarchy and Virtual memory technology – Bus, Cache and shared memory – Pipelining and superscalar techniques.

MODULE III PARALLEL AND SCALABLE ARCHITECTURES 9

Multiprocessors and multi computers – multiprocessors system interconnects – cache coherence and synchronization mechanisms- multi vector and SIMD computers – vector processing principles- compound vector processing –Dataflow architectures – Principles of multithreading- Scalable and multithreaded architectures.

MODULE IV SOFTWARE FOR PARALLEL PROGRAMMING 9

Parallel models, languages and compilers- dependence analysis of data arrays – Code optimization and scheduling – loop parallelization and pipelining – Parallel program development and environments - synchronization and multiprocessing models – message passing program development – mapping programs onto multicomputer.

MODULE V INSTRUCTION AND SYSTEM LEVEL PARALLELISM 9

Instruction level parallelism - compiler detected Instruction level parallelism - Trends in parallel system – Forms of parallelism – Parallel programming models and languages – Case studies

L – 45 ;Total Hours: 45

TEXT BOOKS:

1. M. Raghuwanshi, P. Borkar, R. H. Jhaveri, and R. Raut, Eds., “Parallel and high performance computing in artificial intelligence”, 1st ed. Boca Raton, FL, USA: Auerbach Publications, ISBN: 978-1032540870, 2025.
2. J. Ledin, “Modern computer architecture and organization”, 2nd ed. Birmingham, UK: Packt Publishing, ISBN: 978-1803234519, 2022.
3. J. L. Hennessy and D. A. Patterson, “Computer architecture: A quantitative approach”, 6th ed. San Francisco, CA, USA: Morgan Kaufmann, ISBN: 978-012-81190-51, 2019.

REFERENCES:

1. B. Goossens, “Guide to computer processor architecture: A RISC-V approach with high level synthesis”, 1st ed. Cham, Switzerland: Springer,ISBN: 978-3031180224, 2023.
2. R. Anand and R. S. Salaria, “Computer organization and architecture: Designing for performance”, 1st ed. New Delhi, India: Khanna Publishers, ISBN: 978-9392549380, 2023.
3. K. Hwang, “Advanced computer architecture: Parallelism, scalability, programmability”, 2nd ed. New York, NY, USA: McGraw-Hill Education, ISBN: 978-0071120614, 2010.

COURSE OUTCOMES:

CO1: Analyze different models of parallel computation and apply laws to assess performance gains.

CO2: Evaluate the modern hardware components on parallel system performance.

CO3: Compare various parallel and scalable architectures :SIMD, MIMD, and multiprocessors.

CO4: Implement parallel programs using shared and distributed memory models using

appropriate software tools and libraries.

CO5: Design instruction-level and system-level parallelism using pipelining, superscalar techniques, and advanced scheduling mechanisms.

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

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

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement:

The course builds a strong foundation in high-performance computing principles, enabling students to design and innovate parallel and scalable computing solutions that contribute to sustainable and resilient digital infrastructures.

CSFY 08	SOCIAL NETWORK ANALYSIS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand theoretical foundations and metrics of social networks.

COB2: To study network analysis tools and multivariate techniques for real-world data.

COB3: To detect and analyze communities and diffusion processes.

COB4: To leverage web analytics, NLP, and visual tools for online networks.

COB5: To explore real-world applications in business, healthcare, and online media.

MODULE I FOUNDATIONS OF SOCIAL NETWORK ANALYSIS 9

Introduction to Social Network Analysis (SNA): Concepts & Applications - History and Evolution of SNA - Basic Concepts: Nodes, Edges, Graph Types (directed/undirected, weighted/un weighted) - Sociometry and Sociograms - Matrices and Cliques (Adjacency, Incidence, and Affiliation).

MODULE II DATA HANDLING, ANALYSIS TECHNIQUES & MODELING 9

Data Management in SNA: Data formats, graph databases, cleaning, integration - Multivariate Techniques in SNA - Visualization of Networks: Gephi, Cytoscape, NetworkX - Introduction to ERGMs - SAOMs for Dynamic Network Modeling.

MODULE III EXTRACTION AND COMMUNITY MINING IN WEB SOCIAL NETWORKS 9

Evolution of Web Communities: Web archive analysis - Community Detection: Modularity, Louvain, Label Propagation, Walktrap - Evaluation Metrics: Conductance, Density, NMI - Multi-relational and Temporal/Dynamic Communities - Decentralized Social Networks, Blockchain-based OSNs - Applications: Marketing, Fraud Detection, Epidemics, Hate Speech Detection.

MODULE IV WEB AND SOCIAL MEDIA ANALYTICS 9

Web 2.0 and Social Media Data Characteristics - Social Media APIs and Data Collection (Twitter, Reddit) - Clickstream Analysis and A/B Testing - Web Crawling and Indexing - Micro-text and Short-form Content Analysis - Natural Language Processing for Social Media - Sentiment Analysis - Topic Modeling - Emotion Detection.

MODULE V APPLICATIONS AND ETHICS IN SOCIAL NETWORK ANALYSIS 9

Applications - Health Informatics - Misinformation and Fake News Detection - Social Influence & Information Diffusion - Recommendation Systems - Privacy in SNA - Anonymization, Differential Privacy, and Data Protection. Case Studies: COVID-19 Networks- Educational Discussion Graphs.

Total Hours: 45

TEXT BOOKS:

1. Song Yang, “Social Network Analysis in Action: Basic Methods and Applications”, University of Arkansas, Springer, Cham,1st edition, ISBN 978-3-031-66660-5, December 2024.
2. Dr. Gohar F. Khan, “Creating Value with Social Media Analytics”, Create Space Independent Publishing, 3rd edition.ISBN 978-1977543974, 2024.

REFERENCES:

1. Stephen P Borgatti, Martin G Everett, Jeffrey C Johnson, Filip Agneessens, “Analyzing Social Networks”, SAGE Publications, 3rd edition,ISBN 978-1529609165, February 22, 2024.
2. Jiang Wu, “Social Network Computing”, Springer - Nature New York Inc,1st edition, ISBN 978-981-9740-83-3, 2024.
3. Mehmet Kaya, Sleiman Alhajj, Kashfia Sailunaz, Min-Yuh Day, “Social Network Analysis and Mining Applications in Healthcare and Anomaly Detection”,Springer,1st edition,ISBN 978-3-031-75203-2, 2024.

COURSE OUTCOMES:

CO1: Analyze structural and dynamic properties of networks.

CO2: Interpret Stochastic Actor-Oriented Models for dynamic social network analysis.

CO3: Evaluate communities within large networks.

CO4: Apply SNA methods to real-world web and social media data.

CO5: Examine SNA applications in health, misinformation, and data privacy.

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	H	M	M	L	L	L			L		L		M	L
CO2	M	H	M	H	L	L	L	L					H	M
CO3	M	M	H	H	M	M						L	H	H
CO4	M	M	H	H	H	M		L		L			H	H
CO5	L	M	M	M	H	M		H			M		H	H

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement: The knowledge of social network analysis fosters the ability by applying community detection techniques in areas like social media analysis and fraud prevention thereby promoting safer, healthier, and more inclusive digital ecosystems.

CSFY 09	SECURITY ISSUES IN CLOUD COMPUTING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce students with the fundamentals and essentials of Cloud Computing.

COB2: To equip students with a solid foundation in Cloud Computing .

COB3: To provide students a risk management strategy in Cloud Computing .

COB4: To explore major cloud-driven commercial systems and applications.

COB5: To gain knowledge of advanced topics and research foundations in cloud computing.

MODULE I CLOUD COMPUTING ESSENTIALS 9

Cloud Computing Fundamentals- Definition- Evolution- Essential characteristics- Cloud Deployment Model-Cloud Service Models- Benefits-Cloud Architecture- Virtualization in Cloud- Cloud Data Centre- SLA - Cloud Applications.

MODULE II CLOUD SECURITY CHALLENGES 9

Cloud Security Challenges- Cloud Information Security Objectives- Cloud Security Services-Secure Cloud Software Requirements-Cloud Security Policy Implementation-Infrastructure Security-Data Security and Storage-Privacy in Cloud.

MODULE III RISK MANAGEMENT 9

Threats and Vulnerabilities to Infrastructure-Data, and Access Control-Risk Management and Risk Assessment in Cloud- Cloud Service Provider Risks-Virtualization Security Management in the Cloud-Trusted Cloud Computing-Identity Management and Access Control.

MODULE IV CLOUD SECURITY PLANNING 9

Cloud Computing and Business Continuity Planning-Disaster Recovery-Cloud Audit and Compliance: Internal Policy Compliance -Regulatory/External Compliance-Cloud Security Alliance.

MODULE V STANDARDS FOR SECURITY 9

Standards for Security: SAML OAuth-OpenID-SSL-TLS- Encrypting Data and Key Managemen-Creating a Cloud Security Strategy- The Future of Security in Cloud Computing.

Total Hours: 45

TEXT BOOKS:

1. Ronald L. Krutz, Russell Dean Vines, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, ISBN 978-1449300876, 2010.
2. Tim Mather, SubraKumaraswamy, and ShahedLatif, " Cloud Security and Privacy", O'Reilly Media, Inc.,ISBN: 9781449379513, 2009.

REFERENCES:

1. John R. Vacca, "Cloud Computing Security" ,CRC Press, ISBN: 9781315354927, 2016.
2. Kashif Munir, Mubarak S. Al-Mutairi and Lawan A. Mohammed, "Handbook of Research on Security Considerations in Cloud Computing", IGI Global, ISBN-13: 978-1466683877, 2015.

COURSE OUTCOMES:

CO1: Examine cloud computing models, benefits, and challenges.
CO2: Analyze data center trade-offs in power, efficiency, and cost.
CO3: Develop resource management concepts in cloud infrastructure.
CO4: Apply cloud programming models for scalable solutions.
CO5: Implement cloud computing principles, service, and deployment models.

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	PO10	PO11	PO12	PSO1	PSO2
CO1	H	L	L	M									H	
CO2	H	M	L			H		M					M	
CO3	H	H	M	M		M				H		L		H
CO4		M				H			M	H				M
CO5	L				M	M		M				H	L	

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

SDG 9: Industry, Innovation and Infrastructure – Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Statement: Learners will be able to create, design, develop, maintain, upgrade and continuously improve secure Infrastructure. Learners will be equipped to design and build secure infrastructures, contributing innovatively to the development of clean, efficient, and reliable technologies, aligned with the principles of sustainable development goals.

CSFY 10	IMAGE PROCESSING AND ANALYSIS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the fundamentals of digital images, visual perception, and mathematical tools.

COB2: To learn transformation techniques and spatial filtering for image enhancement.

COB3: To acquire knowledge of frequency domain filtering methods for image smoothing.

COB4: To extract key features of transformations, segmentation, and compression.

COB5: To impart restoration and reconstruction techniques in both spatial and frequency domains.

MODULE I DIGITAL IMAGE FUNDAMENTALS 9

Elements of Visual Perception - Light and the Electromagnetic Spectrum - Image Sensing and Acquisition - Image Sampling and Quantization - Some Basic Relationships between Pixels - Introduction Mathematical Tools and Techniques for Digital Image Processing.

MODULE II INTENSITY TRANSFORMATIONS AND SPATIAL FILTERING 9

Basic Intensity Transformation Functions - Histogram Processing. Fundamentals of Spatial Filtering - Smoothing Spatial Filters - Sharpening Spatial Filters - Combining Spatial Enhancement Methods - Fuzzy Techniques in Intensity Transformations and Spatial Filtering.

MODULE III FILTERING IN THE FREQUENCY DOMAIN 9

Sampling and Fourier analysis of Sampled Functions - Discrete Fourier Transform (DFT) of One Variable - Extension to Functions of Two Variables - Some Properties of the 2-D Discrete Fourier Transform - The Basics of Filtering in the Frequency Domain - Image Smoothing Using Frequency Domain Filters - Image Sharpening Using Frequency Domain Filters - Selective Filtering.

MODULE IV COLOR IMAGE PROCESSING 9

Color Fundamentals - Color Models - Pseudocolor Image Processing - Basics of Full-Color Image Processing - Color Transformations - Smoothing and Sharpening - Image Segmentation Based on Color - Noise in Color Images - Compression in color images.

MODULE V IMAGE RESTORATION AND RECONSTRUCTION 9

A Model of the Image Degradation/Restoration Process - Noise Models - Restoration in the Presence of Noise Only–Spatial Filtering - Periodic Noise Reduction by Frequency Domain Filtering - Linear, Position-Invariant Degradations.

Total Hours: 45

TEXT BOOKS:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, 4th edition, Pearson, ISBN 978-9353062989, 2022.
2. Milan Sonka, Vaclav Hlavac, and Roger Boyle, “Image Processing, Analysis, and Machine Vision, Cengage Engineering”, ISBN: 978-9386858146, 2017.
3. Anil K. Jain, “Fundamentals of Digital Image Processing”, Prentice Hall of India, ISBN-13: 978-8120309296, 2017.

REFERENCES:

1. Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong, Mathematics for Machine Learning, ISBN-13: 978-1108470049, 2020
2. Mark S. Nixon and Alberto S. Aguado, “Feature Extraction and Image Processing for Computer Vision, Newnes, ISBN-13: 978-0080506258, 2002.
3. Monson H. Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley & Sons, ISBN-13: 978-0471594314, 1996.

COURSE OUTCOMES:

CO1: Analyze digital image fundamentals including perception, sensing, and mathematical tools.

CO2: Apply intensity transformations and spatial filtering techniques for image enhancement.

CO3: Implement frequency domain filtering for image smoothing and sharpening.

CO4: Perform color image processing using color models, transformations, and segmentation techniques.

CO5: Apply image restoration techniques to reduce noise and reconstruct degraded images.

Board of Studies (BoS):
25th BOS of CSE held on 07.07.2025

Academic Council:
24th AC held on 26.08.2025

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

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement: Industry, Innovation and Infrastructure by equipping students with advanced skills in image analysis, computer vision, and artificial intelligence. These competencies foster innovation in domains such as healthcare imaging, smart surveillance, autonomous systems, environmental monitoring, and industrial automation, thereby contributing to sustainable industrial growth and technological advancement.

CSFY 11	ADVANCED FULL STACK DEVELOPMENT	L	T	P	C
SDG: 9	FOR FRONT-END	3	0	0	3

COURSE OBJECTIVES:

COB1: To learn the advanced concepts of the web framework development.

COB2: To enable new technologies by applying foundation Paradigms.

COB3: To acquire knowledge on Node.js , MongoDB for control functions in web pages.

COB4: To explore Angular JS and Single Page Application concept in web application.

COB5: To gain knowledge of web application development environment and tools.

MODULE I FRONT-END DEVELOPMENT ESSENTIALS 9

Introduction to Web Development - HTML5 structure - Semantic elements and multimedia in HTML5 -Forms and input types in HTML5 - CSS3 Basics: Selectors - Colors- Borders- Backgrounds - Introduction to Bootstrap and responsive design - Bootstrap Components and Utilities-JavaScript Basics: Variables- Data Types- Operators - JavaScript Functions- Loops and Conditions.

MODULE II FOUNDATION PARADIGMS 9

Introduction to Design Patterns in JS - DOM Manipulation with JavaScript- Introduction to jQuery and basic selectors - jQuery Mobile: Themes, Pages, Transitions - MVC and MVVM Pattern Overview - Object Modeling Concepts - Working with JSON data structure - JSON parsing and stringifying in JavaScript - AJAX – Basics and asynchronous communication - AJAX using jQuery - RESTful concepts using JSON & AJAX

MODULE III MEAN STACK - FRONTEND 9

Overview of MEAN Stack Architecture - Introduction to Node.js and NPM - Creating basic server using Node.js - ExpressJS Framework - Setup and Routing - Middleware in Express - Introduction to MongoDB and NoSQL Concepts - CRUD Operations in MongoDB - Connecting MongoDB with Node using Mongoose.

MODULE IV DATA EXCHANGE TECHNIQUES 9

ReactJS Basics - Directives and Expressions - AngularJS Controllers and Scope - AngularJS Services and Dependency Injection- Single Page Application (SPA) concept using AngularJS - Real-time communication with WebSocket - WebSocket Implementation in Node.js - Using Socket.io with Express - Real-world use cases: Chat, Notification, Multiplayer Apps**.**

MODULE V DEVELOPMENT ENVIRONMENT & TOOLS 9

Setting up development environment VS Code, Git Bash - Git & GitHub for version control - Branching, Merging, and Pull Requests -Task Runners: Gulp and Webpack Basics - Unit testing using Jasmine (Angular) - Testing in Node.js using Mocha and Chai - Deployment on cloud platforms (Heroku, Vercel, Netlify) -CI/CD basics with GitHub Actions.

Total Hours: 45

TEXT BOOKS:

1. Chong Lip Phang, “Mastering Front-End Web Development “, Amazon Digital Services, ISBN-13: 9798567640135, 2020.
2. Kyrnin, Jennifer, and Meloni, Julie, C, “HTML, CSS, and JavaScript All in One”, Pearson Education, ISBN-13: 9780135167076, 2018.

REFERENCES:

1. Ashok N Kamthane, “Computer Programming”,Pearson Education, 2nd Edition, India, ISBN 13: 9788131704370, 2012.

COURSE OUTCOMES:

CO1: Illustrate web page design using HTML, CSS and JavaScript functions.

CO2: Implement basic JavaScript for webpage development.

CO3: Design Code JQuery for DOM traversal, event handling and animation.

CO4: Develop the Bootstrap framework using the forms.

CO5: Analyse the views for the user and control the application workflow using ReactJS

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CO1	L	H	M	-	M	-	-	-	-	-	L	-	H	M
CO2	L	M	M	-	H	-	-	-	H	-	L	-	H	M
CO3	L	M	-	M	M	-	-	-	-	H	-	-	H	M
CO4	M	M	L	-	-	H	-	-	-		L	M	H	M
CO5	L	L	M	-	-	-	-	-	H	M	-	-	H	M

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement: Full stack developers must understand how to integrate front and back end systems by understanding the most commonly used software development and testing methodologies. New mobile app launches to drive action on Sustainable Development Goals.

CSFY 12	EMBEDDED PROGRAMMING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the principles of programming embedded systems.

COB2: To provide proficiency in Embedded C coding techniques.

COB3: To impart knowledge of RTOS services..

COB4: To gain the knowledge of the debugging tools and optimization techniques.

COB5: To learn with embedded software development skills.

MODULE I INTRODUCTION TO THE EMBEDDED PROGRAMMING 9

Embedded system overview - Embedded vs General purpose programming – Applications – Design and development process - Programming the microcontroller – Memory – I/O ports- Interrupts and Event Handling– Linker – Preprocessor – Downloading and Debugging – Communication Protocols on Microcontroller– Embedded toolchains (GCC, Keil, PlatformIO)

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MODULE II EMBEDDED C 9

C programming basics for Embedded Systems – Working with Microcontroller - Using libraries – Advanced C techniques for Embedded Systems – Manipulating bits and bytes - Concurrency and multithreading – Handling interrupts in C – Defensive programming techniques.

MODULE III RTOS CONCEPTS AND PROGRAMMING 9

Understanding Real-Time systems – Overview of RTOS - Tasks management and Scheduling – Intertask communication and synchronization - semaphores – message queues – kernel objects – RTOS services – selecting and porting a RTOS.

MODULE IV DEBUGGING AND OPTIMIZATION 9

Debugging tools and techniques – code profiling and analysis - memory and resource optimization – compiler optimization strategies – Field testing and validation – Security challenges in embedded systems.

MODULE V DEVELOPING EMBEDDED APPLICATIONS: A CASE STUDY **9**

Project specification and requirements – System design and Architecture - Prototyping and development – integrating and testing – deployment and field testing.

Total Hours: 45

TEXT BOOKS:

1. Larry Jones, “Embedded Systems Programming with C: Writing Code for Microcontrollers”, Walzone press, ISBN :9798227273208, 2025.
2. Stephen Qualline, Bare metal C : “Embedded Programming for the Real World”, No starch press, ISBN:1718501625, 9781718501621, 2022.
3. Qing Li and Caroline Yao, “Real-Time Concepts for Embedded Systems”, CMP books, ISBN : 9781482280821, 1482280825, 2003.

REFERENCES:

1. Rajkamal, "Embedded Systems Architecture, Programming and Design",3rd Edition, Tata McGraw-Hill,ISBN: 978-9332901490, 2017.
2. Michael Barr, Anthony Massa,” Programming Embedded Systems with C and GNU development tools”, 2nd edition, Oreilly,ISBN: 978-8184042627, 2007.
3. Michael Bass, “Programming Embedded Systems in C and C++”, Oreilly, ISBN-13: 9781565923546, 2003.

COURSE OUTCOMES:

CO1: Analyze the fundamentals of embedded software development.

CO2: Implement efficient Embedded C code to control peripherals.

CO3: Design RTOS concepts for multitasking in embedded environments.

CO4: Optimize embedded software using tools and simulators.

CO5: Develop interrupt-driven and real-time embedded applications to solve real-world problems.

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CO1	H	M	L	-	-	-	-	-	-	-	-	M	H	M
CO2	H	M	H	-	H	-	-	-	-	-	-	M	H	H
CO3	M	H	M	M	H	-	-	-	-	-	-	M	M	H
CO4	M	M	M	H	H	-	-	-	-	-	-	M	M	H
CO5	H	M	H	M	H	M	M		L	M	M	H	H	H

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement: Supports technological innovation and infrastructure through firmware development. To provide students with ability to design, program, debug, and optimize embedded systems, integrating real-time operating concepts and secure development practices to create innovative, reliable, and efficient solutions for real-world application

CSFY 13	ADVANCED GRAPH THEORY	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand strong theoretical foundation in graph-based modeling and algorithm design.

COB2: To study advanced graph-theoretic structures and optimization techniques relevant to computer science.

COB3: To explore algorithmic applications in domains such as compilers, networks, AI, and databases.

COB4: To interpret and analyze graph data from real-world systems using case studies.

COB5: To learn research in theoretical computer science and algorithm engineering.

MODULE I GRAPH FOUNDATIONS AND REPRESENTATIONS 9

Abstract graph models-Types of graphs- Graph representation in memory and data structures (adjacency list/matrix, edge list, compressed sparse row).- Graph isomorphism- automorphism- Graph invariants (degree, diameter, girth) - Applications in memory-efficient storage and graph databases.

MODULE II GRAPH TRAVERSALS AND CONNECTIVITY 9

DFS-BFS- Topological sorting- Strongly and weakly connected components- Articulation points and bridges- Applications in software dependency resolution and distributed systems- Network reliability.

MODULE III MATCHINGS, FLOW AND OPTIMIZATION 9

Maximum bipartite matching (Hopcroft-Karp-Stable marriage-Network flows using Ford-Fulkerson and Edmonds-Karp algorithm- Max-flow min-cut theorem - Applications in Compiler register allocation- Scheduling and Cloud task mapping.

MODULE V GRAPH COLORING AND PLANARITY 9

Chromatic number and polynomials- Greedy coloring- Register allocation-Planarity testing-Kuratowski's theorem-Graph embedding- Graph drawing algorithms- Use cases in circuit layout and VLSI routing.

MODULE V CASE STUDIES AND MODERN APPLICATIONS 9

Web and Social Networks: PageRank - Centrality - Community detection - Bioinformatics: Protein interaction and Gene regulatory networks - Security: Attack graphs and vulnerability propagation-Big Data: Graph algorithms using Apache Spark GraphX - Neo4j - NetworkX. Case Studies: Real-world graph analytics from GitHub - StackOverflow- COVID contact graphs.

Total Hours: 45

TEXT BOOKS:

1. R. Diestel, “Graph Theory”, 6th ed., Springer-Verlag, ISBN 978-3-662-70106-5, 2024.

REFERENCES:

1. J. Kottarathil, S. Naduvath, and J. V. Kureethara, “Graph Theory and Decomposition”, 1st edition, Boca Raton, FL, USA: Chapman & Hall/CRC, ISBN 978-1-032-48923-0, 2024
2. R. Diestel, Tangles,“A Structural Approach to Artificial Intelligence in the Empirical Sciences”, Cambridge, UK: Cambridge University Press, ISBN 978-1-00947-3316, 2024.
3. D. Easley and J. Kleinberg, “Networks, Crowds, and Markets: Reasoning About a Highly Connected World”, Cambridge, UK: Cambridge University Press, ISBN 978-0-521-19533-1, 2010.

COURSE OUTCOMES:

CO1: Analyze graph structures programmatically.

CO2: Apply traversal and connectivity techniques in software analysis and optimization.

CO3: Design and analyze algorithms for matching, flow, and optimization problems.

CO4: Solve real-world layout, allocation, and scheduling problems using graph coloring and planarity.

CO5: Develop graph-based models and tools to investigate complex systems in computing and data science

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CO1	H	H	-	-	M	-	-	L	-	-	L	-	H	H
CO2	H	H	M	-	-	-	-	M	-	L	-	-	M	M
CO3	H	M	H	M	L	-	M	-	L	-	-	-	M	-
CO4	H	M	H	L	L	-	-	-		-	L	-	M	M
CO5	H	M	H	M	L	-	L	M	L	-	-	L	M	-

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement: By providing students with graph-theoretical tools essential for designing innovative, efficient, and sustainable technological infrastructures in communication, transportation, and data networks.

CSFY 14	QUANTUM COMPUTING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To introduce the fundamental concepts of classical and quantum computation

COB2: To build a strong mathematical foundation using quantum mechanics concepts

COB3: To explore the quantum circuit model, qubits, quantum gates, and their role in quantum information processing.

COB4: To understand key quantum algorithms including Deutsch-Jozsa, Simon's, Shor's, and Grover's algorithms.

COB5: To learn computational complexity, error correction, and fault tolerance in quantum computing.

MODULE I FOUNDATION **9**

Traditional computing - Church-Turing thesis - Circuit model of computation - Reversible computation - Quantum physics - Quantum Physics and computation - Dirac notation - Hilbert spaces - Dual vectors – Operators - Spectral theorem - Functions of Operators - Tensor Products - Schmidt decomposition theorem.

MODULE II QUBITS AND QUANTUM MODEL OF COMPUTATION **9**

State of a quantum system – Time evolution of a Closed System – Composite systems – Measurement – mixed states and general quantum operations – Quantum circuit model – Quantum Gates – Universal sets of Quantum Gates – Unitary Transformations – Quantum Circuits.

MODULE III QUANTUM ALGORITHMS – I **9**

Superdense coding – Quantum Teleportation – Applications of teleportation – Probabilistic versus quantum algorithms – Phase kick-back – Deutsch algorithm – Deutsch- Jozsa algorithm – Simon's algorithm – Quantum phase estimation and Quantum Fourier Transform – Eigenvalue estimation.

MODULE IV QUANTUM ALGORITHMS – II 9

Order-finding problem – Eigenvalue estimation approach to order finding – Shor's algorithm for order finding –Finding discrete logarithms – Hidden subgroups – Grover's quantum search algorithm – Amplitude amplification – Quantum amplitude estimation – Quantum counting – Searching without knowing the success probability.

MODULE V QUANTUM COMPUTATIONAL COMPLEXITY AND ERROR CORRECTION 9

Computational complexity – Black-box model – Lower bounds for searching – General black-box lower bounds – Polynomial method – Block sensitivity – Adversary methods – Classical error correction – Classical three-bit code – Fault tolerance – Quantum error correction – Three and nine-qubit quantum codes – Fault-tolerant quantum computation.

L – 45 ;Total Hours: 45

TEXT BOOK:

1. Ray LaPierre, “An introduction to Quantum Computing”, Springer International Publisher, e-book, ISBN- 9783030693183, 303069318X,2021.

REFERENCES:

1. Eleanor G. Rieffel and Wolfgang H. Polak , “Quantum Computing: A Gentle Introduction” , MIT Press, ISBN-13: 978-0262526678, 2011.
2. Michael A. Nielsen and Isaac L. Chuang , “Quantum Computation and Quantum Information” , Cambridge University Press, 10th Edition, ISBN-13: 978-1107002173,2010 .

COURSE OUTCOMES:

CO1: Interpret the Theoretical Foundations of Quantum Computation.

CO2: Analyze Quantum States and Computation Models.

CO3: Apply Quantum Algorithms to Solve Problems.

CO4: Evaluate Quantum Computational Complexity.

CO5: Apprehend and Implement Quantum Error Correction.

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CO1	M				H				H					H
CO2		M	L		L		H						H	
CO3			M	H			H		M					M
CO4					H	M								
CO5		H						M	L				M	

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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

Statement: Students will gain expertise in the principles, models, algorithms, and error correction techniques of quantum computation, empowering them to design, analyze, and implement quantum solutions for solving complex real-world computational challenges.**"**

CSFY 15	STATISTICS FOR BUSINESS ANALYTICS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To elucidate the theoretical aspects of the 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 and implement effective forecasting Models.

MODULE I FOUNDATION 9

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

MODULE II ORGANIZATION STRUCTURES AND DESCRIPTIVE ANALYTICS 9

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

MODULE III PREDICTIVE ANALYTICS 9

Predictive Modeling– Logic-Driven Models- Time series forecasting -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 APPLIED BUSINESS ANALYTICS 9

Descriptive Analytics and Interpretation– Designing 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

TEXT BOOK:

1. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cenage Learning, 4th Edition, ISBN-13**:** 978-0-357-69584-7**,** 2023.

REFERENCES:

1. Marc J. Schniederjans Dara G. Schniederjans Christopher M. Starkey, “Business Analytics Principles, Concepts, and Applications”, Pearson Education Inc, ISBN-13: 978-0-13-355218-8,2014.
2. 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 different concepts 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.

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CO1	M	-	-	-	H	-	-	-	H	-	-	-	-	H
CO2	-	M	L	-	L	-	H	-	-	-	-	-	H	-
CO3	-	-	M	H	-	-	H	-	M	-	-	-	-	M
CO4	-	-	-	-	H	M	-	-	-	-	-	-	-	-
CO5	-	H	-	-	-	-	-	M	L	-	-	-	M	-

*** Legend: L – Low (1), M – Medium (2), H – High (3)**

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