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
(As approved by the 24th Academic Council)
August - 2025

M.Tech.
(Information Technology)

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. INFORMATION TECHNOLOGY

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 INFORMATION TECHNOLOGY

VISION AND MISSION

VISION

To be a leader in providing quality education and training in the field of Information Technology at Undergraduate and Postgraduate levels and undertake Research activities thereby contributing to the progress of the country.

MISSION

- To impart quality education and inculcate professionalism to suit the needs of the industries and society.
- To involve graduates in undertaking need based research activities and disseminate the knowledge to develop entrepreneurial skills
- To improve the professionalism through extension activities, industrial visits and in-plant training.
- To improve communicate effectively both in documentation and presentation.
    - To create awareness of social, economic responsibilities ethically.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

M. TECH. (INFORMATION TECHNOLOGY)

PROGRAMME EDUCATIONAL OBJECTIVES

The students will,

PEO1: Focus efficiently on need-based research in different domains related to Information Technology and carry out research projects of national and social relevance.

PEO2: Identify problems and solve them using IT tools and techniques to meet the industry/ societal needs for the sustainable development.

PEO3: Communicate effectively, exhibit team spirit, and leadership skills required for a successful professional career

PEO4: Demonstrate professional ethics, independent and life-long learning skills

PROGRAMME OUTCOMES

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

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report / document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: An ability to design, implement, and evaluate complex IT systems using advanced computing technologies, frameworks, and tools relevant to IT Industry.

PO5: An ability to innovate IT solutions responsibly by integrating ethical principles and understanding the societal, environmental, and legal implications of technology in a global context.

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)

S. No.	Name of the Department	Programmes offered
3.	Mechanical Engineering	M.Tech. (CAD/CAM)
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 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.

Sl. No.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
	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.
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.

Sl. No.	Programme	Eligibility for Admission in M.Tech. / MCA / M.Sc. / M.Com. / MA Programmes
	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 / 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 & TECHNOLOGY,

REGULATIONS 2025

CURRICULUM & SYLLABI FOR

M.TECH. INFORMATION TECHNOLOGY

SEMESTER I

S. No	Category	Course Code	Course Title	L	T	P	C
1	BS	MAF 6181	Algebraic Structures and Discrete Algorithms	3	1	0	4
2	PCC	ITF 6101	Advanced Data Structures and Algorithms	2	0	2	3
3	PCC	ITF 6102	Software Development Methodologies	3	0	0	3
4	PCC	ITF 6103	Software Development and Testing Laboratory	0	0	3	1
5	PCC	ITF 6104	AI and Data Science	3	0	2	4
6	PEC		Professional Elective I	3	0	0	3
			Credits				**18**

SEMESTER II

S.No	Category	Course Code	Course Title	L	T	P	C
1	ES	GEF 6201	Research Methodology and IPR for Engineers	2	0	0	2
2	PCC	ITF 6201	Advanced Software Testing	3	0	2	4
3	PCC	ITF 6202	Large Language Models	2	0	2	3
4	PCC	ITF 6203	Cloud Architecture and Computing	2	0	2	3
5	PEC		Professional Elective II				3
6	PEC		Professional Elective III				3
6	MP	ITF 6204	Mini Project	0	0	6	3
7	HS	ENF 6281	Professional Communication	0	0	2	1
			Credits				**22**

SEMESTER III

S.No	Category	Course Code	Course Title	L	T	P	C
1	OEC		Open Elective	3	0	0	3
2	PCC	ITF 7101	Explainable AI	2	0	2	3
3	PEC		Professional Elective IV				3
4	PEC		Professional Elective V				3
4	Internship	ITF 7102	Industry Internship	0	0	4	2
5	Project	ITF 7103	Project Work – Phase I	0	0	14	7*
6	MOOC		MOOC (Project-Aligned)				-
			Credits				**14**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PROJ	ITF 7103	Project Work (Phase II)	0	0	35	18
			Credits				**7 + 18 = 25**

Overall Total Credits – 79

* 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

SEMESTER I

S.No	Course Code	Course Title	L-T-P	Credits
1	ITFY 101	Modern Operating Systems	3-0-0	3
2	ITFY 102	Block chain and Smart Contracts	3-0-0	3
3	ITFY 103	Cyber Security and Ethical Hacking	3-0-0	3
4	ITFY 104	Machine Learning Tools and Techniques	2-0-2	3

SEMESTER II

S.No	Course Code	Course Title	L-T-P	Credits
1.	ITFY 201	IoT Architecture and Protocol	3-0-0	3
2.	ITFY 202	Secure Blockchain and Crypto-Economics	3-0-0	3
3.	ITFY 203	AI-Driven Cybersecurity	3-0-0	3
4.	ITFY 204	Deep Learning for Computer Vision	2-0-2	3
5.	ITFY 205	Applied Cryptography	3-0-0	3
6.	ITFY 206	Quantum Computing	3-0-0	3
7.	ITFY 207	Kubernetes and Containerization	2-0-2	3
8.	ITFY 208	Federated Learning and Privacy-Preserving AI	3-0-0	3
9.	ITFY 209	High-Performance Cloud Systems	3-0-0	3

SEMESTER III

S.No	Course Code	Course Title	L-T-P	Credits
1.	ITFY 110	Agentic AI	3-0-0	3
2.	ITFY 111	Cloud Security and Governance	3-0-0	3
3.	ITFY 112	Edge AI and Embedded ML	3-0-0	3
4.	ITFY 113	Zero Trust Architectures	3-0-0	3
5.	ITFY 114	AR/VR Development Frameworks	3-0-0	3
6.	ITFY 115	Scalable Microservices Architecture	3-0-0	3
7.	ITFY 116	Responsible AI and Fairness in ML	3-0-0	3
8.	ITFY 117	Advanced Reinforcement Learning	3-0-0	3
9.	ITFY 118	. Block chain for Enterprise Applications	3-0-0	3
10.	ITFY 119	Scrum Master	3-0-0	3

SEMESTER I

MAF 6181	**ALGEBRAIC STRUCTURES AND DISCRETE**	**L**	**T**	**P**	**C**
SDG: 4	**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
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.

ITF 6101	ADVANCED DATA STRUCTURES AND	L	T	P	C
SDG: 8	ALGORITHMS	2	0	2	3

COURSE OBJECTIVES:

COB1: Understand the concept of linear data structures with time and space complexities.

COB2: Understand the concepts of trees & hashing apply the same for applications.

COB3: Know the different sorting and heap algorithms.

COB4: Study the different graph structures algorithms for suitable applications.

COB5: Understand the concepts of NP hard and NP completeness.

MODULE I LINEAR DATA STRUCTURES AND ALGORITHM ANALYSIS **L: 7 Hrs**

The List ADT – Implementation of Lists- Applications of List-Linked List-The Stack ADT –Implementation of Stacks-Applications of Stack– The Queue ADT – Implementation of Queues– Applications of Queue- Algorithm Analysis, Time complexity – Case Study.

MODULE II NON LINEAR DATA SRUCTURES: TREES AND HASHING **L:8 Hrs**

Preliminaries – Binary Trees – Expression Trees - Tree Traversals - Binary Search Trees –Average case analysis- AVL Trees – B Tree – B+ Tree- Red-Black Trees – Application of trees- General idea of Hashing – Hash function – Separate Chaining – Hash Tables without Linked lists – Rehashing.

MODULE III SORTING AND HEAPS **L: 7 Hrs**

Insertion Sort – Shell Sort – worst case analysis of shell sort- Heap Sort - analysis– Merge Sort – analysis - Quick Sort – Analysis- External Sort- Binary Heap – Applications of Priority Queues – d-Heaps.

MODULE IV GRAPHS ALGORITHMS AND NP-COMPLETENESS **L: 8Hrs**

Representation of Graphs – Topological Sort – Shortest Path Algorithms – Analysis- Network Flow Problems – Minimum Spanning Tree – Analysis- Applications of Depth-First Search-Introduction to NP-Completeness-The Class NP-NP-Complete Problems- Dynamic Programming – Bellman – Ford, Greedy Algorithms.

LABORATORY SESSIONS **P: 30 Hrs**

List of Experiments

1. Implementation of List, Stack, Queue ADTs using array
2. Implementation of Singly Linked List.
3. Implementation of Stack & Queue ADT using Linked List.
4. Implementation of binary search trees.
5. Implementation of tree traversals.
6. Implementation of Hashing techniques
7. Implementation of different Sorting algorithms.
8. Implementation of basic heap operations.
9. Implementation of a Shortest path of a given graph using Dijkstra's algorithm
10. Implementation of a Spanning tree for a given graph using Prim's algorithm
11. Implementation of real-world applications using suitable data structures.

L – 30 P – 30; Total Hours:60

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Fourth Edition, Prentice-Hall, 2022.
2. Yashavant Kanetkar," Data Structures Through C", BPB, ISBN-13:978-9388511391, 2019.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4th Edition., Addison Wesley, 2014.

REFERENCES:

1. Narasimha Karumanchi, “Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles”, 5th Edition, Career Monk Publications, 2016.
2. R.S. Salaria, “Data Structures & Algorithms Using C”,Khanna Publishing, 5th edition, ISBN- 13:978- 9381068588, 2018.
3. Horowitz, Sahni, Anderson-Freed, “Fundamentals of Data Structures in C”, 2nd edition, Universities Press, 2008.

COURSE OUTCOMES:

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

CO1: Analyze and implement linear data structures algorithms for a given problem with minimum complexity.

CO2: Implement the concept of trees and hashing algorithms and perform average case analysis.

CO3: Implement the different sorting algorithms and perform average case analysis.

CO4: Analyze and develop algorithms using graph structures for suitable applications

CO5: Solve NP Complete problems efficiently.

Board of Studies (BoS):

20th BoS of IT held on 12.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	H	H	L	M	M
CO2	H	H	L	M	M
CO3	H	H	L	M	M
CO4	H	H	-	M	M
CO5	H	H	-	-	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.

The linear and nonlinear data structures are used to implement efficient algorithms for real world applications. The analysis of algorithms provides efficient methods for data storage & retrieval.

ITF 6102	SOFTWARE DEVELOPMENT METHODOLOGIES	L	T	P	C
SDG: 8		3	0	0	3

COURSE OBJECTIVES:

COB1: Understand various **software process models**, including traditional, unified, and agile, and how they guide the development lifecycle.

COB2: Gain the ability to perform **requirements analysis** using **Unified Modeling Language (UML)** and **object-oriented techniques** to define system behavior.

COB3: Learn key principles and practices of **software design**, including class, component, UI, and mobile app design for scalable system architecture.

COB4: Explore the **DevOps framework**, including its tools and methodologies for continuous integration, delivery, and deployment in modern development.

COB5:.Understand software **testing techniques** and the importance of **software process improvement** practices in ensuring software quality and sustainability.

MODULE I SOFTWARE PROCESS MODELS **9**

Software Life Span Models – Software Technologies – Software Models – Specialized Process Models – The Unified Process – Agile Development – Software Processes – Team Iterative Processes – Initial Development – Final Stages.

MODULE II SOFTWARE REQUIREMENTS ANALYSIS **9**

Unified Modeling Language – Object Oriented Analysis Process: Identifying Classes – Object Analysis: Classification – Identifying Object Relationships, Attributes and Methods.

MODULE III SOFTWARE DESIGN **9**

Designing Classes - Component-Level Design - User Interface Design - Wasp Design - Mobile App Design.

MODULE IV DEVOPS **9**

Introduction to DevOps - DevOps Framework - DevOps – Continuous Integration and Delivery - DevOps Continuous Deployment.

MODULE V SOFTWARE PROCESS IMPROVEMENT 9

Testing Conventional Applications – Testing Web Applications – Software Process Improvement – Emerging Trends in Software Engineering.

L – 45 ; TOTAL HOURS – 45

REFERENCES:

1. Roger S. Pressman, “Software Engineering” 9th edition, Mc Graw Hill Education, 2019.
2. Vaclav Rajlich, “The Software Engineering Current Practice”, CRC Press, 2012.
3. Ali Bahrami, "Object Oriented Systems Development", Tata McGraw-Hill, 2017.
4. Robert C. Martin First Edition Agile Software Development, Principles, Patterns, and Practices, 2024.
5. Lara Letaw, “Handbook of Software Engineering Methods - 2nd Edition”, 2024.

COURSE OUTCOMES:

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

CO1. Apply appropriate **software process models**, including agile and unified processes, for various software development scenarios.

CO2. Analyze software requirements using **Unified Modeling Language (UML)** and **object-oriented analysis** to model classes, objects, relationships, and methods.

CO3. Design robust software components, user interfaces, and mobile applications using **component-level** and **user-centric design principles**.

CO4. Explain the principles of **DevOps**, including continuous integration, delivery, and deployment, to support agile software delivery pipelines.

CO5. Evaluate the effectiveness of software testing techniques and assess **process improvement models** in the context of emerging trends in software engineering.

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

20th BoS of IT held on 12.06.2025

24th AC held on 26.08.2025

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	M	L	M	H	M
CO2:	M	M	M	H	L
CO3:	M	M	H	H	M
CO4:	M	L	M	H	H
CO5:	H	M	H	H	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 proper learning of the Software Development Methodologies leads to develop software for the business requirements and engineering problems and this will support the students to get employment.

ITF 6103	SOFTWARE DEVELOPMENT AND TESTING LABORATORY	L	T	P	C
SDG: 8		0	0	3	1

COURSE OBJECTIVES:

By the end of this lab course, students will:

COB 1. Understand and apply object-oriented system development methodologies for real-world software applications.

COB 2. Acquire skills to prepare software development documents including project planning, SRS, cost estimation, and design.

COB 3. Design and model software systems using object-oriented principles and implement data models effectively.

COB 4. Apply software testing principles to develop test cases, execute tests, and debug applications systematically.

COB 5. Develop a complete project report documenting the software development lifecycle with an emphasis on testing and quality assurance.

LABORATORY SESSIONS:

Application Domains:

1. Development of a **Health Insurance Management System**
2. Development of a **Mobile Recharge System**
3. Development of a **Tour Management System**
4. Development of a **Conference Management System**
5. Development of a **Recommender System**

For each of the above applications, students will perform the following software development lifecycle activities using Object-Oriented System Development Methodologies:

Software Engineering Activities:

1. **Project Planning :** Define scope, objectives, deliverables, and schedule for the selected application.
2. **Software Requirement Specification (SRS) :** Prepare use-case-based functional and non-functional requirements using UML.

3. **Software Cost Estimation :** Estimate development effort using models like COCOMO or Function Point Analysis.
4. **Object-Oriented Software Design:** Create class diagrams, sequence diagrams, and other OO design artifacts.
5. **Data Modeling and Implementation:** Design ER diagrams and implement databases using appropriate DBMS.
6. **Test Case Specification:** Define input, expected output, and execution conditions for testing.
7. **Software Testing:** Conduct functional and non-functional testing using white-box and black-box techniques.
8. **Software Debugging:** Identify and fix software errors during implementation and testing phases.
9. **Software Testing Report:** Document test results, defect logs, and coverage analysis.

P –45; Total Hours:45

TEXT BOOKS:

1. Paul Amman, Jeff Offutt George," Introduction to Software Testing ", 2024.

REFERENCES:

1. Mauro Pezze, Michael Young, "Software Testing and Analysis: Process, Principles, and Techniques, 2024.

COURSE OUTCOMES:

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

CO1. Apply object-oriented methodologies to design and plan real-time software projects like Health Insurance or Tour Management Systems.

CO2. Prepare software development documentation including SRS, cost estimation, and test case specifications aligned with industry practices.

CO3. Design object-oriented software architectures and implement data models using suitable tools and technologies.

CO4. Execute software testing using various strategies, debug the code, and generate detailed test reports.

CO5. Demonstrate the ability to deliver a fully tested software solution along with comprehensive documentation covering the entire SDLC.

Board of Studies (BoS) : 20th BoS of IT held on 12.06.2025

Academic Council: 24th AC held on 26.08.2025

CO \ PO	PO1	PO2	PO3	PO4	PO5
CO1	M	L	H	H	M
CO2	M	H	M	H	M
CO3	M	M	H	H	L
CO4	H	M	H	H	L
CO5	H	H	H	H	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 proper learning of the Software Development and testing laboratory leads to develop software for the business requirements and engineering problems and this will support the students to get employment.

ITF 6104	AI AND DATA SCIENCE	L	T	P	C
SDG: 8		3	0	2	4

COURSE OBJECTIVES: This course aims to enable the students to

COB1: Understand the Foundations of Artificial Intelligence (AI)

COB2: Apply Knowledge Representation and Reasoning Techniques

COB3: Use Python for Data Handling

COB4: Study the importance of data Cleaning, Transformation, and Time Series Analysis

COB5: Implement Visualization and Machine Learning Algorithms

MODULE I PROBLEM SOLVING/ SEARCHING TECHNIQUES L:9 P:6

Problems of AI, Intelligent Agents and Environment, state space search, production system, Problem solving agents, breadth first search, depth first search, depth limited search, bidirectional search, Greedy best -first search, A* search, AO* search, Hill climbing search, simulated annealing search.

MODULE II KNOWLEDGE REPRESENTATION AND REASONING FOR VARIOUS AI APPLICATIONS L:9 P:6

Probability and Bayes' Theorem, Certainty Factors and Rule-Base Systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic. AI for knowledge representation, rule-based knowledge representation, procedural and declarative knowledge, Applications: Expert Systems, Decision Support System, Generative AI in Natural Language Processing (NLP).

MODULE III PYTHON: DATA STRUCTURES, NUMPY AND PANDAS L:9 P:6

Data structures and sequence, Functions, Array and vectorization, NumPy ndarray, array oriented programming, file input and output with array, linear algebra, pandas data structures, Essential functionalities, summarization and computing statistics.

MODULE IV Data loading, cleaning and Time series L:9 P:6

Reading and writing text format, binary data formats, handling missing data, data transformation, string manipulation, hierarchical indexing, complaining and merging dataset, reshaping, pivoting, , data aggregation, pivot tables and cross tabulation, categorical data, basic of time series, data ranges, frequences and shifting, time zone handling, resampling and frequency conversion.

MODULE V VISUALIZATION AND MACHINE LEARNING ALGORITHMS L:9 P:6

Matplotlib, Seaborn, Distribution Plots, K-Nearest neighbor, Naïve bayes, simple and multiple linear regression, logistic regression, decision trees, Neural Networks.

L – 45; P – 30; Total Hours:75

LABORATORY SESSION P: 30 Hrs

Lab 1: Implement a state-space model for the Missionaries and Cannibals problem using Python. Apply BFS and DFS to find valid solutions.

Lab 2: Solve 8-puzzle or shortest path problems using A* and Greedy Best-First Search. Use Manhattan or Euclidean heuristics.

Lab 3: Implement Hill Climbing and Simulated Annealing for N-Queens or optimization problems (e.g., Maximize a function).

Lab 4: Implement a simple Bayesian reasoning problem (e.g., spam filter or weather prediction).

Lab 5: Create a fuzzy inference system for temperature control using skfuzzy library.

Lab 6: Create and manipulate arrays, perform linear algebra operations, and vectorized calculations.

Lab 7: Load CSV, explore datasets, summarize, filter, and compute basic statistics.

Lab 8: Read from CSV, handle missing values, and perform transformation (rename, drop, replace, fill).

Lab 9: Create and manipulate time-indexed data, resample data, frequency conversion, handle time zones.

Lab 10: Implement classification on a dataset (e.g., Iris or Titanic) using K-NN and Naïve Bayes.

Lab 11: Implement simple and multiple linear regression models and evaluate performance.

TEXT BOOKS:

1. Stuart J. Russell, Peter Norvig - Artificial Intelligence_ A Modern Approach, 4th Edition, Pearson Education Limited 2022.
2. Joel Grus," Data Science from Scratch: First Principles with Python, Second Edition.O'Reilly,2019
3. Charles R. Severance, "Python for Everybody Exploring Data Using Python",Charles Severance, 2016.

REFERENCES:

1. Alvaro Fuentes, Become a Python Data Analyst – By Packt Publishing (2018)
2. Introduction to Machine Learning with Python by Andreas C. Müller and Sarah Guido(2016)

COURSE OUTCOMES: Upon completion of this course, students will be able to

CO1: Apply AI concepts and search strategies to solve real-world problems using appropriate problem-solving agents and search algorithms.

CO2: Demonstrate the ability to represent and reason with knowledge using rule-based systems, logic programming, fuzzy logic, and probabilistic models such as Bayesian networks for AI applications.

CO3: Develop Python programs using core data structures and libraries like NumPy and Pandas for performing numerical and statistical analysis.

CO4: Manipulate structured and time series data by loading, cleaning, transforming, and aggregating datasets using Python tools.

CO5: Visualize data and implement fundamental machine learning algorithms including K-NN, Naïve Bayes, regression models, decision trees, and neural networks to solve classification and prediction problems.

Board of Studies (BoS):

20th BoS of IT held on 12.06.2025

Academic Council:

24th AC held on 26.08.2025

CO \ PO	PO1	PO2	PO3	PO4	PO5
CO1	M	L	H	H	M
CO2	H	M	H	H	M
CO3	M	M	H	H	L
CO4	M	M	H	H	L
CO5	H	H	H	H	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 Ai and Data science helps to design and develop solutions for solving real world application in any engineering domain.

SEMESTER II

GEF 6201	RESEARCH METHODOLOGY AND IPR FOR	L	T	P	C
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.

ITF 6201	ADVANCED SOFTWARE TESTING	L	T	P	C
SDG: 9		3	0	2	4

COURSE OBJECTIVES:

COB1: Apply advanced testing strategies and methodologies.

COB2: Use tools for automated and performance testing.

COB3: Design and implement complex test cases and frameworks.

COB4: Understand security and mobile application testing techniques.

COB5: Integrate testing into DevOps and Agile workflows.

MODULE I ADVANCED TESTING STRATEGIES L: 9 Hrs

Risk-based testing – Test estimation and planning – Exploratory and Ad-hoc testing – Mutation testing – Test metrics and measurements – Traceability matrix and defect lifecycle.

MODULE II TEST AUTOMATION AND FRAMEWORKS L:9 Hrs

Principles of test automation – Automation tools: Selenium, TestNG, Junit – Designing test automation frameworks – Data-driven, keyword-driven, and hybrid frameworks – CI/CD pipeline integration using Jenkins/GitHub Actions.

MODULE III PERFORMANCE AND LOAD TESTING L: 9 Hrs

Concepts of performance, load, and stress testing – Tools: Apache JMeter, LoadRunner – Bottleneck detection and optimization – Interpreting test results and generating reports – Scalability and endurance testing

MODULE IV SECURITY AND MOBILE TESTING L: 9 Hrs

Security testing principles – OWASP Top 10 vulnerabilities – Static and dynamic analysis tools (e.g., SonarQube, Burp Suite) – Mobile app testing strategies (Android/iOS) – Mobile testing tools: Appium, Espresso

MODULE V AGILE, DEVOPS & EMERGING TRENDS IN TESTING L: 9 Hrs

Agile testing principles (SCRUM, TDD, BDD) – DevOps and continuous testing – Testing in microservices and containerized environments – TestOps and AI in testing – Future trends: Shift-left/Shift-right testing, AIOps

LABORATORY SESSIONS

1. **Experiment 1: Risk-Based Testing Analysis**
    - Use a sample software spec to identify and categorize risk areas.
    - Prepare a risk matrix and test priority list.
2. **Experiment 2: Defect Lifecycle and Bug Reporting**
    - Simulate defects in a demo application.
    - Report and track bugs using **Bugzilla / Jira**.
3. **Experiment 3: Mutation Testing with PIT or MuJava**
    - Write unit tests and apply mutation testing.
    - Analyze surviving mutants and improve test quality.
4. **Experiment 4: Selenium WebDriver - Basic UI Test Automation**
    - Automate login and form submission on a sample web application.
5. **Experiment 5: Selenium TestNG Framework Integration**
    - Create reusable test suites using TestNG annotations and XML configurations.
6. **Experiment 6: Data-Driven Framework Implementation**
    - Design a data-driven test for user registration using Excel or CSV.
7. **Experiment 7: Load Testing Using Apache JMeter**
    - Record and simulate multiple users accessing a website.
    - Generate reports for response time, error %, and throughput.
8. **Experiment 8: Stress Testing and Bottleneck Analysis**
    - Configure JMeter to increase load gradually.
    - Analyze performance degradation and suggest optimization.
9. **Experiment 9: Integration with CI/CD**
    - Run Selenium or JMeter test scripts in Jenkins.
    - Generate test reports in the CI pipeline.
10. **Experiment 10: Static Code Analysis Using SonarQube**

- Scan Java or Python project code for vulnerabilities and code smells.

11. **Experiment 11: Web Application Vulnerability Testing**

- Use **OWASP ZAP** or **Burp Suite** to identify security flaws in a demo app.

12. **Experiment 12: Mobile Application Testing Using Appium**
- Automate tests for a simple Android app (e.g., calculator or to-do app).

13. **Experiment 13: Behavior-Driven Testing with Cucumber**
- Write feature files and automate them using Gherkin syntax and Selenium.

14. **Experiment 14: Test Case Management using TestLink or Zephyr**
- Create test plans, test cases, and execution reports for a sample project.

15. **Experiment 15: Shift-Left Testing Simulation**
- Integrate testing at requirement or design phase using mockups or user stories.

Tools Required

- Selenium WebDriver
- TestNG, JUnit, Cucumber
- Apache JMeter
- Appium, Android Emulator
- OWASP ZAP / Burp Suite
- SonarQube, Jenkins, GitHub
- Jira / Bugzilla / TestLink

L – 45 P – 30; Total Hours:75

REFERENCES:

1. *Software Testing: Principles and Practices,* Srinivasan Desikan & Gopalaswamy Ramesh*,* **Publisher***:* Pearson Education*, 2006*
2. Foundations of Software Testing: ISTQB Certification, Dorothy Graham | Rex Black | Erik van Veenendaal, 5th edition, 2024.
3. *Software Testing A Craftsman's Approach, Paul C Joregensen and Byron DeVries, 5th edition,* **Publisher***: CRC Press, 2021.*

COURSE OUTCOMES:

Upon completion of this course, students will be able to

CO1: Apply advanced testing strategies including risk-based, mutation, exploratory, and ad-hoc techniques to ensure high software quality and traceability across the development lifecycle.

CO2: Design and implement automated test frameworks using tools such as Selenium, TestNG, and JUnit, and integrate them into CI/CD pipelines for continuous testing.

CO3: Conduct performance, load, and stress testing using industry-standard tools like Apache JMeter and LoadRunner, and interpret results to optimize system performance

CO4: Perform security testing by identifying vulnerabilities using OWASP Top 10 principles and tools like Burp Suite and SonarQube, and apply mobile testing strategies with Appium/Espresso.

CO5: Demonstrate testing practices in Agile and DevOps environments, including TDD, BDD, microservices, and containerized applications, and evaluate emerging trends such as AI in testing and TestOps.

Board of Studies (BoS):
20th BoS of IT held on 12.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	2	1
CO2	3	3	3	2	3
CO3	3	3	3	3	2
CO4	3	2	3	3	2
CO5	3	3	3	2	3

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

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

The Advanced Software Testing course directly contributes to this goal by emphasizing quality, reliability, and innovation in digital systems which are now foundational to modern infrastructure and industry.

ITF 6202	LARGE LANGUAGE MODELS	L	T	P	C
SDG: 9		2	0	2	3

COURSE OBJECTIVES:

COB1: Understand the concepts of encoder, decoder and language modelling in LLM.

COB2: **Explain**the neural network architecture and word embeddings.

COB3: Describe the neural language models and self attention mechanisms.

COB4: Discuss the importance ofpretraining and fine-tuning stages in large language models.

COB5: Explore the advanced concepts in augmented and responsible language models.

MODULE I INTRODUCTION TO LANGUAGE MODELLING L:7

Language Model - Language modelling technologies – LLM emergence – Encoder and decoder in LLM development – NLP pipeline – Morphology – Tokenisation – Syntactics – Semantics – Language modelling fundamentals.

MODULE II NEURAL NETWORKS AND WORD EMBEDDING L: 8

Neural networks – Perceptron – Multilayer Perceptron – Training neural networks – Word embedding – Distribution hypothesis - Bias in word embedding – Limitations and Applications.

MODULE III TRANSFORMER AND LANGUAGE MODELS L: 8

Neural language models – CNN – RNN – sequence to sequence – attention mechanisms – Transformers – Self Attention – Transformer encoder and decoder – Positional embeddings– Language model pretraining – Pretraining to fine tuning in LLM.

MODULE IV AUGMENTED AND MULTIMODAL LLM L: 7

Augmented LLM – Retreival Augmented Generation – LLM Augmentation with agents – Multilingual language models – multimodal language models – challenges and limitations

of multilingual and multimodal LLM – responsible LLM – Hallucination - emerging trends in Language Models.

LABORATORY SESSIONS **P : 30**

1. Study of T5, BART and Transformer models.
2. Use an encoder only model (BERT) and handle the input sentences.
3. Use the encoder – decoder model for text summarization.
4. Predicting the next word with NLTK or GPT.
5. Train a Word2Vec model on a small text corpus and visualize the embedding.
6. Prediction of the next word using RNN / LSTM language model.
7. Use PyTorch/TensorFlow to build a Transformer and train on a small translational dataset.
8. Using a pre trained model like BERT, perform sentiment analysis or question answering.
9. Generate one modality (e.g., image) from another (e.g., text) using transformers and diffusers.
10. Build a simple RAG pipeline to retrieve context from a document and generate an answer.

L – 30;P – 30; Total Hours:60

TEXT BOOKS:

1. Dr. Tanmoy Chakraborty, “Introduction to Large Language Models”, 1st edition, Wiley India, 2024.
2. Sebastian Raschka, “Build a Large Language Model”, Manning Publications, 2024.

REFERENCES:

1. AmanKharwal, “From ML Algorithms to GenAI& LLMs: Master ML Algorithms and Generative AI & LLMs with Python from Scratch!”, 2nd edition, Bluerose Publishers, 2024.
2. Louis-Francois Bouchard, Louie Peters “Building LLMs for Production”, Towards AI, O’Reilly, 2024.

COURSE OUTCOMES: Upon completion of this course, students will be able to

CO1: Explain the Language modelling technologies and NLP pipeline.

CO2: Apply the distributional hypothesis in context of word similarity and semantic analysis.

CO3: Explore transformer-based models for text classification, translation, and summarization.

CO4: Train and fine-tune pretrained transformer models (e.g., BERT, GPT) s using Hugging Face Transformers.

CO5: Evaluate ethical, social, and technical implications of LLM deployment in real-world scenarios.

Board of Studies (BoS):
20th BoS of IT held on 12.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	H	M	-	L	M
CO2	M	H	M	L	-
CO3	M	H	L	-	L
CO4	M	M	L	-	-
CO5	M	M	L	L	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:

LLM supports the development of smart, scalable, and adaptive systems. AI-assisted design tools enable small-scale industries and startups to rapidly prototype and innovate at lower costs.

ITF 6203	CLOUD ARCHITECTURE AND COMPUTING	L	T	P	C
SDG: 9		2	0	2	3

COURSE OBJECTIVES:

COB1: To explore cloud architecture and management for gaining knowledge of cloud infrastructure components and network connectivity.

COB2: To analyze cloud Application Development Environments (ADEs)for application development environments, methodologies, and platforms.

COB3: To learn how networking, storage, and virtualization services interact to support efficient.

COB4: To expose Open-Source tools for research and distributed computing for studying the role of open-source solutions and research-based cloud management.

COB5: To develop the ability to deploy and evaluate **t**he importance of audit mechanisms and ensuring data integrity and privacy.

MODULE I Cloud Computing Fundamental, Architecture and Management **L: 7 Hrs**

Cloud Computing Fundamentals – Motivation for Cloud Computing – The need for Cloud Computing – Cloud Computing Architecture and Management – Introduction – Network connectivity in Cloud Computing – Managing Cloud – Migrating Application to Cloud – Cloud Deployment Models – Service Models.

MODULE II Operating System and Virtualization **L:8 Hrs**

Types of Operating Systems – Role of OS in Cloud Computing – Features of Cloud OS. Application Environment – Need for Effective ADE – Application Development Methodologies – Cloud Application Development Platforms and Cloud Computing API's – Virtualization – Introduction – Opportunities – Approaches to Virtualization – Hypervisors – Virtualization to Cloud Computing.

MODULE III Software Development in Cloud and Networking **L: 8 Hrs**

Introduction - Different Perspectives on SaaS Development - New Challenges – Cloud Aware Software Development Using PaaS Technology - Networking for Cloud Computing: Introduction – Overview of Data Center Environment – Networking Issues in Data Centers – Transport Layer Issues in DCNs.

MODULE IV Open-Source Support and Security **L: 7 Hrs**

Open-Source Support for Cloud – Introduction - Open Source Tools for all Service Models – Distributed Computing Tools – Security in Cloud Computing: Introduction - Security Aspects – Platform-Related Security: Security issues in Cloud Service Models, SaaS, PaaS, IaaS security issues – Audit and Compliance - Disaster Recovery, Privacy and Integrity.

LABORATORY SESSIONS **P: 30 Hrs**

Lab 1: Install Virtualbox /VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.

Lab 2: Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.

Lab 3: Install Google App Engine. Create hello world app and other simple web applications using python/java.

Lab 4: Use Setting up a Private Cloud using OpenStack

Lab 5: Kubernets Basics with Minikube

Lab 6: Find a procedure to transfer the files from one virtual machine to another virtual machine.

Lab 7: Cloud Deployment using Terraform

Lab 8: Creating and Executing Your First Container Using Docker.

Lab 9: Run a Container from Docker Hub.

L – 30 P – 30; Total Hours: 60

TEXT BOOKS:

1. Cloud Computing: Principles and Paradigms,Rajkumar Buyya, James Broberg, Andrzej Goscinski, 2nd Edition, 2023.
2. Cloud Computing: Concepts and Technologies, Thomas Erl, Zaigham Mahmood, Ricardo Puttini, 2021 Edition.

REFERENCES:

1. Cloud Security Handbook: Find Out How to Effectively Secure Cloud Environments Using AWS, Azure, and GCP, Eyal Estrin, Packt Publishing, 1st Edition, 2022.
2. OpenStack for Architects, Ben Silverman & Michael Solberg, Packt Publishing , 2nd Edition, 2020.
3. Cloud Native Security, Chris Binnie, Wiley (John Wiley & Sons), 1st Edition,2021

COURSE OUTCOMES:

CO1: Understand and Illustrate the architecture of cloud systems, including essential components and network configurations.

CO2: Demonstrate an understanding of hypervisors (e.g., VMware, Hyper-V, KVM) and how they support virtual machine management.

CO3: Develop cloud-aware applications using PaaS technologies and understand their benefits for agile and scalable software delivery.

CO4: Apply open-source tools for distributed computing and research to manage and simulate cloud infrastructures.

CO5: Evaluate strategies for audit, compliance, and disaster recovery in cloud environments, and ensure the privacy and integrity of user data.

Board of Studies (BoS):
20th BoS of IT held on 12.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2
CO2	3	3	3	2	2
CO3	2	3	3	2	2
CO4	3	2	2	2	2
CO5	2	2	3	2	2

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

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

- Promotes resilient infrastructure and innovation by encouraging the use of open-source cloud platforms and secure, scalable technologies for digital transformation.
- Encourages partnerships in the technology sector through the use and contribution to open-source platforms and collaborative cloud development projects.

ITF 6204	MINI PROJECT	L	T	P	C
SDG: 9		0	0	6	3

COURSE OBJECTIVES:

COB1: To develop students' competency in the design, development, and evaluation of computational and information technology solutions.

COB2: To enable students to identify, analyze, and solve real-world IT problems through systematic literature review and the application of appropriate tools, algorithms, and methodologies.

Students can select **minor issues in the Information Technology domain or IT enabled Interdisciplinary domain** for their mini project. The work may include:

- **Algorithm Design and Optimization** – Designing new algorithms or improving existing algorithms to enhance efficiency, accuracy, or scalability.
- **Software and Web Application Development** – Designing, developing, and deploying software systems or web-based applications to address practical IT problems.
- **Data Exploration, Analysis, and Visualization** – Collecting, cleaning, exploring, and analyzing datasets to extract meaningful insights and support decision-making.
- **Machine Learning and Intelligent Systems** – Implementing, experimenting with, and evaluating machine learning models or intelligent systems for prediction, classification, or automation tasks.
- **Security, Privacy, and Risk Analysis** – Analyzing system vulnerabilities, data privacy issues, and security risks, and proposing suitable protection or mitigation mechanisms.
- **Application of Tools, Platforms, and Frameworks** – Applying existing tools, platforms, APIs, and frameworks to develop efficient solutions for real-world IT challenges.

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1 Identify and analyze relevant problems in the Information Technology or IT-enabled interdisciplinary domain by understanding system requirements and constraints.

CO2 Design, implement, test, and evaluate an IT solution using appropriate frameworks, and tools to address the identified problem effectively.

CO3 Communicate project outcomes effectively technical documentation, and professional presentations.

Board of Studies (BoS):
20th BoS of IT held on 12.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	3	1
CO2	2	1	3	3	1
CO3	1	3	2	1	2

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

SDG 9 – Industry, Innovation and Infrastructure

Software development, AI & data-driven systems, Cloud computing and networking, Secure and scalable IT infrastructure Promotes **innovation**, **digital infrastructure**, and **technological advancement.**

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:

4. Bovee, C. L., & Thill, J. V. *Business Communication Today* (14th ed.). Pearson, 2021.
5. 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.
6. Guffey, M. E., & Loewy, D. *Essentials of Business Communication* (11th ed.). Cengage Learning, 2020.
7. 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.
8. 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.
9. Krizan, A. C., Merrier, P., Logan, J., & Williams, K. *Business Communication* (9th ed.). Cengage Learning, 2016.
10. 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.
11. Madlock, P. E. The link between leadership style, communicator competence, and employee satisfaction. *Journal of Business Communication*, 45(1), 2008, 61–78.
12. Raman, M., & Sharma, S. Technical communication: Principles and practice (3rd ed.). Oxford University Press, 2015.
13. 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

	PO1	PO2	PO3	PO4	PO5
CO1					
CO2					
CO3					
CO4					
CO5					

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: 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.

PROFESSIONAL ELECTIVES

ITFY 101	MODERN OPERATING SYSTEMS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: Understand the system calls and operating system structure of modern OS.

COB2: Discuss about the process states and various scheduling techniques.

COB3: Explore the concepts of memory management and file systems.

COB4: Examine deadlocks with one or multiple resources and modern virtualization technique.

COB5: Study about trusted computing bases and secure systems for controlled access.

MODULE I INTRODUCTION L: 9

Operating system as resource manager- Mainframe OS– Server OS – Smart phone OS- Real time OS- Smart card OS –System Calls - Process, File and Directory management- Structure of OS – Monolithic, Layered, Microkernels, Client server models, Virtual Machines.

MODULE II PROCESSES AND SYNCHRONIZATION L: 9

Process model – process creation and termination – process hierarchy and states – thread usage- race conditions- critical regions- mutual exclusion- semaphores- Scheduling – scheduling in batch systems – scheduling in interactive systems and real time systems.

MODULE III MEMORY MANAGEMENT AND FILE SYSTEMS L: 10

Memory abstraction – virtual memory – page replacement algorithms – design issues for paging systems – pure segmentation – segmentation with paging- files and directories – file system management and optimization – UNIX V7 file system.

MODULE IV DEADLOCKS AND VIRTUALIZATION L: 9

Resources and resource deadlocks – deadlock detection and recovery with one resource and multiple resources – deadlock avoidance – bankers algorithm for single and multiple resources – Hypervisors – Microkernels – virtual machines on multicore CPU – virtual machine migration- VMWare Case study.

MODULE V OPERATING SYSTMES SECURITY L: 8

Basics of OS security – CIA security triad – trusted computing base – attackers – building secure systems- controlling access to resources – formal models of secure systems – operating system hardening – Case study – Process, Memory management, file systems and security in Linux.

L – 45; Total Hours:45

TEXT BOOKS:

1. Andrew S. Tanenbaum and Herbert Bos, “Modern Operating Systems”, 5th edition, Pearson Education, 2023.
2. Abraham Silberschatz, Peter B. Galvin and Greg Gagn, “Operating System Concepts”, 10th edition, John Wiley & Sons.,2018.

REFERENCES:

1. William Stallings, “Operating Systems: Internals and Design Principles”, 9th edition, Pearson education, 2018.
2. Brian Ward, “How Linux Works: What Every Superuser Should Know”, 3rd edition, No Starch Press, 2024
3. Thomas Anderson and Michael Dahlin, “Operating Systems: Principles and Practice”, 2nd edition, Recursive books, 2014.
4. Christine Bresnahan and Richard Blum “Linux Essentials”, 2nd edition, Wiley / Sybex, 2020.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Describe the various types of operating systems and their structure.

CO2: Illustrate the different states of a process and scheduling in batch, interactive and real time systems.

CO3: Describe the memory abstraction and structure of files in modern operating systems.

CO4: Evaluate the design of virtual machines on multicore CPU with a real world case study.

CO5: Assess a case study involving Linux OS security to understand real-world implementation challenges and solutions.

Board of Studies (BoS):
20th BoS of IT held on 12.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	M	M	L	-	M
CO2	M	M	-	-	L
CO3	M	H	M	L	M
CO4	H	M	M	L	L
CO5	H	M	M	L	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:
Modern Operating Systems discusses process management, memory management, fault tolerance, and virtualization—all foundational to building robust, fault-resilient computing systems and secure OS environments critical to sustainable development and disaster resilience.

ITFY 102	BLOCKCHAIN AND SMART	L	T	P	C
SDG: 4	CONTRACTS	3	0	0	3

COURSE OBJECTIVES:

COB1: Learn how blockchain works

COB2: Understand about cryptographic hash functions and consensus algorithms.

COB3: Gain the knowledge about bitcoin and other cryptocurrencies

COB4: Understand about smart contract and ethereum

COB5: Learn different technologies to implement the real time applications of blockchain.

MODULE I INTRODUCTION TO BLOCKCHAIN L: 9Hrs

New technological paradigm - Security and privacy – Cryptography–-blockchain categories-Blockchain Architecture-working of Block chain – Distributed Ledgers-Creating a Block- Adding Transactions-Compiling the Ledger – Time stamp and Block ID – Linking Blocks together.

MODULE II CRYPTOGRAPHIC HASH FUNCTIONS L:8Hrs

Working of block chain hashing- Cryptographic hash functions – Consensus – Consensus algorithms-High level overview of hashing in proof of work- Proof of stake – other consensus mechanisms.

MODULE III BITCOIN AND CRYPTOCURRENCIES L: 8Hrs

Mining a Bitcoin block by hand- Bitcoin history – story of Satoshi – Bitcoin Scalability problem – wait times –restricted block size-Alternative Coins - Bitcoin Limitations-Litecoin – Privacy coins, Name Coin – Prime Coin – Zcash-Bitcoin Smart Contracts.

MODULE IV SMART CONTRACT AND ETHEREUM L: 11Hrs

Ricardian contracts-Smart contract templates-Smart Oracles-Deploying smart contracts on a blockchain- Ethereum and its features- Ethereum Architecture: Ethereum Virtual Machine (EVM) -The Ethereum Network –Runtime Byte Code-

Blocks and Blockchain-Ethereum Programming Languages-Smart Contracts Development; Ethereum Scaling Solutions-Ethereum DApps and Use Cases-Ethereum Community and Ecosystem

MODULE V BLOCKCHAIN TECHNOLOGIES AND APPLICATIONS **L: 9Hrs**

Web3 – Web3 concepts and Architecture- Benefits and Features of Web3- Web3 Development Tools and Frameworks –Hyperledger Projects and Frameworks - Hyperledger Fabric, Hyperledger Sawtooth, Hyperledger Indy, Hyperledger Iroha, Hyperledger Besu- Hyperledger Tools-IOTA – Ripple- Governments and block chain- Applications: finance, Governance, crowdfunding, Insurance.

L – 45; Total Hours:45

TEXT BOOKS:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.
2. Alan T.Norman, “block chain Technology Explained – The Ultimate Beginner’s Gide”,Create Space Independent Publishing Platform, 2017.

REFERENCES:

1. Kumar Saurabh , Ashutosh Saxena, ”Blockchain Technology: Concepts and Applications”, Wiley; First Edition, ISBN-13 : 978-8126557660, 2020.
2. Antony Lewis. ‘The Basics of Bitcoins and Block chains: An introduction to Cryptocurrencies and the Technology that Powers Them”, two rivers distribution publishers, 2019.
3. Alex Leverington, “Ethereum Programming”, Packt Publishing, 2017.
4. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.

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

CO1 Explain the components and working of of Blockchain.

CO2	Discuss about cryptographic hash functions and consensus algorithms.
CO3	Explain the significance of digital currencies like bitcoin.
CO4	Apply knowledge of implementations of smart contract using Ethereum to develop solutions in the appropriate domains.
CO5	Discuss about the various block chain technologies for implementing real world applications.

Board of Studies (BoS):
20th BoS of IT held on 12.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	H	M	-	-	-
CO2	H	M	-	-	-
CO3	H	H	-	-	-
CO4	H	H	L	M	M
CO5	H	H	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.

Understanding the concept of block chain Technology, smart contract and its applications and analyzing the significance of it enable both the genders to get a quality education and promote their lifelong learning opportunities in the fast growing internet field.

ITFY 103	CYBER SECURITY AND ETHICAL HACKING	L	T	P	C
SDG: 9 & 16		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the types of cyber threats, vulnerabilities, and security mechanisms and respond to them effectively in real-world IT systems.

COB2: To learn how cryptographic methods and access control mechanisms protect data and communications in secure systems.

COB3: To explore how to ethically gather information and scan systems using tools and techniques used by professional ethical hackers.

COB4: To gain knowledge in identifying system weaknesses and simulating attacks in a controlled environment to better understand how real-world exploits work.

COB5: To analyze the security risks in web, mobile, and wireless systems and apply best practices to secure them against threats.

PREREQUISITE COURSES:

Data Structures and Algorithms, Computer Networks, Operating System

MODULE I CYBER SECURITY FUNDAMENTALS L:9 T:0 P:0

Introduction to Cyber Security - Security Triad (CIA), Threats, Vulnerabilities, Risk - Malware Types: Virus, Worms, Trojans, Ransomware, Rootkits - Cyber Attacks: DoS, DDoS, Phishing, Man-in-the-Middle - Security Policy and Cyber Laws.

MODULE II SECURITY MODELS AND CRYPTOGRAPHY L:9 T:0 P:0

Authentication and Authorization Models - Symmetric and Asymmetric Encryption (AES, RSA) - Digital Signatures and Certificates – Hashing - Public Key Infrastructure (PKI) - Intrusion Detection Systems and Firewalls.

MODULE III ETHICAL HACKING BASICS L:9 T:0 P:0

Introduction to Ethical Hacking and Phases - Legal Aspects and Scope of Hacking - Footprinting Techniques: DNS Interrogation, WHOIS, Web Spidering - Network

Scanning Tools (Nmap, Angry IP Scanner) – Enumeration - Sniffing - Social Engineering.

MODULE IV SYSTEM AND NETWORK HACKING L:9 T:0 P:0

Vulnerability Analysis - System Hacking - Password Cracking – Trojans – Backdoors - Buffer Overflow.

MODULE V WEB, WIRELESS AND MOBILE HACKING L:9 T:0 P:0

Web Attacks: SQL Injection, XSS, CSRF - Wireless Attacks: WPA Cracking, Evil Twin, Rogue Access Point – Mobile Hacking (Android) – Security Measures.

L – 45; T – 0; P – 0; Total Hours: 45

TEXT BOOKS:

1. Raef Meeuwisse, Cybersecurity for Beginners, Packt Publishing, 2024.
2. William Stallings, Cryptography and Network Security, Pearson, 8th Ed., 2023.
3. Peter Kim, The Hacker Playbook 3, No Starch Press, 2024.
4. Michael Solomon, Hands-On Ethical Hacking and Network Defense, Packt Publishing, 2024.
5. Georgia Weidman, Penetration Testing: A Hands-On Introduction to Hacking, No Starch Press, 2024.

REFERENCES:

1. Charles J. Brooks et al., *Cybersecurity Essentials*, Wiley, 2024.
2. Chwan-Hwa Wu, *Introduction to Cyber Security*, Springer, 2024.
3. Rafay Baloch, *Ethical Hacking and Penetration Testing Guide*, CRC Press, 2024.
4. Dafydd Stuttard, *The Web Application Hacker's Handbook*, Wiley, 2024.
5. Jon Erickson, *Hacking: The Art of Exploitation*, No Starch Press, 2024.

COURSE OUTCOMES:

CO1: Identify various types of cyber threats and propose preventive strategies using appropriate cyber security principles. (K2)

CO2: Apply cryptographic techniques and access control models to secure data and systems. (K3)

CO3: Conduct reconnaissance and information gathering using ethical hacking tools and techniques.

CO4: Perform vulnerability assessment and exploit common system flaws using ethical hacking frameworks.

CO5: Evaluate and mitigate security threats in web, wireless, and application environments.

Board of Studies (BoS): 20th Meeting of BoS of IT Department held on 12.06.2025

Academic Council: 24th AC held on 26.08.2025

	PO1	PO2	PO3	PSO1	PSO2
CO1	M	H	L	L	H
CO2	H	H	L	L	M
CO3	M	H	M	L	H
CO4	H	H	M	M	M
CO5	M	M	L	L	H

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

SDG 9: Develops advanced knowledge in securing digital infrastructure and fostering innovation.

SDG 16: Supports justice and accountability through ethical hacking, cybersecurity, and legal compliance.

Statement:

This course contributes to developing secure information systems that promote inclusive and sustainable digital innovation, thereby supporting justice, peace, and institutional resilience in cyberspace.

ITFY 104	MACHINE LEARNING TOOLS AND	L	T	P	C
SDG: 8	TECHNIQUES	2	0	2	3

COURSE OBJECTIVES: This course aims to enable the students to

COB1: Understand the fundamentals of Machine Learning, including its types, challenges, and techniques for model validation and data handling.

COB2: Introduce classification techniques such as binary and multiclass classification, and performance evaluation using regression models.

COB3: Explore advanced supervised learning methods including Support Vector Machines (SVM), Decision Trees, and Ensemble methods.

COB4: Study unsupervised learning techniques such as clustering and dimensionality reduction for pattern recognition and data compression.

COB5: Study the students with neural networks and deep learning architectures, including CNNs and generative models like Autoencoders and GANs using TensorFlow.

MODULE I MACHINE LEARNING L:7 T:0 P:7

Machine Learning Landscape, Types of Machine Learning, Challenges of Machine Learning, Testing and Validating, Working with real data, Get the data, Visualizing the data, Machine Learning algorithm, Select the model, Fine turn the model.

MODULE II CLASSIFICATION L:7 T:0 P:7

MNIST, Binary Classifier, Performance Measure, Multiclass classification, Multiclass classification, Error analysis, Linear regression, Gradient descent, Polynomial regression, Regularized linear model, Logistic regression model,

MODULE III SUPPORT VECTOR MACHINE L:8 T:0 P:7

Linear SVM Classification, Non linear Classification, SVM regression, Decision tree, Training and visualization a decision tree, CART training algorithms, Ensemble learning and Random forest, voting classifier, Bagging and Pasting, Boosting, AdaBoost, Dimensionality reduction.

MODULE IV CLUSTERING AND NEURAL NETWORKS L:8 T:0 P:7

K-means, DBSCAN, Gaussian Mixtures, Bayesian Gaussian Mixtures models, biological to artificial neurons, perceptron, Deep Neural networks, Custom model with tensorFlow, Deep computer vision using convolutional neural networks, Generative learning using Autoencoder and GAN,

L – 30; T – 0; P – 30; Total Hours:60

LABORATORY SESSION: 30 hrs

Lab 1: Train models (e.g., Linear Regression, Decision Tree), evaluate using cross-validation, RMSE, MAE.

Lab 2: Load MNIST dataset, train classifiers (SGD, Logistic Regression), evaluate accuracy.

Lab 3: Implement binary classifier for spam/ham; extend to multiclass (e.g., digit classification).

Lab 4: Evaluate with confusion matrix, precision, recall, F1-score, ROC-AUC curves.

Lab 5: Implement linear/polynomial regression with different cost functions and gradient descent.

Lab 6: Train Decision-Tree Classifier; visualize tree; extract feature portance.

Lab 7: Implement ensemble methods for noisy datasets and compare performance.

Lab 8: Compare Ridge, Lasso, and ElasticNet regression on overfitting-prone datasets.

TEXT BOOKS:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurelien Geron, 2018.
2. Introduction to Machine Learning with Python A Guide for Data Scientists, Andreas C. Müller and Sarah Guido, 2016.

REFERENCES:

1. Introduction to Machine Learning with Python by Andreas C. Müller and Sarah Guido (2016).
2. Tom M. Mitchell, “Machine Learning”, First Edition, McGraw Hill Education, 2017.

3. AurélienGéron, “Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems”, Second edition, O'Reilly Media, 2019.
4. Andreas C. Muller and Sarah Guido, “Introduction to Machine Learning with Python: A guide for data scientists”, First edition,O′Reilly, 2017.
5. Sebastian Raschka, “Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 2”, 3rdedition, PacktPublishing , 2019.

COURSE OUTCOMES: Upon completion of this course, students will be able to

CO1: Apply basic Machine Learning concepts to real-world problems, including data preprocessing, visualization, and algorithm selection.

CO2: Implement and evaluate classification and regression models using appropriate performance metrics and optimization techniques.

CO3: Develop and assess machine learning models using SVM, Decision Trees, and Ensemble methods for both classification and regression tasks.

CO4: Analyze and implement clustering algorithms and perform dimensionality reduction to extract meaningful features from data.

CO5: Train deep neural networks and apply them to tasks such as image classification and generative modelling using modern frameworks like TensorFlow.

Board of Studies (BoS):
20th BoS of IT held on 12.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M		L
CO2	H	H	M		L
CO3	H	H	M	L	L
CO4	H	H	L		L
CO5	H	H	M	L	L

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

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

Statement:

The machine learning algorithms can aid in statistical analysis of data and provide solutions to real time problems using classification and regression techniques.

ITFY 201	IOT ARCHITECTURE AND PROTOCOLS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the fundamentals of IoT, including its architecture, components, and real-world applications.

COB2: To analyze the different layers of IoT architecture and comprehend the role of edge, fog, and cloud computing.

COB3: To identify suitable networking technologies and communication protocols used in IoT systems.

COB4: To evaluate and compare various IoT protocol stacks for data transmission and device communication.

COB5: To recognize the importance of security, privacy, and standardization in IoT implementations and assess related challenges.

MODULE I INTRODUCTION TO IOT L: 9 Hrs

Overview of IoT – Characteristics – IoT Ecosystem – Components – Cloud and IoT Applications – Industry 4.0 – Key Challenges and Issues in IoT – M2M vs IoT, WSN and IoT – IoT Reference Models – OSI, TCP/IP.

MODULE II IOT ARCHITECTURE AND SYSTEM DESIGN L:9 Hrs

IoT Levels and Deployment Templates – IoT Functional Blocks and Logical Design – Basic Building Blocks of IoT: Sensors, Actuators, Edge Devices – IoT Communication protocols – Fog Computing and Edge Computing in IoT – Applications.

MODULE III IOT NETWORKING TECHNOLOGIES L: 9 Hrs

Networking Basics: IPv4, IPv6, Addressing in IoT – Wireless Technologies: Bluetooth, BLE, Zigbee, RFID, NFC – Long-range Protocols – Medium Access Control in IoT – Topologies for IoT – Software Defined Networking (SDN) in IoT.

MODULE IV IOT PROTOCOL STACK L: 9 Hrs

IoT protocol Stack – Fundamental concepts – Application Layer Protocols – Transport Layer Protocols – Network Layer Protocols – Data Link and Physical Layer Protocols – Comparison and Use Cases of Various Protocols.

MODULE V IOT SECURITY, STANDARDS AND CASE STUDIES **L: 9 Hrs**

Security in IoT – Authentication, Authorization, Confidentiality – Data Integrity and Privacy Challenges – Device and Network Security – IoT Security Frameworks and Best Practices – IoT Standards: IEEE, IETF, ITU, ETSI – IoT Platforms: AWS IoT, Azure IoT Hub, Google IoT Core – Case Studies.

L – 45 ; Total Hours:45

TEXT BOOKS:

1. Internet of Things: Architecture and Design Principles **– *Raj Kamal,* McGraw Hill Education** Edition**:** 2nd, **2022*.***
2. Internet of Things: Principles and Paradigms **– *Rajkumar Buyya & Amir Vahid Dastjerdi ,* Morgan Kaufmann,** Edition**:** 1st, 2016.

REFERENCES:

1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things – *David Hanes et al.,*Cisco Press, Edition: 1st, 2017.
2. Designing the Internet of Things – *Adrian McEwen & Hakim Cassimally,* John Wiley & Sons Edition: 1st, 2013.

COURSE OUTCOMES:

CO1: Describe the architecture, characteristics, and components of IoT systems.

CO2: Design and explain IoT system architecture involving sensors, actuators, gateways, and cloud platforms.

CO3: Apply suitable networking and communication protocols (e.g., MQTT, CoAP, 6LoWPAN) for different IoT applications.

CO4: Analyze and implement various protocol stacks and evaluate their suitability based on application requirements.

CO5: Identify and mitigate security risks in IoT systems and demonstrate understanding of global IoT standards and frameworks.

Board of Studies (BoS):

20th BoS of IT held on 12.06.2025

Academic Council:

24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	2
CO2	2	3	3	3	2
CO3	3	2	3	3	2
CO4	3	2	2	2	2
CO5	3	2	3	3	2

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

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

Core alignment: IoT forms the backbone of smart infrastructure, industrial automation (Industry 4.0), and intelligent transportation.

ITFY 202	SECURE BLOCKCHAIN AND CRYPTO-ECONOMICS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand blockchain architecture, evolution, and cryptographic basics.

COB2: To analyze consensus protocols and identify security attacks.

COB3: To apply blockchain knowledge to develop smart contracts and DApps.

COB4: To design token economies using cryptoeconomic principles.

COB5: To Evaluate privacy-enhancing cryptographic techniques.

MODULE I INTRODUCTION TO BLOCKCHAIN AND CRYPTOGRAPHY L:9 Hrs

Evolution of blockchain-Blockchain architecture and components - Cryptographic primitives - hash functions- digital signatures- public-key cryptography- Merkle trees-Use cases.

MODULE II CONSENSUS PROTOCOLS AND SECURITY L:9 Hrs

Proof of Work (PoW) - Proof of Stake (PoS) – Various Stake Types-Stakeholders-Difficulty adjustment and retargetingalgorithms -Consensus attacks- Security assumptions and attack models.

MODULE III BLOCKCHAIN PLATFORMS AND SMART CONTRACTS L: 9 Hrs

Bitcoin Protocol and Mining - Introduction to smart contracts–Ricardian Contracts-Smart contract templates - Oracles - Smart Oracles - Deploying smart contracts on a blockchain - Decentralized Applications(DApps) - Ethereum blockchain–Components of the Ethereum ecosystem.

MODULE IV CRYPTOECONOMICS & TOKEN INCENTIVES L: 9 Hrs

Crypto-Economic principles -Economic incentivesand mining rewards - Game theory - Tokenomics and digital assets - Security deposits- slashing conditions - penalties.

MODULE V PRIVACY, SCALING & FUTURE TRENDS L: 9 Hrs

Advanced cryptography-Zero-Knowledge Proofs- ring signatures - stealth addresses - Multisignature- Layer-2 scaling solutions: sidechains, Sharding, DAGs–Privacy-Interoperability - token economics security.

L – 45; Total Hours:45

TEXT BOOKS:

1. Lorne Lantz and Daniel Cawrey “Mastering Blockchain”, First Edition,O’Reilly Media, ,2021.
2. Diego Rodrigues, “Learn Blockchain: From Fundamentals to Practical Applications”, StudioD21, 2025.

REFERENCES:

1. Arvind Narayanan et al., “Bitcoin and Cryptocurrency Technologies”,Princeton University Press, 2021.
2. Imran Bashir, “Mastering Blockchain”, Second Edition, Packt Publishing, 2021.

COURSE OUTCOMES:

CO1: Understand blockchain evolution, architecture, cryptographic primitives, and types.

CO2: Analyze consensus protocols and evaluate blockchain security attacks.

CO3: Explain blockchain platforms and deploy smart contracts/DApps.

CO4: Apply cryptoeconomics and design token incentive models

CO5: Evaluate privacy techniques, scaling solutions, and governance issues.

Board of Studies (BoS):
20th BoS of IT held on 12.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	H	H	M	M	L
CO2	H	H	H	M	M
CO3	H	H	H	H	M
CO4	M	H	H	H	M

CO5	H	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.

- Blockchain improves transparency, traceability, and efficiency in industries such as supply chain, healthcare, and finance.
- The course promotes understanding and innovation in advanced technologies like smart contracts, cryptoeconomics, and Layer-2 scaling.

ITFY 203	AI-DRIVEN CYBER SECURITY	L	T	P	C
SDG: 16		3	0	0	3

COURSE OBJECTIVES:

COB1: To learn the foundational concepts of AI and its integration with cyber security.

COB2: To analyze the role of big data and automation in cyber security, exploring how AI techniques enhance data analytics and decision-making.

COB3: To explore the application of Generative AI and large language models (LLMs) in cybersecurity domains.

COB4: To examine real-world use cases of AI in cyber defense, including malware detection, behavioral analysis, phishing prevention, and threat intelligence.

COB5: To identify and address critical challenges in deploying AI for cyber security.

PREREQUISITE COURSES:

Data Structures and Algorithms, Computer Networks, Introduction to Cyber Security, Introduction to Artificial Intelligence and Machine Learning.

MODULE I INTRODUCTION TO AI IN CYBER SECURITY L:9 T:0 P:0

Introduction – Cyber Security and Threat Intelligence - AI and its relevance in Cyber Security - Traditional vs. AI-driven cybersecurity approaches – Cyber Security Life Cycle Types of Learning Technologies - Learning Tasks and Algorithms in Cyber Security - Detecting Anomalies and Multi-attacks through Cyber Learning.

MODULE II DATA-DRIVEN CYBER SECURITY AND AI L:9 T:0 P:0

Big Data in Cyber Security – Technical Requirements – Big data challenges, applications, and technologies in Cyber Security - Automation in Cyber Security – Tools and Technologies – Potential drawbacks and challenges of automation in Cyber Security - Cyber Security Data Analytics – AI in Data Analytics – Types of AI used in Cyber Security Data Analytics – Applications and challenges of using AI.

MODULE III GENERATIVE AI AND LLM IN CYBER SECURITY **L:9 T:0 P:0**

Introduction to Generative AI and LLM - Potentiality of Generative AI-enabled Cyber Security - Generative AI Modelling – Cyber Security Large Language Modelling - Cybersecurity Data Science - Types of Analytics and Outcome - Understanding Data Science Modelling - Data Science-Based Knowledge Discovery Process - Data-Driven Rule-Based Explainable Cybersecurity Modelling.

MODULE IV APPLICATION OF AI IN CYBER SECURITY L:9 T:0 P:0

Malware and Network Intrusion Detection and Analysis - User and Entity Behavior Analysis - Fraud, Spam, and Phishing Detection - ser Authentication and Access Control - Threat Intelligence - Anomaly Detection in Industrial Control Systems

MODULE V COMMON PROBLEMS WHEN APPLYING AI IN CYBER SECURITY **L:9 T:0 P:0**

Data Quality and its Usage in the AI and LLM Era - Correlation, Causation, Bias, and Variance - Evaluation, Monitoring, and Feedback Loop - Learning in a Changing and Adversarial Environment - Privacy, Accountability, Explainability, and Trust – Responsible AI.

L – 45; Total Hours: 45

TEXT BOOKS:

1. Iqbal H. Sarker, “AI-Driven Cybersecurity and Threat Intelligence: Cyber Automation, Intelligent Decision-Making and Explainability”, Springer, 2024.
2. Bojan Kolosnjaji, Huang Xiao, Peng Xu, Apostolis Zarras, “Artificial Intelligence for Cybersecurity: Develop AI approaches to solve cybersecurity problems in your organization”, Packt Publishing, 2024.

REFERENCES:

1. Alessandro Parisi, “Hands-On Artificial Intelligence for Cybersecurity: Implement smart AI systems for preventing cyber attacks and detecting threats and network anomalies”, Packt Publishing, 2019.
2. Ishaani Priyadarshini, Rohit Sharma, “Artificial Intelligence and Cybersecurity: Advances and Innovations”, CRC Press, 2022.

3. Steve Wilson, “Cybersecurity and Artificial Intelligence: Threats and Opportunities”, Contrast Security, 2023.

COURSE OUTCOMES:

CO1: Understand and differentiate between traditional and AI-driven approaches to cyber security, and apply basic machine learning concepts to detect anomalies and threats. (K2)

CO2: Assess big data challenges and apply AI techniques to automate cyber security analytics and decision-making processes. (K3)

CO3: Apply Generative AI techniques and Large Language Models (LLMs) in developing explainable and intelligent cyber security models. (K3)

CO4: Use AI-based techniques to real-world cyber security problems such as malware detection, phishing identification, and user behavior analysis. (K3)

CO5: Identify and address key challenges such as data quality, bias, and privacy concerns in deploying AI solutions responsibly in cyber security. (K2)

Board of Studies (BoS): 20th MeetingofBoS of IT Department held on 12.06.2025

Academic Council: 24th AC held on 26.08.2025

	PO1	PO2	PO3	PSO1	PSO2
CO1	M	H	L	L	M
CO2	H	H	L	M	M
CO3	H	H	L	M	M
CO4	H	H	L	M	L
CO5	M	M	L	L	H

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

SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

Statement:

The application of AI technologies in cyber security strengthens the protection of digital infrastructures, enhances threat detection and response mechanisms, and ensures data integrity and privacy. This contributes to building trustworthy, accountable, and secure digital systems, which are vital for inclusive and peaceful societies in the digital era.

ITFY 204	DEEP LEARNING FOR COMPUTER VISION	L	T	P	C
SDG: 9		2	0	2	3

COURSE OBJECTIVES:

COB1: **To introduce the fundamentals of deep learning architectures** and their application in solving computer vision tasks such as image classification and feature extraction.

COB2: **To enable learners to design and train convolutional neural networks (CNNs)** using modern deep learning frameworks like TensorFlow and Keras.

COB3: **To expose students to advanced vision tasks** such as object detection, semantic segmentation, and model evaluation using state-of-the-art deep learning techniques.

COB4: **To provide insights into generative models** including GANs and their application in creative vision systems like style transfer and super-resolution.

COB5: **To develop the ability to deploy and evaluate deep learning models** in real-world vision systems with considerations of performance, ethics, and usability.

PREREQUISITE: Python Programming, Basic ML

MODULE I FUNDAMENTALS OF DEEP LEARNING & IMAGE PROCESSING **L: 7 Hrs**

Overview of computer vision vs image processing - Setting up DL environments: Python, TensorFlow/Keras, OpenCV - Perceptron, MLP, and Gradient Descent - Fundamentals of convolution, pooling, and CNN layer types - Backpropagation and loss functions.

MODULE II DEEP CNN ARCHITECTURES & TRANSFER LEARNING **L:8 Hrs**

CNNs in depth: LeNet, AlexNet, VGG, ResNet, DenseNet - Training deep networks: data augmentation, regularization, dropout - Transfer learning: Feature extraction, fine-tuning - Batch normalization, activation functions, optimizers - Best practices: learning rate schedules, early stopping.

MODULE III OBJECT DETECTION & SEGMENTATION L: 8 Hrs

Sliding windows, image pyramids (traditional detection) - Object detection with R-CNN, Fast R-CNN, Faster R-CNN - YOLO and SSD: speed vs accuracy trade-offs - Semantic segmentation: FCN, U-Net, Mask R-CNN - Evaluation metrics: mAP, IoU.

MODULE IV ADVANCED APPLICATIONS & GENERATIVE MODELS L: 7 Hrs

Super-resolution, style transfer, deep dreaming - Introduction to GANs: DCGAN, CycleGAN, StyleGAN - OCR and document image analysis - Vision + NLP: basics of multimodal models (CLIP-style) - Model deployment and ethical considerations.

LABORATORY SESSIONS P: 30 Hrs

Lab 1: Setting up the environment (Anaconda, TensorFlow, OpenCV)

- Create virtual environment, install dependencies
- Load and display images using OpenCV

Lab 2: Building a Perceptron & MLP using NumPy

- Manual forward and backward pass
- Simple digit classification (MNIST)

Lab 3: CNN for Image Classification

- Build LeNet and train on MNIST/CIFAR-10
- Use different activation functions and optimizers

Lab 4: Transfer Learning with VGG16/ResNet50

- Feature extraction on flower dataset
- Fine-tuning for improved performance

Lab 5: Image Data Augmentation & Visualization

- Apply Keras ImageDataGenerator
- Save augmented images and visualize them

Lab 6: Object Detection with YOLOv5

- Use pre-trained YOLOv5 on COCO format images
- Modify detection thresholds and analyze output

Lab 7: Semantic Segmentation with U-Net

- Load medical or aerial dataset
- Train and evaluate U-Net

Lab 8: Style Transfer and Super-resolution

- Use TensorFlow Hub for real-time style transfer
- Compare original and super-resolved images

Lab 9: Introduction to GANs with DCGAN

- Train GAN to generate handwritten digits
- Visualize progression across epochs

Lab 10: OCR and Vision + NLP (Bonus)

- Use Tesseract or OpenCV for text extraction
- Basic image-captioning demo or CLIP-based similarity

L – 30 P – 30; Total Hours:60

TEXT BOOKS:

1. *Adrian Rosebrock, " Deep Learning for Vision Systems (2nd Edition)", PyImage Search, 2023*
2. Richard Szeliski, " **Computer Vision: Algorithms and Applications",** Springer, 2022

REFERENCES:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning (Adaptive Computation and Machine Learning)", MIT Press, 2016.
2. Anirudh Koul, Siddha Ganju, Meher Kasam. " Practical Deep Learning for Cloud, Mobile & Edge" , O'Reilly, 2020.
3. Benjamin Planche, Eliot Andres. " Hands-On Computer Vision with TensorFlow",: Packt 2019.
4. Jakub Langr, Vladimir Bok, " GANs in Action: Deep learning with Generative Adversarial Networks", Manning, 2019.

COURSE OUTCOMES:

COURSE OUTCOMES:

CO1 Understand and implement core CNN architectures for vision tasks.

CO2	Apply transfer learning and regularization in practical deep learning models.
CO3	Develop and evaluate object detection and segmentation models using deep learning.
CO4	Use deep generative and style transfer models in creative vision applications.
CO5	Apply deep vision systems in real-world tasks like OCR and multimodal integration.

Board of Studies (BoS):
20th BoS of IT held on 12.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	2	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	2	1	2	2	3
CO5	3	2	3	3	3

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

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

Statement:

- Fosters innovation in computer vision technologies (e.g., automated inspection, smart manufacturing, autonomous systems).
- Enables development of intelligent systems in healthcare, agriculture, smart cities, and transportation

ITFY 205	APPLIED CRYPTOGRAPHY	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the fundamental principles of classical cryptographic techniques.

COB2: To analyze symmetric key encryption algorithms including DES and AES.

COB3: To apply number-theoretic concepts to public-key cryptography.

COB4: To examine secure identification protocols and key agreement schemes.

COB5: To evaluate modern cryptographic protocols and trends.

MODULE I CLASSICAL CIPHER TECHNIQUES L: 9 Hrs

Cryptosystems and Basics Cryptographic Tools- Message Integrity-Cryptographic Protocols -Security - Classical Cryptography - Cryptanalysis - Shannon's Theory.

MODULE II SYMMETRIC ENCRYPTION TECHNIQUES WITH AES L:9 Hrs

Linear Cryptanalysis-Differential Cryptanalysis-Data Encryption Standard-Advanced Encryption Standard-Modes of Operation- Hash Function and Data Integrity-Security of Hash Functions-Iterated Hash Functions-Message Authentication Codes-Unconditionally Secure MACs.

MODULE III NUMBER THEORY AND PUBLIC-KEY CRYPTOGRAPHY L: 9 Hrs

Introduction to Public-key Cryptography-Number Theory -Implementing RSA-Factoring Algorithms- Semantic Security of RSA- ElGamal Cryptosystem-Algorithms for the Discrete Logarithm Problem- Elliptic Curves -RSA Signature Scheme –Full Domain Hash –Certificates - Signing and Encrypting.

MODULE IV SECURE IDENTIFICATION AND MUTUAL AUTHENTICATION L: 9 Hrs

Secure Identification Schemes-Challenge and Response in the Secret-key Setting - Challenge and Response in the Public Key Setting - Schnorr Identification Scheme- Key Predistribution -Session Key Distribution Schemes- Key Agreement Scheme - Diffie-Hellman Key agreement- MTI key Agreement Schemes-Deniable Key Agreement Schemes -Key Updating - Conference Key Agreement Schemes.

MODULE V MODERN CRYPTOGRAPHIC APPLICATIONS AND EMERGING TRENDS **L: 9 Hrs**

Key Management Protocols – Kerberos –Kryptoknight - Sesame- Capstone- Secret Sharing Algorithms - Zero-Knowledge Proofs and Identification Schemes-Blind Signature- Secure Multi-party Computation- Quantum Cryptography and Post-Quantum Cryptography-Cryptography in IoT and Cloud Security- Case Studies.

L – 45; Total Hours:45

REFERENCES:

1. Douglas R. Stinson, “Cryptography Theory and Practice”, Third Edition, Chapman & Hall / CRC, 2019.
2. Menezes A. J, Oorschot P, Vanstone S.A, “Handbook of Applied Cryptography” CRC Press, 2015.
3. William Stallings, “Cryptography and Network Security: Principles and Practices”, Third Edition, Pearson Education, 2006.
4. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Fourth Edition, Pearson Education, 2007.

COURSE OUTCOMES:

CO1: Understand the classical cryptographic algorithms and their vulnerabilities through cryptanalysis techniques.

CO2: Demonstrate comprehensive knowledge of symmetric key encryption algorithms and their applications.

CO3: Apply mathematical foundations to implement, analyze, and evaluate public-key cryptosystems and digital signature schemes.

CO4: Design and analyze secure identification and key-agreement protocols to achieve mutual authentication.

CO5: Evaluate advanced cryptographic protocols and emerging technologies.

Board of Studies (BoS):
20th BoS of IT held on 12.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	1
CO2	3	3	3	2	2
CO3	3	3	3	3	2
CO4	2	3	3	3	2
CO5	3	2	3	3	3

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

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

- Cryptography supports secure digital infrastructure, enabling innovation in fields like IoT, cloud computing, and secure communication.

ITFY 206	QUANTUM COMPUTING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

Students will:

COB1: Understand the fundamental principles of quantum mechanics as applied to quantum computing.

COB2: Explore the mathematical framework of quantum computation including qubits, gates, and quantum circuits.

COB3: Analyze foundational quantum algorithms such as Deutsch-Jozsa, Grover's, and Shor's algorithms.

COB4: Examine quantum computing hardware models and quantum error correction mechanisms.

COB5: Understand and illustrate the integration of quantum techniques in practical AI/ML and optimization pipelines.

PREREQUISITE:

Linear Algebra, Probability Theory,Data Structures,Python

MODULE I FOUNDATIONS OF QUANTUM COMPUTING **L: 10**

A Brief History of Quantum Computing -Superposition- Entanglement, and Reversibility-The Born rule and its implications-Schrödinger's equation and its role in quantum systems- -Early developments and foundational algorithms-Contributions of Shor and Grover to quantum algorithms- Qubits- The concept and representation of qubits, Operators-Quantum operators and their functionsand Measurement.

MODULE II QUANTUM COMPUTERS -DATA REPRESENTATION **L: 9**

Quantum theory-Quantum gates-Measuring Qubits in computational basis-Quantum parallelism and functional evaluation. Strategies of input encoding- important quantum algorithms- Deutsch Josza Algorithm-Variational Quantum algorithms-Quantum Annealing-Encoding a dataset via the Hamiltonian-Data encoding as feature map.

MODULE III QUANTUM MACHINE LEARNING L: 9

Merging two disciplines-Rise of Quantum Machine Learning- Quantum Algorithm for classification-Three ingredient of a Learning Problem-Risk Minimization in supervised Learning-Methods in Machine Learning models.

MODULE IV VARIATIONAL CIRCUITS AS MACHINE LEARNING L: 9

Deterministic Quantum models- Probabilistic Quantum models-Quantum models as linear combination of periodic functions-Training variational Quantum models-Quantum circuits and Neural networks.

MODULE V QUANTUM KERNEL MODELS L: 8

Connection between Quantum models and kernel models-Feature maps of Quantum computing-Examples of Quantum kernels-RKHS of Quantum Kernels-Kernel Based Training.Potential Quantum advantages.

L – 45; Total Hours:45

TEXT BOOKS:

1. Jack D. Hidary, “Quantum Computing: An Applied Approach”, Second Edition, Springer, 2021.
2. Maria Schuld and Francesco Petruccione, "Machine Learning with Quantum Computers", Second Edition, Springer International Publishing, 2021
3. Javad Shabani and Eva Gurra, “First Step to Quantum Computing: A Practical Guide for Beginners”, First Edition, World Scientific Publishing Company, 2024.

REFERENCES:

1. Santanu Ganguly, “Quantum Machine Learning: An Applied Approach”, First Edition, Apress, 2021.
2. Michael A. Nielsen and Isaac L. Chuang, “Quantum Computation and Quantum Information”, 10th Anniversary Edition, Cambridge University Press, 2010.

COURSE OUTCOMES:

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

CO1: Explain the key postulates of quantum mechanics and their relevance to quantum information processing.

CO2: Represent and manipulate quantum states and operations using linear algebra and quantum gates.

CO3: Implement and simulate basic quantum algorithms using programming tools such as Qiskit or Cirq.

CO4: Describe quantum hardware architectures and analyze the challenges in building scalable quantum systems.

CO5: Evaluate the potential of quantum computing in solving complex real-world problems across industries.

Board of Studies (BoS):
20th BoS of IT held on 12.06.25

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	H	M	L	-	-
CO2	H	H	M	L	-
CO3	M	H	H	M	L
CO4	-	M	H	H	M
CO5	-	-	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: Quantum computing fosters cutting-edge innovation.It contributes to the development of advanced technologies for industry and science.It supports breakthroughs in AI, healthcare, cybersecurity, and material science, aligning with sustainable industrialization.

ITFY 207	KUBERNETES AND CONTAINERIZATION	L	T	P	C
SDG: 9		2	0	2	3

COURSE OBJECTIVES: Students will

COB1: Understand the fundamentals of containerization and the role of Docker in modern DevOps workflows.

COB2: Learn to build, deploy, and manage containers using Docker CLI and Docker Compose.

COB3: Acquire skills to deploy and scale applications using Kubernetes and its core components.

COB4: Gain hands-on experience in configuring and managing Kubernetes clusters in cloud environments.

COB5: Explore container security, monitoring, orchestration, and service discovery in real-world deployments.

PREREQUISITE COURSES:

Basic knowledge of computer networks, operating systems, and programming fundamentals. bASIC Linux commands and scripting, virtualization or cloud computing concepts.

MODULE I GETTING KUBERNETES AND WORKING WITH PODS **L:8 P:7**

Install everything with Docker Desktop-Linode Kubernetes Engine (LKE)-Build a Kubernetes cluster in the Linode Cloud-Configure **kubectl**-Test your LKE cluster- **kubectl** and your kubeconfig filePod theory-Multi-container Pods-Namespaces-use cases- Default Namespaces-Creating and managing Namespaces-Deploying objects to Namespaces-Kubernetes Deployments.

MODULE II KUBERNETES DEPLOYMENTS **L:8 P:7**

Deployment theory- Create a Deployment- Manually scale the app- Kubernetes Services - Service registration-Service discovery-Kubernetes storage-The Container Storage Interface (CSI)-The Kubernetes persistent volume subsystem- Dynamic

provisioning with Storage Classes- Stateful Set theory- API security and RBAC-Authentication- Authorization (RBAC) -Admission control-The Kubernetes API.

MODULE III DOCKER THE CONTAINER L: 7 P:8

Container-Docker Architecture and components-Installation of Docker-Working with Docker CLI-Building DockerImages-Docker networking-Docker Volumes-working with docker volumes-docker volumes with local drive-docker storage drivers.

MODULE IV ORCHESTRATION WITH DOCKER COMPOSE L: 7 P:8

Docker registry-setup, applying authentication of docker registry- orchestration with docker compose for simple application deployment-Docker swarm-setup and deploy containers on swarm clustering-docker secrets-Dashboard and Monitoring containers.

LAB SESSIONS P:30 Hrs

Lab 1 Hands-on with Services and WebAssembly (Wasm) on Kubernetes

- Create and deploy Kubernetes services.
- Integrate WebAssembly modules into the container runtime.

Lab 2 Hands-on with ConfigMaps and Secrets in Kubernetes

- Create and mount ConfigMaps and Secrets in Pods.
- Secure sensitive environment variables using Secrets.

Lab 3 Building a Docker Image for Python using Flask

- Create a simple Flask web application.
- Write a Dockerfile and build a container image**.**

Lab 4 Pushing a Docker Image to Docker Hub

- Tag and push the custom Flask image to Docker Hub.
- Pull and verify deployment on a new system.

Lab 5 Export, Import, Save and Load Docker Images

- Use Docker CLI to export, import, save, and load images.
- Understand the difference between .tar exports and saved images.

Lab 6 Configuring MySQL and phpMyAdmin on the Same Docker Network

- Use Docker Compose to deploy MySQL and phpMyAdmin containers.
- Connect both containers within a custom network.

Lab 7 Working with Docker Volume and Database Persistence

- Attach volumes to MySQL container to persist data.
- Demonstrate backup and recovery using volumes.

Lab 8 Building a Node.js Express App with MySQL using Docker Compose

- Write a multi-container Compose file.
- Link the backend server with the database service.

Lab 9 Deploying Containers on Docker Swarm Cluster

- Initialize and configure Docker Swarm.
- Deploy services using docker stack deploy.

Lab 10 Scaling Applications with Docker Swarm

- Scale services up and down using Swarm.
- Perform rolling updates and monitor changes**.**

L – 30; P – 30; Total Hours:60

TEXT BOOKS:

1. Nigel Poulton, *The Kubernetes Book*, Latest Edition (2025)
2. Agus Kurniawan, “Hallo Docker: Learning Docker Containers by Doing Projects”, First Edition, Ilmu Data, 2023.
3. Meysam Azad, “Ultimate Docker for Cloud Native Applications”, First Edition, AVA™ (An Orange Education Label), 2024.

REFERENCES:

1. Justin Domingus & John Arundel, *Cloud Native DevOps with Kubernetes – Second Edition*, O'Reilly (2023)
2. Brendan Burns, Joe Beda, Kelsey Hightower & Lachlan Evenson, *Kubernetes: Up & Running – Third Edition*, O'Reilly (2022)
3. Alessandro Arrichiello and Gianni Salinetti, “Podman for DevOps: Containerization Reimagined with Podman and Its Companion Tools”, First Edition, Packt Publishing, 2022.
4. Ravikanth Chaganti, “Containerization – From Zero to Hero”, First Edition, Leanpub, 2022.

COURSE OUTCOMES:

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

CO1: Explain the concepts of containerization and demonstrate the use of Docker to build and run containers.

CO2: Create and manage multi-container applications using Docker Compose and Swarm.

CO3: Deploy and manage pods, services, and namespaces in Kubernetes using kubectl.

CO4: Configure persistent storage, RBAC, and API security in Kubernetes environments.

CO5: Integrate DevOps tools and best practices for monitoring and orchestrating containers in production.

Board of Studies (BoS): 20th BoS of IT held on 12.06.25

Academic Council: 24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	H	M	-	-	-
CO2	M	H	H	M	-
CO3	M	H	H	-	L
CO4	-	M	H	H	M
CO5	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 scalable, cloud-native infrastructure:

The course equips students with skills in containerization and orchestration, which are essential for building efficient, scalable, and resilient cloud infrastructures used in modern industry.

Encourages automation and innovation in software deployment: By introducing students to DevOps tools like Docker and Kubernetes, the course fosters innovation and efficiency in software development, deployment, and maintenance — critical to the digital transformation of industries.

ITFY 208	FEDERATED LEARNING AND PRIVACY-PRESERVING AI	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

The students have to:

COB1: Understand the basic principles and motivation behind Federated Learning and its significance in modern AI.

COB2: Learn the different types of Federated Learning architectures and optimization techniques.

COB3: Explore incentive models and system-level challenges involved in deploying FL systems.

COB4: Analyze the application of FL in various real-world domains such as healthcare, NLP, and mobile systems.

COB5: Gain knowledge about key privacy-preserving techniques in AI, including differential privacy and secure data handling.

Prerequisites:

Machine Learning, Distributed Systems , Python Programming and Data Handling

MODULE I FOUNDATIONS OF FEDERATED LEARNING L: 9

Introduction to Federated Learning- Motivation and Need for FL - Overview of Distributed Machine Learning- Centralized vs Federated ML- Scalability and Privacy motivated DML- Threats and Challenges in Federated Learning- Data Valuation: Importance, Metrics, and Implications.

MODULE II FEDERATED LEARNING ARCHITECTURES AND OPTIMIZATION L:9

Horizontal Federated Learning- Vertical Federated Learning- Federated Transfer Learning- Architectural Differences and Use Case Scenarios-Federated Optimization: FedAvg, FedProx, FedNova- Handling Data and System Heterogeneity.

MODULE III INCENTIVE MECHANISMS AND SYSTEM-LEVEL ISSUES IN FL L:9

Incentive Mechanisms for Participation: Paying for Contributions, Profit-Sharing Games, Reverse Auctions- Fairness-Aware Profit Sharing: Contribution, Cost, Regret

Modeling- Policy Orchestration & Payoff Calculation- System-Level Challenges: Communication cost, Efficiency.

MODULE IV FEDERATED LEARNING APPLICATIONS L:9

FL in Computer Vision- FL for Natural Language Processing- FL for Recommender Systems- Use Case Discussion: Healthcare, Finance, Mobile Applications- Research Challenges and Deployment Considerations.

MODULE V PRIVACY-PRESERVING AI L:9

Privacy Considerations in ML- Differential Privacy for Machine Learning- Advanced Differential Privacy Concepts- Privacy-Preserving Synthetic Data Generation- PPML Applications and Platforms.

L – 45; Total Hours:45

TEXT BOOKS:

1. Qiang Yang, Yang Liu, Yong Cheng, Yan Kang, Tianjian Chen, Han Yu, “Federated Learning”, Springer, June 2022.
2. J. Morris Chang, Di Zhuang, G. Samaraweera, G. Dumindu Samaraweera, “Privacy-Preserving Machine Learning”, Manning Publications Co., 2023.

REFERENCES:

1. Y. Zhao, L. Lai, Y. Liu, Q. Yang, *Federated Learning: A Comprehensive Overview of* Methods and Applications, Springer, First Edition, 2021.
2. N. Li, W. Qardaji, D. Su, Differential Privacy and Applications, Springer, First Edition, 2016.
3. X. Chen, Y. Liu, G. Xu, Deep Learning Security: Advances in Protecting Privacy and Robustness, Springer, First Edition, 2021.
4. W.C. Lin, P.Y. Chen, Y. Jin, Secure and Trustworthy Cyberphysical Systems: Data Security and Privacy, Springer, First Edition, 2020.
5. S. Nepal, S. Vatsalan, D. Meyer, Data Privacy and Trust in Cloud Computing, Springer, First Edition, 2022.

COURSE OUTCOMES:

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

CO1: Describe the principles and motivation for Federated Learning and its comparison with centralized ML.

CO2: Compare and analyze various FL architectures and optimization algorithms for heterogeneous data.

CO3: Evaluate incentive mechanisms and system-level challenges including communication efficiency and fairness.

CO4: Illustrate applications of FL in healthcare, finance, NLP, and mobile ecosystems.

CO5: Explain privacy-preserving AI concepts, including differential privacy and privacy-preserving machine learning methods.

Board of Studies (BoS):
20th BoS of IT held on 12.06.2025

Academic Council:
24th AC held on 26.08.2025

:	PO1	PO2	PO3	PO4	PO5
CO1	M				L
CO2			M		
CO3	M		H		
CO4			M		
CO5			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 course promotes development and understanding of secure, scalable, and ethical AI infrastructure, especially in sensitive domains such as healthcare and finance.

ITFY 209	HIGH PERFORMANCE CLOUD NETWORKS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: Tounderstand the foundational concepts of cloud computing

COB2: To describe the core principles of scalable cloud network architectures

COB3: To illustrate key performance optimization approaches for cloud

COB4: To explain different cloud storage architectures

COB5: To learnthe concepts and architectures of emerging computing in cloud

MODULE I CLOUD INFRASTRUCTURE AND VIRTUALIZATION L:9 T:0 P:0

Cloud Computing Fundamentals, Evolution, Cloud economics, **Service and Deployment Models**, **Virtualization Technologies: Hypervisors,** Resource allocation, Containers ,Cloud Networking Models

MODULE II SCALABLE CLOUD NETWORK ARCHITECTURES L: 9 T:0 P:0

SDN fundamentals, SDN controllers, **Network Function Virtualization (NFV),** Performance challenges, **Container Networking**, **Auto-Scaling Methodologies,** Cost-performance tradeoffs, Load Balancing **Architectures**

MODULE III PERFORMANCE OPTIMIZATION ANDQOS L: 9 T:0 P: 0

Performance Metrics and SLAs, Network KPIs, Application performance, Benchmarking methodologies, QoS models, QoS isolation, **Content Delivery Optimization, Protocol Optimization,** Latency Reduction, **Security-Performance Tradeoffs**

MODULE IV CLOUD DATA AND STORAGE NETWORKS L: 9 T: 0 P: 0

Cloud Storage Architectures, **Storage Networking Protocols,** SMB optimizations for cloud, **Data-Intensive Workloads, B**ig Data pipelines, Database networking, SQL - NoSQL clusters, **Performance Optimization,** Data replication and consistency models

MODULE V EMERGING CLOUD NETWORK PARADIGMS **L:9 T:0 P:0**

Edge and Fog Computing Networks, Latency-critical applications, Multi-Cloud and Hybrid Cloud Networking, Consistent security policies across clouds, Cost-optimized workload placement, **Sustainable Cloud Networking**, Liquid cooling innovations, Cross-cloud event routing.

L – 45; Total Hours:45

TEXT BOOKS:

1. Thomas Erl, and Eric Barcelo, Cloud Computing: Concepts, Technology, Security, and Architecture, Second Edition 2023, Pearson

REFERENCES:

1. Naresh Kumar Sehgal, Pramod Chandra P. Bhatt, and John M. Acken, Cloud Computing with Security and Scalability. Concepts and Practices, Third Edition 2023, Springer

COURSE OUTCOMES:

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

CO1: the fundamental principles of virtualization and containerization of cloud

CO2: the scalable cloud architectures

CO3: the critical performance and protocol optimization for cloud networks

CO4: the advanced storage concepts of cloud

CO5: the emerging concepts in cloud computing

Board of Studies (BoS):
20th BoS of IT held on 12.06.2025

Academic Council:
24th AC held on 26.08.2025

	PO1	PO2	PO3	PO4	PO5
CO1	M	H	L	L	M
CO2	H	H	M	M	M
CO3	H	H	M	H	M
CO4	H	H	M	M	L
CO5	H	H	M	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 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