



B.S. Abdur Rahman™

**Crescent**

Institute of Science & Technology

Deemed to be University u/s 3 of the UGC Act, 1956

*Regulations 2021  
Curriculum and Syllabi  
(Updated upto September 2024, as per  
22<sup>nd</sup> Academic Council)*

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**B.Tech.  
(Artificial Intelligence and Data Science)**



## **REGULATIONS 2021**

### **CURRICULUM AND SYLLABI**

**(Updated upto September 2024, as per 22<sup>nd</sup> Academic Council)**

## **B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**



## **VISION AND MISSION OF THE INSTITUTION**

### **VISION**

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

### **MISSION**

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



**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING****VISION AND MISSION****VISION**

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

**MISSION**

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

**PROGRAMME EDUCATIONAL OBJECTIVES**

- To introduce the fundamentals of science and engineering concepts essential for a data architect / data scientist.
- To inculcate the knowledge of mathematical foundations and algorithmic principles for effective problem solving.
- To provide knowledge in data science for modern computational data analysis and modeling methodologies.
- To provide the knowledge in artificial intelligence techniques and apply them to develop relevant models and real time products.
- To impart knowledge to analyze, design, test and implement the model required for various applications.
- To hone personality skills, trigger social commitment and inculcate societal responsibilities.

**PROGRAMME OUTCOMES**

PO1: Analyse and build models applying the knowledge of mathematics, statistics, electronic, electrical and computer science discipline and solve the problem.

PO2: Identify the sources of information for data collection, design and conduct the experiments and interpret the result.

PO3: Think out-of-the box and solve the real time problems using their creativity in designing human friendly software systems.

PO4: Comprehend computer engineering concepts of the new research developments and apply them to develop relevant software and hardware products.

PO5: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: Apply the computing knowledge to solve the socially relevant problems.

PO7: Understand the impact of engineering solutions in global, economic, environmental, societal context and apply it in exploring the new developments, research trends and involve them in research.

PO8: Develop professional integrity by understanding and appreciating professional, legal, ethical, cyber security and related issues and act with responsibility.

PO9: Communicate, collaborate and work as a team by involving in the group projects of multi-disciplinary nature.

PO10: To prepare documents as per the standards and present effectively to improve software documentation skills.

PO11: Apply the hardware and software project management techniques to estimate the time and human resources required to complete computer engineering projects.

PO12: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### **PROGRAMME SPECIFIC OUTCOMES**

PSO1: Understand, analyze and develop essential proficiency in the areas related to data science and artificial intelligence in terms of underlying statistical and computational principles and apply the knowledge to solve practical problems.

PSO2: Implement Artificial Intelligence and data science techniques such as search algorithms, neural networks, machine learning and data analytics for solving a problem and designing novel algorithms for successful career and entrepreneurship.





**REGULATIONS - 2021**  
**B.TECH. DEGREE PROGRAMMES**  
**(Under Choice Based Credit System)**

(Amendments Approved by the 19th Academic Council – September 2022)

**1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE**

In these Regulations, unless the context otherwise requires:

- i) **"Programme"** means B.Tech. Degree Programme.
- ii) **"Branch"** means specialization or discipline of B.Tech. Degree Programme like Civil Engineering, Mechanical Engineering, etc.,
- iii) **"Course"** means theory / practical / laboratory integrated theory / seminar / internship / project and any other subject that is normally studied in a semester like English, Mathematics, Environmental Science, Engineering Graphics, Electronic Devices etc.,
- iv) **"Institution"** means B.S. Abdur Rahman Crescent Institute of Science and Technology.
- v) **"Academic Council"** means the Academic Council, which is the apex body on all academic matters of this Institute.
- vi) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of the Institution who is responsible for the implementation of relevant rules and regulations for all the academic activities.
- vii) **"Dean (Student Affairs)"** means the Dean (Students Affairs) of the Institution who is responsible for activities related to student welfare and discipline in the campus.
- viii) **"Controller of Examinations"** means the Controller of Examinations of the Institution who is responsible for the conduct of examinations and declaration of results.
- ix) **"Dean of the School"** means the Dean of the School of the department concerned.
- x) **"Head of the Department"** means the Head of the Department concerned.

**2.0 ADMISSION**

**2.1a)** Candidates for admission to the first semester of the eight semester B. Tech. degree programme shall be required to have

passed the Higher Secondary Examination of the 10+2 curriculum (Academic stream) prescribed by the appropriate authority or any other examination of any University or authority accepted by the Institution as equivalent thereto.

- 2.1b)** The student shall have studied at least any three of the following courses: Physics, Mathematics, Chemistry, Computer Science, Electronics, Information Technology, Biology, Informatics Practices, Biotechnology, Technical Vocational Subjects, Agriculture, Engineering Graphics, Business Studies, Entrepreneurship at 10+2 level. In case if the student has not studied any or all the courses viz., mathematics, physics and chemistry, he / she shall undergo bridge course(s) in the concerned course(s) at 10+2 level knowledge.
- 2.2** Notwithstanding the qualifying examination, the candidate might have passed at 10+2, the candidate shall also write an entrance examination prescribed by the Institution for admission. The entrance examination shall test the proficiency of the candidate in the courses considered eligible for admission on the standards prescribed for 10+2 academic stream.
- 2.3** Candidates for admission to the third semester of the eight semester B.Tech. programme under lateral entry category shall be required to have passed minimum Three years / Two years (Lateral Entry) Diploma examination in any branch of Engineering / Technology or passed B.Sc. Degree from a recognized University as defined by UGC and passed 10+2 examination with Mathematics as a subject or Passed three year Diploma of Vocation Stream (D.Voc) in the same or allied sector or any other examination of any other authority accepted by the Institution as equivalent thereto.
- 2.4** The Institution shall offer suitable bridge courses in Mathematics, Physics, Engineering drawing, etc., for the students of diverse backgrounds.
- 2.5** The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Institution in adherence to the guidelines of regulatory authorities from time to time.

### **3.0 BRANCHES OF STUDY**

**3.1** Regulations are applicable to the following B.Tech. Degree programmes in various branches of Engineering and Technology, each distributed over eight semesters, with two semesters per academic year.

1. Aeronautical Engineering
2. Artificial Intelligence and Data Science
3. Automobile Engineering
4. Biotechnology
5. Civil Engineering
6. Computer Science and Engineering
7. Computer Science and Engineering (Cyber Security)
8. Computer Science and Engineering (Internet of Things)
9. Electrical and Electronics Engineering
10. Electronics and Communication Engineering
11. Electronics and Instrumentation Engineering
12. Information Technology
13. Mechanical Engineering
14. Polymer Engineering

### **4.0 STRUCTURE OF THE PROGRAMME**

**4.1** Every programme has a curriculum with syllabi consisting of theory and practical courses such as,

- i) Basic Science Courses - BSC
- ii) Humanities and Social Sciences including Management Courses - HSC
- iii) Engineering Science Courses - ESC
- iv) Professional Core Courses - PCC
- v) Professional Elective Courses - PEC
- vi) Open Elective Courses - OEC
- vii) Laboratory Courses – LC
- viii) Laboratory Integrated Theory Courses – LITC
- ix) Mandatory Courses- MC
- x) Project - PROJ (Project work, seminar and internship in industry or at appropriate workplace)

#### **4.1.1 Mandatory Induction Programme for First year Students**

The first year students upon admission shall undergo a

mandatory three week induction programme consisting of physical activity, creative arts, universal human values, literary, proficiency modules, lectures by eminent people, visits to local areas, familiarization with departments / schools and centres, etc.,

#### **4.1.2 Personality and Character Development**

All students shall enroll, on admission, in any of the following personality and character development programmes:

- National Cadet Corps (NCC)
- National Service Scheme (NSS)
- National Sports Organization (NSO)
- Youth Red Cross (YRC)
- Rotaract
- Crescent Indian Society Training Development (ISTD – C)
- Crescent Creative Strokes
- Crescent Technocrats club

The training activities / events / camp shall normally be organized during the weekends / vacation period.

#### **4.1.3 Online Courses for Credit Transfer**

Students are permitted to undergo department approved online courses under SWAYAM up to 40% of credits of courses in a semester excluding project semester 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 ratified by the respective Board of Studies shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

#### **4.1.4 Value Added Courses**

The students are permitted to pursue department approved online courses (excluding courses registered for credit transfer) or courses offered / approved by the department as value added courses.

The details of the value added course viz., syllabus, schedule of

classes and the course faculty shall be sent to the Dean (Academic Affairs) for approval. The students may also undergo the valued added courses offered by other departments with the consent of the Head of the Department offering the course.

These value added courses shall be specified in the consolidated mark sheet as additional courses pursued by the student over and above the curriculum during the period of study.

#### **4.1.5 Industry Internship**

The students shall undergo training for a period as specified in the curriculum during the summer vacation in any industry relevant to the field study.

The students are also permitted to undergo internship at research organizations / eminent academic institutions for the period prescribed in the curriculum during the summer vacation, in lieu of Industrial training.

In any case, the student shall obtain necessary approval from the Head of the Department / Dean of School and the training has to be taken up at a stretch.

#### **4.1.6 Industrial Visit**

The student shall undergo at least one industrial visit every year from the second year of the programme. The Heads of Departments / Deans of Schools shall ensure the same.

#### **4.2 Each course is normally assigned certain number of credits:**

- one credit per lecture period per week
- one credit per tutorial period per week
- one credit for two to three periods and two credits for four periods of laboratory or practical sessions per week
- one credit for two periods of seminar / project work per week
- one credit for two weeks of industrial training or 80 hours per semester.

#### **4.3 Each semester curriculum shall normally have a blend of lecture courses, laboratory courses, laboratory integrated theory courses, etc.**

#### **4.5 The medium of instruction, examinations and project report shall be in English, except for courses in languages other than English.**

**5.0 DURATION OF THE PROGRAMME**

**5.1** A student is expected to complete the B.Tech. programme in eight semesters (six semesters in the case of lateral entry scheme), but in any case not more than 14 continuous semesters reckoned from the date of first admission (12 semesters in the case of lateral entry students).

**5.2** Each semester shall consist of a minimum of 90 working days including the days of examinations.

**5.3** The maximum duration for completion of the programme as mentioned in clause 5.1 shall also include period of break of study vide clause 7.1 so that the student may be eligible for the award of the degree.

**6.0 REGISTRATION AND ENROLLMENT**

**6.1** The students of first semester shall register and enroll for courses 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 Course**

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

**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.

**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 5.1).

**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 Head of the Department as class advisor for the class throughout the period of study except first year.

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.

However, for the first and second semester, the class advisors (first year class advisors) are nominated by the first year coordinator.

### **8.2 Faculty Advisor**

To help the students in planning their courses of study and for general counseling, the Head of the Department 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 course offered to more than one group of students shall have a "Course Committee" comprising all the course faculty teaching the common course with one of them nominated as a course coordinator. The nomination of the course



coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending on whether all the course faculty teaching the common course belong to a single department or from several departments. The course committee shall ensure preparation of a common question paper and scheme of evaluation for the tests and semester end examination.

#### **10.0 CLASS COMMITTEE**

A class committee is constituted branch wise and semester wise by the Head of the Department / Dean of the School shall normally comprise of faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman.

**10.1** The composition of class committees for first and second semester is as follows:

- i) The first year coordinator shall be the chairman of the class committee
- ii) Faculty members of all individual courses of first / second semester
- iii) Six student representatives (male and female) of each class nominated by the first year coordinator
- iv) The class advisor and faculty advisors of the class

**10.2** The composition of the class committee for each branch from 3<sup>rd</sup> to 8<sup>th</sup> semester is 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) All the faculty members handling courses of the semester
- iii) Six student representatives (male and female) of each class nominated by the Head of the Department in consultation with the relevant faculty advisors
- iv) All faculty advisors and the class advisors
- v) Head of the Department

**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 components 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, etc.

**10.5** The third meeting of the class committee, excluding the student members, shall meet after the semester end examinations to analyse 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 course faculty concerned.

#### **11.0 CREDIT LIMIT FOR ENROLLMENT & MOVEMENT TO HIGHER SEMESTER**

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

**11.2** The minimum credits earned by the student to move to 7<sup>th</sup> semester shall not be less than 60 credits (40 credits for lateral entry students).

#### **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:

<b>Assessments</b>	<b>Course Coverage in Weeks</b>	<b>Duration</b>	<b>Weightage of Marks</b>
<b>Assessment 1</b>	1 to 6	1.5 hours	25%
<b>Assessment 2</b>	7 to 12	1.5 hours	25%
<b>Semester End Examination</b>	Full course	3 hours	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 60% weightage for continuous assessments and 40% for semester end examination. However, a student shall have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

### **12.4 Laboratory Integrated Theory Courses**

For laboratory integrated theory courses, the theory and practical components shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 75% for theory component and 25% for practical component. Grading shall be done for this consolidated mark. Assessment of theory components shall have a total of three assessments with two continuous assessments carrying 25% weightage each and semester end examination carrying 50% weightage. The student shall secure a separate minimum of 40% in the semester end theory examination. The evaluation of practical components shall be through continuous assessment.

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

### **12.6 Industry Internship**

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

### **12.7 Project Work**

In the case of project work, a committee of faculty members constituted by the Head of the Department / Dean of the School will carry out three periodic reviews. Based on the project report submitted by the students, an oral examination (viva voce) shall

be conducted as semester end examination by an external examiner approved by the Controller of Examinations. The weightage for periodic reviews shall be 50%. Of the remaining 50%, 20% shall be for the project report and 30% for the viva voce examination.

**12.8** Assessment of seminars and comprehension shall be carried out by a committee of faculty members constituted by the Head of the Department.

**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 the School for that purpose. There is no substitute examination for semester end examinations.

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

#### **14.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION**

- 14.1** A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% to become eligible to appear for the semester end examination in that course, failing which the student shall be awarded “I” grade in that course.
- 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 secures attendance between 65% and less than 75% in any course in a semester, due to medical reasons (hospitalization / accident / specific illness) or due to participation in the institution approved events, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the semester end examination of that course. In all such cases, the students shall submit the required documents immediately after joining the classes to the class advisor, which shall be approved by the Head of the Department / Dean of the School. The Vice Chancellor, based on the recommendation of the Dean (Academic Affairs) may approve the condonation of attendance.
- 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.
- 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 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.

#### **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	-

**"W"** - denotes withdrawal from the course

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

**"U"** - denotes unsuccessful performance in the course.

**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  $i^{\text{th}}$  course and  $GP_i$  is the Grade Point in the  $i^{\text{th}}$  course,

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

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" and "W" grades are excluded for calculating GPA.

"U", "I" and "W" 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 credits in VI semester 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 the even semester.

## **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. This committee shall also address the grievances related to the conduct of online classes.

## 19.0 ELIGIBILITY FOR THE AWARD OF DEGREE

**19.1** A student shall be declared to be eligible for the award of B.Tech. degree provided the student has:

- i) Successfully earned the required number of total credits as specified in the curriculum of the programme of study within a maximum period of 14 semesters (12 semesters for lateral entry) from the date of admission, including break of study.
- ii) Successfully completed the requirements of the enrolled professional development activity.
- iii) No dues to the Institution, Library, Hostel, etc.
- iv) No disciplinary action pending against him/her.

**19.2** The award of the degree must have been approved by the Institution.

## 20.0 MINOR DEGREE PROGRAMMES OFFERED FOR STUDENTS

**20.1** The students admitted in the following B.Tech. programmes can graduate with a minor degree, which is optional, along with a major degree:

• Civil Engineering	• Mechanical Engineering
• Electronics and Communication Engineering	• Electrical and Electronics Engineering
• Automobile Engineering	• Aeronautical Engineering
• Polymer Engineering	• Biotechnology Engineering
• Electronics and Instrumentation Engineering	• Computer Science and Engineering
• Information Technology	• Artificial Intelligence and Data Science
• Computer Science and Engineering (IoT)	• Computer Science and Engineering (Cyber Security)

**20.2** The eligibility for choosing the minor degree is given as below:

Sl. No.	Minor Degree	Eligible Major Degree Programmes (from other Departments)
1.	Artificial Intelligence and Machine Learning	Mechanical Engineering Aeronautical Engineering
2.	Block Chain	Polymer Engineering
3.	Cyber Security	Automobile Engineering

4.	Data Science	Civil Engineering
5.	Internet of Things (IoT)	Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering
6.	Virtual and Augmented Reality	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering
7.	Sensor Technology	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engineering
8.	Robotics	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Civil Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering
9.	3D Printing	Artificial Intelligence and Data Science

		Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering
10.	Electric Vehicles	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Civil Engineering Biotechnology Electronics and Communication Engineering
11.	Industrial Automation	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electronics and Communication Engineering
12.	GIS and Remote	Artificial Intelligence and Data

	Sensing	Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering
13.	Computational Biology	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering

**20.3** A student shall earn an additional 18 to 20 credits for the award of a minor degree.

**20.4** A student shall be awarded a minor degree only when he / she completes the requirements for the award of major degree stipulated in the respective programme.

**21.0 POWER TO MODIFY**

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

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

**B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**

**CURRICULUM & SYLLABUS, REGULATIONS 2021**

*(Choice Based Credit System)*

**SEMESTER I**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BSC	PHD 1182	Engineering Physics *	3	0	2	4
2.	BSC	CHD 1182	Chemistry for Electrical and Electronic Engineering *	3	0	2	4
3.	BSC	MAD 1181	Algebra and Differential Calculus	3	1	0	4
4.	ESC	GED 1101	Engineering Graphics	2	0	2	3
5.	ESC	GED 1102	Engineering Design	2	0	0	2
6.	ESC	GED 1103	Manufacturing Practices Laboratory **	0	0	2	1
7.	ESC	GED 1104	Programming for Problem Solving **	1	0	2	2
<b>Credits</b>							<b>20 #</b>

**SEMESTER II**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC	END 1281	English for Engineers	3	0	0	3
2.	BSC		Physics Elective	2	0	0	2
3.	BSC		Chemistry Elective	2	0	0	2
4.	BSC	MAD 1284	Statistics	3	1	0	4
5.	ESC	GED 1201	Engineering Mechanics	3	1	0	4
6.	ESC	GED 1202	Basic Electrical and Electronics Engineering *	3	0	2	4
7.	PCC	CSD 1251	Artificial Intelligence	3	0	0	3
8.	MC	GED 1206	Environmental Sciences	2	0	0	2
<b>Credits</b>							<b>24</b>

### SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC		Humanities Elective I	3	0	0	3
2.	BSC	MAD 2181	Statistics for Data Analysis	3	1	0	4
3.	PCC	CSD 2151	Foundations of Data Structures	3	0	0	3
4.	PCC	CSD 2152	Programming in Python Language	3	0	0	3
5.	PCC	CSD 2153	Principles of Software Engineering	3	0	0	3
6.	PCC	CSD 2154	Database Management and SQL	3	0	0	3
7.	PCC	CSD 2155	Foundations of Data Structures Laboratory **	0	0	2	1
8.	PCC	CSD 2156	Database Management and SQL Laboratory **	0	0	2	1
9.	PCC	CSD 2157	Python Programming Laboratory **	0	0	2	1
10.	HSC	GED 2101	Essential Skills and Aptitude for Engineers **	0	0	2	1
<b>Credits</b>							<b>23</b>

### SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	CSD 2251	Networking Methodologies*	3	0	2	4
2.	PCC	CSD 2252	Algorithmic Design Techniques#	3	1	0	4
2.	PCC	CSD 2253	Knowledge Engineering#	3	0	0	3
3.	PCC	CSD 2254	Data Warehousing and Data Mining	3	0	0	3
4.	PCC	CSD 2255	Essentials of Data Science #	2	0	0	2
5.	PCC	CSD 2256	Fundamentals of Operating System	3	0	0	3



B.Tech.	Artificial Intelligence and Data Science			Regulations 2021			
6.	PEC		Professional Elective Courses				3
7.	PCC	CSD 2257	Algorithmic Design Techniques Laboratory **	0	0	2	1
8.	PCC	CSD 2258	Data Mining Tools Laboratory **	0	0	2	1
9	PCC	CSD 2259	Algorithmic Design Techniques	3	0	0	3
10	PCC	CSD 2260	Essentials of Data Science	3	0	0	3
11.	MC	GED 2202	Indian Constitution and Human Rights	2	0	0	0
12.	HSC	GED 2201	Workplace Skills and Aptitude for Engineers **	0	0	2	1
			<b>Credits</b>				<b>22</b>

# - Applicable for 2021-22 admitted students

#### SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	CSD 3151	Data and Network Security	3	0	0	3
2.	PCC	CSD 3152	Cloud Computing Services	3	0	2	4
3.	PCC	CSD 3153	Automata Theory	3	0	0	3
4.	PCC	CSD 3154	Machine Learning Techniques	3	0	0	3
5.	PEC		Professional Elective courses				6
6.	PCC	CSD 3155	Machine Learning Laboratory **	0	0	2	1
7.	PCC	CSD 3156	Data and Security Laboratory **	0	0	2	1
8.	HSC	GED 3101	Communication Skills For Career Success **	0	0	2	1
9.	PROJ	CSD 3159	Internship I ##	0	0	0	1
			<b>Credits</b>				<b>23</b>

### SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC	MSD 3181	Fundamental of Entrepreneurship	3	0	0	3
2.	HSC		Humanities Elective II	2	0	0	2
3.	OEC		Open Elective I	3	0	0	3
4.	PCC	CSD 3251	Data Analytics and Visualization	3	0	0	3
5.	PCC	CSD 3252	IoT and Embedded Systems	3	0	0	3
6.	PEC		Professional Elective courses				6
7.	PCC	CSD 3253	Data Analytics and Visualization Laboratory **	0	0	2	1
8.	PCC	CSD 3254	Mobile Application Laboratory **	0	0	2	1
9.	PCC	CSD 3255	Software Tools and Techniques Laboratory**	0	0	2	1
10.	HSC	GED 3201	Reasoning and Aptitude for Engineers**	0	0	2	1
<b>Credits</b>							<b>24</b>

### SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	OEC		Open Elective II				3
2.	OEC		Open Elective III				3
3.	PCC	CSD 4151	Applied Artificial Intelligence	3	0	0	3
4.	PEC		Professional Elective Courses				12
5.	PROJ	CSD 4152	Internship II ###				1
6..	HSC	GED 4202	Employability Skills \$	0	0	2	1
<b>Credits</b>							<b>22</b>

**SEMESTER VIII**

<b>Sl. No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	PROJ	CSD 4251	Project work				9
<b>Credits</b>							<b>9</b>

**Overall Total Credits – 167**

\* Laboratory Integrated Theory course

\*\* Laboratory Course

# Three Week Orientation Programme – Mandatory Non-Credit Course

## 15 days of Industrial training during the summer vacation of second year.

The credit will be awarded in the 5<sup>th</sup> Semester.

### 15 days of Industrial training during the summer vacation of third year.

The credit will be awarded in the 7<sup>th</sup> Semester.

\$ Not a Mandatory Course - The student will take up this course during the Summer Holidays of III year as a comprehension of Soft Skills courses offered from semester III to VI. Upon successful completion, the course will be mentioned in grade sheet of VII semester.

**LIST OF PROFESSIONAL ELECTIVE COURSES****SEMESTER IV**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	PEC	CSDX 601	Business Intelligence	3	0	0	3
2	PEC	CSDX 602	Knowledge Management	3	0	0	3
3	PEC	CSDX 603	Intelligent Information Retrieval	3	0	0	3
4	PEC	CSDX 604	Ethics in Artificial Intelligence & Data Science	3	0	0	3
5	PEC	CSDX 605	Open Source tools for AI & Data Science	3	0	0	3
6	PEC	CSDX 606	R programming for Artificial Intelligence and Data Science	3	0	0	3
7	PEC	CSDX 607	Artificial Intelligence in Data analytics	3	0	0	3
8	PEC	CSDX 608	Data science for Intelligent Gaming system	3	0	0	3

**SEMESTER V**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	PEC	CSDX 501	Web and Social Media Mining	3	0	0	3
2	PEC	CSDX 502	Artificial Neural Networks	3	0	0	3
3	PEC	CSDX 503	Artificial Intelligence based Web application	3	0	0	3
4	PEC	CSDX 504	Game Theory	3	0	0	3
5	PEC	CSDX 505	Detective Database and Logic Programming	3	0	0	3
6	PEC	CSDX 506	Artificial Intelligence and Expert System	3	0	0	3
7	PEC	CSDX 507	Decision Making for Data Science	3	0	0	3

B.Tech.	Artificial Intelligence and Data Science			Regulations 2021			
8	PEC	CSDX 508	Social Network Analysis	3	0	0	3
9	PEC	CSDX 509	Pattern Recognition	3	0	0	3
10	PEC	CSDX 510	Healthcare Data Analytics	3	0	0	3
11	PEC	CSDX 511	Recommender System	3	0	0	3
12	PEC	CSDX 512	Agriculture Data Analytics	3	0	0	3
13	PEC	CSDX 513	Intrusion Detection and Data Analytics	3	0	0	3

#### SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	PEC	CSDX 621	Process Automation	3	0	0	3
2	PEC	CSDX 622	Applied Machine Learning	3	0	0	3
3	PEC	CSDX 623	Agent Based Intelligent System	3	0	0	3
4	PEC	CSDX 624	High Performance Computing	3	0	0	3
5	PEC	CSDX 625	Human and Intelligent Systems	3	0	0	3
6	PEC	CSDX 626	Natural Language Processing	3	0	0	3
7	PEC	CSDX 627	Generative Artificial Intelligence	3	0	0	3
8	PEC	CSDX 628	Web Analytics	3	0	0	3
9	PEC	CSDX 629	Exploratory Data Analysis	3	0	0	3
10	PEC	CSDX 630	Text Analytics	3	0	0	3
11	PEC	CSDX 631	Graph Theory and its Applications in Data Science	3	0	0	3
12	PEC	CSDX 632	Spatial Databases	3	0	0	3

#### SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	PEC	CSDX 521	Speech Processing	3	0	0	3
2	PEC	CSDX 522	Visual Data Analysis and Machine Perception	3	0	0	3

B.Tech.	Artificial Intelligence and Data Science			Regulations 2021			
3	PEC	CSDX 523	Advanced Artificial Intelligence	3	0	0	3
4	PEC	CSDX 524	Reinforcement Learning	3	0	0	3
5	PEC	CSDX 525	Fuzzy Systems	3	0	0	3
6	PEC	CSDX 526	Artificial Intelligence Chatbot	3	0	0	3
7	PEC	CSDX 527	Soft Computing Techniques	3	0	0	3
8	PEC	CSDX 528	Semantic Web	3	0	0	3
9	PEC	CSDX 529	Emotional Intelligence	3	0	0	3
10	PEC	CSDX 530	Deep learning techniques	3	0	0	3
11	PEC	CSDX 531	Cognitive Analytics	3	0	0	3
12	PEC	CSDX 532	Predictive Analytics	3	0	0	3
13	PEC	CSDX 533	Time Series Analysis	3	0	0	3
14	PEC	CSDX 534	Data Science and Bioinformatics	3	0	0	3
15	PEC	CSDX 535	Malware Analysis in Data Science	3	0	0	3
16	PEC	CSDX 536	Image & Video analytics	3	0	0	3
17	PEC	CSDX 537	Bayesian data analysis	3	0	0	3
18	PEC	CSDX 538	Feature Engineering	3	0	0	3
19	PEC	CSDX 539	Distributed Computing for Artificial Intelligence and Data Science	3	0	0	3
20	PEC	CSDX 540	Secure Data Science	3	0	0	3

**PHYSICS ELECTIVES – II Semester**

<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	PHDX 01	Non Destructive Testing of Materials	2	0	0	2
2	PHDX 02	Materials Science for Engineering	2	0	0	2
3	PHDX 03	Biomaterials	2	0	0	2
4	PHDX 04	Optical Fibre Communication	2	0	0	2
5	PHDX 05	Semiconductor Physics for Information Technology	2	0	0	2
6	PHDX 06	Sensors and Actuators	2	0	0	2
7	PHDX 07	Fundamentals of Nanotechnology and its Applications	2	0	0	2

**CHEMISTRY ELECTIVES – II Semester**

<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	CHDX 01	Chemistry of Construction Materials	2	0	0	2
2	CHDX 02	Chemistry of Materials and Electrochemical Devices	2	0	0	2
3	CHDX 03	Chemistry and Instrumentation for Electrical And Electronic Applications	2	0	0	2
4	CHDX 04	Functional Materials and Applications	2	0	0	2
5	CHDX 05	Chemistry of Fuels, Combustion and Lubricants	2	0	0	2
6	CHDX 06	Instrumental Methods of Polymer Analysis	2	0	0	2
7	CHDX 07	Medicinal Chemistry	2	0	0	2

**HUMANITIES ELECTIVES – III Semester**

<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	SSDX 01	Engineering Economics and Management	3	0	0	3
2	SSDX 02	Sociology of Science and Technology	3	0	0	3
3	SSDX 03	Industrial Economics and Management	3	0	0	3
4	SSDX 04	Dynamics of Indian Social Structure	3	0	0	3

**HUMANITIES ELECTIVES – VI Semester**

<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	SSDX 11	Economics of Sustainable Development	2	0	0	2
2	SSDX 12	Sociology of Industrial Relations.	2	0	0	2
3	SSDX 13	Professional Ethics and Human Values	2	0	0	2



**OPEN ELECTIVE COURSES FOR  
B.TECH. PROGRAMMES R 2021 - VI SEMESTER**

Sl. No.	Course Code	Course Title	L	T	P	C	Offering Department
1	GEDX 201	Application of Fluid Mechanics in Everyday Life	3	0	0	3	Aero
2	GEDX 202	Basics of Management and Organizational Behaviour	3	0	0	3	CSB
3	GEDX 203	Big Data Analytics	3	0	0	3	CA
4	GEDX 204	Biology for Engineers	3	0	0	3	SLS
5	GEDX 205	Consumer Electronics	3	0	0	3	ECE
6	GEDX 206	Creative Writing	2	1	0	3	English
7	GEDX 207	Cyber Forensics	3	0	0	3	CSE
8	GEDX 208	Cyber Security	3	0	0	3	IT
9	GEDX 209	Disaster Management	3	0	0	3	Civil
10	GEDX 210	English for Competitive Examination	2	1	0	3	English
11	GEDX 211	Enterprise Risk Management	3	0	0	3	CSB
12	GEDX 212	Fundamentals of Project Management	3	0	0	3	CSB
13	GEDX 213	Industrial Robotics	2	0	2	3	Mech.
14	GEDX 214	Internet of Things and its Applications	3	0	0	3	ECE
15	GEDX 215	Introduction to Health Care Analytics	3	0	0	3	CA
16	GEDX 216	IPR and Patent Laws	3	0	0	3	CSB
17	GEDX 217	Logistics and Supply Chain Management	3	0	0	3	CSB
18	GEDX 218	Nano Materials and Technology	2	0	2	3	Physics / Chemistry
19	GEDX 219	Numerical Computational Tools for Engineers	2	0	2	3	EIE
20	GEDX 220	Optimization Techniques	3	0	0	3	EEE
21	GEDX 221	Polymers for Emerging Technologies	3	0	0	3	Polymer
22	GEDX 222	Programming Language Principles	3	0	0	3	CSE

B.Tech.	Artificial Intelligence and Data Science				Regulations 2021	
23	GEDX 223	Public Speaking and Rhetoric	2	1	0	3 English
24	GEDX 224	Python Programming	2	0	2	3 IT
25	GEDX 225	R Programming	3	0	0	3 CA
26	GEDX 226	Smart Sensors for Healthcare Applications	3	0	0	3 EIE
27	GEDX 227	Total Quality Management	3	0	0	3 Mech.
28	GEDX 228	Value Education	3	0	0	3 Commerce
29	GEDX 229	Waste Water Management	3	0	0	3 Civil
30	GEDX 230	Web Application Development	3	0	0	3 CA

**OPEN ELECTIVE COURSES FOR  
B.TECH. PROGRAMMES R 2021 - VII SEMESTER**

Sl. No.	Course Code	Course Title	L	T	P	C	Offering Department
1	GEDX 101	Advanced Entrepreneurship	3	0	0	3	CSB
2	GEDX 102	Artificial Intelligence and Machine Learning Applications	3	0	0	3	CSE
3	GEDX 103	Automotive Technology	3	0	0	3	Automobile
4	GEDX 104	Behavioural Psychology	3	0	0	3	SSSH
5	GEDX 105	Building Repair Solutions	3	0	0	3	Civil
6	GEDX 106	Cloud Services and Management	3	0	0	3	CA
7	GEDX 107	Cost Management for Engineers	3	0	0	3	Commerce
8	GEDX 108	Cyber Law and Ethics	3	0	0	3	CSL
9	GEDX 109	Data Analytics and Visualization	3	0	0	3	CA
10	GEDX 110	Deep Learning Essentials	3	0	0	3	CSE
11	GEDX 111	Drone Technologies	2	0	2	3	Aero
12	GEDX 112	Electric Vehicle	3	0	0	3	EEE
13	GEDX 113	Emerging Technologies in Mobile Networks	3	0	0	3	ECE
14	GEDX 114	Fundamentals of Data Science and Machine	3	0	0	3	IT

B.Tech.		Artificial Intelligence and Data Science				Regulations 2021	
Learning							
15	GEDX 115	Genetic Engineering	3	0	0	3	SLS
16	GEDX 116	Green Design and Sustainability	3	0	0	3	Civil
17	GEDX 117	Image Processing and its Applications	3	0	0	3	ECE
18	GEDX 118	Industrial Automation and Control	3	0	0	3	EIE
19	GEDX 119	Industrial Safety	3	0	0	3	Mech.
20	GEDX 120	Industry 4.0	3	0	0	3	Mech.
21	GEDX 121	Introduction to Artificial Intelligence	3	0	0	3	IT
22	GEDX 122	Introduction to Artificial Intelligence and Evolutionary Computing	3	0	0	3	EEE
23	GEDX 123	Motor Vehicle Act and Loss Assessment	3	0	0	3	Automobile
24	GEDX 124	National Service Scheme	3	0	0	3	SSSH
25	GEDX 125	National Cadet Corps	3	0	0	3	SSSH
26	GEDX 126	Personal Finance and Investment	3	0	0	3	Commerce
27	GEDX 127	Soft Computing Techniques	3	0	0	3	CSE
28	GEDX 128	Value Analysis and Engineering	3	0	0	3	Mech.
29	GEDX 129	Vehicle Maintenance	3	0	0	3	Automobile

**SEMESTER I**

<b>PHD 1182</b>	<b>ENGINEERING PHYSICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To equip the students on the knowledge of electromagnetic waves.

**COB2:** To make the students in understanding the importance of mechanics.

**COB3:** To introduce the basics of oscillations, optics and lasers.

**COB4:** To acquire basic knowledge about the principle and theory of solids.

**COB5:** To understand the importance of physics behind semiconductor devices.

<b>MODULE I</b>	<b>ELECTROMAGNETIC WAVES</b>	<b>9</b>
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Gauss's law – Faraday's law - Ampere's law–Properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Reflection and transmission of electromagnetic waves from a non-conducting medium.

<b>MODULE II</b>	<b>QUANTUM MECHANICS</b>	<b>9</b>
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Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh-Jean's law– Matter waves–Physical significance of wave function – Schrodinger wave equation – Time independent and time-dependent wave equation – Applications: Particle in one-dimensional box – Introduction to quantum computing.

<b>MODULE III</b>	<b>OSCILLATIONS, OPTICS AND LASERS</b>	<b>9</b>
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Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - Anti-reflection coating - Air Wedge – Michelson's Interferometer – Determination of wavelength of light and thickness of thin transparent sheet-Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of Laser: Nd:YAG laser He-Ne laser and semiconductor laser - Applications : Laser Materials Processing - Holography.

**MODULE IV INTRODUCTION TO SOLIDS****9**

Free electron theory of metals- Expression for electrical conductivity of metal- Fermi level-Fermi distribution function-Effect of Fermi function with temperature- Density of energy states-carrier concentration in metals-Effect of temperature on Fermi energy- Energy distribution of electrons- Work function of a metal- Electron in a periodic potential (Kronig and Penny model)-Brillouin Zones- Fermi surface-Effective mass of electron and hole-Energy bands in solids.

**MODULE V PHYSICS OF SEMICONDUCTORS****9**

Elemental and compound semiconductors –Direct and Indirect band gap semiconductors- Drift and diffusion current – Intrinsic semiconductors: Intrinsic carrier concentration (derivation) – Fermi energy – Variation of Fermi energy level with temperature – Mobility and electrical conductivity – Band gap determination – Extrinsic semiconductors – Carrier concentration in n-type and p-type semiconductor (derivation) – Variation of Fermi level with temperature and impurity concentration – Variation of Electrical conductivity with temperature – Hall effect – Experiment and applications of Hall effect.

**PRACTICALS**

## List of Experiments

1. Determination of thickness of a thin wire / sheet using Air Wedge method.
2. Determination of wavelength of laser light using semiconductor laser diffraction.
3. Determination of angle of divergence of a laser beam using semiconductor diode laser and He-Ne laser.
4. Resistivity measurement of a semiconductor using four point probe method.
5. Determination of band gap of a semiconductor diode.
6. Determination of Hall coefficient of a given semiconductor material.
7. Determination of frequency of a tuning fork using Melde's string arrangement in transverse and longitudinal modes.
8. Determination of particle size of lycopodium powder using semiconductor laser.

**L – 45; P – 30 ; Total Hours – 75**

**TEXT BOOKS:**

1. P K. Palanisamy, Engineering Physics Vol I and II Scitech Publications (India) Pvt Ltd, 2018.
2. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.

**REFERENCES:**

1. D.J.Griffiths. Introduction to Electrodynamics. Pearson Education, 2015.
2. Serway R.A. and Jewett, J.W., Physics for Scientists and Engineers with Modern Physics, Brooks/cole Publishing Co., 2010.
3. Tipler P.A. and Mosca, G.P., Physics for Scientists and Engineers with Modern Physics, W.H. Freeman, 2007.
4. Markert J.T., Ohanian. H. and Ohanian, M., Physics for Engineers and Scientists, W.W. Norton & Co., 2007.
5. Palanisamy P.K., "Semiconductor physics and optoelectronics" Scitech Publications, 2003.
6. Linear Integrated Circuits by D. Roy Choudhury and Shail Jain - New Age International (P) Ltd.(2003).
7. Integrated Electronics by J.Millman and C.Halkias, Tata McGraw Hill, New Delhi (2001).

**COURSE OUTCOMES:**

**CO1:** Express the knowledge of electromagnetic waves.

**CO2:** Comprehend the importance & principles of quantum mechanics and apply it to understand ideas of quantum computing.

**CO3:** Grasp ideas related to oscillations, interference phenomenon, apply it to understand optical based devices and classify the different laser systems used for various applications.

**CO4:** Conceptualize the electron theory of metals and band structure of solids.

**CO5:** Understand the principles of physics behind semiconductors, Hall effect and apply the same to identify type of any semiconductor sample, evaluate no. of charge carriers.

**Board of Studies (BoS) :**

BOS of Physics was held on 21.06.21

**Academic Council:**17<sup>th</sup> AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	L	L	M	M	M	L	L	L	M	M			
CO2	H	M	M	L	L	M	L	L	L	L	L	M			
CO3	H	M	M	L	L	L	L	L	L	L	L	M			
CO4	H	M	M	L	M	M	M	L	L	L	M	M			
CO5	H	M	M	L	M	M	M	L	L	L	M	M			

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

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

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

<b>CHD 1182</b>	<b>CHEMISTRY FOR ELECTRICAL AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>ELECTRONIC ENGINEERING</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

To make the students conversant with

**COB1:** preparation, properties and applications of polymers and moulding techniques.

**COB2:** synthesis, properties and applications of nanomaterials

**COB3:** classification and description of different types of batteries and their applications.

**COB4:** concepts of photochemistry related to photophysical processes, chemical reactions and its applications.

**COB5:** types of corrosion and its prevention.

<b>MODULE I</b>	<b>POLYMERS FOR ELECTRICAL AND</b>	<b>10</b>
	<b>ELECTRONIC APPLICATIONS</b>	

Classification: source, heat, composition – glass transition temperature – preparation, properties and applications of polyethene (LDPE, HDPE), poly(vinyl chloride), PMMA, polycarbonate, teflon, ABS, bakelite, urea-formaldehyde, epoxy resin - conducting polymers: polyaniline, polyacetylene and poly(phenylenevinylene), rubber- vulcanised rubber, ebonite, EPDM, polymer blends and alloys - moulding techniques: injection moulding, compression moulding.

<b>MODULE II</b>	<b>NANOMATERIALS</b>	<b>10</b>
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Introduction – classification based on dimension with examples – properties of nanomaterials (surface to volume ratio and size quantisation effect) - synthesis of nanomaterials (Top-down and Bottom-up)– role of capping & reducing agents - CVD (CNT), laser ablation (Ag, Ag<sub>2</sub>O), electrodeposition (semiconductor materials), precipitation (Ag, Au), thermolysis: solvothermal (CuO, CeO<sub>2</sub>) and hydrothermal (TiO<sub>2</sub>, ZnO, carbon dots), microwave method (metal oxide), biogenic method – nanocomposite.

<b>MODULE III</b>	<b>BATTERIES</b>	<b>8</b>
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Electrochemical and electrolytic cell – batteries: types (primary, secondary and flow cell) – primary batteries: dry cell, alkaline battery – secondary batteries: nickel cadmium cell – lead acid storage cell - lithium battery: primary and secondary type - PN junction solar cell, thin film solar cell.



**MODULE IV                      PHOTOCHEMISTRY                      9**

Introduction: absorption and emission – laws of photochemistry: Grotthus-Draper law, Stark Einstein law – quantum efficiency – determination of quantum yield (problems) – Jablonski diagram: photo physical processes – IC, ISC, fluorescence and phosphorescence –(electronic states and transitions) – quenching – chemiluminescence – bioluminescence – photosensitization: principle and applications(photosynthesis and artificial photosynthesis) – photoelectrolysis.

**MODULE V                      CORROSION AND ITS PREVENTION                      8**

Types of corrosion – dry and wet corrosion – galvanic corrosion – differential aeration corrosion – Prevention of corrosion: choice of materials, electroplating, electroless plating of PCB, coatings : paints: constituents and function – hot dipping – galvanizing, tinning – powder coating – anodising – special coatings: water repellent coatings, fire-retardant coatings, temperature indicating coatings.

**PRACTICALS**

1. Free radical polymerization of PMMA.
2. Preparation of phenol-formaldehyde.
3. Preparation of urea-formaldehyde.
4. Synthesis of epoxy resin.
5. Determination of molecular weight and degree of polymerisation of polyvinyl alcohol using viscometer
6. Electrochemical synthesis of graphene oxide
7. Synthesis of nano-ZnO by precipitation
8. Demonstration of Laser ablation techniques for nanomaterials
9. Construction of dry cell and alkaline battery
10. Measurement of EMF for different batteries.
11. Electroplating of copper
12. Determination of corrosion of mild steel in acidic, neutral and basic

medium.

**L –45;P – 30; Total Hours –75**

**TEXT BOOKS:**

1. Jain P.C and Renuka Jain, Physical Chemistry for Engineers, Dhanpat Rai and Sons, New Delhi. 2016.

**REFERENCES:**

1. Gowarikar V.R., Viswanathan N.V and JayadevSreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1986.
2. Michael L. Berins, Plastics Engineering Hand Book, 5<sup>th</sup> Edition, Chapman and Hall, New York, 1991.
3. G.A. Ozin and A.C. Arsenault, "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, Thomas Graham House, Cambridge, 2005.
4. Principles of molecular photochemistry: An introduction, Nicholas J. Turro, V.Ramamurthy and Juan C. Scaiano, University Science Books, Sausalito, CA, 2009.

**COURSE OUTCOMES:**

The students will be able to

- CO1:**summarise the preparation, properties and applications of plastics used in electrical and electronic applications
- CO2:** synthesize different types of nanomaterials based on its size and applications.
- CO3:** illustrate construction and working of various types of batteries with the aid of a diagram.
- CO4:** state laws of photochemistry and elaborate the various types of photophysical processes and concepts of photochemistry.
- CO5:** explain the different types of corrosion and elaborate the methods of various coating techniques.

**Board of Studies (BoS) :**

11<sup>th</sup>BoS of Chemistry held on 17.06.2021

**Academic Council:**

15<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO 3
CO1		H		M					L						
CO2		H		M					L						
CO3		H													
CO4		M													
CO5		M	M			L	L								

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

#### SDG 9 : Industry, Innovation & Infrastructure

Statement: The synthesis and use of polymers and nanomaterials supports the industrial growth and innovation activities of the nation. The aspects of corrosion and its prevention will lead to corrosion free environment in the industry and infrastructure.

<b>MAD1181</b>	<b>ALGEBRA AND DIFFERENTIAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>	<b>CALCULUS</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To introduce matrix algebra techniques for engineers to apply in practical problems

**COB2:** To find the roots of polynomial equations using different techniques

**COB3:** To demonstrate the concepts of limits, continuity and application of differential calculus.

**COB4:** To familiarize the students with the functions of several variables

**COB5:** To develop the use of differential equations necessary for engineering applications

<b>MODULE I</b>	<b>MATRICES</b>	<b>9+3</b>
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Characteristic Equation- Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton Theorem (without proof) – Orthogonal matrices – orthogonal transformations of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation

<b>MODULE II</b>	<b>THEORY OF EQUATIONS</b>	<b>9+3</b>
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Introduction - Surds and irrational roots – simple problems – Equations whose roots are in A.P, G.P and in H.P – Relations between the roots and coefficients – symmetric functions – Formation of equations – Decreasing and Increasing the roots – transformation of equation – Reciprocal equations

<b>MODULE III</b>	<b>DIFFERENTIAL CALCULUS</b>	<b>9+3</b>
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Limits of functions - one sided limits – Continuity - Curvature – Cartesian and polar coordinates – center and radius of curvature – Circle of curvature – Involute and evolute – Envelopes

<b>MODULE IV</b>	<b>DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES</b>	<b>9+3</b>
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Laws of limits – Functions of two variables – partial derivatives – total differential – Implicit Functions – Jacobian - Taylor's series expansion – Optima of two variables – Lagrange's multiplier method

**MODULE V                      ORDINARY DIFFERENTIAL EQUATIONS                      9+3**

Linear equations of second order with constant and variable coefficients –  
Simultaneous first order linear equations with constant coefficients –  
homogeneous equations of Euler's type – method of undetermined  
coefficients- method of variation of parameters

**L – 45; T-15; Total Hours – 60**

**TEXT BOOKS:**

1. Ramana, B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2010.
2. Grewal B.S., "Higher Engineering Mathematics" 44th edition, Khanna Publishers, New Delhi, 2017.
3. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2011

**REFERENCES:**

- 1.Veerarajan.T., "Engineering Mathematics" (5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Jain, R.K. &Iyengar, S. R. K., "Advanced Engineering Mathematics", Narosa Publishers, 5<sup>th</sup> edition, 2016.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
4. Venkataraman, M.K., "Engineering Mathematics", Volume I, 2nd edition, National Publishing Co., Chennai, 2003.
5. James Stewart , " Calculus" 7th edition, Brooks/Cole Cengagelearning, UK

**COURSE OUTCOMES:**

At the end of the course students will be able to

**CO1:**use the matrix algebra methods for finding eigenvalues, eigenvectors and diagonalization

**CO2:** solve equations using the relations between roots and coefficients

**CO3:** apply differential calculus in various engineering problems

**CO4:** able to use differential calculus on several variable functions

**CO5:** solve various types of differential equations that arise in many applications

**Board of Studies (BoS) :**

12<sup>th</sup> BOS of Mathematics & AS held on  
23.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

Learning of various mathematical techniques like matrices and calculus will lead to knowledge of applications in Computer Science

<b>GED 1101</b>	<b>ENGINEERING GRAPHICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To introduce the basic concepts of engineering drawing, and familiarize with conic sections, special curves and orthographic projection of points and straight lines

**COB2:** To get practical exposure on projection of planes and solids

**COB3:** To be familiar with sectioning of solids, and development of surfaces

**COB4:** To conversant with 3D isometric projection, and perspective projection of simple solids

**COB5:** To introduce computerized drafting using CADD for drawing the orthographic views of simple solids

<b>MODULE I</b>	<b>BASICS, ENGINEERING CURVES AND</b>	<b>L: 7</b>
	<b>ORTHOGRAPHIC PROJECTION OF POINTS AND</b>	<b>P: 7</b>
	<b>STRAIGHT LINES</b>	

Drawing instruments, dimensioning, BIS conventions, types of lines, simple geometric constructions.

Conic sections: ellipse, parabola, hyperbola. Special curves: cycloid, epicycloid, hypocycloid and involutes.

Orthographic projection – first angle, second angle, third angle and fourth angle projections. Orthographic projection of points in all quadrants. Projection of straight lines in first quadrant – true length and true inclinations – traces of straight line.

<b>MODULE II</b>	<b>PROJECTION OF PLANES AND SOLIDS</b>	<b>L: 7</b>
		<b>P: 7</b>

Projection of plane lamina in first quadrant and its traces

Projection of solids in first quadrant: Axis inclined to one reference plane only- prism, pyramid, cone, and cylinder – change of position method

<b>MODULE III</b>	<b>SECTION OF SOLIDS AND DEVELOPMENT OF</b>	<b>L:5</b>
	<b>SURFACES</b>	<b>P:5</b>

Section of solids: prism, pyramid, cone and cylinder– sectional view – true shape of section- cutting simple position solids - plane inclined to one reference plane only.

Development of surface of truncated solids: prism, pyramid, cone and cylinder

– frustum of cone, pyramid and simple sheet metal parts.

#### **MODULE IV THREE DIMENSIONAL PROJECTIONS**

**L:4****P: 4**

Isometric projection: Isometric scale – isometric axes- Isometric projection and view of prism, pyramid, cylinder, cone and frustums.

Perspective projection: station point – vanishing point – Perspective projection and views of prism, pyramid by Visual ray method.

#### **MODULE V ORTHOGRAPHIC PROJECTION USING CADD**

**L:7****P:7**

Introduction to CADD - Basic commands for sketching - Editing sketches - creating texts and tables - Basic dimensioning and editing dimensions - Sketching orthographic views of simple solids and machine parts as per first angle projection - Plotting drawings.

**L – 30; P – 30; Total Hours – 60**

#### **TEXT BOOKS:**

1. N.D. Bhatt, “Engineering Drawing”, Charotar Publishing house, 53<sup>rd</sup> Edition, 2014.
2. Venugopal. K, and V. Prabhu Raja, “Engineering Graphics”, New Age International (P) Ltd., Publication, Chennai, Edition 15, 2017.

#### **REFERENCES:**

1. K.V. Natarajan, “A text book of Engineering Graphics”, Dhanalakshmi publishers, Chennai, 31<sup>st</sup> Edition, 2018.
2. Agrawal B. & Agrawal C. M., “Engineering Graphics”, TMH Publication, 2012.
3. Jeyapoovan, T., “Engineering Graphics using AutoCAD”, Vikas Publishing House Pvt. Ltd., New Delhi, 2015.
4. AutoCAD Software Theory and User Manuals
5. Engineering graphics You tube Lecture videos link:  
<https://www.youtube.com/user/BSAUNIV/videos>

#### **COURSE OUTCOMES:**

After completion of the course, students should be able to



**CO1:** identify the specifications and standards of technical drawing and draw conic sections, special curves and orthographic projection of points and straight lines

**CO2:** apply the concept of orthographic projection to draw the orthographic views of plane figures and simple solids

**CO3:** draw the sections of solids and development of solid surfaces

**CO4:** apply the concept of isometric and perspective projection to draw the 3-D views of simple solids

**CO5:** draw the orthographic views of simple objects using drafting software

**Board of Studies (BoS):**

18<sup>th</sup> BoS of MECH held on 21.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO1	PSO2
CO1	M	L	L	-	-	-	-	-	-	L	-	-	-	-
CO2	M	L	L	-	-	-	-	-	-	L	-	-	-	-
CO3	M	L	L	-	-	-	-	-	-	L	-	-	-	-
CO4	M	L	L	-	-	-	-	-	-	L	-	-	-	-
CO5	M	L	L	-	M	-	-	-	-	L	-	-	-	-

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

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

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

<b>GED 1102</b>	<b>ENGINEERING DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG:9</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To learn the basic concepts of design in engineering

**COB2:** To study the basic design thinking principles in problem solving

**COB3:** To encourage the students to develop a prototype using design concepts

**COB4:** To introduce the role of innovation in engineering

**MODULE I INTRODUCTION TO DESIGN 08**

Introduction to Engineering design – Design thinking – Problem identification - Design of Product, Process, System and Software – Case studies on Product, Process, Systems and Software design.

**MODULE II DESIGN THINKING PROCESS 08**

Empathy – Ideate - Need analysis - Voice of customers - product specification - concept generation - Bench marking - Quality function deployment - Concept evaluation - Case studies

**MODULE III PROTOTYPE DESIGN 07**

Product form and function – High level design – Design detailing - Sketch models – Prototypes - 3D printing - Case studies.

**MODULE IV INNOVATION 07**

Creativity and innovation – Role of innovation in Engineering – incremental changes and systemic changes; scientific approach to driving innovation – Intellectual property rights - case studies on innovative products.

**L – 30; Total Hours – 30**

**TEXT BOOKS:**

1. Clive L. Dym, Patrick Little, and Elizabeth J. Orwin, "Engineering Design: A Project Based Introduction", 4<sup>th</sup> Edition, Wiley, 2014.
2. Eppinger, S. and Ulrich, K., "Product design and development", McGraw-Hill Higher Education, 2015.

**REFERENCES:**

1. Nigel Cross, "Design Thinking", Berg Publishers, 2011.
2. Tom Kelley, "The Art of Innovation", Profile Books Ltd, London, 2016.
3. Tim Brown, "Change by Design", HarperCollins e-books, 2009.
4. Cliff Matthews, "Case Studies in Engineering Design", John Wiley & Sons Pvt. Ltd, New York, 1998.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:** explain the basic concepts of design in engineering products / process / Service

**CO2:** analyse the problems and perform design thinking process

**CO3:** correlate the basic principles of design thinking to solve engineering problems and develop prototypes

**CO4:** apply innovative approaches to engineering problems and provide design solutions

**Board of Studies (BoS):**

18<sup>th</sup>BoS of MECH held on 21.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

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

The holistic understanding of basic knowledge in Engineering design and its process in the development of prototypes results in satisfying industrial challenges.

<b>GED 1103</b>	<b>MANUFACTURING PRACTICES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>LABORATORY</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To learn the basics of pipe connections used in household and industrial systems

**COB2:** To educate the usage of welding equipment's and machining methods

**COB3:** To impart knowledge on sand mould preparation for simple components

**COB4:** To explore various tools, instruments and methods used in electrical wiring

**COB5:** To impart knowledge on Design, assembly and testing of electronic circuits

**PRACTICALS**

List of Experiments:

**CIVIL ENGINEERING PRACTICE:**

1. Study of plumbing in general household and industrial systems: Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
2. Making a small window frame with Lap and Mortise & Tenon Joints by sawing planing and cutting.
3. Introduction to power tools

**MECHANICAL ENGINEERING PRACTICE**

1. Fabrication of a small Table frame with Butt, Lap and Fillet Joints using Arc Welding - Gas cutting (Demo)
2. Machining of a component using simple turning and drilling practices.
3. Foundry operations such as sand mold preparation for simple component.
4. Plastic Component Manufacturing (Demo on Injection / Blow moulding)

**ELECTRICAL ENGINEERING PRACTICE:**

1. Comparison of incandescent, fluorescent, CFL and LED lamps.
2. Domestic, staircase and go down wiring.
3. Measurement of earth resistance.
4. Study of protection devices (small relay, fuse, MCB, HRC, MCCB, ECCB).
5. Familiarization of household electrical gadgets (Iron Box, Wet Grinder).
6. Study of inverter fed UPS/Emergency lamp

**ELECTRONICS ENGINEERING PRACTICE:**

1. Identifications and symbolic representation of active and passive electronic components
2. Soldering and tracing of electronic circuits and checking its continuity
3. Design and testing of electronic circuits using active and passive electronic components

**P –30; Total Hours –30**

**TEXT BOOK:**

1. S. Gowri and T. Jeyapoovan, "Engineering Practices Lab Manual – Civil, Mechanical, Electrical, Electronics included", Vikas Publishing, 5<sup>th</sup> Edition, 2019.

**REFERENCES:**

1. SubhransuSekhar Dash & K. Vijayakumar, "Electrical Engineering Practice Lab Manual", Vijay Nicole Imprints Private Ltd., First Edition, 2013.
2. Raghbir Singh Khandpur, "Printed Circuit Boards: Design, Fabrication, and Assembly", Tata McGraw-Hill Education, 2005.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:** demonstrate Plumbing requirements of domestic buildings.

**CO2:** use welding equipment's to join the structures and to carry out machining operations

**CO3:** perform the task of making sand mould for simple components

**CO4:** execute simple electrical wiring and comprehend the construction and working of household appliances.

**CO5:** assemble and test simple electronic circuits used in day-to-day life

**Board of Studies (BoS):**

18<sup>th</sup>BoS of MECH held on 21.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	L	-	-	-	-	-	-	-	-	-	-	-	-	-

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

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

The holistic understanding of welding, moulding, machining, wiring and electronic circuit increases the access of small-scale industrial and other enterprises in developing countries.

<b>GED 1104</b>	<b>PROGRAMMING FOR PROBLEM</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>SOLVING</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To explore the hardware and software components of the computer

**COB2:** To learn the structured and procedural programming concepts using C.

**COB3:** To study the constructs of decision making in branching and iteration statements

**COB4:** To learn Functions for effective reusability and readability of the code.

**COB5:** To understand pointer and file operation concepts.

<b>MODULE I</b>	<b>INTRODUCTION TO C PROGRAMMING</b>	<b>05</b>
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Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, system software, compilers, creating, compiling and executing a program, Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming - Structure of C - C Tokens – Data Types – Declaration of Variables and Storage class – Operators – Expressions - Type Conversion.

<b>MODULE II</b>	<b>DECISION MAKING AND ARRAY</b>	<b>05</b>
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Decision Making and Branching: Simple if Statements, The if..else statements, Nesting of if..else statements, else...if Ladder, switch Statements, goto Statements, Looping: while, do...while, for Statements, Array: One-Dimensional, Two-Dimensional and Multi-Dimensional operations.

<b>MODULE III</b>	<b>USER-DEFINED FUNCTIONS AND FILE OPERATIONS</b>	<b>05</b>
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Definition of Functions - Function Types – Nesting of Functions – Recursion – Structures and Unions – Pointers - File handling operations.

**PRACTICALS****LIST OF PROGRAMS IN C:**

1. Computer organization –Hardware in a typical computer Identification – Booting error messages and what it means
2. Structure of a basic program - Hello world program
3. Data types and Type conversions
4. Input / Output: Formatted functions – Unformatted functions – Library functions

5. Properties of operators – Priority of operators – Arithmetic relational logical and bitwise operators
6. Conditional Statements: If – if else- nested if else- goto- switch case – nested switch case
7. Iteration Statements: for loops – nested for loops – while loop – do-while loop – break and continue statement
8. I/O operations of one- and two-dimensional arrays
9. Bubble Sort and Linear Search using arrays.
10. Functions and its types, Recursion Function
11. Pointers File Operations

**L – 15; P – 30 ; Total Hours – 45**

**TEXT BOOKS:**

1. Richard L. Stegman, “Focus on Fundamentals of Programming with C”, Ninth Edition, ISBN -170077395X, 9781700773951, 2019.
2. E.Balagurusamy, “Programming in ANSI C”, McGraw Hill Education, Eighth Edition, ISBN-13: 978-93-5316-513-0, ISBN-10: 93-5316-513-X, 2019.

**REFERENCES:**

1. Brian W. Kernighan and Dennis M. Ritchie, “ The C Programming Language”, Prentice Hall, ISBN 0-13-110362-8, 2015.
2. Ashok N Kamthane, “Computer Programming”, Pearson Education, 2nd Edition, ISBN 13: 9788131704370, 2012.
3. Paul J. Deitel, Deitel& Associates, “C How to Program”, Pearson Education, 7th Edition, ISBN-13: 978-0132990448, 2012.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** identify the hardware components and describe the software components of computer.

**CO2:** bring out the importance of structural and procedural programming

**CO3:** write C coding using conditional and iteration statements

**CO4:** develop programs using Functions, Pointers and Files

**CO5:** implement program to build a real time application.

**Board of Studies (BoS) :**

18<sup>th</sup>BoS of CSE held on 26.07.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021



	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	-	M	L	H	-	L	-	-	M	-	-	-	-	-
CO2	H	M	M	-	-	H	M	-	M	-	-	-	-	-
CO3	H	M	H	-	-	H	-	-	H	-	-	-	-	-
CO4	H	H	H	H	M	H	-	-	H	-	-	-	-	-
CO5	H	H	H	H	H	H	H	H	H	L	H	H	-	-

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

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

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

**SEMESTER II**

<b>END 1281</b>	<b>ENGLISH FOR ENGINEERS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To train students to use appropriate vocabulary in academic and technical contexts

**COB2:** To facilitate students to speak effectively while exchanging ideas and making presentations

**COB3:** To develop students' listening skill for comprehending and analysing information

**COB4:** To develop their reading skill through sub skills like skimming, scanning and critical reading of a text

**COB5:** To sharpen their academic writing skills

**COB6:** To expose them to the correct usage of language and help them to apply that knowledge appropriately

<b>MODULE I</b>	<b>HUMAN RESOURCES</b>	<b>10</b>
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L: Listening to short texts – short formal & informal conversations.

S: Introducing one self – exchanging personal info.

R: Process of reading purposes, Reading comprehension, improving comprehension skills, Reading activities – short comprehension passages, practice in skimming & scanning.

W: Scientific & Technical Writing, Editing skills, Activities – completing sentences, developing hints - Paragraph Writing

Voc. development: Prefixes, Suffixes

Lang. development: Articles, Countable and Uncountable nouns, Present tense, Wh– Questions, Yes or No questions.

<b>MODULE II</b>	<b>TRANSPORT</b>	<b>10</b>
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L: Listening to long scientific talks

S: Sharing personal information – greeting, leave taking.

R: Comprehension passages with multiple choice questions / Wh–questions/ openended questions - Reading longer technical texts & completing exercises based on them.

W: Use of reference words & discourse markers on a text, jumbled sentences, describing a process – flow chart, use of sequence words.

Voc. development: Guessing meanings of words in context, vocabulary used

in formal letters, e-mails & reports.

Lang. development: Preposition of Time, Place & Date, Past tense, Conjunctions, Impersonal passive voice, Question tags, Numerical Adjectives.

### **MODULE III ENERGY 9**

L: Listening to talk on the topic & completing tasks.

S: Asking about routine actions & expressing opinions.

R: Locating Specific Information

W: Letter seeking permission for Industrial Visit / symposium – Letter of invitation

Voc. development: Sequence words, misspelt words.

Lang. development: Adverbs, Degrees of comparison, Future tense, Homophones

### **MODULE IV OUR LIVING ENVIRONMENT 8**

L: Listening to scientific texts & making notes – Effective ways of making notes.

S: Speaking about one's friend.

R: Reading texts & magazines for detailed comprehension. (Students can be asked to read any book of their choice to encourage reading habit)

W: Argumentative writing.

Voc. Development: Synonyms, antonyms, phrasal verbs.

Lang. development: If clauses, Subject - Verb Agreement

### **MODULE V TECHNOLOGY 8**

L: Listening to talks (General & Scientific).

S: Short group conversations.

R: Reading and understanding technical articles, Short narratives & articles from Newspaper including conversations.

W: Short essays, Dialogue writing.

Voc. Development: Idioms & Phrases.

Lang. development: Modal verbs.

**L - 45; Total Hours - 45**

#### **TEXT BOOKS:**

1. Board of Editors. Using English A Coursebook for Undergraduate

Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015

2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP,

2015.

**REFERENCES:**

1. Perry, Carol Rosenblum (2011). The Fine Art of Technical Writing, Create Space Independent Publishing Platform, New Delhi.
2. Dutt, P.K. Rajeevan G. and Prakash, C.L.N. (2007). A course in Communication Skills, Cambridge University Press, India.
3. Sen, Leena (2004). Communication Skills, Prentice Hall, New Delhi.
4. Matt Firth, Chris Sowton et.al (2012). Academic English An Integrated Skills Course for EAP, Cambridge University Press, Cambridge.
5. Bailey Stephen 2011. Academic Writing: A practical guide for students, New York, Rutledge.
6. Redston, Chris & Gillies (2005). Cunningham Face2Face (Pre-intermediate Student's Book & Workbook) Cambridge University Press, New Delhi.
7. Dutt P. Kiranmai and Rajeevan Geeta (2013). Basic Communication Skills, Foundation Books.

**COURSE OUTCOMES:**

**CO1:** Read articles of a general kind in magazines and newspapers

**CO2:** Participate effectively in conversations, introduce themselves and their friends and express opinions in English

**CO3:** Comprehend conversations and short talks delivered in English

**CO4:** Write short essays of a general kind and letters and emails in English

**CO5:** Express through speaking and writing using appropriate vocabulary and grammar

**Board of Studies (BoS) :**

13<sup>th</sup> BoS of Department of English held on 17.6.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
C01	-	-	-	-	-	-	-	-	-	M	-	-
C02	-	-	-	-	-	-	-	-	-	H	-	-
C03	-	-	-	-	-	-	-	-	-	M	-	-
C04	-	-	-	-	-	-	-	-	-	H	-	-
C05	-	-	-	-	-	-	-	-	-	M	-	-

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

SDG No. 4 : Give Quality Education to all the Engineers

Statement: In future, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

<b>MAD 1284</b>	<b>STATISTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** Understand the fundamental knowledge on probability

**COB2:** Understand one dimensional random variable, Expectation and Inequalities

**COB3:** Discuss Probability distributions and their uses

**COB4:** To evaluate Generating functions

**COB5:** Learn joint density function and use of generating functions

<b>MODULE I</b>	<b>BASIC PROBABILITY CONCEPTS</b>	<b>9+3</b>
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Types of data- Frequency distributions-Lineplot- Cumulative frequency curves- Location- Spread. Set theory, Venn diagrams, Basics of probability- The addition and multiplication rule – Conditional Probability- and Total probability – Baye's Theorem.

<b>MODULE II</b>	<b>RANDOM VARIABLES</b>	<b>9+3</b>
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Random Variables and Expectation of a random variable – Moment inequalities (Tchebyshev, Markov, Jensen)-Continuous random variables - Functions of a random variable

<b>MODULE III</b>	<b>PROBABILITY DISTRIBUTIONS</b>	<b>9+3</b>
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Discrete distributions- Bernoulli, Binomial, Geometric, Negative binomial, Hypergeometric and Poisson distribution. Continuous distributions- Uniform, Gamma, exponential, Normal distribution, Random number simulation

<b>MODULE IV</b>	<b>GENERATING FUNCTIONS</b>	<b>9+3</b>
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Probability generating functions- Moment generating functions- moments- Cumulant generating functions- Linear functions

<b>MODULE V</b>	<b>JOINT DISTRIBUTIONS</b>	<b>9+3</b>
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Joint distributions- Expectations of functions of two variables- Independence of random variables - Convolutions- Use of generating functions –deriving distributions of linear combinations of independent random variables- Correlation

**L – 45 ; T - 15; Total Hours – 60**

**TEXT BOOKS:**

1. Miller, I.; Miller, M.; —Mathematical Statistics II, 7th Edition. Prentice Hall International, New Jersey 1999
2. Ross, S.M., II Probability and Statistics for Engineers and Scientists II John Wiley & Sons, New Jersey 2007

**REFERENCES:**

- 1 S.C Gupta, V.K Kapoor, II Fundamentals of mathematical statistics—, Sultan ch and sons, New Delhi, 2019
- 2 S.C Gupta, V.K Kapoor, II Fundamentals of Applied statistics —, Sultan chand and sons, New Delhi, 2017
- 3 Dekking, F.M., Kraaikamp, C., Lopuhaä, H.P., Meester, L.E. —A Modern Introduction to Probability and Statistics II Springer text series, 2<sup>nd</sup> Edition
- 4 Chin Longchiang—Statistical Methods of Analysis—World Scientific Books, 2003

**COURSE OUTCOMES:**

At the end of the course students will be able to

**CO1:** Evaluate Probability and apply Baye's theorem

**CO2:** Evaluate upper and lower bounds using moment inequalities

**CO3:** Calculate probabilities and expected values for distributions

**CO4:** Derive probability generating function, a moment generating function, a cumulant generating function and cumulants, and use them to evaluate moments.

**CO5:** Analyse jointly distributed random variables and conditional distributions, and use generating functions

**Board of Studies (BoS) :**

12<sup>th</sup> BOS of Mathematics & AS  
held on 23.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

Learning of various statistical methods will lead to knowledge of applications in Data Science and Computing



<b>GED 1201</b>	<b>ENGINEERING MECHANICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 9</b>		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To impart knowledge about the basic laws of mechanics, resolution of forces, equilibrium of particles in 2D and 3D force systems.

**COB2:** To learn about supports, reactions and equilibrium of rigid bodies

**COB3:** To educate surface properties such as centroid and moment of inertia

**COB4:** To impart knowledge on friction and its applications

**COB5:** To study the laws of motion, impulse, momentum and elastic bodies

<b>MODULE I</b>	<b>VECTOR APPROACH AND EQUILIBRIUM OF PARTICLE</b>	<b>L:11</b>
		<b>T:3</b>

Introduction - Vectors – Vectorial representation of forces and moments – Vector Algebra and its Physical relevance in Mechanics – Laws of Mechanics – Parallelogram and triangular Law of forces- Coplanar Forces Principle of transmissibility, Resolution and Composition of forces- Forces in plane and space - Lame's theorem - Equilibrium of a particle in 2D plane - Equilibrium of a particle in 3D space - Equivalent systems of forces – Single equivalent force

<b>MODULE II</b>	<b>EQUILIBRIUM OF RIGID BODY</b>	<b>L:7</b>
		<b>T:3</b>

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis –Vectorial representation of moments and couples – Scalar components of a moment –Varignon's theorem - Equilibrium of Rigid bodies in two dimensions –Examples

<b>MODULE III</b>	<b>PROPERTIES OF SURFACES</b>	<b>L:10</b>
		<b>T:3</b>

Determination of Areas – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, Angle section, Hollow section using standard formula – second and product moments of plane area – Physical relevance - Standard sections: Rectangle, triangle, circle- composite sections, Hollow section using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of Inertia

**MODULE IV FRICTION****L:9****T:3**

Introduction to friction- types of friction- Laws of Coloumb friction- Frictional force – simple contact friction –Block friction– Rolling resistance –ladder friction and wedge friction

**MODULE V LAWS OF MOTION****L:8****T:3**

Review of laws of motion – Newton's second law – D'Alembert's principle and its applications in plane motion; Work Energy Equation of particles– Impulse and Momentum – Impact of elastic bodies.

**L – 45; T – 15; Total Hours – 60****TEXT BOOKS:**

1. Beer, F.Pand Johnston Jr. E.R, —Vector Mechanics for EngineersII, McGraw Hill Education, 10<sup>th</sup> Edition,2017.
2. R.K. Bansal.,—A Text Book of Engineering MechanicsII, Laxmi Publications, 6<sup>th</sup> Edition,2015.

**REFERENCES:**

1. Russell CHibbeler, —Engineering Mechanics: Statics &DynamicsII, 14<sup>th</sup> Edition, Pearson,2015.
2. IrvingH.Shames,—Engineering Mechanics—Statics and DynamicsII, 4<sup>th</sup> Edition, Pearson Education India, 2005.
3. R.S. Khurmi., —A Text Book of Engineering MechanicsII, S. Chand Publishing, 22<sup>nd</sup> Edition, 2018.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:** resolve composite forces, apply concept of equilibrium to particles and solve problems

**CO2:** apply the concept of equilibrium to rigid bodies and solve problems

**CO3:** determine the properties of surfaces

**CO4:** analyse and evaluate the frictional forces between the bodies

**CO5:** apply the laws of motion in solving dynamics problems

**Board of Studies (BoS):**

19<sup>th</sup> BOS held on 21.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

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

The understanding of force systems and its components leads to construction of robust engineering systems.

<b>GED 1202</b>	<b>BASIC ELECTRICAL AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 3, 5, 8, 12</b>	<b>ELECTRONICS ENGINEERING</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To make the students understand the basic calculations and measurements in DC circuits.

**COB2:** To provide the basic knowledge on AC circuit calculations and measurements.

**COB3:** To familiarize with working and characteristics of different DC and AC machines.

**COB4:** To impart knowledge on basic semiconductor devices and their applications.

**COB5:** To introduce the students to fundamentals of digital electronics.

**MODULE I DC CIRCUITS & MEASUREMENTS 12**

The concept of voltage and current - Electric circuit elements: R, L, C – Independent and dependent sources - Ohm's law- Kirchhoff's law- series and parallel resistive circuits – Voltage and current division – Star-delta transformation - Mesh and nodal analysis of resistive circuits – simple problems - Measurement of voltage, current and power in DC circuits.

**MODULE II AC CIRCUITS & MEASUREMENTS 17**

Sinusoidal voltage - RMS, average, peak value, peak factor and form factor - single phase RL, RC and RLC circuits – phasor representation - complex power – power factor - simple problems - Resonance in RLC circuits – 3 phase balanced circuit calculations– star and delta connections - Principles of measurement of AC voltage, current, power and energy - Measurement of three phase power.

**MODULE III ELECTRICAL MACHINES 18**

Construction, principle of operation, basic equations, characteristics and applications of DC generators, DC motors, single phase transformers and three phase induction motors. Working principle of BLDC Motor and its applications in home appliances.  
(Qualitative treatment only).

**MODULE IV SEMICONDUCTOR DEVICES AND APPLICATIONS 14**

Introduction to semiconductors - Characteristics of PN Junction Diode – Zener Diode and its characteristics – SCR and its characteristics – Bipolar Junction Transistor and its characteristics – JFET & MOSFET – their characteristics.

Applications: Half wave and full wave rectifiers - Voltage Regulation – Regulator ICs.

## **MODULE V INTRODUCTION TO DIGITAL CIRCUITS 14**

Logic gates- Boolean algebra theorems– K Map-Introduction to combinational circuits– Flip-Flops – Registers– A/D and D/A Conversion – Data acquisition systems

### **PRACTICALS**

#### **List of Experiments**

1. Verification of KCL and KVL (ii) Measurement of voltage, current and power in DC circuits.
2. (i) Resonance of RLC series circuit  
(ii) Measurement of voltage, current, power and power factor in single phase & three phase AC circuits.
3. (i) Magnetization characteristics of DC generator  
(ii) Characteristics of DC shunt motor, single phase transformer and three phase induction motor.
4. Fabrication of a low voltage regulated power supply.
5. Implementation of half and full adders.

**L – 45 ; P – 30 ; Total Hours – 75**

#### **REFERENCES:**

1. Edward Hughes, “Electrical and Electronics Technology”, Pearson India, 12th Edition, 2016.
2. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, McGraw Hill Education, First Edition, 2017.
3. Cotton H, “Electrical Technology”, CBS Publishers, 7th Edition, 2007.
4. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2015.
5. Jacob Millman & Christos C. Halkias, Satyaprataba Jit “Electronic Devices and Circuits” McGraw Hill Education, 4th Edition, 2021.
6. Floyd, “Electronic Devices: Conventional Current Version” Pearson Education India, 7th Edition, 2008.

7. S. Salivahanan, N. Sureshkumar and A. Vallavaraj, "Electronic Devices and Circuits", McGraw Hill Education (India) Pvt. Ltd., 2018.
8. Thomas L. Floyd, "Digital Fundamentals", 10th Edition Pearson Education Inc., New Delhi, 2008.

### COURSE OUTCOMES:

At the end of this course, the student will be able to

**CO1:** perform the basic calculations in DC circuits and measure the various quantities associated with DC circuits.

**CO2:** measure and compute the rms current and voltage, power, power factor and energy in AC circuits.

**CO3:** choose appropriate motor for specific applications based on the motor characteristics.

**CO4:** fabricate a regulated power supply for low voltage applications and build static switches using BJT and SCR.

**CO5:** build simple digital circuits like half adder and full adder.

### Board of Studies (BoS) :

15th meeting of BoS of EEE  
held on 25.06.2021

### Academic Council:

17<sup>th</sup> AC held on  
15.07.2021

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

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

SDG 3: Good health and well being.

Statement: Understanding of the fundamentals of electrical and electronics systems can help in designing systems to promote good health and well being.

SDG 5: Gender equality

Statement: Acquiring the interdisciplinary knowledge help overcome the gender barriers in work place.

SDG 8: Decent work and economic

Statement: The learners of this course can get decent work and earn financial benefits and they can work in interdisciplinary areas.

SDG 12: Responsible consumption and production.

Statement: Use of right and energy efficient electric and electronic components and devices results in reasonable consumption and production.

<b>CSD 1251</b>	<b>ARTIFICIAL INTELLIGENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To gain a historical perspective of AI and its foundations.

**COB2:** To become familiar with basic principles of AI toward knowledge representation.

**COB3:** To explore the various methods of reasoning under uncertainty.

**COB4:** To familiarize with different types of learning algorithms.

**COB5:** To learn the importance of AI in diverse applications.

<b>MODULE I</b>	<b>INTRODUCTION</b>	<b>9</b>
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Introduction - Foundation and history of AI - AI Problems and techniques - AI programming languages – Introduction to LISP and PROLOG – Problem spaces and searches - Blind search strategies; Breadth first - Depth first – Heuristic search techniques Hill climbing - Best first – A\* algorithm AO\* algorithm – game trees - Minimax algorithm – Game playing – Alpha beta pruning.

<b>MODULE II</b>	<b>KNOWLEDGEREPRESENTATION</b>	<b>9</b>
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Knowledge representation issues – Predicate logic – logic programming – Semantic nets- Frames and inheritance - constraint propagation – Representing Knowledge using rules – Rules based deduction system.

<b>MODULE III</b>	<b>REASONINGUNDERUNCERTAINTY</b>	<b>9</b>
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Introduction to uncertain knowledge review of probability–Baye's Probabilistic inferences and Dempster Shafer theory–Heuristic methods–Symbolic reasoning under uncertainty- Statistical reasoning – Fuzzy reasoning – Temporal reasoning- Non monotonic reasoning.

<b>MODULE IV</b>	<b>LEARNING</b>	<b>9</b>
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Learning from examples- Discovery as learning – Learning by analogy – Explanation based learning –Introduction to Neural nets –Genetic Algorithms.



**MODULE V APPLICATIONS****9**

AI applications – Language Models - Information Retrieval - Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition

**L – 45; Total Hours – 45****TEXT BOOK:**

1. Elaine Rich, —Artificial Intelligence 3E (Sie) II, Tata McGraw - Hill Publ. – 2019, ISBN: 9780070087705, 0070087709

**REFERENCES:**

1. Daugherty, Paul R., and H. James Wilson. —Human+ machine: reimagining work in the age of AI II, Harvard Business Press, 2018, ISBN: 9781633693876, 1633693872.
2. Prateek, J. —Artificial Intelligence with Python II, pp. 14–16. Packt Publishing, Birmingham, 2017, ISBN: 9781786469670, 1786469677
3. Husain, Amir, —The sentient machine: The coming age of artificial intelligence II, Simon and Schuster, 2017, ISBN: 9781501144684, 1501144685
4. Kaplan, Jerry. II Artificial intelligence: What every one needs to know II, Oxford University Press, 2016, ISBN: 9780190602390, 0190602392

**COURSE OUTCOMES:**

At the end of this course, the student will be able to:

**CO1:** Identify the fundamental concepts of AI and employ the methods for solving the AI problem.

**CO2:** Construct knowledge to the machine using the different methods like logic, rules, semantic and frames.

**CO3:** Analyze the missing, ambiguous data and identify the reasoning to find the solution.

**CO4:** Apply various learning methods to design the model in AI.

**CO5:** Implement and examine the real world applications with AI.

**Board of Studies (BoS) :**

19th BOS of CSE held on 26.06.2021

**Academic Council:**

17<sup>th</sup> ACM held on 15.07.21

	PO 1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	H	H	M	M									
CO2	M	H	M	M	L									
CO3	H	H	M	M		L	L				L	M		
CO4	H	H	M	M										
CO5	M	H	H	H		M	L	L	L					

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

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

Statement: By learning —Artificial Intelligence, the students are able to develop and evaluate ideas for sustainability-driven innovation and Entrepreneurship.

<b>GED 1206</b>	<b>ENVIRONMENTAL SCIENCES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: All</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

To make the student conversant with the

**COB1:** various natural resources, availability, utilization and its current scenario.

**COB2:** diverse ecosystems and its function, importance of biodiversity, its values, threats and conservation.

**COB3:** types of pollutants and its impacts on the environment and the effects of natural disasters.

**COB4:** impacts of human population, human health, diseases and immunization for a sustainable lifestyle.

**MODULE I NATURAL RESOURCES****8**

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems - (a) Land resources: Land degradation soil erosion and desertification - (b) Forest resources: Use and over-exploitation, deforestation (c) Water resources: Use and over-utilisation of surface and ground water, conflicts over water, dams: benefits and problems, effects on forest and tribal people - (d) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, mining (e) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture (f) Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources.

**MODULE II ECOSYSTEMS AND BIODIVERSITY****8**

Concept of an ecosystem - Food chains, food webs, Energy flow in the ecosystem - ecological pyramids - Ecological succession - Characteristic features, structure and function of (a) Terrestrial Ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem (b) Aquatic fresh water ecosystems: Ponds and lakes, rivers and streams (c) Aquatic salt water ecosystems: oceans and estuaries

Biodiversity and its conservation - Types: genetic, species and ecosystem diversity - Values of biodiversity - India as a mega-diversity nation - Invasive, endangered, endemic and extinct species - Hot spots of biodiversity and Red Data book - Threats to biodiversity - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

### **MODULE III ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT 8**

Sources, cause, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear pollution (h) ill-effects of fireworks and upkeep of clean environment, types of fire and fire extinguishers- Solid waste Management: types, collection, processing and disposal of urban waste, industrial waste, e-waste and biomedical wastes - Disaster management: flood, drought, cyclone, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

### **MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES 6**

Human Population - Population growth, Population explosion, population pyramid among nations - Family Welfare Programme - Human Rights - Value Education - Environment and human health: air-borne, water borne, infectious diseases, contagious diseases and immunisation (all types of vaccines from birth), risks due to chemicals in food and water, endocrine disrupting chemicals, cancer and environment - Sustainable development - Resettlement and rehabilitation of people - Environment Legislative laws- Women and Child Welfare, Public awareness.

**Case studies related to current situation.**

**L – 30; Total Hours - 30**

#### **TEXT BOOKS:**

1. Erach Bharucha, —Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education for University Grants Commission, Orient Blackswan Pvt.Ltd., Hyderabad, India, 2013.
2. Benny Joseph, —Environmental Studies, Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A,—Environmental Science and Engineering, SriKrishna Publications, Tamil Nadu, India, 2018.
4. Raman Sivakumar, —Introduction to Environmental Science and Engineering, McGrawHill Education, India, 2009.
5. Venugopala Rao P, —Principles of Environmental Science and Engineering, Prentice Hall India Learning Private Limited, India, 2006.
6. Anubha Kaushik and Kaushik C.P., —Environmental Science and Engineering II, New Age International Pvt.Ltd., New Delhi, India, 2009.

**REFERENCES:**

1. Masters G.M.,—Introduction to Environmental Engineering and Sciencell, Prentice Hall, New Delhi, 1997.
2. Henry J.G. and Heike G.W.,—Environmental Science and Engineering II, Prentice Hall International Inc., New Jersey, 1996.
3. Miller T.G. Jr., —Environmental Sciencell, Wadsworth Publishing Co. Boston, USA, 2016.
4. —Waste to Resources: A Waste Management Handbook II, The Energy and Resources Institute, 2014.
5. <https://www.teriin.org/article/e-waste-management-india-challenges-and-opportunities>.
6. <https://green.harvard.edu/tools-resources/how/6-ways-minimize-your-e-waste>.
7. <https://www.aiims.edu/en/departments-and-centers/central-facilities/265-biomedical/7346-bio-medical-waste-management.html>.
8. <https://tspcb.cg.gov.in/Shared%20Documents/Guidelines%20for%20Management%20of%20Healthcare%20Waste%20Waste%20Management%20Rules,%202016%20by%20Health%20Care%20Facilities.pdf>.

**COURSE OUTCOMES:**

The student will be able to

- CO1:** analyze the current scenario of various natural resources and their depletion and suggest remedies to curb the exploitation.
- CO2:** identify food chains and web and its function in the environment, assess the impacts on the biodiversity and propose solutions to conserve it.
- CO3:** analyse the types and impacts of pollutants in the environment and propose suitable methods to alleviate the pollutants and the natural disasters.
- CO4:** assess on the impact of human population and the health related issues and immunisation practices and sustainable developments for a healthy life.

**Board of Studies (BoS) :**

11<sup>th</sup> BoS of Chem held on  
17.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

SDG All: No Poverty, Zero Hunger, Good Health and Well-Being, Quality Education, Gender Equality, Clean Water and Sanitation, Affordable & Clean Energy, Decent Work and Economic Growth, Industry, Innovation & Infrastructure, Reduced Inequalities, Sustainable Cities and Communities, Responsible Consumption and Production, Climate Action, Life Below Water, Life on Land, Peace, Justice and Strong Institutions, Partnerships for the Goals.

Statement: This course discuss about the environment, all the natural resources available, sharing of resources, effective utilisation, effects of over utilisation, health and environmental issues pertained to that, global warming and related issues, climates, disasters, impact assessments, population, human rights, societal welfare, laws to conserve the environment and sustainability.

**SEMESTER III**

<b>MAD 2181</b>	<b>STATISTICS FOR DATA</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>ANALYSIS</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To represent data by graphical methods

**COB2:** To study the fundamentals of Statistics

**COB3:** To introduce correlation and carry out Regression analysis

**COB4:** To perform hypothesis testing

**COB5:** To perform Analysis of Variance

**MODULE I DATA DESCRIPTION 9+3**

Exploratory Data Analysis - Motivation, Population vs Sample, Scientific Method - Definitions, Examples, Medical Study Designs – Graphical Displays: Dot plots, Stem plots, Pie chart, Histograms - Summary Statistics: Measures of Central tendency

**MODULE II MEASURES OF DISPERSION 9+3**

Range, Quartile deviation, Mean deviation, Standard deviation, Variance, Coefficient of Dispersion: coefficient of variation, Moments: Relationship between raw and central moments, Effect of change of Origin and Scale, Pearson beta and gamma coefficients, Skewness: Measures of Skewness, Kurtosis

**MODULE III CORRELATION AND REGRESSION 9+3**

Bi-variate data – Correlation and Regression coefficients and their relation, properties - Effect of change of origin and scale on correlation coefficient, Linear regression, Association and Independence of attributes

**MODULE IV SAMPLING TECHNIQUES 9+3**

Concept of population and sample, Random sample, Tests of Significance: Large sample tests (test for an assumed mean and equality of two population means with known S.D.); small sample tests : t-test for an assumed mean and equality of means of two populations when sample observations are independent, F-test for comparison of variances of two populations, Chi-square test for independence of attributes, Goodness of fit.

**MODULE V EXPERIMENTAL DESIGNS 9+3**

Analysis of variance (ANOVA) - Principles of experimental designs, Completely randomized, Randomized block and Latin square designs.

**L –45 ; T-15; TOTAL HOURS – 60**

**TEXT BOOKS:**

1. Ross, S.M., "Probability and Statistics for Engineers and Scientists" Fifth edition, John Wiley & Sons, New Jersey, 2007

**REFERENCES:**

- 1 Norman T J Bailey, "Statistical Methods in Biology " 3<sup>rd</sup> Edition, Cambridge University Press, Cambridge, 1995
- 2 Gupta.S.C and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons ,NewDelhi 2019.
- 3 Gupta.S.C," Fundamentals of Applied Statistics", Sultan Chand & Sons ,NewDelhi 2017.
- 4 Peter Bruce," Practical Statistics for Data Scientists" (2<sup>nd</sup> Edition) 2017

**COURSE OUTCOMES:**

At the end of the course students will be able to

**CO1:** comprehend and represent the data in the pictorial form

**CO2:** Make inferences on statistical data

**CO3:** Correlate the data and compute Regression lines

**CO4:** Interpret the results of hypothesis tests

**CO5:** Make an informed decision based on the results of inferential procedures

**Board of Studies (BoS) :**

12<sup>th</sup> BOS of Mathematics & AS held  
on 23.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P O 10	P O 11	P O 12	PS O1	PS O2
CO1					L									
CO2														
CO3		H						M						
CO4														
CO5										H				

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



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

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

<b>CSD 2151</b>	<b>FOUNDATIONS OF DATA</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>STRUCTURES</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

**COB1:** To emphasize on the importance of data structures in developing and implementing efficient algorithms.

**COB2:** To explore different methods used to manipulate the data structures and examine the efficiency.

**COB3:** To employ the different data structures to find the solutions for specific problems.

**COB4:** To provide the advantages and applications of different data structures

**COB5:** To study the various searching & sorting techniques.

### **MODULE I INTRODUCTION TO DATASTRUCTURES 09**

Introduction - Basic Terminology - Data Structures - Algorithms - Dynamic memory allocation and pointers- Linear Arrays – Representation of linear arrays in Memory - Traversing linear arrays - Searching - Multidimensional arrays

### **MODULE II STACK AND QUEUE 09**

Stacks - Implementation using Arrays and Linked Lists - Operations on stack - Applications of stacks - recursion - Conversion of an arithmetic expression from Infix to postfix - Towers of Hanoi - Queues - Implementation using Arrays and Linked Lists - Operations on queue - Priority Queues - Applications of queue

### **MODULE III LINKED LIST 09**

Definition - Linked Lists - Components of linked list- Singly Linked List, Doubly Linked List, Circular Linked List - Implementation - Operations: Traversing - Searching - Insertion - Deletion - Advantages and Disadvantages of linked list- Applications.

### **MODULE IV NON-LINEAR DATA STRUCTURE AND THEIR APPLICATIONS 09**

Binary Trees - Properties - Basic tree traversals - Binary tree - Binary search tree -AVL trees - Red - Black Trees - Graphs - Types of Graphs - Directed Graphs, Weighted Graphs - Basic definitions and properties of Graphs, Graph Traversal - Breadth First Search - Depth first search - Topological Sorting - and

their applications.

**MODULE V****SORTING AND SEARCHING****09**

Basic Search Techniques - linear search - binary search - Fibonacci search - Hash tables - Collision - Chaining - Linear Probing - Quadratic Probing - Double Hashing - Sorting - Insertion Sort - Selection Sort - Bubble sort - Quick sort - Merge Sort - Radix Sort.

**L – 45; TOTAL HOURS – 45****TEXT BOOK:**

1. Yashavant Kanetkar, "Data Structures Through C", BPB, ISBN-13:978-9388511391, 2019.
2. Langsam, Augenstein and Tanenbaum, "Data structures using C and C++", Second edition, PHI, ISBN:9788131518236, 2010.

**REFERENCES:**

1. Narasimha Karumanchi, "Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles", CareerMonk Publications, 5th Edition, ISBN-13: 978-8193245279, 2016.
2. R.S. Salaria, "Data Structures & Algorithms Using C", Khanna Publishing, 5th edition, ISBN-13:978-9381068588, 2018.
3. R.F. Gilberg and B.A. Forouzan, "Data structures: A Pseudocode Approach with C", 2nd edition, Cengage Learning, ISBN: 9788131503140, 2005.

**COURSE OUTCOMES:** Students who complete this course will be able to

**CO1:** Write algorithms to solve problems with the help of fundamental data structures.

**CO2:** Apply the different linear data structures like stack and queue to various computing problems.

**CO3:** Analyze the impact of various implementation and design choices on the data structure performance.

**CO4:** Compare different data structures and pick up an appropriate data structure for a given design situation.

**CO5:** Employ Algorithm for solving problems like sorting and searching.

**Board of Studies (BoS):****Academic Council:**20<sup>th</sup> BoS of CSE held on 16.08.202319<sup>th</sup> AC held on 29.09.2022

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

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

Statement: By learning the concepts of Data Structures, the students are able to apply the data structures to solve real time problems which improves productive employment and decent work.

<b>CSD 2152</b>	<b>PROGRAMMING IN PYTHON</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>LANGUAGE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To describe the core syntax and semantics of Python programming language.

**COB2:** To discover the need for working with the strings and functions.

**COB3:** To Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.

**COB4:** To indicate the use of modules, packages and built-in functions to navigate the file system.

**COB5:** To develop the ability to write database applications in Python.

**MODULE I                      BASICS OF PYTHON                      09**

Basic concepts of Python-Variables-Data types- Operators-Conditional Statements Looping-Control Statements-If-If else-Nested If else-Looping Statements- for-while nested loop-Control Statements.

**MODULE II                      PYTHON DATASTRUCTURES                      09**

Lists-Introduction -Accessing list-Operations-Working with lists -Function and Method Tuple- Introduction-Accessing-Tuples -Operations- Working-Functions and Methods Dictionaries-Introduction- Accessing values in dictionaries- Working with dictionaries Properties- Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

**MODULE III                      STRINGS AND FUNCTIONS                      09**

String Manipulation-Accessing Strings- Basic Operations-String slices-Function and Methods- Functions-Defining a function- Calling a function-Types of functions Function Arguments-Anonymous functions- Global and local variables

**MODULE IV                      OOPS CONCEPTS, MODULES AND PACKAGES                      09**

Classes and Objects – Attributes – Inheritance – Overloading – Overriding - Data hiding Standard modules-Importing own module as well as external modules Understanding Packages Powerful Lamda function in python Programming using functions, modules and external packages.

**MODULE V WORKING WITH DATA IN PYTHON****09**

Printing on screen- Reading data from keyboard- Opening and closing file-  
Reading and writing files- Functions-Loading Data with Pandas-Numpy

**L – 45; TOTAL HOURS – 45****TEXT BOOK:**

1. Larry Lutz, “Python for Beginners: Step-By-Step Guide to Learning Python Programming”, CreateSpace Independent Publishing Platform, First edition, ISBN- 1717410588, 9781717410580, 2018.

**REFERENCES:**

1. Nicholas Ayden, “Python Programming”, Independently Published, First Edition, ISBN- 1707051933, 9781707051939, 2019.
2. Michał Jaworski, Tarek Ziadé, “Expert Python Programming”, Packt Publishing Ltd., Third Edition, ISBN-9781789808896, 2019.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.

**CO2:** Express proficiency in the handling of strings and functions.

**CO3:** Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.

**CO4:** Identify the commonly used operations involving file systems and packages.

**CO5:** Develop cost-effective robust applications using the latest Python trends and technologies.

**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	M						L							
CO2				L										
CO3	H					L							M	
CO4														
CO5		H	M			H							H	M

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

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

Statement: By learning Python Programming, the students can be able to develop software which in turn improves their productive employment and decent work.

<b>CSD 2153</b>	<b>PRINCIPLES OF SOFTWARE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>ENGINEERING</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To learn the process involved in developing software.

**COB2:** To guide the significance of requirements gathering.

**COB3:** To represent the requirements collected using the various design models

**COB4:** To explore the various testing methodologies.

**COB5:** To provide reengineering and reverse engineering concepts.

**MODULE I                  SOFTWARE    PROCESS    AND    PROCESS    09**  
**MODELS**

Software Process - Software Engineering Practice - Generic Process Model – Defining Framework Activity - Identifying Task Set - Process Patterns - Process Assessment and Improvement - Process Models - Prescriptive Process Models - Specialized Process Models - Unified Process – Agile Development – What is Agile Process? – Extreme Programming – Other Agile Process Models

**MODULE II                  REQUIREMENTS ENGINEERING                  09**

Establishing the Groundwork - Eliciting requirements - Developing use cases - Building the Analysis Model - Requirements Monitoring - Validating requirements - Requirements Modeling-UML Diagrams.

**MODULE III                  DESIGN                  09**

Design Concepts - Design Model - Architectural Design – Software Architecture – Architectural Genres – Architectural Styles – Architectural considerations – Architectural Decisions – Architectural Design - Assessing Alternative Architectural Designs

**MODULE IV                  SOFTWARE TESTING                  09**

Software Testing – Strategic Approach – Strategic Issues – Test Strategies – Validation Testing – System Testing – Debugging – Testing Fundamentals - Path Testing - White Box and Black Box– Testing Applications.

**MODULE V                  MANAGING SOFTWARE PROJECTS                  09**

Project Management Concepts – Management spectrum – People – The



Product – The Process – Process and Product Metrics – Metrics in the process and product domain – Software Measurement – metrics for software Quality – Integrating metrics within the Software Process – Estimation for Software Project.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOK:**

1. Roger S. Pressman, "Software Engineering – A Practitioners Approach", Mc Graw Hill, Eighth Edition, ISBN : 9789339212087, 2017.

**REFERENCES:**

1. Ian Sommerville, "Software Engineering", Addison-Wesley, 9th Edition, ISBN-13: 978-0137035151, 2016.
2. Jibitesh Mishra, Ashok Mohanty, "Software Engineering", Pearson Education, ISBN 978-81-317-5869-4, 2016.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Choose the appropriate process model for the software project to be developed.

**CO2:** Collect requirements based on the application.

**CO3:** Design frameworks for the application to be developed.

**CO4:** Apply appropriate testing strategies to the developed products.

**CO5:** Modify and improve the deployed product based on user requirements.

**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

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

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

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

Statement: By learning the concepts of Software Engineering, the students are able to develop software product systematically for any application which improve economic growth, productive employment and decent work for all.

<b>CSD 2154</b>	<b>DATABASE MANAGEMENT AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>SQL</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To learn the fundamentals in database management systems and their design aspects.

**COB2:** To impart the knowledge of relational database design and the query processing strategies.

**COB3:** To provide the transaction management and design related to physical database.

**COB4:** To adapt database in developing an application as well as exploring big data analytics and block chain databases.

**COB5:** To explore advanced topics related to database systems.

**MODULE I INTRODUCTION OF DATABASE SYSTEMS 09**  
**AND DESIGN**

Introduction – Relational Languages – Introduction to Relational Model – Introduction to SQL – Intermediate SQL – Advanced SQL – Database Design using E-R model.

**MODULE II RELATIONAL DATABASE DESIGN 09**  
**AND STRATEGIES IN QUERY PROCESSING**

Functional Dependency – Normalization - Query Processing – Evaluation of Expressions - Query Optimization.

**MODULE III TRANSACTION MANAGEMENT AND 09**  
**PHYSICAL DATABASE DESIGN**

Transactions - Concurrency Control - Recovery System - Physical Storage Systems – Data Storage Structures – Indexing.

**MODULE IV APPLICATION DEVELOPMENT AND BIG 09**  
**DATA ANALYTICS**

Complex Data Types – Application Development – Big Data – Data Analytics – Advanced indexing Techniques – Advanced Application Development – Blockchain Databases.

**MODULE V ADVANCED DATABASES 09**

Database System Architectures – Parallel and Distributed Storage –

Parallel and Distributed Query Processing – Parallel and Distributed Transaction Processing. Advanced Relational Databases Design – Object-based Databases – XML - Information Retrieval – PostgreSQL – NoSQL- mongoDB

**L – 45; TOTAL HOURS – 45**

**TEXT BOOK:**

1. AviSilberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill, ISBN 9780078022159, Seventh Edition, 2019.

**REFERENCES:**

1. RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson, Seventh Edition, ISBN-13: 978-0-13-397077-7, 2016.
2. C.J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Mc Graw Hill, ISBN-13: 978-0321197849, 2006.
3. Sadalage, P. & Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Pearson Education, ISBN-13: 978-0-321-82662-6, 2013
4. Brad Dayley, "NoSQL with MongoDB in 24 Hours", Sams, ISBN 9780672337130, 2014

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Demonstrate the basic concepts and the design aspects in database management systems.

**CO2:** Write SQL queries in designing the relational database design and apply the strategies related to query processing.

**CO3:** Analyze the transaction process and physical storage management.

**CO4:** Deploy database in an application and acquire knowledge on big data analytics and block chain databases.

**CO5:** Solve real world problems by identifying and applying appropriate database systems.

**Board of Studies (BoS) :**

19th BOS of CSE held on 28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P O 10	P O 11	P O 12	PS O1	PS O2
CO1	L				L									
CO2				M							L			
CO3		H											M	
CO4			M											H
CO5											M		H	

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

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

Statement: By learning the concepts of DBMS, the students can be able to create Database for any real life cases and deploy it in an application which leads to sustainable economic growth, full and productive employment and decent work for all.

<b>CSD 2155</b>	<b>FOUNDATIONS OF DATA</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>STRUCTURES LABORATORY</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To demonstrate functions of linear structures.

**COB2:** To illustrate functions of non-linear structures.

**COB3:** To choose the appropriate data structure for different scenarios.

**COB4:** To demonstrate recursion

**COB5:** To choose algorithm design method for a specified application.

Design problems and implement solutions for the following concepts:

1. Arrays
2. Stack using Array
3. Queue using Array
4. Stack using Linked List
5. Queue using Linked List
6. Linked Lists
7. Recursion
8. Binary Trees
9. Binary Search Trees
10. Sorting – Searching
11. Priority queue implementation
12. AVL Balanced Trees
13. Graphs
14. Travelling Salesman Problem (Brute-force Technique)
15. Floyd's algorithm (Dynamic Programming)
16. Huffman Trees (Greedy Technique)

**P- 30 ; TOTAL HOURS – 30**

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Write programs that use arrays, linked structures, stacks, queues

**CO2:** Select the data structures that efficiently model the information in a problem.

**CO3:** Analyze the transaction process and physical storage management.

**CO4:** Assess efficiency trade-offs among different data structure implementations.

**CO5:** Apply different algorithmic technique to solve classic problems

**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

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

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

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

Statement: By learning the programming concepts of Data Structures, the students are able to analyze the problem, write the code and implement using data structures which improves productive employment and decent work.

<b>CSD 2156</b>	<b>DATABASE MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>AND SQL LABORATORY</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To explore the schema definition on database creation.

**COB2:** To implement the complex SQL queries.

**COB3:** To demonstrate cursors, triggers, procedure and functions in PL/SQL.

**COB4:** To design and implement integrity constraints in databases.

**COB5:** To deploy the database in a real time application.

**SOFTWARE REQUIRED:****SQL plus/Oracle, Tableau and Python/Java**

1. Draw E-R diagram and convert entities and relationships to relation table for a given scenario. College and Bank.
2. Implement SQL queries for DDL, DML and DCL commands.
3. Execute the system defined functions in SQL.
4. Using SQL commands to implement integrity constraints.
5. Implement Join and Nested Sub-Queries using SQL.
6. Execute PL/SQL programs.
7. Create and Manipulate Views.
8. Execute Cursor implementation using PL/SQL.
9. Implement Triggers in PL/SQL.
10. Execute Procedures and Functions using PL/SQL.
11. Develop a user interface for accessing the records in the database.

**P- 30 ; TOTAL HOURS – 30**

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Identify the schema for the database.

**CO2:** Design complex SQL queries for retrieving the results.

**CO3:** Apply constraints to the database.

**CO4:** Implement the features of database.

**CO5:** Analyze real time problems and come up with appropriate solution for it.

**Board of Studies (BoS) :**

19th BOS of CSE held on

**Academic Council:**

18th AC held on 24.02.2022



28.12.2021

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

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

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

Statement: By learning the programming concepts of DBMS, the students can be able to collect data to create database and write queries to interface with an application which leads to sustainable economic growth, full and productive employment and decent work for all.

<b>CSD 2157</b>	<b>PYTHON PROGRAMMING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>LABORATORY</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

- COB1:** To interpret the use of procedural statements like assignments, conditional statements, loops and function calls
- COB2:** To infer the supported data structures like lists, dictionaries and tuples in Python
- COB3:** To illustrate the application of matrices and regular expressions in building the Python programs
- COB4:** To discover the use of external modules in creating excel files and navigating the file systems.
- COB5:** To describe the need for Object-oriented programming concepts in Python.

**SOFTWARE REQUIRED:**

**Python 3.8.2**

**Design problems and implement solutions for the following concepts:**

1. Basic Python concepts
2. Python Data structures
3. Linear Search and Binary Search
4. Sum of Array using Lists.
5. String Manipulation and Functions
6. Classes and Objects
7. Overloading
8. Overriding
9. Inheritance
10. Information hiding
11. Modules and Packages
12. File handling
13. Loading Data with Pandas-Numpy

**P- 30; TOTAL HOURS – 30**

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Apply the Python language syntax including control statements, loops and functions to write the programs for the wide variety of problems in mathematics, science, and games.

**CO2:** Explore the core data structures like lists, dictionaries, tuples and sets in Python to store, process and sort the data

**CO3:** Interpret the concepts of Object-oriented programming as used in Python using encapsulation, polymorphism and inheritance, polymorphism and inheritance.

**CO4:** Discover the capabilities of Python regular expression for data verification and utilize matrices for building performance efficient Python programs.

**CO5:** Identify the external modules for creating and writing data to excel files and inspect the file operations to navigate the file systems.

**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

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

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

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

Statement: By learning Python Programming, the students can be able to write python code to solve any real time problem which in turn improves the productive employment and decent work.

<b>GED 2101</b>	<b>ESSENTIAL SKILLS AND APTITUDE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 17</b>	<b>FOR ENGINEERS</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:**To enable them to make effective business presentations

**COB2:**To train them to participate in group discussions

**COB3:**To enhance the problem-solving skills

**COB4:**To train students in solving analytical problems

**MODULE I ORAL DISCOURSE 07**

Importance of oral communication-verbal and non-verbal communication,  
Presentation Strategies- one minute presentation (using Audacity/vocaro) -  
Effective listening skills, listening for specific information

**MODULE II VERBAL COMMUNICATION 08**

Understanding negotiation, persuasion & marketing skills - Listening to short  
conversations & monologues - Group Discussion techniques - Role plays -  
Interview techniques

**MODULE III BASIC NUMERACY 08**

Simplification and Approximation – Competitive Examination Shortcut  
Techniques - Number Systems - Simple and Compound Interest-Progression

**MODULE IV ANALYTICAL COMPETENCY 07**

Blood Relations – Clocks and Calendars – Coding and Decoding – Analytical  
Reasoning(Linear Arrangement, Circular Arrangement, Cross Variable  
Relationship and Linear Relationship)– Directions .

**L – 30; TOTAL HOURS - 30**

**REFERENCES:**

1. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK
2. Swan, Michael (2005). Practical English Usage, Oxford University Press
3. Bhattacharya. Indrajit (2008). An Approach to Communication Skills, Dhanpat Rai & Co., (Pvt.) Ltd. New Delhi.
4. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
5. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations,

S. Chand Limited, 2017

6. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning , S. Chand Limited, 2010
7. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016
8. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018
9. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

### COURSE OUTCOMES:

**CO1:**Make effective business presentations

**CO2:**Speak English intelligibly, fluently and accurately in group discussions

**CO3:**To apply the various problem-solving techniques

**CO4:** Understand and solve aptitude problem

### Board of Studies (BoS) :

13<sup>th</sup>BoS of the Department of  
English held on 17.6.2021

### Academic Council:

17<sup>th</sup> AC held on 15.07.2021

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

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

SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Statement: This course ensures capacity building and skills development requisite for implementing global partnership.

**SEMESTER IV**

<b>CSD 2251</b>	<b>NETWORKING METHODOLOGIES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**COURSE OBJECTIVES:**

**COB1:** To give the overview of computer network and its layers.

**COB2:** To learn about the physical layer and wireless transmission.

**COB3:** To explore the error detection and correction methods and its protocols.

**COB4:** To learn the different routing algorithms used in network layer.

**COB5:** To comprehend the logical communication between application processes running on different hosts.

**MODULE I      COMPUTER NETWORKS      09**

Uses of Computer Networks – Hardware – Software – Reference Models – Communication Services.

**MODULE II      PHYSICAL LAYER      09**

Transmission Media – Wireless Transmission – Multiplexing – Switching – ISDN – ATM – Communication Satellites.

**MODULE III      DATA LINK LAYER      09**

Design Issues – Error Detection and Correction – Protocols – Sliding Window Protocols – MAC Protocols.

**MODULE IV      NETWORK LAYER      09**

Routing Algorithms – Congestion Control Algorithms – IP Protocol – Internetworking.

**MODULE V      TRANSPORT LAYER & APPLICATION LAYER      09**

Transport Service - Elements – TCP – UDP – ATM Layer Protocols. Network Security – DNS – SNMP – Email – Multimedia.

**PRACTICAL**

1. Understanding and using of commands like ifconfig, netstat, ping, arp, telnet, ftp, finger, traceroute, whois
2. Implementation of Connection-Oriented Service using standard

ports

3. Implementation of Connection-Less Service using standard ports
4. Implementation of Connection-Oriented Iterative Echo-Server, date and time, character generation using user-defined ports
5. Implementation of Connectionless Iterative Echo-server, date and time, character generation using user-defined ports.
6. Implementation of DNS
7. Program to implement Web Server using sockets

**L – 45;P – 30; TOTAL HOURS – 75**

**TEXT BOOK:**

1. Andrew S. Tanenbaum, “Computer Networks “, Pearson Education, ISBN 978-81-317-0918, 2014

**REFERENCES:**

1. Olivier Bonaventure, “Computer Networking - Principles, Protocols and Practice”, ISBN: 9781365185830, 2016.
2. Larry L. Peterson, Bruce S. Davie, “Computer Networks A system Approach”, Morgan Kaufmann, 5<sup>th</sup> Edition, ISBN 978-0-12-385059, 2011.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Comprehend the basis and structure of the network layer and protocols.

**CO2:** Identify the different types of network devices and their functions within a network.

**CO3:** Detect the reason for the data loss and delay in the network.

**CO4:** Specify the shared communications protocols and interface methods used by hosts in a communications network

**CO5:** Choose the appropriate transport protocol for any network application.

**Board of Studies (BoS) :**

19<sup>th</sup> BOS of CSE held on  
28.12.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

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

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

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

Statement: By Learning the Computer Networking and programming, the students are able to apply the network concepts and create network programs that leads to sustainable economic growth, full and productive employment and decent work for all.



<b>CSD 2252</b>	<b>ALGORITHMIC DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>TECHNIQUES</b>	<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

### **COURSE OBJECTIVES:**

**COB1:** To analyze the complexity of data structures and associated methods.

**COB2:** To explore various algorithmic design techniques and solve classical problems.

**COB3:** To assess the Brute-Force and Divide and conquer techniques.

**COB4:** To comprehend and apply Dynamic programming and greedy techniques.

**COB5:** To apply algorithms to solve real world problems.

### **MODULE I INTRODUCTION 09**

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types– Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations and their properties. Analysis Framework – Empirical analysis – Mathematical analysis for Recursive and Non-recursive algorithms – Visualization

### **MODULE II BRUTE FORCE AND DIVIDE-AND- CONQUER 09**

Brute Force – Computing an– String Matching – Closest-Pair and Convex-Hull Problems -Exhaustive Search – Travelling Salesman Problem – Knapsack Problem – Assignment problem - Divide and Conquer Methodology – Binary Search – Merge sort – Quick sort – Heap Sort - Multiplication of Large Integers – Closest-Pair and Convex – Hull Problems.

### **MODULE III DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE 09**

Dynamic programming – Principle of optimality – Coin changing problem, Computing a Binomial Coefficient – Floyd's algorithm – Multi stage graph – Optimal Binary Search Trees – Knapsack Problem and Memory functions. Greedy Technique – Container loading problem – Prim's algorithm and Kruskal's Algorithm – Knapsack problem, Optimal Merge pattern – Huffman Trees.

### **MODULE IV ITERATIVE MODELS 09**

The Simplex Method – The Maximum-Flow Problem – Maximum Matching in

**MODULE V                      LIMITATIONS OF ALGORITHMIC POWER    09**  
**&ALGORITHMIC FRAMEWORKS**

**L – 45; T-15 ;TOTAL HOURS – 60**

1. Rajesh K.Shukla, Analysis and Design of Algorithms, Wiley India Private Limited, ISBN : 978-81-265-5477-5, 2015.

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", Third edition, Prentice Hall of India Private Limited, ISBN: 9780262533058, 0262533057, 2009.
2. Michael T Goodrich and Roberto Tamassia, Algorithm Design Foundations - Analysis and Internet Examples, John Wiley & Sons, Third Edition, ISBN: 9788126509867, 2007.

**CO4:** Apply iterative models in problem solving.

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	M					L								
CO2				M									H	
CO3			L											
CO4					H						L		H	
CO5		M												M

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

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

Statement:

By learning the Algorithmic design techniques, the students are able to implement better software by applying the appropriate algorithms that leads to sustainable economic growth, full and productive employment and decent work for all.

**L T P C**

**3 0 0 3**

**COB5:** To gain knowledge about knowledge-based system design.

Structuring -UML Notations in KADS. Applications – Knowledge System Building Tool Study.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOK:**

1. Ela Kumar, “Knowledge Engineering”, I.K International Publishing, First Edition, ISBN 978-93-85-909-27-6, 2018.

**REFERENCES:**

1. Hamed Fazlallahtabar, “Knowledge Engineering: The Process Paradigm”, CRC Press, First Edition, ISBN: 978-0-367-51736-6, 2020.
2. Simon Kendal and Malcolm Creen, “An Introduction to Knowledge Engineering”, Springer, First Edition, ISBN 13: 978-1-84628-475-5, 2007.

**COURSE OUTCOMES:** Students who complete this course will be able to

**CO1:** Recognize the different stages of knowledge based systems.

**CO2:** Evaluate the knowledge based system.

**CO3:** Design knowledge acquisition system for an expert system.

**CO4:** Construct semantic web.

**CO5:** Analyze case study for real time applications of knowledge engineering and artificial intelligence.

**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	M													
CO2			M										M	
CO3		H				M								
CO4				L										
CO5					H			L						M

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

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

Statement: By learning the concepts of Knowledge engineering, the students are able to create Artificial Intelligence based software, which in turn improve productivity and economic growth.

<b>CSD 2254</b>	<b>DATA WAREHOUSING AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>DATA MINING</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To be familiar with the Data warehouse and Data Mining architecture and its Implementation.

**COB2:** To study various Data classification

**COB3:** To perform data clustering and outlier detection of data.

**COB4:** To explore the various data stream mining methodologies.

**COB5:** To implement web mining algorithm.

**MODULE I INTRODUCTION 09**

Data Mining–Types of Data-Pattern – Technologies – Applications-Issues- Data Objects and Attribute Types- Basic Statistical Descriptions of Data- Data Visualization- Measuring Data Similarity and Dissimilarity- Data Preprocessing- Data Cleaning- Data Integration- Data Reduction- Data Transformation and Data Discretization.

**MODULE II DATA WAREHOUSING AND ONLINE ANALYTICAL PROCESSING 09**

Data Warehouse: Basic Concepts- Data Warehouse Modeling: Data Cube and OLAP- Data Warehouse Design and Usage- Data Warehouse Implementation - Data Generalization by Attribute-Oriented Induction.

**MODULE III DATA CLASSIFICATION 09**

Basic Concepts- Decision Tree Induction- Bayes Classification Methods- Rule-Based Classification- Model Evaluation and Selection- Techniques to Improve Classification Accuracy- Classification by Back propagation- Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods.

**MODULE IV DATA CLUSTERING AND OUTLIER DETECTION 09**

Cluster Analysis- Partitioning Methods- Hierarchical Methods- Density-Based Methods- Grid-Based Methods- Evaluation of Clustering- Outliers and Outlier Analysis- Outlier Detection Methods.

**MODULE V MINING DATA STREAMS & WEB MINING 09**

The Stream Data Model- Sampling Data in a Stream-Filtering Streams- Counting Distinct Elements -Moments of Streams-Decaying Windows Information Retrieval Models- Text and Web Page Pre-Processing - Web Spamming- Social Network Analysis- HITS Algorithm- A Basic Crawler Algorithm- Document Sentiment Classification. Case Study: Text mining: extracting attributes (keywords), structural approaches (parsing, soft parsing). Web mining: classifying web pages, extracting knowledge from the web

**L – 45; TOTAL HOURS – 45**

**TEXT BOOK:**

1. Jiawei Han & Micheline Kamber, “Data Mining – Concepts and Techniques”, 3<sup>rd</sup> Edition, ISBN 978-0-12-381479- Morgan Kaufmann Publishers, Elsevier, 2012.

**REFERENCES:**

1. Parteek Bhatia, “Data Mining and Data Warehousing Principles and Practical Techniques”, 1<sup>st</sup> Edition, Cambridge University Press, ISBN: 9781108727747, 2019.
2. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman,” Mining of Massive Datasets, Cambridge University Press, ISBN: 9781316638491, 2019.
3. Alex Berson and Stephen J. Smith, Data Warehousing, Data Mining and OLAP, Tata McGraw – Hill Edition, 35<sup>th</sup> Reprint , ISBN 13: 9780070587410, 2016.
4. Bing Liu,” Web Data Exploring Hyperlinks, Contents and Usage Data”, 2<sup>nd</sup> Edition, Springer, ISBN 978-3-642-19459-7, 2011.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Distinguish between database and data warehouse

**CO2:** Design an application based on the appropriate classification model.

**CO3:** Apply clustering and outlier detection in mining and warehouse techniques through the use of different tools

**CO4:** Apply stream Data Mining principles and techniques for real time applications.

**CO5:** Construct effective web crawling and spamming methods for improving web mining.



**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P O 10	P O 11	P O 12	PS O1	PS O2
CO1						M							M	
CO2				M										M
CO3		H				M								H
CO4	M		L											
CO5					M		L					M		M

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

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

Statement: By learning the concepts of Data Mining and Warehousing, the students are able to analyze the data warehouse data and use it for decision making which improves the productive environment, sustainable economic growth and decent work for all.

**CSD 2255****ESSENTIALS OF DATA SCIENCE****L T P C****SDG: 8****2 0 0 2****COURSE OBJECTIVES:**

**COB1:** To learn critical concepts and skills in computer programming and statistical inference in the process of conducting analysis of real-world datasets

**COB2:** To explore the fundamental concepts and techniques in data science.

**COB3:** To conceive the application of statistics in data science.

**COB4:** To make predictions using statistical methods

**COB5:** To think critically about data and bring in robust conclusions based on incomplete information.

**MODULE I INTRODUCTION****10**

Data Science – Introduction - Computational Tools - Statistical Techniques - Need for Data Science - Plotting the Classics - Literary Characters - Causality and Experiments - Randomness - Conditional Statements - Iteration - Simulation - Finding Probabilities - Sampling and Empirical Distributions - Empirical Distributions - Sampling from a Population - Empirical Distribution of a Statistic - Testing Hypotheses - Assessing Models - Multiple Categories - Decisions and Uncertainty - Error Probabilities.

**MODULE II PROBABILITY AND DISTRIBUTIONS****10**

Comparing Two Samples - A/B Testing –Deflate gate - Causality - Estimation – Importance of Mean- Properties of the Mean - Variability - The SD and the Normal Curve - The Central Limit Theorem - The Variability of the Sample Mean - Choosing a Sample Size - Prediction - Correlation - The Regression Line - The Method of Least Squares - Least Squares Regression - Visual Diagnostics - Numerical Diagnostics.

**MODULE III CLASSIFICATION****10**

Inference for Regression - A Regression Model - Inference for the True Slope - Prediction Intervals - Classification - Nearest Neighbours - Training and Testing - Rows of Tables - Implementing the Classifier - The Accuracy of the Classifier - Multiple Regression - Updating Predictions - A "More Likely Than Not" Binary Classifier - Making Decisions.

**L – 30; TOTAL HOURS – 30****TEXT BOOK:**

1. Ani Adhikari and John DeNero, "Computational and Inferential Thinking:

The Foundations of Data Science”, 2019.

### REFERENCES:

1. The Art of Data Science: A Guide for Anyone Who Works with Data, Roger D. Peng, and Elizabeth Matsui, ISBN: 9781365061462, 2018.
2. The Big Book of Dashboards: Visualizing Your Data Using Real-World Business Scenarios. by Steve Wexler, Jeffrey Shaffer, Andy Cotgreave, ISBN: 1119282713, 2017

**COURSE OUTCOMES:** Students who complete this course will be able to

**CO1:** Apply statistical techniques for data analysis

**CO2:** Use testing hypothesis to assess data models

**CO3:** Demonstrate data visualization

**CO4:** Appreciate the role of Sampling and Distributions in data analysis

**CO5:** Discuss how data can be used responsibly to benefit society.

**Board of Studies (BoS) :**

19<sup>th</sup> BOS of CSE held on  
28.12.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	H		L										H	
CO2				L									H	
CO3														M
CO4					L									L
CO5		M				M						M		H

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

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

Statement: By learning the concepts of Essentials of Data Sciences, the students are able to apply the probability and statistics into data science and able to discover hidden patterns which in turn improve the economic growth.

<b>CSD 2256</b>	<b>FUNDAMENTALS OF</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>OPERATING SYSTEM</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To learn the objectives, functions and architecture of operating systems.

**COB2:** To impart the knowledge of process management concepts.

**COB3:** To study the functions of process concurrency and synchronization.

**COB4:** To represent the role of operating system in memory management.

**COB5:** To conceive the functions of operating system in file management.

**MODULE I INTRODUCTION 09**

Basic OS functions, resource abstraction, types of operating systems–multiprogramming systems, batch systems, time sharing systems; operating systems for personal computers & workstations, process control & real time systems.

**MODULE II OPERATING SYSTEM ORGANIZATION AND PROCESS MANAGEMENT 09**

Processor and user modes, kernels, system calls and system programs. System view of the process and resources, process abstraction, process hierarchy, threads, threading issues, thread libraries; Process Scheduling, non-pre-emptive and pre-emptive scheduling algorithms; concurrent and processes, critical section, semaphores, methods for inter-process communication; deadlocks

**MODULE III MEMORY MANAGEMENT 09**

Physical and virtual address space; memory allocation strategies –fixed and variable partitions, paging, segmentation, virtual memory

**MODULE IV STORAGE MANAGEMENT 09**

Mass Storage Structure – Overview of Mass storage structure – Disk Structure – Disk Scheduling – Disk Management – Swap space Management – Raid Structure – File System Interface – File Concepts –

Access Methods – Directory and Disk Structure – File system Mounting – File sharing and Protection – File system Structure – File system implementation – Allocation methods – Free space Management

## **MODULE V PROTECTION, SECURITY& CASE STUDY 09**

Policy mechanism, Authentication, Internal access Authorization, Case Study - Windows Operating systems,

**L – 45; TOTAL HOURS – 45**

### **TEXT BOOK:**

1. Abraham Silberschatz, Peter B galvin , Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley & Sons Inc, ISBN:978-1-118- 06333-0, 2013.

### **REFERENCES:**

1. Deitel H M, "Operating Systems", 3rd Edition, Pearson education India, New Delhi, ISBN : 978-0-536-21215-3, 2007.
2. Dhamdhare D M, "Operating Systems", 1st reprint, Tata McGraw Hill, New Delhi, ISBN 978–0–07–295769–3,2006.

### **COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Analyze the functioning of operating systems.

**CO2:** Compare the performance of various process scheduling algorithms.

**CO3:** Evaluate the implementation of processes and problems related to process synchronization

**CO4:** Interpret the management of resources like memory , I/O devices can be managed

**CO5:** Assess the features of various file management techniques

### **Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

### **Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P O 10	P O 11	P O 12	PS O1	PS O2
CO1												M		
CO2					L	M							H	
CO3				L										
CO4	M								M		L		H	
CO5		M												

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

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

Statement: By learning the concepts of Operating Systems, the students are able to understand the hardware and software interaction that helps them to create better software which in turn leads to sustainable economic growth.

<b>CSD 2257</b>	<b>ALGORITHMIC DESIGN TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>LABORATORY</b>				
<b>SDG: 8</b>		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

### COURSE OBJECTIVES:

- COB1:** To conceive the importance of time and space complexity.
- COB2:** To explore real time problems and find the way to implement the solution.
- COB3:** To study the divide and conquer algorithms and analyze the computational complexity.
- COB4:** To impart the knowledge of searching technique and analysis the time complexity.
- COB5:** To demonstrate the shortest path algorithm.

### SOFTWARE REQUIRED : C/C++/JAVA

Design problems and implement solutions for the following concepts:

1. Insertion Sort (The program should report the number of comparisons)
2. Merge Sort (The program should report the number of comparisons)
3. Heap Sort (The program should report the number of comparisons)
4. Implement Randomized Quick sort (The program should report the number of comparisons)
5. Implement Radix Sort
6. Create a Red-Black Tree and perform following operations on it:
  - o Insert a node
  - o Delete a node
  - o Search for a number & also report the color of the node containing this number.
7. Implement Breadth-First Search in a graph
8. Implement Depth-First Search in a graph
9. Write a program to determine the minimum spanning tree of a graph For the algorithms from S.No 1 to 3 test run the algorithm on 100 different inputs of sizes varying from 30 to 1000. Count the number of comparisons and draw the graph. Compare it with a graph of  $n \log n$ .

**P- 30; TOTAL HOURS – 30**

### COURSE OUTCOMES:

Students who complete this course will be able to

- CO1:** Design and evaluate the various sorting algorithms.
- CO2:** Analyze the best-case, average-case and worst-case running times of

algorithms using asymptotic analysis.

**CO3:** Compare and evaluate the standard design techniques of algorithms and know the conditions in which particular technique is to be applied.

**CO4:** Design efficient algorithms for problems encountered in common engineering design situations.

**CO5:** Evaluate the limitations on the time complexity of algorithms.

**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	M													
CO2					H								H	
CO3				M										
CO4		M	L						M					L
CO5						H							M	

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

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

Statement: By learning the Algorithmic design techniques Lab, the students are able to implement better software by applying the appropriate algorithms that leads to sustainable economic growth, full and productive employment and decent work for all.



<b>CSD 2258</b>	<b>DATA MINING TOOLS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>LABORATORY</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To be acquainted with the tools and techniques used for Knowledge Discovery in databases.

**COB2:** To implement web mining and text mining.

**COB3:** To explore data sets and data preprocessing.

**COB4:** To implement searching and sorting techniques.

**COB5:** To learn how to build a data warehouse and query it.

**SOFTWARE REQUIRED:**

WEKA TOOLS/ Oracle Data Mining/ KNIME/R programming

Design problems and implement solutions for the following concepts:

1. Implement various OLAP operations such as slice, dice, roll up, drill up, pivot .
2. Explore the correlation-ship analysis between the data set
3. Apriori Algorithm.
4. K-means clustering.
5. One Hierarchical clustering algorithm.
6. Bayesian Classification.
7. Decision Tree.
8. Classification for web mining.
9. Data Stream Mining Algorithm.
10. Case Study on Text mining: extracting attributes (keywords), structural approaches (parsing, soft parsing).
11. Case Study on Web mining: classifying web pages, extracting knowledge from the web

**P- 30; TOTAL HOURS – 30**

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Apply data mining techniques and methods to large data sets.

**CO2:** Demonstrate the classification, clustering and etc. in large data sets

**CO3:** Develop and implement the data mining algorithm for the application.

**CO4:** Compare and contrast the various classifiers.

**CO5:** Implement DataStream mining and explore the various operations.

**Board of Studies (BoS) :**

19th BOS of CSE held on 28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

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

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

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

Statement: By learning the concepts of Data Mining Lab, the students are able to analyze the data warehouse data and use it for decision making which improves the productive environment, sustainable economic growth and decent work for all.

<b>CSD 2259</b>	<b>ALGORITHMIC DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>TECHNIQUES</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To analyze the complexity of data structures and associated methods.

**COB2:** To explore various algorithmic design techniques and solve classical problems.

**COB3:** To assess the Brute-Force and Divide and conquer techniques.

**COB4:** To comprehend and apply Dynamic programming and greedy techniques.

**COB5:** To apply algorithms to solve real world problems.

**MODULE I INTRODUCTION 09**

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types– Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations and their properties. Analysis Framework – Empirical analysis – Mathematical analysis for Recursive and Non-recursive algorithms – Visualization

**MODULE II BRUTE FORCE AND DIVIDE-AND-CONQUER 09**

Brute Force – Computing an– String Matching – Closest-Pair and Convex-Hull Problems -Exhaustive Search – Travelling Salesman Problem – Knapsack Problem – Assignment problem - Divide and Conquer Methodology – Binary Search – Merge sort – Quick sort – Heap Sort -Multiplication of Large Integers – Closest-Pair and Convex – Hull Problems.

**MODULE III DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE 09**

Dynamic programming – Principle of optimality – Coin changing problem, Computing a Binomial Coefficient – Floyd's algorithm – Multi stage graph – Optimal Binary Search Trees – Knapsack Problem and Memory functions. Greedy Technique – Container loading problem – Prim's algorithm and Kruskal's Algorithm – Knapsack problem, Optimal Merge pattern – Huffman Trees.

**MODULE IV                      ITERATIVE MODELS                      09**

The Simplex Method – The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs, Stable marriage Problem.

**MODULE V                      LIMITATIONS OF ALGORITHMIC POWER                      09  
&ALGORITHMIC FRAMEWORKS**

Lower – Bound Arguments – P, NP NP- Complete and NP Hard Problems. Backtracking – n-Queens problem – Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound – LIFO and FIFO search – Assignment problem – Knapsack Problem – Travelling Salesman Problem –Approximation Algorithms for NP-Hard Problems – Travelling Salesman problem – Knapsack. External-Memory Algorithms -Parallel Algorithms - Online Algorithms

**L – 45; TOTAL HOURS – 45**

**TEXT BOOK:**

1. Rajesh K.Shukla, Analysis and Design of Algorithms, Wiley India Private Limited, ISBN : 978–81-265-5477-5, 2015.

**REFERENCES:**

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", Third edition, Prentice Hall of India Private Limited, ISBN: 9780262533058, 0262533057, 2009.
2. Michael T Goodrich and Roberto Tamassia, Algorithm Design Foundations - Analysis and Internet Examples, John Wiley & Sons, Third Edition, ISBN: 9788126509867, 2007.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Analyze the time complexity and space complexity measures of algorithms.

**CO2:** Asses the various algorithmic design techniques and solve classical problems.

**CO3:** Compare and contrast the dynamic programming and greedy techniques.

**CO4:** Apply iterative models in problem solving.

**CO5:** Solve real world problems by identifying and applying appropriate algorithm analysis techniques.

**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

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

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

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

Statement: By learning the Algorithmic design techniques, the students are able to implement better software by applying the appropriate algorithms that leads to sustainable economic growth, full and productive employment and decent work for all.

<b>CSD 2260</b>	<b>ESSENTIALS OF DATA SCIENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES :**

**COB1:** To understand the fundamental concepts of data science.

**COB2:** To impart knowledge in descriptive data analytics.

**COB3:** To get familiar with inferential statistics.

**COB4:** To acquire knowledge of how to utilize analysis of variance to draw conclusion from distinct dataset.

**COB5:** To explore the predictive models from data.

### **MODULE I INTRODUCTION TO DATA SCIENCE 09**

Need for data science – Benefits and uses – Facets of data – Data Science process – Setting the research goal – Retrieving data – Cleansing, integrating, and transforming data – Exploratory data analysis – Build the models – Presenting and building applications.

### **MODULE II DESCRIPTIVE ANALYTICS 09**

Frequency distributions – Outliers –Interpreting distributions – Graphs – Describing variability – Interquartile range – Variability for qualitative and ranked data - Normal distributions – Z scores –correlation – scatter plots – Regression – regression line – least squares regression line – standard error of estimate – Interpretation of  $r^2$  – Multiple regression equations .

### **MODULE III INFERENCE STATISTICS 09**

Populations – Samples – random sampling – Sampling distribution- Standard error of the mean - Hypothesis testing – Z-test – z-test procedure –decision rule – calculations – decisions – interpretations - one-tailed and two-tailed tests – Estimation – point estimate – confidence interval – level of confidence – effect of sample size.

### **MODULE IV ANALYSIS OF VARIANCE 09**

T-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related samples. F-test – ANOVA – Two-factor experiments – three f-tests – two-factor ANOVA –Introduction to chi-square tests.

**MODULE V PREDICTIVE ANALYTICS****09**

Linear least squares – implementation – goodness of fit – testing a linear model – weighted resampling. Regression using StatsModels – multiple regression – nonlinear relationships – logistic regression – estimating parameters – Time series analysis – moving averages – missing values – serial correlation – autocorrelation.

**L – 45; TOTAL HOURS – 45****TEXT BOOKS:**

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016, ISBN: 9781633430037.
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017, ISBN: 978-1-119-25451-5.

**REFERENCES:**

1. Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentals of Data Science", CRC Press, 2022, ISBN 9781138336186.
2. Chirag Shah, "A Hands-On Introduction to Data Science", Cambridge University Press, 2020, ISBN: 9781108560412.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Describe the fundamental concepts of data science.

**CO2:** Develop proficiency in visualizing data.

**CO3:** Analyze the data and draw valid conclusions.

**CO4:** Recognize the significance of analyses of variance.

**CO5:** Build models for predictive analytics.

**Board of Studies (BoS) :**

22<sup>nd</sup> BoS of CSE held on 17.8.2023

**Academic Council:**

21<sup>st</sup> AC held on 23.12.2023

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

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

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

Statement: By learning the concepts of Essentials of Data Sciences, the students are able to apply the probability and statistics into data science and able to discover hidden patterns which in turn improve the economic growth.



<b>GED 2202</b>	<b>INDIAN CONSTITUTION AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 16</b>	<b>HUMAN RIGHTS</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>0</b>

### **COURSE OBJECTIVES:**

**COB1:** To explicate the emergence and evolution of Indian Constitution.

**COB2:** To have an insight into the philosophy of fundamental rights and duties, and Directive Principles.

**COB3:** To differentiate the structure of executive, legislature and judiciary.

**COB4:** To understand human rights and its implication - local and international and redressal mechanism.

### **MODULE I INTRODUCTION AND BASIC INFORMATION ABOUT INDIAN CONSTITUTION 8**

Meaning of the constitution law and constitutionalism - Historical Background of the Constituent Assembly - Government of India Act of 1935 and Indian Independence Act of 1947 - The Constituent Assembly of India - Enforcement of the Constitution - Indian Constitution and its Salient Features - The Preamble of the Constitution. Citizenship.

### **MODULE II FUNDAMENTAL RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES 7**

Fundamental Rights and its Restriction and limitations in different complex situations - Directive Principles of State Policy (DPSP) & its present relevance in our society with examples- Fundamental Duties and its Scope and significance in nation building - Right to Information Act 2005.

### **MODULE III GOVERNANCE IN INDIA 8**

The Union Executive – the President and the Vice-President – The Council of Ministers and the Prime Minister – Powers and functions. The Union legislature – The Parliament – The Lok Sabha and the Rajya Sabha, Composition, powers and functions – Government of the State - The Governor – the Council of Ministers and the Chief Minister – Powers and Functions-Elections-Electoral Process and Election Commission of India - Indian judicial system.

### **MODULE IV HUMAN RIGHTS AND INDIAN CONSTITUTION 7**

Human rights – meaning and significance - Covenant on civil and political rights - Covenant on Economic, Social and Cultural rights - UN mechanism and agencies - The Protection of Human Rights Act, 1993 – watch on

human rights and enforcement - Roles of National Human Rights Commission of India - Special Constitutional Provisions for SC & ST, OBC - Special Provision for Women, Children & Backward Classes.

**L – 30; TOTAL HOURS –30**

**TEXT BOOKS:**

1. B.K. Sharma, Introduction to the Constitution of India, 6th ed., PHI Learning Private Limited, New Delhi 2011
2. Durga Das Basu "Introduction to the Constitution on India", (Students Edition.) Prentice –Hall EEE, 19th / 20th Edn. 2008
3. M.P. Jain, Indian Constitutional Law, 7th ed., LexisNexis, Gurgaon. 2014.

**REFERENCES:**

1. Fadia B.L "Indian Government and Politics", Sahitya Bhavan Publications. 2010
2. Kashyap Subhash C "Our Constitution: An Introduction to India's Constitution and constitutional Law, NBT. 2017
3. M.V.Pylee "An Introduction to Constitution of India", Vikas Publishing. 2002
4. Sharma Brij Kishore "Introduction to the Indian Constitution", 8th Edition, PHI Learning Pvt. Ltd. 2015
5. Latest Publications of NHRC - Indian Institute of Human Rights, New Delhi.

**COURSE OUTCOMES:**

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

**CO1:** describe the emergence and evolution of Indian Constitution.

**CO2:** realize the status and importance of fundamental rights, fundamental duties and directive principles of state policy and relation among them by understanding the articulation of its basic values under the Constitution of India.

**CO3:** compare the various structure of Indian government.

**CO4:** recognize the human rights, cultural, social and political rights and its relationship with Indian constitution. .

**Board of Studies (BoS) :**

4<sup>th</sup>BoS of SSSH held on 28.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			M			H	M	L	M		M	
CO2			H			M	H	M			H	
CO3			M			H	M	L			L	
CO4			H			H	H	M	M			H

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

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

Application of human, legal and political rights leading to empowerment in real-life situations for protection of fundamental freedoms and freedom from violence, abuse, trafficking and exploitation are at the core of human rights.

<b>GED 2201</b>	<b>WORKPLACE SKILLS AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>APTITUDE FOR ENGINEERS</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To expose them to reading for specific purposes, especially in professional contexts

**COB2:** To expose them to the process of different kinds of formal writing

**COB3:** To prepare the students to be successful in their career

**COB4:** To familiarize various problem-solving techniques in aptitude and puzzles.

**MODULE I      EXTENSIVE READING & WRITING      07**

Reading for comprehension - inferring and note-making – Process of writing- paragraph development - elements of business writing: Email, memos.

**MODULE II      INTENSIVE READING & WRITING      08**

Intensive reading and reviewing - Interpretation of charts, graphs - Résumé - Letter of enquiry, thanksgiving letters.

**MODULE III      QUANTITATIVE APTITUDE      08**

Percentage - Ratio and Proportion - Profit and Loss – Averages, Allegations and Mixtures.

**MODULE IV      LOGICAL COMPETENCY      07**

Syllogism – Blood Relations- Number, Alpha and Alpha numeric series - Puzzles – Cubes and Dice - Odd One Out-Coding and Decoding

**P – 30; TOTAL HOURS - 30**

**REFERENCES:**

1. Sharma, R.C. and Mohan, Krishna (2010). Business Correspondence and Report Writing. 4th edition. Tata McGraw Hill Education Private Limited, New Delhi
2. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK
3. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
4. R. S. Aggarwal , Quantitative Aptitude for Competitive

Examinations, S. Chand Limited, 2017

5. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning , S. Chand Limited, 2010
6. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016
7. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018
8. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

### COURSE OUTCOMES:

**CO1:**Demonstrate reading skills with reference to business related texts

**CO2:**Draft professional documents by using the three stages of writing

**CO3:** Apply various short cut techniques for solving complicated aptitude problems

**CO4:** To understand various problems and patterns of different ways to solve it

### Board of Studies (BoS) :

13<sup>th</sup>BoS of the Department of English  
held on 17.6.2021

### Academic Council:

17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2	PS O1	PSO2	PS O3
CO1		L		H						H					
CO2			L							H					
CO3			L				M								
CO4		H		M											
CO5															

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

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

Statement: Demonstrating, Drafting and applying various techniques for sustainable growth to employment.

**SEMESTER V**

<b>CSD 3151</b>	<b>DATA AND NETWORK</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>SECURITY</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To explain the key security requirements of information systems.

**COB2:** To explore the importance of encryption.

**COB3:** To represent the requirements of advanced cryptographic techniques.

**COB4:** To provide adequate knowledge on data security.

**COB5:** To give in depth on network and internet security.

**MODULE I NETWORK SECURITY CONCEPTS 09**

Computer Security concepts – Security Attacks – Services – Mechanisms – Network Security Model – Number Theory – Division, Euclidean algorithm – Modular Arithmetic, Prime Number, Fermat's and Euler's Theorem – Testing for Primality – Chinese Remainder Theorem.

**MODULE II SYMMETRIC CIPHERS 09**

Symmetric Cipher model – Substitution and Transposition techniques – Block cipher structure – Data Encryption Standard – Advanced Encryption Standard

**MODULE III ASYMMETRIC CIPHERS 09**

Public Key Cryptosystem – Rivest, Shamir, Adleman Algorithm – Other Public– Key Cryptosystems – Diffie– Hellman Key Exchange – Elgamal Cryptographic System – Elliptic Curve Arithmetic and Cryptography

**MODULE IV DATA SECURITY 09**

Data Security: Components of an Information System – Security Systems development Life Cycle – Need for Security: Malicious code, Hoax, Spoof, Man-in-the- Middle, Mail Bombing

**MODULE V NETWORK AND INTERNET SECURITY 09**

Network access control & Cloud security – Transport level security – Wireless network security – Electronic mail security – IP Security

**L – 45; TOTAL HOURS – 45**

**TEXT BOOK:**

1. Stallings, W., "Cryptography and network security", 7<sup>th</sup> edition. Pearson Education India. ISBN: 978– 9332585225, 2017.

**REFERENCES:**

1. Whitman, M. E., & Mattord, H. J., "Principles of information security", 4<sup>th</sup> edition, Cengage Learning .ISBN: 978-1111138219, 2011
2. Kahate, A., "Cryptography and network security", 4<sup>th</sup> edition. Tata McGraw– Hill Education. ISBN: 978– 9353163303, 2019.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Acquire background on network security concepts.

**CO2:** Apply encryption algorithms to achieve confidentiality.

**CO3:** Propose an appropriate cryptographic system framework.

**CO4:** Analyze the need for data security.

**CO5:** Examine the various level of network and internet security.

**Board of Studies (BoS) :**

19<sup>th</sup> BOS of CSE held on 28.12.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	L					M							L	
CO2			M	L										
CO3						M	L							M
CO4								M				H	M	
CO5													H	

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

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

Statement:

By learning "Data & Network Security", the students are able to design and apply security algorithm or frame work to protect data and ensure privacy which may leads to economic growth and employment in security aspects and prevention of security attacks.

**CSD 3152****CLOUD COMPUTING SERVICES****L T P C****SDG: 9****3 0 2 4****COURSE OBJECTIVES:**

**COB1:** To learn the fundamental concepts of Cloud Computing and its Evolution.

**COB2:** To understand various virtualization techniques.

**COB3:** To explore different types of Cloud service models.

**COB4:** To get familiar with different methodologies for cloud application design

**COB5:** To explore cloud security and development tools.

**MODULE I INTRODUCTION****09**

Introduction – Cloud Computing, Service delivery models, Deployment Models- Characteristics and Benefits of Cloud computing, Cloud computing platforms and technologies – Distributed and Parallel Computing – Distributed computing and its properties, Performance consideration in distributed Computing, Parallel Computing, performance consideration in parallel computing, Amdahl's law, Flynn's classical taxonomy, Classes of parallel computers – Multi core Architecture - Multi cores in cloud computing, Classes of parallelism, Limitations.

**MODULE II VIRTUALIZATION****09**

Virtualization – Defining virtualization, Virtualization models, Server virtualization models, Desktop virtualization, Application virtualization- Hardware Maximization – Move to 64 bit, Rely on shared storage, Architectures, Manage virtualization.

**MODULE III CLOUD SERVICE MODELS****09**

Infra structure-as-a-Service(IaaS)-IaaS in cloud, Benefits, Management of VMs in IaaS, IaaS Providers, Key to successfully moving to IaaS, Challenges of IaaS – SaaS and PaaS in cloud – Characteristics, implementation, advantages and disadvantages of SaaS, Characteristics, implementation, advantages and disadvantages of PaaS

**MODULE IV CLOUD APPLICATION DESIGN****09**

Design Considerations - Reference Architectures – Design Methodologies – Data Storage – Data Analytics – Deployment and Management – Python for Cloud – Simulation Tool Study.



## **MODULE V CLOUD COMPUTING SECURITY & 09 DEVELOPMENT TOOLS**

Cloud security – Data Security, Encryption techniques in Cloud, Infra Structure security, PaaS Application security, SaaS Application security, Securing virtual servers, Cloud Security controls – Cloud development tools – Kernel Virtual Machine, Delta Cloud, Eucalyptus, Apache Stack, AWS Cloud, Windows Azure.

### **LIST OF EXPERIMENTS:**

1. Install Virtualbox/VMware Workstation with linux or windows OS on top of windows10 or 11
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
5. Install Hadoop single node cluster.
6. Write program to run simple Hadoop applications like wordcount.
7. Write a procedure to transfer the files from one virtual machine to another virtual machine.

**L – 45; P-30; TOTAL HOURS – 75**

### **TEXT BOOK:**

1. Sunilkumar Manvi, Gopal Shyam, “Cloud Computing Concepts and Technologies”, First Edition, CRC Press, ISBN:9781000337952, 1000337952, 2021.

### **REFERENCES:**

1. Dac-Nhuong Le, Raghvendra Kumar, Gia Nhu Nguyen, Jyotir Moy Chatterjee, “Cloud Computing and Virtualization”, Wiley, SBN:9781119488125, 1119488125, 2018.
2. Dinesh G. Harkut, Kashmira Kasat, Saurabh Shah, “Cloud Computing Technology and Practices”, Intechopne, ISBN:9781789849158, 1789849152, 2019.

### **COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Articulate the main concepts, key technologies of Cloud computing.

**CO2:** Illustrate the concepts of virtualization.

**CO3:** Apply cloud computing model and development tools.

**CO4:** Develop the ability to deploy application in Cloud.

**CO5:** Analyze the security concepts over cloud servers.

**Board of Studies (BoS) :**

22<sup>nd</sup> BoS of CSE held on  
17.08.2023

**Academic Council:**

21st AC held on 23.12.2023

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

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

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

Statement: By learning "Cloud Computing services", the students are able to build cloud infrastructure for business applications that can enhance services and virtual environment for global connection.

**CSD 3153****AUTOMATA THEORY****L T P C****SDG: 9****3 0 0 3****COURSE OBJECTIVES:**

**COB1:** To identify the type of problems that can be solved using computation

**COB2:** To enhance students' ability to derive mathematical proofs for computation.

**COB3:** To construct automata and find its equivalent regular expression.

**COB4:** To describe the challenges of theoretical computer science and its contribution to other sciences.

**COB5:** To learn Turing machines, undecidable problems and NP class problems.

**MODULE I AUTOMATA THEORY****09**

Why study Automata Theory- Introduction to Formal Proof - Additional Forms of Proof Inductive Proofs- The Central Concepts of Automata Theory - Finite Automata- Deterministic Finite Automata-Nondeterministic Finite Automata- Finite Automata with Epsilon Transitions.

**MODULE II REGULAR EXPRESSIONS****09**

Regular Expressions- Finite Automata and Regular Expressions-Pumping Lemma of regular languages- Properties of regular languages.

**MODULE III CONTEXT-FREE GRAMMARS AND LANGUAGES****09**

Context-Free Grammars- Parse Trees- Ambiguity in Grammars and Languages- Normal Forms of Context Free Grammars- Pumping Lemma of Context Free Languages.

**MODULE IV PUSH DOWN AUTOMATA****09**

Definition of the Pushdown Automaton - The Languages of a PDA Equivalence of PDA's and CFG's- Deterministic Pushdown Automata.

**MODULE V TURING MACHINES****09**

The Turing Machine- Programming Techniques for Turing Machines - Rice Theorem - Properties of Recursive and Recursively Enumerable Languages – Undecidability and NP class problems.

**L –45 ; TOTAL HOURS –45****TEXT BOOK:**

1. John Hopcroft, Rajeev Motwani & Jeffery Ullman "Introduction to Automata Theory, Languages & Computation", 3rd Edition, Pearson Education, ISBN : 9781292039053, 1292039051, 2014

**REFERENCES:**

1. John C Martin, "Introduction to Languages and Automata Theory", 3rd Reprint Edition, Tata McGraw-Hill, ISBN: 978-1118014783,2008.
2. Michael Sipser, "Introduction to the Theory of Computation", 3rd Edition, PWS Publishing Company, ISBN: 978-1133187790,2013.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Apply mathematical proof to real time computation problem.

**CO2:** Design finite automata to accept the strings of a language given.

**CO3:** Construct languages using the Grammars of Context Free Languages.

**CO4:** Use pushdown automata to implement a context-free grammar.

**CO5:** Solve problems on undecidability using Turing machine.

**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

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

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

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

Statement :

Interact with decision makers to improve the uptake of sustainable infrastructure

<b>CSD 3154</b>	<b>MACHINE LEARNING TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To learn the basics of Machine Learning .

**COB2:** To understand the methods of Machine Learning

**COB3:** To acquire knowledge on model evaluation techniques.

**COB4:** To know about the implementation aspects of machine learning

**COB5:** To acquire knowledge about use cases of machine learning.

**MODULE I INTRODUCTION 09**

Essential concepts of Machine Learning -Types of learning –Dimensionality — Data representation and visualization

**MODULE II MACHINE LEARNING METHODS 09**

Bias and variance -Supervised learning -- Regressions-K-NN classifier– Support Vector Machine (SVM)–Decision Tree Learning - Neural Networks - Unsupervised learning - K-means algorithm -Evaluating Cluster Size– Metrics for assessing model performance.

**MODULE III MODEL EVALUATION 09**

Cross-Validation -Stratified k-Fold Cross-Validation and Other Strategies - Grid Search-Simple Grid Search-Grid Search with Cross-Validation - Evaluation Metrics and Scoring

**MODULE IV MACHINE LEARNING IMPLEMENTATION 09**

Model Designing and pipelining - Performance measurement -Open-Source Machine learning Libraries-- Azure Machine Learning - Amazon's Machine Learning Tool Kit

**MODULE V APPLICATION OF MACHINE LEARNING 09**

Speech Recognition -Image Recognition– Email spam Filtering – Online fraud detection – Sentiment Analysis- Medical Diagnosis- Recommendation System

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOK:**

1. M.Gopal ,” Applied Machine Learning”,McGraw-Hill Education, ISBN

: 9789353160265, 935316026X,2018.

2. Ameet V Joshi, "Machine Learning and Artificial Intelligence", Springer Publications, 978-3-030-26622-6 ,2020

### REFERENCES:

1. Andreas C. Müller and Sarah Guido, "Introduction to Machine Learning with Python- A Guide for Data Scientists", O'Reilly publications, Second edition, ISBN-9789352134571 ,2018.
2. Wei-Meng Lee, "Python Machine Learning", John Wiley & Sons, First edition, ISBN:9781119545675, 1119545676, 2019

### COURSE OUTCOMES:

Students who complete this course will be able to

**CO1:** Explain the fundamental principles of machine learning techniques.

**CO2:** Illustrate algorithms for supervised and unsupervised learning.

**CO3:** Apply principles and algorithms to evaluate machine learning models

**CO4:** Demonstrate various machine learning techniques using standard packages

**CO5:** Apply machine learning technique to solve the real-world problems.

### Board of Studies (BoS) :

19th BOS of CSE held on  
28.12.2021

### Academic Council:

18th AC held on 24.02.2022

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	H					L							M	
CO2				M								M		H
CO3		L												
CO4					L									H
CO5			M		M		M							H

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

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

Statement:

By learning “Machine Learning Techniques”, the students are able to design and develop various learning methods in real time application for sustainable economic growth in turn provide productive employments.

<b>CSD 3155</b>	<b>MACHINE LEARNING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>LABORATORY</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

- COB1:** To study the basic concepts and techniques of Machine Learning.
- COB2:** To develop skills of using recent machine learning software for solving practical problems.
- COB3:** To impart the knowledge of various clustering techniques.
- COB4:** To develop the appropriate decision tree models.
- COB5:** To use of data sets in implementing the machine learning algorithms.

**SOFTWARE REQUIRED :PYTHON,JAVA**

Design the problems and implement the solutions for following concepts

1. Geometric models, Probabilistic models, Logical models Linear and Non-Linear Regression Techniques
2. multivariate linear regression – regularized regression
3. SVM -Plotting the Hyperplane and the Margins -Making Predictions
4. Learning with Neural Networks
5. Distance based clustering and hierarchical clustering Technique
6. Cross-Validation in scikit-learn
7. Decision trees - ranking and probability estimation trees – regression trees – clustering trees
8. Advanced learning Algorithm-Sequential Covering Algorithm-Explanation Base Learning -FOCL Algorithm
9. Reinforcement Learning

**P- 30 ; TOTAL HOURS – 30**

**COURSE OUTCOMES:**

Students who complete this course will be able to

- CO1:** Analyze the procedures for the machine learning algorithms.
- CO2:** Design the various machine learning algorithms.
- CO3:** Apply appropriate data sets to the evaluation metrics.
- CO4:** Optimize the various models and report on the expected accuracy that can be achieved.
- CO5:** Demonstrate the proficiency in applying machine learning models to real time applications.



**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P O 10	P O 11	P O 12	PS O1	PS O2
CO1						M							M	
CO2							L						M	
CO3		H		M										
CO4			M			L								H
CO5	M				M							M		H

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

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

Statement:

By learning “Machine Learning Techniques lab”, the students are able to design and develop various learning methods in real time application and practice it for sustainable economic growth in turn provide productive employments and innovative solutions.

<b>CSD 3156</b>	<b>DATA AND SECURITY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>LABORATORY</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To explore the classical encryption techniques for problem solving.

**COB2:** To understand DES, RSA, MD5, SHA-1 algorithms

**COB3:** To acquire knowledge on network monitoring to analyze slowdown in an network.

**COB4:** To get familiar with different tools of Wireshark.

**COB5:** To learn network security system using open-source tools.

**SOFTWARE REQUIRED:**

**C , C++ , Java or equivalent, compiler GnuPG KF Sensor or Equivalent ,Snort ,Net Stumbler or Equivalent**

**LIST OF EXPERIMENTS**

1. Implement the following substitution & transposition techniques concepts
2. Write a program to perform Encryption/Decryption using Diffie-Helmen Key exchange.
3. Write a program for simple RSA algorithm to encrypt and decrypt the data.
4. Write a program for DES algorithm to encrypt and decrypt the data.
5. Implement MD5 and SHA-1 algorithms.
6. Implement the SIGNATURE SCHEME-Digital Signature Standard
7. Installation and demonstration of Wireshark Network Analyzer tool. To Analysis Network using Wireshark for (a)Traffic Monitoring (TCP slow down and HTTP slow down) (b) Packet Sniffing
8. To perform man in middle attack using DNS spoofing.
9. Automated Attack and Penetration Tools Exploring N-Stalker, a Vulnerability Assessment Tool.

**P- 30; TOTAL HOURS – 30**

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Interpret the classical encryption techniques for solving real time problems

**CO2:** Demonstrate the DES, RSA, MD5, SHA-1 algorithms.

**CO3:** Express the proficiency in handling different tools of Wireshark

**CO4:** Illustrate the concepts to enhance network speed.

**CO5:** Design real time network security system using open-source tools.

**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on  
24.02.2022

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

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

Statement: The students attending this laboratory can get insight of real time network security system.

<b>GED 3101</b>	<b>COMMUNICATION SKILLS FOR</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>	<b>CAREER SUCCESS</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To develop students' proficiency in English at CEFR B2 level (Business Vantage)

**COB2:** To develop students' receptive skills (Listening and Reading) in a wide range of situations

**COB3:** To develop students' productive skills (Speaking and Writing) in a wide range of situations

**COB4 :**To expose students to the nuances of the English language, grammar and usage.

**MODULE I BRIEF EXCHANGES OF COMMUNICATION 08**

Listening to telephonic conversations - gap filling exercises- short conversations – Promoting a product-Reading short passages and answering matching tasks-Writing short notes and messages. - Framing questions

**MODULE II WORKPLACE COMMUNICATION 07**

Listening to monologues - gap filling exercises - Mini presentations- role play- Reading longer texts – gap filling- Writing memo , emails and Fax - Writing reports on conferences, seminars

**MODULE III INTERPERSONAL COMMUNICATION 08**

Listening to conversations – Collaborative discussion using prompts - Reading comprehension-multiple choice-texts - Writing enquiry letters & replies to customers

**MODULE IV NEGOTIATING AND PERSUADING 07**

Listening to interviews - Group Discussions - Multiple choice and gap filling- writing work reports- cause and effect - Complaint letter and sales letter

**P-30: TOTAL HOURS - 30**

**REFERENCES:**

1. Guy Brook-Hart, 'Business Benchmark-Upper Intermediate, 2nd edition, Cambridge University Press, Shree MaitreyPrintechPvt.

Ltd, Noida, 2016.

2. Leo Jones, 'New International Business English' Students book. Cambridge University Press, Cambridge, 2003.
3. Simon Sweeney, 'Communicating in Business' Teacher's Book. Cambridge University Press, Cambridge, 2004.
4. Simon Sweeney, 'Communicating in Business' Student's Book. Cambridge University Press, Cambridge, 2003.
5. Bill Mascull. 'Business Vocabulary in Use'. Advanced. Cambridge University Press, Cambridge, 2004

### **COURSE OUTCOMES:**

**CO1:** Use the LSRW skills effectively in business and general situations

**CO2:** Demonstrate receptive skills effectively in various formal and informal communication situations.

**CO3:** Demonstrate productive skills effectively in various formal and informal communication situations

**CO4:** Use appropriate grammar and vocabulary in any context.

### **Board of Studies (BoS) :**

13<sup>th</sup>BoS of the Department of  
English held on 17.6.2021

### **Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3	PS O4	PSO 5
CO1									M	H							H
CO2									M	H							H
CO3									M	H							H
CO4										H							M

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

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

This course helps the students to enhance their communication skills, critical thinking, problem solving, conflict resolution, team building and public speaking. This course also helps them to achieve success in their professional and personal life.

<b>CSD 3159</b>	<b>INTERNSHIP – I</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To explore business concepts and theories in real-world decision-making.

**COB2:** To develop and improve business skills in communication, technology, quantitative reasoning, and teamwork.

**COB3:** To enhance the proficiency in business disciplines;

**COB4:** To build a network of professional relationships and contacts.

**COB5:** To appreciate ideas to improve work effectiveness and efficiency by analyzing challenges and considering viable options.

**GUIDELINES:**

- The students shall undergo industry training in any industry relevant to the field study or internship at research organizations / eminent academic institutions for the minimum period of 15 days during the summer vacation of second year.
- In any case, the student shall obtain necessary approval from the Head of the Department / Dean of School and the training has to be taken up at a stretch.
- In the case of industry internship, the student shall submit a report, which shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department.
- The student shall also submit an internship completion certificate issued by the industry / research / academic organization.
- The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively.
- The credit will be awarded in the 5th Semester.

**COURSE OUTCOMES:**

Students those who complete this course will be able to

**CO1:** Demonstrate the application of knowledge and skill sets acquired from the course and workplace in the assigned job function/s;

**CO2:** Solve real life challenges in the workplace by analyzing work environment and conditions, and selecting appropriate skill sets acquired from the course;

**CO3:** Communicate and collaborate effectively and appropriately with different professionals in the work environment through written and oral means;

**CO4:** Exhibit critical thinking and problem-solving skills by analyzing underlying issue/s to challenges;

**CO5:** Demonstrate the ability to harness resources by analyzing challenges and considering opportunities;

**Board of Studies (BoS) :**

20<sup>th</sup> BoS of CSE held on 16.08.2022

**Academic Council:**

19<sup>th</sup> AC held on 29.09.2022

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

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

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

Statement: The student acquires industrial and business experience through internship and can promote new and innovative ideas in the work place after graduation. Also the course enables the students to become a successful entrepreneur in their field of study.

**SEMESTER VI**

<b>MSD 3181</b>	<b>FUNDAMENTALS OF</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: All 1-17.</b>	<b>ENTREPRENEURSHIP</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To understand the fit between individual and their entrepreneurial ambitions.

**COB2:** To identify the customers and find a problem worth solving.

**COB3:** To create a business model for solving the problems of customer, forming solution and present the Business Model Canvas

**COB4:** To develop a solution for customers' problem and analyze the problem solution fit & product market fit.

**COB5:** To build and demonstrate a Minimum Viable Product (MVP) for startup

**MODULE I                      PROBLEM                      IDENTIFICATION                      AND                      9**  
**OPPORTUNITY DISCOVERY**

Entrepreneurial Thinking, Business Opportunities, Problem Identification, Design Thinking, Potential solutions, Presentation of the problem- Case Study

**MODULE II                      CUSTOMER , SOLUTION AND BUSINESS                      10**  
**MODEL**

Customers and Markets, Identification of Customer Segment, Niche Segment, Customers Jobs, Pain and Gain, Early Adopters, Value Proposition Canvas-Case Study, Basics of Business Model-Lean Canvas-Case Study.

**MODULE III                      VALIDATION AND FINANCIALS                      10**

Blue Ocean Strategy, Solution Demo, Problem – Solution Fit, Minimum Viable Product- Product Market Fit, Prototype – Case Study. Cost, Revenues, Pricing, Profitability Checks, Bootstrapping, Initial Financing and Pitching.

**MODULE IV                      GO TO MARKET                      8**

Positioning and Branding, Golden Circle model: Sinek's theory value proposition, Branding Elements, Market Penetration Strategy, Collaboration Tools and Techniques, Channels – Case Study



**MODULE V                      MANAGING GROWTH AND FUNDING                      8**

Sales Planning, Customer Acquisition Strategy, Selling Skills, Identifying Funding Sources, Mapping Start-Up Cycle to Funding Options, Funding Plan, , Creating business valuation

**L -45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Entrepreneurship Rajeev Roy oxford, 2012.
2. <https://web.nen.wfglobal.org/en/home> - Wadhwani Foundation
3. W. Chan Kim , Renée A. Mauborgne, "Blue Ocean Strategy: How to Create Uncontested Market Space and Make the Competition Irrelevant", Harvard Business Press, 2015.

**REFERENCES:**

1. Anil Lamba , "Romancing the Balance Sheet: For Anyone Who Owns, Runs Or Manages a Business", HarperCollins Publishers India, 2016.
2. The Process of social value creation: A multiple case study on Social Entrepreneurship in India, Archana Singh Springer 2016.
3. "Anatomy of Business Plan" – Linda Pinson, OMIM publication , Seventh Edition, 2008.
4. Running Lean: Iterate From Plan A To a Plan That Works, Ash Maurya, "O'Reilly Media, Inc.", 28-Feb-2012.

**COURSE OUTCOMES:**

On completion of the course, students will be able to

**CO1:** Build an entrepreneurial mindset and reach out the customer to identify the problem using design thinking process

**CO2:** Craft solution to the problem through value proposition canvas and develop a business model using lean canvas

**CO3:** Provide product solution demo and deliver a minimum viable product

**CO4:** Work as a team and create brand strategy marketing for product/service

**CO5:** Prepare, make an outstanding sale pitch for startup

<b>CSD 3251</b>	<b>DATA ANALYTICS AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>VISUALIZATION</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To learn the basic concepts of Data analytics.

**COB2:** To familiarize with the techniques to get insight from data.

**COB3:** To explore data analytics tools for various applications.

**COB4:** To understand the fundamentals of data visualization techniques.

**COB5:** To acquire knowledge and design skills using visualization tools

**MODULE I                      INTRODUCTION TO BIG DATA                      09**

Big Data and Data Science – Types of Data.- Architecture – Taxonomy – KDD process –. Data Analytics Lifecycle – Data Quality and Preprocessing.

**MODULE II                      GETTING INSIGHTS FROM DATA                      09**

Descriptive Statistics – Multivariate Analysis – Frequent Pattern Mining- Regression - Performance Estimation – Performance Measures – Parameters of the model – Technique and Model Selection - Classification – Predictive Methods: Search Based Algorithms, Optimization based algorithms – Ensemble Learning – Non- Binary classification –Clustering Techniques

**MODULE III                      ANALYTICAL                      METHODS                      AND                      09**  
**APPLICATIONS**

Time Series Analysis – ARIMA Model –Determining Sentiments – Map Reduce and Hadoop – Ecosystem - NoSQL - Working with texts – Recommender Systems – Social Network Analysis – Open Source Tools.

**MODULE IV                      DATA VISUALIZATION                      09**

Basics of visualization - Translating numbers to images – Statistical Data Visualization- Chart Types - Comparing categories – Time – Distribution – Geospatial – Relationship – Part to whole – Qualitative – Tables.

**MODULE V                      DESIGNING AND REDESIGNING VISUAL                      09**

Developing a data visualization style guide - Redesigns : Paired bar chart, Stacked bar chart, Line chart, Choropleth Map, Dot Plot, Line chart, table- Data visualization tools.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOK:**

1. João Moreira, Andre Carvalho, André Carlos Ponce de Leon Ferreira Carvalho, Tomás Horvath, "A General Introduction to Data Analytics", Wiley Publications, 1st Edition, ISBN:9781119296256, 2019.
2. Jonathan Schwabish, "Better Data Visualizations" Columbia University Press, ISBN 9780231550154, 0231550154, 2021.

**REFERENCES:**

1. Al-Sakib Khan Pathan, Mohiuddin Ahmed, "Data Analytics Concepts, Techniques, and Applications", CRC Press, ISBN:9780429820915, 2018.
2. EMC Education Services, "Data Science and Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data", Wiley Publications, ISBN:9781118876053, 2015.
- 3 Robert Grant, "Data Visualization", CRC Press, ISBN : 9781351781756, 1351781758, 2018
4. Ward, Grinstein Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", Natick: A K Peters, Ltd, 2nd Edition, ISBN: 978-1568814735, 2015.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Identify the different types of data and big data lifecycle.

**CO2:** Analyze appropriate preprocessing methods to get insights from data

**CO3:** Apply big data analytics methods to solve real time problems.

**CO4:** Employ statistical building blocks for visualizing data.

**CO5:** Design dashboards using data visualization tools.

**Board of Studies (BoS) :**

19th BOS of CSE held on 28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

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

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

Statement:

By learning “Data Analytics and Visualization”, the students will be able to analyse and visualize the corporate data using the appropriate tools for various applications which in turn may leads to sustainable economic growth and enormous employment opportunities.

<b>CSD 3252</b>	<b>IOT AND EMBEDDED SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To learn the basic architecture and protocols of IoT.

**COB2:** To explore the IoT communication models and APIs.

**COB3:** To gain knowledge on the fundamental concepts of Embedded systems.

**COB4:** To understand the functionalities of Embedded C and Microcontroller.

**COB5:** To study the installation and working of embedded development tools.

**MODULE I INTERNET OF THINGS CONCEPTS 9**

Internet of Things (IoT) - Characteristics of IoT - IoT Vision - Emerging Trends in IoT - Industry 4.0- Economic Significance of IoT - Societal Benefits of IoT - Technical Building Blocks -High-level Architecture of IoT - Physical Design of IoT -Things in IoT - – Sensors and Actuators – Types and uses.

**MODULE II IOT PROTOCOLS AND COMMUNICATION MODELS 9**

IoT Protocols (Interoperability of IoT Devices - Link Layer Protocols - Network Layer Protocols - Transport Layer Protocols - Application Layer Protocols-Logical Design of IoT - IoT Functional Blocks - IoT Communication Models - Comparison between IoT Communication Models - IoT Communication APIs - Comparison between REST-based and Web Socket based APIs.

**MODULE III EMBEDDED SYSTEMS CONCEPTS 9**

Embedded Systems and its applications - Comparison between Embedded Systems and Other Computing Systems - Characteristics of Embedded Systems - Real-time Systems – Architecture - Real-time Tasks – Classification - Comparison between Hard and Soft Real-time Systems - Real-time Operating System (RTOS) - Characteristics of RTOS - Comparison between GPOS and RTOS - Real-time Tasks Scheduling and its types.

**MODULE IV EMBEDDED C AND MICROCONTROLLERS 9**

Introduction to Embedded C – Constants, Variables and Data types – Operators – Control structures and Loops – Functions - Introduction to 8051 microcontroller - Architecture and Pin diagram - Microcontroller family - Addressing modes - Data Transfer, Branch Operations and Time Delays in 8051.

**MODULE V      EMBEDDED      DEVELOPMENT      TOOLS      AND      APPLICATIONS****9**

KeilVision and Proteus Software - Introduction to Keil C and Keil compiler - Simulating embedded applications - configuration settings - build - compile - link - debug - run commands - Interfacing input and output devices - Applications -Home Automation - Industrial IoT - Personal and Health Care - Other Uses.

**L – 45; TOTAL HOURS – 45****REFERENCES:**

1. A. Dhotre and Rajesh D. Bharti, "Internet of Things and Embedded Systems", Technical Publications, Kindle Edition, First Edition, 2021.
2. Hubert Henry Ward, "C Programming for the PIC Microcontroller: Demystify Coding with Embedded Programming", APress; 1st ed. Edition, 2019
3. David Hanes, Gonzalo Salgueiro, and Patrick Grossetete, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press, 2017. (ISBN:13- 9781587144561).
4. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, "Internet of Things: Architectures, Protocols and Standards", Wiley, 2018.(ISBN: 9781119359708).
5. Shibu Kizhakke, "Introduction to Embedded System", McGraw-Hill Education, 2018.(ISBN: 9789339219697).
6. [www.keil.com](http://www.keil.com)

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:** Describe the functionalities of the IoT protocols.

**CO2:** Apply the appropriate communication models for web-based IoT applications.

**CO3:** Classify the real time operating systems and its scheduling algorithms.

**CO4:** Interfacing external device using Embedded C and 8051 microcontroller.

**CO5:** Simulation of real time applications using embedded development tools.

**Board of Studies (BoS) :**

23rd BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

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

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

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

**Statement:** By learning IoT and Embedded systems functionality and design, the students obtain more productive employment opportunities in the field of IoT.

<b>CSD 3253</b>	<b>DATA ANALYTICS AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>VISIALIZATION LABORATORY</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To explore different tools required to manage and analyze big data.

**COB2:** To learn various data processing and analytic techniques.

**COB3:** To understand various methods of selecting suitable models to solve real-world problems.

**COB4:** To learn visual presentations of data for effective communication.

**COB5:** To get familiar with tools for application of data visualization in various domains.

**SOFTWARE REQUIRED:****Hadoop, R studio**

Design the problems and implement the solutions for following concepts

10. Data collection and preprocessing techniques
11. Classification Techniques.
12. Regression Technique
13. Clustering Techniques
14. Visualize Data Using Any Plotting Framework
15. Implement the applications –Social network analysis
16. 2-D and 3-D chart representation
17. Data visualization using Pictograms
18. Graph data visualization
19. Case study using Data visualization tool

**P- 30; TOTAL HOURS – 30**

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Illustrate the data gathering from a range of data sources.

**CO2:** Analyze datasets and implement data analysis techniques.

**CO3:** Identify suitable statistical measures for data of various structure and present summary statistics.

**CO4:** Apply appropriate plotting frameworks for visualizing the large data sets.

**CO5:** Illustrate data of real-world applications using data visualization tools.



**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

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

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

Statement: The students attending this laboratory can get insight of analyzing and visualizing real time data which may lead them to have productive employment opportunity.

<b>CSD 3254</b>	<b>MOBILE APPLICATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>LABORATORY</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

### **COURSE OBJECTIVES:**

**COB1:** To provide an overview of an exciting growing field of big data analytics.

**COB2:** To be familiarized with Intent, Broadcast receivers and Internet services.

**COB3:** To work with SQLite Database and content providers.

**COB4:** To integrate multimedia, camera and Location based services in Android Application.

**COB5:** To explore Mobile security issues.

### **SOFTWARE REQUIRED :Android, Ios**

1. Mobile Application Development Framework: Types- Features- challenge.
2. Android: Introduction – Architecture -Installation and configuration-
3. ADE- APIs User Interfaces: Components-views-Layouts and its types- Menus and its types – Dialogues and its types - Notifications and its types
4. Data Storage: SQLite database-Files- shared preferences- Content Providers Location Based Services: Location Provider- Geo Coder- Map
5. Multimedia: Audio Video- Animations- Drawing.
6. Phone Gap and HTML5: Phone Gap Introduction – Architecture- Installation and configuration, HTML5 Introduction -Data list control- Validation feature -Application Cache in HTML 5.
7. Events: Listener and its types-handler and its types. Geo location, Media, Storage.
8. Mini project : Mobile App development

**P- 30 ; TOTAL HOURS – 30**

### **COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Develop various Android applications related to layouts & rich uses interactive interfaces.

**CO2:** Demonstrate the android features and create and create ,develop using android.

**CO3:** Implement the Phone Gap features and advance android

development.

**CO4:** Develop Android applications related to mobile related server-less database like SQLITE.

**CO5:** Design the multimedia, camera and Location based services in Android App and Implement various security issues in Android platform.

**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P O 10	P O 11	P O 12	PS O1	PS O2
CO1				M										
CO2	L													H
CO3							L							
CO4					H									M
CO5								M					M	

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

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

Statement: The students can have productive employment on mobile application development and decent work by learning and practicing this course mobile application development.

<b>CSD 3255</b>	<b>SOFTWARE TOOLS AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>TECHNIQUES LABORATORY</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To be familiar with all the UML notations and understand how it supports the entire software development process.

**COB2:** To understand how to map a design to code and code to a good design.

**COB3:** To expose students to the basic tools and applications used in Web publishing.

**COB4:** To prepare a LaTeX document, to make scientific articles and Project report.

**COB5:** To study software management tools for various projects.

**SOFTWARE REQUIRED: UML tool – Visual Paradigm.**

1. Model a Data Flow diagram and ER diagram
2. Model using UML diagrams
3. Forward and reverse engineering
4. Linux based Shell programming
5. Python based program to check the working of network external interfaces
6. Javascript based Web browser application of dynamic pages
7. Web programming using python - Form design and Validation
8. Deploying a web application via Docker
9. Development of Ajax-Enabled Rich Internet Application with XML and JSON.
10. GUI programming tools using python - Create GUI and take inputs & process them on the local machine /server
11. Document creation using LaTeX
12. Software management tools - Version control (SVN), Bug reporting (Bugzilla)
13. Mini Project (using the above mentioned tools) - Developing large system and application programs

**P- 30 ; TOTAL HOURS –30****COURSE OUTCOMES:**

**CO1:** Design UML diagrams for various cases in different applications.

**CO2:** Develop a new software product from scratch based on the requirements.

**CO3:** Create dynamic web pages using JavaScript, Python, XML and JSON.

**CO4:** Create and typeset a LaTeX document.

**CO5:** Implement software management tools for productivity and computing mechanisms.

**Board of Studies (BoS) :**23<sup>rd</sup>BoS of CSE held on 09.05.2024**Academic Council:**22<sup>nd</sup> AC held on 04.09.2024

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

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

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

**Statement:**

Develop quality, reliable, sustainable and resilient software, encouraging sustainable industrialization through software tools and techniques.

<b>GED 3201</b>	<b>REASONING AND APTITUDE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>	<b>FOR ENGINEERS</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To develop students' critical reading skills

**COB2:** To foster their writing skills

**COB3:** To enlighten the various methods of solving quantitative problems

**COB4:** To make students ready for clearing placement and competitive examination

**MODULE I            OBJECTIVE ENGLISH            07**

Reading Comprehension - Sentence Rearrangement - Cloze Test – Error Spotting

**MODULE II            VOCABULARY DEVELOPMENT            08**

Vocabulary (Synonyms and Antonyms, one word Substitutes, Spellings, Idioms and Phrases, etc) - Fill in the blanks - Paragraph Completion

**MODULE III            GENERAL MENTAL ABILITY            08**

Time speed and Distance –Problems on Trains – Boats and Streams - Permutation and Combination - Probability

**MODULE IV            QUANTITATIVE ABILITY            07**

Data Interpretation (charts, graphs, tables, data sufficiency, etc.) – Time and work-Pipes and Cisterns-Venn Diagrams-Mensuration

**P – 30 ; TOTAL HOURS - 30**

**REFERENCES:**

1. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK.
2. Swan, Michael (2005). Practical English Usage, Oxford University Press.
3. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
4. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017
5. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal

Reasoning, S. Chand Limited, 2010

6. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016
7. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018
8. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

### **COURSE OUTCOMES:**

**CO1:**Demonstrate their reading ability

**CO2:**Exhibit their vocabulary and writing skills

**CO3:**Apply the problem-solving techniques

**CO4:**Gain confidence mentally and be successful in their career

### **Board of Studies (BoS) :**

13<sup>th</sup>BoS of the Department of  
English held on 17.6.2021

### **Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

SDG No. 4 : Give Quality Education to all the Engineers

Statement: In future, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

**SEMESTER VII**

<b>CSD 4151</b>	<b>APPLIED ARTIFICIAL INTELLIGENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG : 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To learn the fundamental concepts of robotics, artificial intelligence, and natural language processing.

**COB2:** To gain expertise using AI approaches in the fields of business, finance, and medicine.

**COB3:** To acquire knowledge on AI approaches to create smart cities.

**COB4:** To get familiarize with the foundation of cognitive science with AI.

**COB5:** To understand AI techniques effectively within governmental processes.

**MODULE I                      INTRODUCTION TO AI TECHNOLOGY** **9**

Computer Graphics: Overview of computer graphics applications and history – Robotics: Introduction to Robotics - Robot Kinematics - Robot Control - Robot Planning - Image Processing and Computer Vision: Overview of digital image processing and computer vision - Image representation and visualization - Image acquisition and digitization - Natural Language Processing: Origins and challenges of NLP – High Performance Computing.

**MODULE II                      AI IN BUSINESS, FINANCE AND MEDICINE** **9**

Electronic commerce technology - Operations research - Financial calculus - Fraud Detection and Prevention-Marketing analytics - Time-series analysis - Survival analysis - Bayesian learning - Modern biostatistics - Omics data analysis - Medical image analysis

**MODULE III                      AI IN SMART CITY** **9**

Theories and Global Trends in Urban Development - Urban Problems, Interventions and Design Thinking - Smart building and Infrastructure-Introduction to geographic information systems - GIS in environmental studies - Transport and society-Waste management.

**MODULE IV                      AI IN NEUROCOGNITIVE SCIENCE** **9**

Introduction to psychology – Perception - Foundations of cognitive science - Emotion Recognition and Affective Computing - Cognitive Agents and Virtual Humans - Brain Imaging analysis-Brain Computer Interfaces (BCIs) - Neural Data analysis.



**MODULE V AI FOR GOVERNMENT PROCESSES****9**

Deep Learning and intelligent Robots in Government – AI and Systems thinking in Public sector – AI based CHATBOTS in Public Administration – Sentiment Analysis for Public Reactions to COVID-19 Vaccine – Development and Adoption of Peruvian Public Sector.

**L -15; P - 30; TOTAL HOURS – 45****REFERENCES:**

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach." Bost MA: Pearson, 2022. ISBN: 978-0134610993
2. David Valle cruz, Nely Plata, Jacobo Leonardo, " HandBook of Research o Applied Artificial Intelligence and Robotics for Government Processes" , IC Global Publisher of Timely Knowledge.
3. I. Goodfellow, Y. Bengio, and A. Courville," Deep Learning." Cambridge, MA: MIT Press, 2016. [ISBN: 978-0262035613]
4. V. C. Müller, "Ethics of Artificial Intelligence and Robotics". Stanford, CA: Stanford University Press, 2020. [ISBN: 978-1509513716]
5. C. Molnar, "Interpretable Machine Learning. "Leanpub, 2019. [ISBN: 978-13030183085]

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Describe the foundations of AI Technologies such as robotics, NLP, Image processing and Computer vision.

**CO2:** Implement AI development techniques in Business, Finance and Medicine.

**CO3:** Utilize AI techniques for the development of Smart Cities, implement innovative solutions for sustainable urban development

**CO4:** Apply AI development techniques in Neurocognitive Science

**CO5:** Analyze the importance of AI techniques in Government Public sector applications.

**Board of Studies (BoS) :**23<sup>rd</sup>BoS of CSE held on 09.05.2024**Academic Council:**22<sup>nd</sup> AC held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2
CO1	H	H	H		H								H	
CO2	H	H	H	M	H	M	L						H	
CO3	H	H	H	M	H	M	L		M				H	H
CO4	H	H	H	M	M	H							H	H
CO5	H	H	H	H	H	H		M	L	L			H	H

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

**SDG 9:** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

**Statement:** This course aims to Some more AI techniques like Robotic and Automation are also minimizing the human afford and can help to achieve SDG.

<b>CSD 4152</b>	<b>INTERNSHIP II</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>

**COURSE OBJECTIVES:**

**COB1:** To explore career alternatives in Artificial Intelligence and

Data Science domain prior to graduation.

**COB2:** To assess interests and abilities in their field of study.

**COB3:** To build a record of work experience.

**COB4:** To appreciate work and its function in the Economy.

**COB5:** To enhance employment and business contacts in the software and hardware industry.

**GUIDELINES:**

- The students shall undergo industry training in any industry relevant to the field study or internship at research organizations / eminent academic institutions for the minimum period of 15 days during the summer vacation of third year.
- In any case, the student shall obtain necessary approval from the Head of the Department / Dean of School and the training has to be taken up at a stretch.
- In the case of industry internship, the student shall submit a report, which shall be evaluated along with an oral examination by a committee of faculty members constituted by the Head of the Department.
- The student shall also submit an internship completion certificate issued by the industry / research / academic organization.
- The weightage of marks for industry internship report and viva voce examination shall be 60% and 40% respectively.
- The credit will be awarded in the 7th Semester.

**COURSE OUTCOMES:**

Students those who complete this course will be able to

**CO1:** Integrate theory and practice in the field of Artificial Intelligence and Data Science

**CO2:** Extend work habits and attitudes necessary for job success.

**CO3:** Develop communication, interpersonal, ethical and other critical

skills in the job interview process.

**CO4:** Acquire directly a full-time job in Software/Hardware Industry with the help of Industry training experience.

**CO5:** Become a successful entrepreneur and benefit society with new ideas and innovations using computer technology.

**Board of Studies (BoS) :**

20<sup>th</sup> BoS of CSE held on  
16.08.2022

**Academic Council:**

19<sup>th</sup> AC held on  
29.09.2022

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

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

Statement : The student acquire industrial and business experience through internship and can promote new and innovative ideas in the work place after graduation. Also the course enables the students to become a successful entrepreneur in their field of study.

<b>CSD 4251</b>	<b>PROJECT WORK</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4,9</b>		<b>0</b>	<b>0</b>	<b>18</b>	<b>9</b>

**COURSE OBJECTIVES:**

**COB1:** To explore the team spirits among the students

**COB2:** To investigate the real word problems that are effectively solved by Artificial Intelligence

**COB3:** To provide knowledge on the different machine learning algorithms

**COB4:** To learn the different tools and techniques to analyze the data set

**COB5:** To inculcate the presentation skills and write effective reports

**PROCEDURE**

The students are allowed to do their project as an individual or as a team of two to three students. A committee of faculty members constituted by the Head of the Department will carry out three periodic reviews. Based on the project report submitted by the student, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by Controller of Examinations.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Communicate, collaborate and work as an individual and as a team in industries.

**CO2:** Analyze the real world problems and apply various machine learning algorithms to provide engineering solutions.

**CO3:** Design and implement the Artificial Intelligence and Data science techniques for solving the problems.

**CO4:** Construct an optimized and cost effective learning model.

**CO5:** Document the project with the results obtained.

**Board of Studies (BoS) :**

20<sup>th</sup> BoS of CSE held on 16.08.2022

**Academic Council:**

19<sup>th</sup> AC held on 29.09.2022

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

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

**SDG 4:** Quality Education: Ensuring inclusive and equitable quality education for all persons

Statement: Doing projects using Artificial Intelligence and Machine learning algorithms, will enable students to gain quality education.

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

Statement: Students doing projects in Artificial Intelligence and Data Science will promote industrialization and foster innovation.

## PROFESSIONAL ELECTIVE COURSES SEMESTER IV

<b>CSDX 601</b>	<b>BUSINESS INTELLIGENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### COURSE OBJECTIVES:

**COB1:** To gain knowledge on the concepts and components of Business Intelligence (BI).

**COB2:** To understand the technologies that make up Business Intelligence.

**COB3:** To provide knowledge on how Business Intelligence used in organization.

**COB4:** To learn the technological architecture used in Business Intelligence systems.

**COB5:** To highlight the importance of a Business Intelligence system.

### **MODULE I      UNDERSTANDING      BUSINESS      09** **INTELLIGENCE**

The Challenge of Decision Making - What Is Business Intelligence -The Business Intelligence Value Proposition -The Combination of Business and Technology.

### **MODULE II      BUSINESS INTELLIGENCE TECHNOLOGY      09** **COUNTERPARTS**

Data Warehousing - Enterprise Resource Planning -Customer Relationship Management - Business Intelligence and Financial Information.

### **MODULE III      THE      SPECTRUM      OF      BUSINESS      09** **INTELLIGENCE**

Enterprise and Departmental Business Intelligence -Strategic and Tactical Business – Intelligence-Power and Usability in Business Intelligence-Finding the Right Spot on the Continuum.

### **MODULE IV      BUSINESS      INTELLIGENCE      USER      09** **INTERFACES**

Querying and Reporting -Reporting and Querying Toolkits-Basic Approaches-Data Access- Dashboards.

**MODULE V      BUSINESS                      INTELLIGENCE      09**  
**CUSTOMIZATION AND PROJECT PLAN**

Visualization -Handling Unstructured Data - The Business Intelligence  
Project Plan - Human Factors -Choosing the Right Size, Shape, and  
Cost.

**L – 45 ; TOTAL HOURS – 45**

**TEXT BOOK:**

1. Rajiv Sabherwal, Irma Becerra Fernandez,” Business Intelligence: Practices, Technologies, and Management,”, Wiley Publishers, ISBN: 978-0-470-46170-9, 2013.

**REFERENCES:**

1. Chandraish Sinha,” Mastering Power BI: Build Business Intelligence Applications Powered with DAX Calculations, Insightful Visualizations, Advanced BI Techniques, and Loads of Data Sources”, BPB Publications,1st Edition, ISBN: 978-93-91030-728, 2022.
2. Ramesh Sharda, Dursun Delen & Efraim Turban, “Business Intelligence and Analytics: Systems for Decision Support”, 10th Edition, Pearson Education, ISBN-13: 978-0133050905, 2019.

**COURSE OUTCOMES:**

Students those who complete this course will be able to

**CO1:** Describe the fundamental concepts of Business Intelligence system.

**CO2:** Demonstrate the technological counterparts of Business Intelligence.

**CO3:** Analyze the spectrum of Business Intelligence.

**CO4:** Create the dashboards to visualize the Business Intelligence analytics.

**CO5:** Develop Business Intelligence systems for real time applications.

**Board of Studies (BoS) :**

20<sup>th</sup> BoS of CSE held on 16.08.2022

**Academic Council:**

19<sup>th</sup> AC held on 29.09.2022



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

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

Statement: Effective use of Business Intelligence can empower every person throughout an organization to truly understand and utilize the power of data to make better business decisions in an intelligent and ethical way.

**COB5:** To acquire knowledge through future trends and case studies.

Knowledge Management and Vocabulary Control - Information Mapping in  
Information Retrieval-Information Coding in the Internet Environment -  
Repackaging Information- Case Studies: From Library to Knowledge Center,  
Knowledge Management in the Health Sciences, Knowledge Management in  
Developing Countries.

**MODULE V****FUTURE TRENDS AND CASE STUDIES****09**

Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - Corporate Memories for supporting various aspects in the process life -cycles of an organization.

**L – 45; TOTAL HOURS – 45****REFERENCES:**

1. Donald Hislop, "Knowledge Management in Organizations: A Critical Introduction", OUP Oxford, ISBN. 0198724012, 2021.
2. Nick Milton and Patrick Lambe, "The Knowledge Manager's Handbook: A Step-by-Step Guide to Embedding Effective Knowledge Management in your Organization", ISBN-13: 978-0749482041, 2020.
3. Nadeem Uz Zaman and Imed Boughzala, "Knowledge Management for Development: Domains, Strategies, and Technologies for Developing Countries", ISBN-13: 978-1138626357, 2019.
4. Kimiz Dalkir, "Knowledge Management in Theory and Practice", The MIT Press, ISBN: 9780262036870, 2018.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Describe the foundation and evolution of Knowledge Management.

**CO2:** Identify various sources of knowledge within and outside an organization.

**CO3:** Evaluate appropriate technologies and tools for effective knowledge management in organizational settings.

**CO4:** Apply Knowledge Management principles in practical scenarios, solving real-world problems and challenges

**CO5:** Analyze insights from real-world case studies of successful and unsuccessful knowledge management implementations.

**Board of Studies (BoS) :**

23<sup>rd</sup> BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 4.9.2024

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

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

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

**Statement:** Knowledge Management contributes to the efficient transfer of knowledge and expertise within organizations, fostering innovation and economic growth.

**CSDX 603****INTELLIGENT INFORMATION  
RETRIEVAL****L T P C****SDG: 8****3 0 0 3****COURSE OBJECTIVES:****COB1:** To provide an overview of information retrieval systems.**COB2:** To learn computing mechanism of the various search engines.**COB3:** To understand text classification, clustering and evaluation in information retrieval system.**COB4:** To gain knowledge on working of retrieval models and clustering.**COB5:** To acquire knowledge on intelligent information retrieval and filtering.**MODULE I****INTRODUCTION****09**

Overview of Information Retrieval Systems, Data Representation, Evaluation- Retrieval Models.

**MODULE II****COMPUTING SCORES IN A SEARCH SYSTEM****09**

Efficient scoring and ranking - Inexact top K document retrieval - Index elimination - Champion lists -- Static quality scores and ordering - Impact ordering - Cluster pruning - Components of an information retrieval system- Tiered indexes - Query-term proximity - Designing parsing and scoring functions - Vector space scoring and query operator interaction.

**MODULE III****TEXT CLASSIFICATION ,CLUSTERING AND  
EVALUATION IN IR****09**

Information retrieval system evaluation- Standard test collections - Evaluation of unranked retrieval sets - Evaluation of ranked retrieval results - Assessing relevance- Critiques and justifications of the concept of relevance - Flat clustering – hierarchical clustering – Matrix decomposition – latent semantic indexing – web search basics – web crawling – indexes – link analysis.

**MODULE IV****RETRIEVAL MODELS AND CLUSTERING****09**

Similarity Measures and Ranking – Boolean Matching – Vector Space Models- Probabilistic Models. Relevance Feedback – User Profiles – Collaborative Filtering –Document and Term Clustering – Document Categorization.

**MODULE V****IR IN THE WORLD WIDE WEB****09**

Information Retrieval Systems and the WWW – PageRank and Hyperlink Analysis – Search Personalization – Web Mining and Its Applications.

**L – 45; TOTAL HOURS –45****TEXT BOOK:**

1. Christopher Manning, Prabhakar Raghavan and Hinrich Schutze, "Introduction to Information Retrieval", Cambridge University Press, ISBN : 9781107666399, 2017.

**REFERENCE:**

1. Grossman, David A., Frieder, and Ophir, "Information Retrieval", Algorithms and Heuristics, ISBN: 9781402030055, 2012.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Describe the various types of data and its representation techniques.

**CO2:** Illustrate the ranking algorithm used to evaluate the performance of various search engines.

**CO3:** Evaluate the information retrieval system created in any environment.

**CO4:** Assess the filtering techniques and clustering in real world scenarios.

**CO5:** Analyze the applications of information retrieval system in World Wide Web.

**Board of Studies (BoS) :**

19th BOS of CSE held on 28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

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

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

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

Statement:

By learning this course will able to analyze the data in learning storage models and apply them to various real world problems thereby promote sustainable economic growth and productive employment.

<b>CSDX 604</b>	<b>ETHICS IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

**COB1:** To provide the fundamental concepts of AI and ethics.

**COB2:** To explore different types of risks and privacy issues in business of AI.

**COB3:** To gain knowledge on basics of data science ethics.

**COB4:** To get familiarized with ethical data preprocessing and modeling.

**COB5:** To impart knowledge on ethical evaluation and deployment strategies.

<b>MODULE I</b>	<b>INTRODUCTION TO AI AND ETHICS</b>	<b>9</b>
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Introduction to AI – Strong and Weak AI – Type of AI Systems – Robots – Science and Fiction of AI – Ethics – Descriptive Ethics – Normative Ethics – Meta, Applied and Machine Ethics – Trust and Fairness in AI Systems – Case Study: Responsibility and Liability.

<b>MODULE II</b>	<b>RISK AND PRIVACY ISSUES IN BUSINESS OF AI</b>	<b>9</b>
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General Business Risks – Ethical Risks – Managing Risks of AI – Business Ethics for AI Companies – Psychological Aspects – Privacy Issues – Private Data Collection and its dangers – Ethical issues related to Robots and Healthcare.

<b>MODULE III</b>	<b>INTRODUCTION TO DATA SCIENCE ETHICS</b>	<b>9</b>
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Rise of Data Science Ethics – Right and Wrong – Personal, Sensitive and Behavioral Data – Data Science Ethics Equilibrium – Ethical Data Gathering-Uphold Applicable Statutes, Regulations, Professional Practices, and Ethical Standards-Application of Data Ethics

<b>MODULE IV</b>	<b>ETHICAL DATA PREPROCESSING AND MODELING</b>	<b>9</b>
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Introduction – Defining and Measuring Privacy – Selecting Variables – Fair Relabeling – Ethical Modeling – Privacy Preserving Data Mining – Discrimination Aware Modeling – Comprehensive Models – Explainable AI.

<b>MODULE V</b>	<b>ETHICAL TESTING, EVALUATION AND DEPLOYMENT</b>	<b>9</b>
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Introduction to Ethical Testing-Evaluation – Ethical Measurement – Ethical Interpretation of Results – Ethical Reporting – Ethical Deployment – Access to the Systems – Treatment for Different Predictions – Honesty and DeepFake – Governance – Unintended Consequences.

**L – 45; TOTAL HOURS – 45****REFERENCES:**

- 1 Bartneck, C., Lütge, C., Wagner, A., Welsh, S. "An Introduction to Ethics in Robotics and AI", Springer International Publishing, Germany, 2020.
- 2 Martens, D., "Data Science Ethics: Concepts, Techniques, and Cautionary Tales", OUP Oxford, United Kingdom, 2022.
- 3 Martin, K., "Ethics of Data and Analytics: Concepts and Cases", CRC Press, United Kingdom, 2022.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Describe the fundamentals of AI and ethics.

**CO2:** Apply different types of risks and privacy issues in business of AI.

**CO3:** Elaborate the concepts of data science ethics in real time applications.

**CO4:** Demonstrate the ethical data preprocessing and modeling techniques for various applications.

**CO5:** Analyze various ethical evaluation and deployment strategies.

**Board of Studies (BoS) :**

23<sup>rd</sup>BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

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

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

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

**Statement:** Ethics in AI &DS is designed to explore ethical and social implications of the use of Artificial Intelligence (AI) to advance the Sustainable Development.



<b>CSDX 605</b>	<b>OPEN SOURCE TOOLS FOR AI &amp; DATA SCIENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG</b>	<b>8</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To understand the importance of open source tools like python and R tools for Artificial Intelligence and Data Science.

**COB2:** To gain hands-on learning in data science and artificial intelligence concepts using Julia.

**COB3:** To learn the implementation of Data Science, Machine learning and AI techniques using H2O.

**COB4:** To explore best practices for working with Rasa framework.

**COB5:** To acquire knowledge on AI & Data Science using KNIME analytics platforms.

<b>MODULE I</b>	<b>INTRODUCTION TO OPEN SOURCE TOOLS FOR AI &amp; DATA SCIENCE</b>	<b>10</b>
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Overview of AI & Data Science - Importance of open source tools for AI & Data Science–Data Manipulation and Analysis with Pandas – Machine Learning with Scikit-Learn – Deep Learning with TensorFlow and Keras–R for AI & Data Science.

<b>MODULE II</b>	<b>JULIA FOR AI AND DATA SCIENCE</b>	<b>9</b>
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Introduction to Julia programming language- Installing Julia and setting up the development environment -Basic syntax, data types, and variables -Functions and control flow–Exploratory Analysis using Julia –Distribution Analysis – Interactive Visualizations usingPlotly – Data Munging in Julia.

<b>MODULE III</b>	<b>H2O, KNIME FOR AI &amp; DATA SCIENCE</b>	<b>9</b>
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Installation and Quick-Start – Data Import, Data Export – Data set loading – preprocessing – Data Driven Modeling –Supervised Learning with H2O.ai – Unsupervised Learning and Anomaly Detection – Visual Programming with KNIME – Exploratory Data Analysis – Machine Learning Theory – Machine Learning Models

<b>MODULE IV</b>	<b>CONVERSATIONAL AI WITH RASA</b>	<b>9</b>
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Introduction to Chatbots and the Rasa Framework – Natural Language Understanding in Rasa – Training and running Rasa NLU – Rasa Core – Technical Requirements – Training Data for Dialogue Management – Building custom actions using Rasa SDK – Building a tell-the-time bot.

**MODULE V CASE STUDY****8**

Building a sentiment analysis application – Developing a predictive model for early disease detection in health care – Predicting network traffic, equipment failure – Optimizing inventory management – Sales forecasting.

**L – 45; TOTAL HOURS – 45****REFERENCES:**

1. Wes McKinney, "Python for Data Analysis: Data Wrangling with pandas, NumPy, and Jupyter", O'Reilly Media, 3<sup>rd</sup> Edition, ISBN-13: 978-1098104030, 2022.
2. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 1<sup>st</sup> Edition, ISBN-13: 978-9352134915, 2016.
3. Hadley Wickham, Garrett Grolemund, "R for Data Science", Shroff/O'Reilly, 1<sup>st</sup> Edition, ISBN-13: 978-9352134977, 2017.
4. Aurelien Geron, "Hands-on Machine Learning with Scikit-Learn, Keras&TensorFlow", O'Reilly, 3<sup>rd</sup> Edition, ISBN-13: 978-9355421982, 2022.
5. Yoni Nazarathy and Hayden Klok, "Statistics with Julia: Fundamentals for Data Science, Machine Learning and Artificial Intelligence", Springer Nature Switzerland AG, 1<sup>st</sup> Edition, ISBN-13 : 978-3030709006, 2021.
6. Paul D. McNicholas and Peter Tait, "Data Science with Julia", Chapman and Hall/CRC, 1<sup>st</sup> Edition, ISBN-13 : 978-1138499980, 2019.
7. Darren Cook, "Practical Machine Learning with H2O: Powerful, Scalable Techniques for Deep Learning and AI", O'Reilly, 1<sup>st</sup> Edition, ISBN-13 : 978-1491964606, 2017.
8. Xiaoquan Kong, "Conversational AI with Rasa", Packt Publishing, ISBN-13: 978-1801077057, 2021.
9. Dr Nickholas Anting PhD and Dr Alvin Lim PhD, "Data Science with KNIME", NASPSOFT Intelligence Academy, ISBN-13 : 978-6299694106, 2022.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Apply python and R programming for AI & Data Science applications..

**CO2:** Develop skills in data munging and manipulation using Julia.

**CO3:** Deploy H2O models to real-world data science projects, gaining practical experience in solving business problems with AI and machine learning.

**CO4:** Execute data science and AI real time tasks with KNIME analytics platform.

**CO5:** Design an efficient and robust chatbot using Rasa framework.

**Board of Studies (BoS) :**23<sup>rd</sup> BoS of CSE held on 09.05.2024**Academic Council:**22<sup>nd</sup> AC held on 04.09.2024

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

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

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

**Statement:** The students can use the open-source tools which reduce barriers to entry for individuals and businesses, facilitating innovation and entrepreneurship. Open-source tools drive innovation by providing a collaborative environment for the development of cutting-edge technologies.

<b>CSDX 606</b>	<b>R PROGRAMMING FOR ARTIFICIAL INTELLIGENCE AND DATA SCIENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
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<b>SDG</b>	<b>8</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
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**COURSE OBJECTIVES:****COB1:** To learn the basics of R programming.**COB2:** To understand and import the data from various sources and clean the data.**COB3:** To familiarize with Artificial Neural Network concepts and algorithms.**COB4:** To provide techniques to create an interactive environment for data science and represent data through visualization techniques.**COB5:** To impart knowledge in analyzing real time data.**MODULE I INTRODUCTION TO R 9**

Evolution – Probability and Statistics – Basic Building Blocks of R –Data Types - Data Structures - Control Structures – Functions – Conditional Executions - Function Arguments - Return Value - Environments - Data frames – Graphics - Statistics - Packages in R - R Interface for H2O -Keras and kerasR.

**MODULE II WORKING WITH REAL DATA 9**

Read Data from CSV, Excel and online HTML Tables – Remove NA's – Working with External Data in H2O - Data Cleaning – Data Summarizing - dplyr – EDA – Supervised and Unsupervised Learning – R Packages for Algorithms – Dimension Reduction.

**MODULE III ARTIFICIAL NEURAL NETWORK USING R TOOL 9**

Neuron – Activation Function – Learning Neural Network – Building ANN using R:NN for Binary Classifications - Evaluate Accuracy -Implement a Multi-Layer Perceptron (MLP) For Supervised Classification - Implement an ANN with H2o For Multi-Class Supervised Classification – MLP with Keras on Real Data - Keras MLP for Regression.

**MODULE IV DATA SCIENCE USING R TOOL 9**

Learning from Data – General Prediction Models – Error Measure – Resampling – Data Visualization: mpg data frame- gg plot- aesthetic mappings- facets- geometry objects- statistical transformations- Position and Coordinate Adjustments – Wrangle: tibbles -- Hypothesis Testing in R

**MODULE V CASE STUDY****9**

Keras for Outlier Detection – Credit Card Fraud Detection - Word Embeddings for Classifying Fraud - Autoencoders on Text Data – Anomaly Detection - Eight Queens Problem in R – Setup CNN with Keras: Real Images - Image Classification - Fit - Evaluate - Predict.

**L – 45; TOTAL HOURS – 45****REFERENCES:**

1. Frank Emmert-Streib, SalissouMoutari, Matthias Dehmer Elements of Data Science, Machine Learning, and Artificial Intelligence Using R, Springer International Publishing, ISBN:9783031133398, 3031133390, 2023.
2. Chirag Shah, “A Hands-On Introduction to Data Science”, Cambridge University Press, 2020, 9781108472449, 1108472443.
3. Avrim Blum, John Hopcroft, and RavindranKannan, “Foundations of Data Science”, Cambridge University Press, 2020, ISBN:9781108485067, 1108485065.
4. Garrett Grolemund, “R for Data Science: Import, Tidy, Transform, Visualize, and Model Data ”O’Reilly Publications, First Edition, ISBN:1491910399,2019.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Describe control structures and interfaces that influence program behavior and data processing.

**CO2:** Import R packages that provide functions and tools for data manipulation, analysis, and machine learning.

**CO3:** Implement ANN using the R tool.

**CO4:** Analyze the data using prediction models and visualize the data.

**CO5:** Apply the Artificial Intelligence and Data Science concepts for real world data.

**Board of Studies (BoS) :**

23rd BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

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

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

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

**Statement:** By learning this course, the students will be able to analyse the problem and build predictive models which will promote sustainable economic growth and productive employment.

<b>CSDX 607</b>	<b>ARTIFICIAL INTELLIGENCE IN DATA ANALYTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES :**

**COB1:**To understand the concepts of artificial intelligence and data analytics.

**COB2:**To learn the strategies of data collection and pre-processing.

**COB3:**To comprehend the text analytics using natural language processing.

**COB4:**To gain knowledge on the advanced Artificial Intelligence techniques.

**COB5:**To study the importance of Artificial Intelligence and data analytics in real time applications.

<b>MODULE I</b>	<b>INTRODUCTION</b>	<b>9</b>
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Introduction to AI - Artificial Intelligence and Autonomy – Data Analytics – Types- Descriptive-Diagnostic, Predictive and Prescriptive Analytics-Data Analytics with Artificial Intelligence – Managerial decision-making - Strategic, tactical, and operational – Study of Predictive tools-Gaming in AI.

<b>MODULE II</b>	<b>DATA ANALYTICS SKILLS</b>	<b>9</b>
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Data Generation - Cleaning and Preparation of Data - Data Exploration and Analysis - Statistical Understanding - Data Modeling -Designing Data Visualizations – Automated visualization and Insight Generation- Creating Dashboards and Reports - Communication and writing.

<b>MODULE III</b>	<b>ARTIFICIAL INTELLIGENCE SKILLS</b>	<b>9</b>
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Computer Programming Languages - Data Engineering - Analyzing Exploratory Data – Models - Services - AWS - conversational interfaces - Automatic speech recognition - speech to text - Natural Language Understanding (NLU) - Text Intention – Deploying.

<b>MODULE IV</b>	<b>AI ON DATA ANALYTICS</b>	<b>9</b>
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AI-Driven Analytics - Data-Driven Decision-Making - Artificial Intelligence and Data Analytics Interaction- Natural Language Processing in Data Analytics – Generative AI – Big Data - Big Data Analytics Techniques- Anomaly Detection.

**MODULE V APPLICATIONS****9**

Implementing AI in Data Analysis Automation - Integration Challenges - Ethical and Regulatory Considerations - Future Trends and Developments - Case Study - AI in Smart Cities Development - AI in Cognitive Neuro-imaging Digital Transformation- AI-Informed Analytics Cycle – Reinforcing.

**L – 45; TOTAL HOURS – 45****REFERENCES:**

1. Jay Liebowitz, Data Analytics and AI, CRC Press, 1st edition, 2020, ISBN: 978-0367522001.
2. Edward Mize, Data Analytics: The Ultimate Beginner's Guide to Data Analytics, Venture Ink, 2019, ISBN: 978-1925997576.
3. RayanWali, A Practical Guide to Artificial Intelligence and Data Analytics, e-book, 2022.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Describe predictive models to forecast future trends and outcomes based on historical data.

**CO2:** Apply the skills of data inspecting and cleansing.

**CO3:** Identify problems where artificial intelligence techniques are applicable.

**CO4:** Implement various data analytics techniques on Big Data.

**CO5:** Analyze real time social related problems using AI and data analytics techniques.

**Board of Studies (BoS) :**

23<sup>rd</sup>BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	H											H	
CO2	H	H		M	H								H	
CO3	H	H		M	H									M
CO4		H	L		H									H
CO5	H				H								H	H

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



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

**Statement:** Data science and AI can be used to solve some of the world's most important problems, from improving healthcare outcomes to reducing crime and improving traffic flow in cities.

<b>CSDX 608</b>	<b>DATA SCIENCE FOR INTELLIGENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>GAMING SYSTEM</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To familiarize with the fundamentals of Game data and data preprocessing techniques.

**COB2:** To learn the concept of Statistics and Probability.

**COB3:** To gain knowledge on data abstraction and data analysis through visualization.

**COB4:** To inculcate the importance of machine learning and deep learning in gaming.

**COB5:** To explore the applications and case study of Data Science in gaming.

**MODULE I INTRODUCTION TO GAME DATA SCIENCE 9**

Game Data – Era of Game Data and Machine Learning –Process of Game Data Science – Metrics in Game Data Science – Customer metrics – Gameplay metrics – Data Preprocessing - Reading and parsing file - Purpose of cleaning and data type checks – Data consistency Processing – Data Normalization and Standardization.

**MODULE II STATISTICS AND PROBABILITY WITH GAME DATA 9**

Probability and Statistics – Game data with descriptive statistics - Application of probability and its distributions in games – Inferential Statistics with game data – Correlation analysis - Predicting player behavior using regression models - T-test and its types – Analysis of variance - Case studies of advanced statistical methods in games.

**MODULE III GAME DATA ABSTRACTION AND DATA ANALYSIS 9**

Significance of Behavioral Telemetry – Game data set and Feature extraction – Feature Selection – Entropy – Game data analysis through Visualization – Heat maps – Spatio Temporal Visualization system –State action visualization system.

**MODULE IV MACHINE LEARNING AND DEEP LEARNING IN GAMING 9**

Supervised learning in Gaming Data Science – Clustering methods in Game Data Science– Player segmentation using clustering techniques – Usage of CNNs in Game Data Science - AI for games - Introduction to AR & VR games - Performance analytics in AR and VR games.

**MODULE V APPLICATIONS AND CASE STUDY****9**

Sequence analysis of Game Data- Applications of deep learning in gaming -Character animation and behavior modeling- Reinforcement learning for intelligent gaming agents – Future trends in game data science - Case study.

**L – 45; TOTAL HOURS –45****REFERENCES :**

1. MagySeif El-Nasr, Truong-Huy D. Nguyen, Alessandro Canossa, Anders Drachen, "Game Data Science", OUP Oxford, ISBN: 9780192652713,2021.
2. AskePlaat, "Learning to Play, Advances and Applications", Springer International Publishing, ISBN: 9783030592387,2020.
3. Micheal Lanham, "Hands-on Reinforcement learning for Games", Packt Publishing, ISBN: 9781839216770,2020.
4. DeevyankarAgarwal, Moolchand Sharma, Prerna Sharma, VikasChaudhary, "Deep Learning in Learning and Applications", CRC Press, ISBN: 9781000504378,2021.

**COURSE OUTCOMES:**

After completion of the course, students should be able to

**CO1:** Apply data preprocessing techniques on the game data.

**CO2:** Solve the problem through probability and statistics methods.

**CO3:** Analyze the game data and abstract data through visualization.

**CO4:** Use machine learning and deep learning techniques in gaming.

**CO5:** Analyze the importance of data science in gaming through applications and case study.

**Board of Studies (BoS) :**

23<sup>rd</sup>BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1		H											H	
CO2		H		H									H	M
CO3	M				H								H	
CO4	M		M									M	H	H
CO5	M	M	M	M	H			L				M	H	H

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

**SDG 9:** To build resilient infrastructure, promote sustainable industrialization and foster innovation.

**Statement:** At the end of course, the students would be able to analyze the game on applying the concept of Data Science which promotes industry innovation and infrastructure.

**SEMESTER V**

<b>CSDX 501</b>	<b>WEB AND SOCIAL MEDIA</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>MINING</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To provide information extraction from Web documents and services.

**COB2:** To impart knowledge on web page content using web crawling.

**COB3:** To understand the concepts, methods and algorithms of social network analysis.

**COB4:** To learn the concept of community analysis.

**COB5:** To impart knowledge from the reviews of people posted in social media.

<b>MODULE I</b>	<b>WEB MINING AND CRAWLING</b>	<b>09</b>
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Introduction to Web Mining - Web Content – Structure - Web Usage Mining - Web Crawling - A basic crawler algorithm - Implementation issues - Universal Crawlers - Focused Crawlers - Topical Crawlers - Evaluation - Crawler Ethics and Conflicts.

<b>MODULE II</b>	<b>INFORMATION RETRIEVAL AND WEB SEARCH</b>	<b>09</b>
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Basic concepts of Information Retrieval - Information Retrieval Models - Relevance Feedback - Evaluation Measures - Text and Web page pre-processing - Latent Semantic Indexing - Web Search - Meta search - Web Spamming.

<b>MODULE III</b>	<b>SOCIAL NETWORK ANALYSIS</b>	<b>09</b>
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Introduction to Social Media Mining - Graph Basics - Graph Representation - Connectivity in graphs - Special Graphs - Network Measures – Centrality – Prestige - Co-Citation and Bibliographic Coupling Link – PageRank - Hits and Logsum Algorithms - Mining Path - Traversal Patterns.

<b>MODULE IV</b>	<b>COMMUNITY ANALYSIS</b>	<b>09</b>
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Community Detection - Community Evolution - Community Evaluation - Network clustering - Network visualization algorithms - spring-like layouts - multidimensional scaling – Gephi - Information Diffusion in Social Media -

Herd Behavior - Information Cascades - Diffusion of Innovations - Epidemics.

## **MODULE V                      OPINION MINING AND SENTIMENT ANALYSIS                      09**

Opinion Mining - Problem definition - Document Sentiment classification - Sentence subjectivity and sentiment classification - Opinion lexicon expansion - Aspect-based opinion mining - Mining comparative opinions - Opinion search retrieval - Opinion spam detection - Utility of Reviews - Recommender Systems – Challenges - Recommendation using Social Context.

**L – 45; TOTAL HOURS – 45**

### **TEXT BOOK:**

1. Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, "Introduction to Information Retrieval", Cambridge University Press, ISBN : 9781107666399,2017.
2. Gabor Szabo, Gungor Polatkan, P. Oscar Boykin, Antonios Chalkiopoulos, "Social Media Data Mining and Analytics", Wiley, ISBN: 9781118824894,2018.

### **REFERENCES:**

1. Bing Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data", 2nd Edition, Springer, ISBN 978-3-642-19459-7,2011.
2. Reza Zefarani, Mohammad Ali Abbasi, Huan Liu, "Social Media Mining: An Introduction." Cambridge University Press. ISBN: 978-1107018853,2014.

### **COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Extract useful information or knowledge from web page contents.

**CO2:** Identify the basic concepts behind information retrieval and data mining.

**CO3:** Apply the concepts, methods and models to analyze, model and visualize data from social networks.

**CO4:** Analyze communities that help to understand the users in social media.

**CO5:** Analyze the subjective information from the reviews posted on social media.

**Board of Studies (BoS) :**

19th BOS of CSE held on 25.08.2020

**Academic Council:**

18th AC held on 24.02.2022

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

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

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

Statement : The holistic understanding of Web and Social Media Mining leads to business development, social science research, health services and educational purposes.

<b>CSDX 502</b>	<b>ARTIFICIAL NEURAL NETWORKS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To understand the fundamentals of artificial neural networks.

**COB2:** To be familiar with perceptron and madaline.

**COB3:** To learn basic principles about back propagation and Hopfield networks.

**COB4:** To acquire the knowledge on Automatic Resonance Theory and Cognitron.

**COB5:** To explore deep neural network concepts.

**MODULE I INTRODUCTION 09**

Role of Artificial neural network – Fundamentals of Biological Neural networks – Basic principles of ANNs and their structures.

**MODULE II PERCEPTRON AND MADALINE 09**

The Perceptron – The basic structure – The Single-Layer Representation problem – Many layer perceptrons – Perceptron case study- Madaline training – Madaline Case study.

**MODULE III BACK PROPAGATION AND HOPFIELD NETWORKS 09**

The Back propagation Learning Procedure – BP Algorithm – Back Propagation Case studies – Hopfield network – BAM principle-Walsh functions – Procedure of implementing the Hopfield network – Hop field network case studies – Cell shape detection using neural network – Counter Propagation.

**MODULE IV ART AND COGNITRON 09**

Automatic Resonance Theory (ART): Network structure – Network operation – Properties of ART – ART I Case study – Cognitron: Basic principles of Cognitron – Network operation – Cognitron's network training – The Neocognitron.

**MODULE V DEEP LEARNING NEURAL NETWORK 09**

Deep Learning Neural Network (DLNN) – Principles and its Scope – Deep Learning Convolutional Neural Network.



**L – 45; TOTAL HOURS – 45****TEXT BOOK:**

1. Daniel Graupe, "Principles Of Artificial Neural Networks: Basic Designs To Deep Learning", World Scientific Publishing Company, ISBN : 9789811201240, 9811201242, 4th Edition, 2019.

**REFERENCES:**

1. Kevin Gurney , " An Introduction to Neural Networks", CRC Press , ISBN: 9781482286991, 2018.
2. Christian Dawson, "Applied Artificial Neural Network", MDPI AG, ISBN: 9783038422709, 2018.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Describe the complexity of simple elements of neural information processing.

**CO2:** Illustrate formal definitions for the neural network components.

**CO3:** Solve the classic problems by learning the concepts through case studies.

**CO4:** Demonstrate the advanced neural networks techniques.

**CO5:** Design the deep learning model for real time problems.

**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PS02
CO1	M					L								
CO2													M	
CO3			H				M							
CO4				M								M		M
CO5			L									M		M

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

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

Statement: By learning “Artificial Neural Networks”, the students are able to build artificial network infrastructure ,develop the learning concepts and thinking out of box on solving the problems.

<b>CSDX 503</b>	<b>ARTIFICIAL INTELLIGENCE BASED</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>WEB APPLICATION</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES :**

**COB1:** To learn about basic concepts of Artificial Intelligence.

**COB2:** To understand Artificial Intelligence based Web Intelligence.

**COB3:** To explore deep neural networks and machine learning in web applications.

**COB4:** To get familiar with social implications and security issues in web application.

**COB5:** To explore web applications using Artificial Intelligence techniques.

### **MODULE I                      BASICS OF AI AND INTRODUCTION TO                      09** **WWW**

History and Evolution of AI, Basic Concepts-ML, Language, Speech, Computer Vision, Application Domains for AI, Microsoft's Cognitive Services-Vision, Speech, Language, Knowledge, Search. Brief History of Web and the Internet, Open Platforms, API and Programming Tools, Web Intelligence, Intelligence in Web Applications.

### **MODULE II                      AI AND WEB INTELLIGENCE                      09**

Foundations of new AI and Knowledge based System-Fuzzy Systems-Artificial Neural Networks, Genetic algorithms and evolutionary computing, Rough sets, Soft Computing. Internet, Web grid and Cloud, Introduction to Web Intelligence, Web Intelligence – Perspectives, Levels, Goals, Characteristics, Challenges and Issues, Web based Support Systems.

### **MODULE III                      NEURAL NETWORKS, DEEP LEARNING                      09** **AND MACHINE LEARNING FOR WEB** **APPLICATIONS**

Concepts of Neural Networks- Understanding artificial neural networks, Basics of deep learning techniques, Deep learning model, Applications of Deep learning in aerial robotics, Difference between deep learning and neural network, Machine Learning Techniques, Web Applications using Machine Learning.

**MODULE IV                      ETHICAL AND SOCIAL IMPLICATIONS OF                      09**  
**AI IN WEB DEVELOPMENT**

Exploring Today's AI Concerns, Exploring AI and Ethics, Defining AI Ethics, Understanding Bias and AI, AI Ethics and Regulations, AI Ethics and Governance, Agent based Web, Security issues, Human Computer Interaction.

**MODULE V                      AI POWERED WEB APPLICATION                      09**

Web Mining, Structured Data Extraction, Semantic Web-Metadata, Layered Architecture, Refined Architecture Web Knowledge Management, Ontology, Virtual Entries, Social Network Intelligence.

**L – 45; TOTAL HOURS – 45**

**TEXTBOOKS:**

1. Priti Srinivas Sajja, Rajendra Akerkar, "Intelligent Technologies for Web Applications" CRC Press, ISSN: 9781439871645, 2016.
2. Tshepo Chris Nokeri, "Web App Development and Real-Time Web Analytics: Develop and Integrate Machine Learning Algorithms Into Web Apps", ISBN :978-1-4842-7783-6 2021.

**REFERENCES:**

1. "Elaine Chang & Darren Jeffer, "A Developer's Guide to Building AI applications" O'Reilly Media, Inc Second Edition, ISBN: 9781492037828, 2020.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Explain the basic concepts of Artificial Intelligence.

**CO2:** Summarize Artificial Intelligence based Web Intelligence techniques.

**CO3:** Identify the use of Deep neural networks and Machine Learning in Web Applications.

**CO4:** Analyze the social implications and security issues in web application.

**CO5:** Apply Artificial Intelligence techniques in designing web applications.

**Board of Studies (BoS) :**

18<sup>th</sup> BoS of CSE held on  
26.07.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

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

Statement: The students can have productive employment and decent work by learning the Artificial Intelligence based web application course.

<b>CSDX 504</b>	<b>GAME THEORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:** To learn the fundamental concepts of game theory.

**COB2:** To familiarize with the concept of strategic believing and logical options.

**COB3:** To explore motivational examples of Bayesian games.

**COB4:** To gain knowledge in computing Nash equilibria of two-player zero-sum games.

**COB5:** To understand the mechanism of game design.

**MODULE I INTRODUCTION 09**

Game Theory- History of Game Theory- The Theory of Rational Choice- Basic Solution Concepts- Finding Equilibria And Learning In Games- Cooperative Games-Markets And The Algorithmic Issues.

**MODULE II GAMES WITH PERFECT INFORMATION 09**

Strategic games - prisoner's dilemma, matching pennies, the stag Hunt-Nash equilibrium- theory and illustrations - Best response functions-Dominated actions-Symmetric games and symmetric equilibria-Cournot and Bertrand's models of oligopoly- Electoral Competition-War of Attrition-Auctions-Accident law-Extensive Games with Perfect Information.

**MODULE III GAMES WITH IMPERFECT INFORMATION 09**

Bayesian Games – Motivational Examples – General Definitions – Information aspects – Illustrations – Extensive Games with Imperfect – Information – Strategies – Nash Equilibrium – Beliefs and sequential equilibrium – Illustrations – Repeated Games – The Prisoner's Dilemma – Bargaining.

**MODULE IV NON-COOPERATIVE GAME THEORY 09**

Self-interested agents – Games in normal form – Analyzing– Computing Solution Concepts of Normal – Form Games – Computing Nash equilibria of two-player, zero-sum games –Computing Nash equilibria of two-player, general sum games – Identifying dominated strategies.

**MODULE V MECHANISM DESIGN****09**

Aggregating Preferences – Social Choice – Formal Model – Voting – Existence of social functions – Ranking systems – Protocols for Strategic Agents: Mechanism Design – Mechanism design with unrestricted preferences – Efficient mechanisms – Vickrey and VCG mechanisms (shortest paths) – Combinatorial auctions – profit maximization Computational applications of mechanism design – applications in Computer Science – Google’s sponsored search – eBay auctions – K-armed bandits.

**L – 45; TOTAL HOURS – 45****TEXT BOOKS:**

1. M. Machler, E. Solan, S. Zamir, “Game Theory”, Cambridge University Press, ISBN : 9781108493451, 2020.
2. Zhu Han, Dusit Niyato, Walid Saad, Tamer Basar and Are Hjorungnes, “Game Theory in Wireless and Communication Networks”, Cambridge University Press, ISBN: 9780521196963, 2019.

**REFERENCES :**

1. Michael Maschler, Shmuel Zamir, Eilon Solan, “Game Theory”, Cambridge University Press, ISBN: 9781108493451, 2020.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Demonstrate about the idea of a strategic game and equilibria.

**CO2:** Formulate the uses of Nash Equilibrium for real time problems.

**CO3:** Identify key strategic aspects and appropriate game theoretic concepts.

**CO4:** Analyzing games represented in normal form.

**CO5:** Explore the mechanism to design games for application in computer science.

**Board of Studies (BoS) :**

18<sup>th</sup> BoS of CSE  
held on 26.07.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

Statement: The students can empower to be effective decision-makers and designers, contributing meaningfully to improved social welfare and optimal resource allocations in an ever-evolving world.



<b>CSDX 505</b>	<b>DETECTIVE DATABASE AND LOGIC</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>PROGRAMMING</b>				

<b>SDG</b>	<b>8</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
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**COURSE OBJECTIVES :**

COB1: To understand the foundational on relational database concepts.

COB2: To study fundamental concepts of Logic Programming Languages.

COB3: To gain knowledge and analytical skills to detect database models.

COB4: To study proficiency in advanced querying techniques.

COB5: To learn critical thinking and problem-solving skills to integrate database systems.

**MODULE I FOUNDATIONAL UNDERSTANDING OF DATABASE SYSTEMS 9**

Relational Database Fundamentals - Normalization Techniques - Database Design Principles - Data Integrity and Security - Querying and Data Manipulation - Transaction Management -Database Indexing and Performance Optimization - Emerging Trends in Database Systems

**MODULE II PROFICIENCY IN LOGIC PROGRAMMING LANGUAGES 9**

Introduction to Logic Programming - Fundamental Concepts in Prolog - Advanced Prolog Programming Techniques - Application of Logic Programming in Detective Work - Debugging and Error Handling in Logic Programming - Efficient Use of Built-in Predicates - Logic Programming for Knowledge Representation - Integration with External Systems

**MODULE III DATA MODELLING FOR INVESTIGATIVE ANALYSIS 9**

Concepts of Data Modelling - Requirement Analysis for Investigative Databases - Normalization Techniques for Investigative Data - Temporal Data Modelling - Geospatial Data Modelling - Multidimensional Modelling for Analysis - Hierarchical Data Modelling - Documenting Data Models -Change Management in Data Modelling

**MODULE IV QUERYING AND ANALYSIS TECHNIQUES 9**

Semantic Data Modeling - Data Modeling Tools and Software - Data Privacy and Compliance in Models - Data Model Validation and Testing -Big Data Modeling Considerations - Categorical and Numerical Data Modeling - Metadata Management in Investigative Databases - Machine Learning Integration in Data Models -Data Model Optimization for Performance.

**MODULE V INTEGRATION OF DATABASE AND LOGIC****9****PROGRAMMING IN DETECTIVE WORKFLOWS**

Case Management Systems Integration - Real-time Data Integration - Automated Alert Systems -Evidence Tracking and Chain of Custody -Collaborative Investigation Platforms- Predictive Analytics in Investigations- Forensic Data Analysis -Geospatial Analysis Integration -Dynamic Querying and Reporting - Adaptive Workflow Automation - Incident Response and Crisis Management

**L – 45; TOTAL HOURS – 45****REFERENCES**

1. Minker, J, Foundations of deductive databases and logic programming, Morgan Kaufmann, 2014.
2. Adrian Lily,” Foundations of Deductive Databases and Logic Programming”,Intelliz Press, 1<sup>st</sup> edition, 2019.
3. Umanath, N. S., &Scamell, Data modeling and database design, Delmar Learning,2014
4. Apt, K. R., Marek, V. W., Truszczyński, M., & Warren, D. S. The Logic Programming Paradigm: A 25-Year Perspective. Springer Science & Business Media, 2012.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Develop a comprehensive understanding of relational database concepts and design principles.

**CO2:** Demonstrate expertise in logic programming languages, specifically Prolog.

**CO3:** Apply knowledge and analytical skills to model and structure data tailored for investigative analysis.

**CO4:** Demonstrate proficiency in advanced querying techniques and logic programming.

**CO5:** Employ critical thinking and problem-solving skills to integrate database systems and logic programming.

**Board of Studies (BoS) :**

23<sup>rd</sup>BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	H	M		L	M	L	M		L				H	L
CO2			M		H								M	
CO3	H	M	H	H	M								L	H
CO4	M	M								L			H	
CO5				L	L						L		H	

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

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

**Statement:**

The learner can use all opportunities for education throughout life and apply the knowledge acquired in everyday situations to promote sustainable development.

<b>CSDX 506</b>	<b>ARTIFICIAL INTELLIGENCE AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>EXPERT SYSTEMS</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To get familiar with the concepts of Expert Systems.

**COB2:** To provide the details on knowledge representation.

**COB3:** To provide knowledge on reasoning and decision making in uncertain world.

**COB4:** To characterize the plans and methods for generating knowledge.

**COB5:** To explore the design methodologies of expert systems.

**MODULE I INTRODUCTION TO EXPERT SYSTEMS 09**

Meaning of an Expert System - Problem Domain and Knowledge Domain - Advantages of Expert System - General Characteristics of An Expert System - History and Uses of Expert Systems - Rule-Based Expert Systems - Procedural and Nonprocedural Paradigms - Characteristics of Artificial Neural Systems.

**MODULE II REPRESENTATION OF KNOWLEDGE 09**

Study of Logic - Formal Logic and Informal Logic - Meaning of Knowledge - Semantic Nets - Translate Semantic Nets into PROLOG - Limitations of Semantic Nets - Schemas - Frames and Limitations - Logic and Set Symbols to Represent Knowledge - Propositional and First Order Predicate Logic - Quantifiers - Limitations.

**MODULE III METHODS OF INFERENCE 09**

Trees, Lattices, Graphs - State and Problem Spaces - AND-OR Trees and Goals - Methods of Inference - Rules of Inference - Resolution Rule of Inference - Resolution Systems - Shallow and Causal Reasoning - Applying Resolution to First-Order Predicate Logic - Forward and Backward Chaining - Additional Methods of Inference – Metaknowledge - The Markov Decision Process.

**MODULE IV REASONING UNDER UNCERTAINTY 09**

Meaning of Uncertainty - Types of Errors Attributed to Uncertainty - Errors Associated with Induction - Features of Classical Probability - Experimental and Subjective Probabilities - Compound and Conditional Probabilities - Hypothetical Reasoning and Backward Induction - Temporal Reasoning - Markov Chains - Odds of Belief - Sufficiency and Necessity - Uncertainty in Inference Chains - Implications of Combining Evidence - Role of Inference Nets.

**MODULE V DESIGN OF EXPERT SYSTEMS****09**

Select Appropriate Problem - Stages in Development of Expert System - Types of Errors in Development Stages - Role of Knowledge Engineer in Building of Expert Systems - Expected Life Cycle of An Expert System - Life Cycle Model- Using Domain Knowledge – Knowledge Acquisition – Design for Explanation – Black Board Architecture – Truth Maintenance Systems – Machine Learning – Case Based Reasoning.

**L –45 ; TOTAL HOURS – 45****TEXT BOOKS:**

1. I.Gupta, G. Nagpal,"Artificial Intelligence and Expert Systems", Mercury Learning and Information, ISBN : 9781683925064,2020.
2. V S Janakiraman, "Foundations of Artificial Intelligence and Expert Systems", Macmillan Series in Computer Science, ISBN-13 978-0333926253, 2005.

**REFERENCES:**

1. William Lawless, Ranjeev Mittu, Donald Sofge, Ira S. Moskowitz and Stephen Russel, "Artificial Intelligence for the Internet of Everything",978-0-12-817636-8,2019.
2. J. Giarratano and G. Riley, "Expert Systems -- Principles and Programming". 4th Edition, PWS Publishing Company, ISBN :978-0534384470 ,2004.

**COURSE OUTCOMES:**

Students those who complete this course will be able to

**CO1:** Demonstrate the fundamental concepts of Expert Systems.

**CO2:** Analyse the ways of representing knowledge.

**CO3:** Identify various methods of inferences.

**CO4:** Conceptualize the importance of reasoning during the uncertainty.

**CO5:** Design an Expert System.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H					L							H		
CO 2										L		M		M	
CO 3		H	M											M	
CO 4				H		L								L	
CO 5	M		H										H		

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

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

Statement: Effective use of information and communication technology (ICT) is essential to long-term development and community empowerment. Expert systems have been acknowledged as a necessary component of economic growth, improved health and educational outcomes.

<b>CSDX 507</b>	<b>DECISION-MAKING FOR DATA</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>SCIENCE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB 1:** To learn the role of Data Science in decision-making.

**COB 2:** To familiarize with probability concepts to real-world decision-making situations.

**COB 3:** To acquire knowledge in designing interactive dashboards.

**COB 4:** To explore programming techniques to optimize linear objective functions.

**COB 5:** To impart knowledge in decision optimization techniques.

### **MODULE I      INTRODUCTION      07**

Introduction to decision making - its importance - Overview of data science - applications in decision making - Ethical considerations in data-driven decision making - Introduction to data collection - preprocessing techniques - Exploratory data analysis for decision making.

### **MODULE II      STATISTICAL ANALYSIS      10**

Statistical concepts for decision making - Probability theory - applications in decision making - Hypothesis testing - confidence intervals - Regression analysis for predictive decision making - Time series analysis - forecasting for decision making.

### **MODULE III      DATA VISUALIZATION      09**

Principles of data visualization - Visualization techniques - exploratory data analysis - Dashboard design - interactive visualization for decision making - Communicating insights through data visualization - Tools and libraries for data visualization.

### **MODULE IV      DECISION OPTIMIZATION USING DATA SCIENCE      10**

Introduction to decision optimization - its applications - Formulating optimization problems for decision making - Linear programming - integer programming for decision optimization – Heuristic algorithms - metaheuristic algorithms for optimization - multi-objective optimization - complex decision scenarios.

**MODULE V      APPLIED DECISION-MAKING PROJECTS      09**

Real-world case studies - applications of data-driven decision making -  
Project-based assignments - data science techniques for decision making -  
Presenting and interpreting results of decision-making projects - Discussion  
and analysis of decision-making outcomes.

**L – 45; TOTAL HOURS-45**

**TEXT BOOKS:**

1. Wickham, H., & Grolemund, G., "R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, O'Reilly Media, ISBN-13 :9789352134977,2017.
2. Provost, F., & Fawcett, T. , " Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking ",O'Reilly Media. ISBN-13 : 978-1449361327,2013.
3. Hastie, T., Tibshirani, R., & Friedman, J.," The Elements of Statistical Learning: Data Mining, Inference, and Prediction", Springer, ISBN 978-0-387-84857-0,2009.

**REFERENCES:**

1. Witten, I. H., Frank, E., Hall, M. A., & Pal, C. J.,"Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann," ISBN-13 978-0123748560 ,2016
2. Gelman, A., Carlin, J. B., Stern, H. S., Dunson, D. B., Vehtari, A., & Rubin, D. B. "Bayesian Data Analysis", CRC Press. ISBN-13 978-1439840955 ,2013
3. Kelleher, J. D., Mac Namee, B., & D'Arcy, A. , "Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies", MIT Press, ISBN-13: 978-0262029445 ,2015

**COURSE OUTCOMES:**

After completion of the course, students will be able to

**CO 1:** Recognize the principles and concepts of decision-making using data science.

**CO 2:** Utilize statistical analysis methods to support decision-making.

**CO 3:** Create effective data visualizations to communicate insights for decision-making.

**CO 4:** Analyze the various optimization techniques to enhance the



performance.

**CO 5:** Execute data-driven decision-making projects by applying relevant data science tools and techniques.

**Board of Studies (BoS) :**

19<sup>th</sup> BoS of CSE held on 28.12.2021

**Academic Council:**

18th Academic council held on  
24.02.2022

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

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

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

By learning this course, the student may be able to apply advanced analytics techniques that can be used to improve any business via smart decision-making in various scenarios.

<b>CSDX 508</b>	<b>SOCIAL NETWORK ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To learn the components of the social network.

**COB2:** To provide different ontology languages used in the Semantic Web.

**COB3:** To gain knowledge in community detection algorithms.

**COB4:** To familiar with the privacy controls available on YouTube.

**COB5:** To explore techniques to secure content, prevent unauthorized sharing, and protect intellectual property rights on social media.

<b>MODULE I</b>	<b>INTRODUCTION</b>	<b>09</b>
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Introduction: Definition and Features – The Development of Social Network Analysis – Basic Graph Theoretical Concepts of Social Network Analysis – Ties, Density, Path, Length, Distance, Betweenness, Centrality, Clique – Electronic Sources for Network Analysis – Electronic Discussion Networks, Blogs and Online Communities, Web-based Networks.

<b>MODULE II</b>	<b>SEMANTIC TECHNOLOGY FOR SOCIAL NETWORK ANALYSIS</b>	<b>09</b>
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Introduction To Ontology Based Knowledge Representation – Ontology Languages for the Semantic Web – Rdf and Owl – Modeling Social Network Data – Network Data Representation, Ontological Representation of Social Individuals and Relationships -Aggregating and Reasoning With Social Network Data – Advanced Representations.

<b>MODULE III</b>	<b>EXTRACTION IN WEB SOCIAL NETWORKS AND VISUALIZATION</b>	<b>10</b>
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Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining – Visualization of Social Networks Node-Edge Diagrams – Random Layout – Force-Directed Layout – Tree Layout – Matrix Representations -Matrix and Node - Link Diagrams – Hybrid Representations – Visualizing Online Social Networks.

**MODULE IV POLICIES AND PRIVACY ISSUES 08**

Policies – Privacy – Blocking users on Facebook, Twitter, Youtube, Whatsapp – Controlling app privacy in Facebook – Location awareness in Facebook and Twitter – Case Studies.

**MODULE V SECURITY AND TOOLS 09**

Security – Fake accounts – Passwords – Privacy and information sharing – Content security – Monitor social media – Best practices – Security tools. – Applications of Social Network Analysis.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. John Scott, Peter J. Carrington, "The SAGE Handbook of Social Network Analysis", Sage Publication, ISBN : 9781529779615, 2023.
2. Peter Mika, "Social Networks and the Semantic Web", Springer, ISBN: 9781441943729, 2010.

**REFERENCES:**

1. Song Yang, Franziska B. Keller, Lu Zheng, "Social Network Analysis: Methods and Examples", Sage Publication, ISBN: 9781506362120, 2016.
2. Michael Cross, "Social Media Security: Leveraging Social Networking While Mitigating Risk", ISBN 1597499870, 9781597499873, Newnes Publication, 2013.
3. Alan Oxley, "Security Risks in Social Media Technologies: Safe Practices in Public Service Applications", ISBN 1780633807, 9781780633800, Elsevier, 2013.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Explain the internal components of the social network.

**CO2:** Analyze network structures and behaviors to uncover meaningful patterns, trends, and insights within social networks.

**CO3:** Interpret and draw meaningful insights about relationships, interactions, and patterns within social networks.

**CO4:** Develop policies and privacy framework of various social networks.

**CO5:** Design the security threats associated with social media and best practices.

**Board of Studies (BoS) :**

20<sup>th</sup> BoS of CSE held on  
16.08.2022

**Academic Council:**

19th Academic Council  
29.09.2022

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

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

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

Statement: The holistic understanding of Social Network Analysis and semantic web which are used to learn knowledge representation using ontology and also understand human behavior in social web and related communities.

**CSDX 509****PATTERN RECOGNITION****L T P C****SDG: 8****3 0 0 3****COURSE OBJECTIVES:****COB1:** To learn the fundamentals concepts of pattern recognition**COB2:** To be familiar with mathematical functions used in designing pattern recognition system**COB3:** To impart knowledge on various statistical pattern recognition techniques**COB4:** To recognize the importance of neural pattern associators**COB5:** To provide knowledge on how to design neural pattern recognition in real time.**MODULE I INTRODUCTION TO PATTERN RECOGNITION 09**

Pattern recognition, Classification and Description—Patterns and feature Extraction with Examples—Training and Learning in PR systems—Pattern recognition Approaches— Other Approaches to PR.

**MODULE II DECISION THEORY 09**

Introduction— Decision theory— Minimum Error Rate Classification—Normal Density— Discriminant Functions for the Normal Density— Error probabilities and bounds— Missy and Noisy Features— Maximum-Likelihood Estimation

**MODULE III STATISTICAL PATTERN RECOGNITION 09**

Introduction to statistical Pattern Recognition—supervised Learning using Parametric and Non Parametric Approaches.

**MODULE IV NEURAL PATTERN RECOGNITION 09**

Introduction to neural networks—Neural networks based pattern associators— Matrix approaches and linear associative mappings—Content Addressable Memory Approaches in Neural Pattern Recognition—Hopfield approach to Neural Computing

**MODULE V APPLICATIONS 09**

Syntactic pattern recognition - Application to Pattern Recognition –Remote sensing – Seismic Wave Recognition – Automatic Visual Inspection – Failure detection and analysis in Non-digital systems – Medical data analysis –Advances in Character

Recognition – Automatic Speech Recognition.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Robert Schalkoff, "Pattern Recognition: statistical, structural and neural approaches", John Wiley & sons, ISBN 978-0-471-52974-3, 2007.
2. Duda RO, Hart PE, Stork DG. Pattern Classification. John Wiley & Sons, ISBN: 978-0-471-05669-0, 2012.
- 3.

**REFERENCES:**

1. King-Sun Fu," Applications of Pattern Recognition", CRC Press, ISBN 9781351078252, 1351078259, 2019.
2. Bishop C.M., "Neural Networks for Pattern Recognition", Oxford University Press, ISBN: 0-19853862, 1995.

**COURSE OUTCOMES:** Students who complete this course will be able to

**CO1:** Identify the fundamental concepts of pattern recognition and employ the methods for solving real time problems.

**CO2:** Interpret the knowledge related to pattern recognition using mathematical functions

**CO3:** Express proficiency in the handling syntax of pattern recognition.

**CO4:** Apply various pattern recognizer to design the models in AI.

**CO5:** Implement advanced pattern recognition techniques to solve practical problems.

**Board of Studies (BoS) :**

22<sup>nd</sup> BoS of CSE held on 17.08.2023

**Academic Council:**

21<sup>st</sup> AC held on 23.12.2023

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

Statement:

By learning "Pattern Recognition", the students are able to develop methods to identify the patterns for various real time applications which leads to sustainable economic growth in turn provide productive employments.

<b>CSDX 510</b>	<b>HEALTHCARE DATA ANALYTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES :**

**COB1:** To learn the fundamentals of data analysis for healthcare records.

**COB2:** To provide knowledge on different medical image analysis techniques.

**COB3:** To explore the scope and challenges in sensor data mining in healthcare.

**COB4:** To get familiar with NLP based components in clinical text analysis.

**COB5:** To understand the statistical prediction models and evaluate the findings.

### **MODULE I INTRODUCTION TO HEALTHCARE DATA ANALYSIS 08**

Introduction - Healthcare Data Sources and Basic Analytics - Advanced Data Analytics for healthcare - Applications and Practical Systems for healthcare - History of ESIR - Components of HER - Coding Systems - Benefits of Adopting HER - Challenges of using HER Data.

### **MODULE II BIOMEDICAL IMAGE ANALYSIS 10**

Biomedical Imaging Modalities - Object Detection - Image Segmentation - Image Registration -Features Extraction.

### **MODULE III MINING OF SENSOR DATA IN HEALTHCARE 09**

Mining Sensor Data in Medical Informatics - Challenges Healthcare Data Analysis - Sensor Data Mining Applications - Non clinical Healthcare Applications.

### **MODULE IV BIOMEDICAL SIGNAL ANALYSIS 09**

Introduction - Natural Languages Processing - Mining Information from Clinical Text - Challenges of Processing Clinical Reports - Clinical applications.

### **MODULE V PREDICTION MODEL 09**

Linear Regression – Logistic Regression - Bayesian Models – Markov Random Fields – Alternative Clinical Prediction models.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOK:**

1. Chandan K. Reddy , Charu C. Aggarwal ,” Healthcare Data Analytics”. CRC Press, ISBN: 036757568X, 2020.

**REFERENCES:**

1. Vikas Kumar, “Healthcare Analytics Made Simple: Techniques in healthcare computing using machine learning and Python”, Packt Publishing Limited, ISBN : 978178728670,2018.
2. Pantea,” Big Data Analytics for health care”, Elsevier Science, ISBN: 9780323985161,2022.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Identify the different types of healthcare records for data analysis.

**CO2:** Comprehend the biomedical image processing techniques.

**CO3:** Summarize the sensor data analysis process and the challenges.

**CO4:** Apply NLP based analysis for the clinical application.

**CO5:** Analyze a given real time scenario, apply regression and interpret the results.

**Board of Studies (BoS) :**

20<sup>th</sup> BoS of CSE held on 16.08.2022

**Academic Council:**

19th Academic Council held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	L	M												
CO2	L	M			M	M							L	M
CO3	L				M	M		H	L				L	H
CO4	L		M	H	M	M		H	M	L				
CO5	L	H	H	H	H	H	H	H	H	L	H	H	M	H

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

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

By learning this course, the student may be able to learn about the challenges and opportunities in healthcare data analysis and identify solutions to clinical problems.



<b>CSDX 511</b>	<b>RECOMMENDER SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:** To provide the fundamentals of Recommender System.

**COB2:** To impart knowledge on Neighborhood-Based Collaborative Filtering.

**COB3:** To learn the working of Content-Based Recommender Systems.

**COB4:** To get familiar with Knowledge-Based Recommender Systems.

**COB5:** To explore the concepts of Context-Sensitive Recommender Systems.

**MODULE I                      INTRODUCTION TO RECOMMENDER                      09**  
**SYSTEMS**

Introduction- Goals of Recommender Systems-Basic Models of Recommender Systems -Domain-Specific Challenges in Recommender Systems- Advanced Topics and Applications.

**MODULE II                      NEIGHBORHOOD-BASED COLLABORATIVE                      09**  
**FILTERING**

Neighborhood-Based Collaborative Filtering - Key Properties of Ratings Matrices- Dimensionality Reduction and Neighborhood Methods- Model-Based Collaborative Filtering: Decision and Regression Trees - Latent Factor Models.

**MODULE III                      CONTENT-BASED RECOMMENDER                      09**  
**SYSTEMS**

Basic Components of Content-Based Systems - Preprocessing and Feature Extraction- Learning User Profiles and Filtering- Content-Based Versus Collaborative Recommendations- Using Content-Based Models for Collaborative Filtering.

**MODULE IV                      KNOWLEDGE-BASED RECOMMENDER                      09**  
**SYSTEMS**

Constraint-Based Recommender Systems- Case-Based Recommenders- Incorporating Diversity in Similarity Computation- Persistent Personalization in Knowledge-Based Systems.

**MODULE V                      CONTEXT-SENSITIVE RECOMMENDER                      09**  
**SYSTEMS**

Multidimensional Approach- Contextual Pre-filtering: A Reduction-Based Approach- Post-Filtering Methods- Case Study: Applications using Context Sensitive Recommender Systems.

**L – 15; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Francesco Ricci, Lior Rokach, Bracha Shapira “Recommender Systems Handbook” 3rd Edition, Springer-Verlag New York Inc. ISBN-13978-1071621998, 2022.
3. Charu C. Aggarwal, “Recommender Systems” , IBM T.J. Watson Research Center Yorktown Heights, NY, USA. ISBN 978-3-319-29657-9, 2016.

**REFERENCES:**

1. Manouselis N., Drachsler H., Verbert K., Duval E., “Recommender Systems For Learning”, 1st Edition, Springer, 2013.
2. P. Pavan Kumar, S. Vairachilai, “Recommender Systems”, CRC Press, ISBN: 9781000387377, 2021.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Describe the fundamentals of recommender systems and their applications.

**CO2:** Apply the different approaches towards neighborhood-based collaborative filtering.

**CO3:** Demonstrate the effectiveness of content-based recommender systems.

**CO4:** Analyze the data using knowledge based recommender systems.

**CO5:** Design applications using recommender systems.

**Board of Studies (BoS) :**

20<sup>th</sup> BoS of CSE held on  
16.08.2022

**Academic Council:**

19th Academic Council  
held on 29.09.2022

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

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

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

Statement: The students can obtain challenging job opportunities and facilitate sustainable growth of economy by learning Recommender System course.

<b>CSDX 512</b>	<b>AGRICULTURE DATA ANALYTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:** To learn the fundamental concepts of data analytics in agriculture

**COB2:** To understand the various data sources and its acquisition techniques

**COB3:** To study statistical and machine learning techniques for agriculture.

**COB4:** To gain skills in supply chain and resource optimization

**COB5:** To acquire knowledge on sustainable agriculture practices.

**MODULE I INTRODUCTION 9**

Overview of data analytics - applications in agriculture- role of data driven - optimization decision making in agriculture industry- sources of agricultural data - Precision agriculture - challenges of agriculture - introduction to supply chain management.

**MODULE II AGRICULTURAL DATA SOURCES AND ACQUISITION 9**

Traditional agricultural data- Remote Sensing Data: Satellite Imagery (NDVI), LiDAR- Sensor Data: Farm machinery sensors, IoT devices- Data Acquisition and Management Techniques - IoT in farming - farm management - livestock analytics.

**MODULE III DATA ANALYSIS TECHNIQUES FOR AGRICULTURE 9**

Statistical analysis for agricultural data - Time series analysis for crop growth modeling and yield prediction- Geospatial analysis for soil fertility mapping, crop health monitoring- Machine Learning applications in agriculture.

**MODULE IV DISTRIBUTION AND RESOURCE OPTIMIZATION 9**

Supply chain dynamics- challenges- logistics and distribution optimization- crop health monitoring- crop disease detection- water management- irrigation optimization - predictive analytics for crop management - sustainable farming practices.

**MODULE V SUSTAINABILITY IN AGRICULTURE 9**

Sustainable agriculture principles - practices-environmental impact assessment – carbon footprint analysis- greenhouse gas emissions- sustainable supply chain management- applications of big data in agriculture.

**L – 15; TOTAL HOURS – 45**

**REFERENCES:**

1. Prashant K. Srivastava," Big Data Analytics in Agriculture: Algorithms and Applications", ISBN 019872411, 2023.
2. John Hopcraft ,"Data Analytics Essentials" ,Vibrant publisher ,2024
3. Prasant Kumar Pattnaik , Raghvendra Kumar , S. N. Panda,"IoT and Analytics for Agriculture" ,Springer, 2020.
4. Anil K. Maheshwari, "Big Data and Business Analytics Business" ISBN - 13, CRC press,2020.
5. MouniaKhelfaoui ,SorayaSedkaoui , "Big Data Analytics", CRC press,2020
6. SubhashiniChellappanSeemaAcharya , "Big Data and Analytics", Wileypress,2019.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Describe fundamental concepts of data analytics in agriculture

**CO2:**Apply data management techniques to clean and prepare agricultural data for analysis.

**CO3:**Utilize the statistical and machine learning methods to analyze agricultural data.

**CO4:**Examine data analytics concepts to address agricultural challenges.

**CO5:** Apply sustainability practices in agriculture data analytics

**Board of Studies (BoS) :**

23rd BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H		L										H	
CO2	H	M	M										H	H
CO3	H	H	M		M								H	M
CO4	M	L				L							M	H
CO5	H		H	H			M	L		L		M	M	M

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

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

**Statement:** On learning the course, students will integrate agriculture and analytics thereby promote sustainable economic growth and productive employment.

<b>CSDX 513</b>	<b>INTRUSION DETECTION &amp; DATA ANALYTICS</b>	<b>L T P C</b>
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SDG	9	3 0 0 3
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**COURSE OBJECTIVES :****COB1:**To study the fundamental concepts in Intrusion detection**COB2:**To understand the wireless intrusion detection systems and prevention system.**COB3:**To gain knowledge on various anomaly detection approaches.**COB4:**To learn the basics of data analytics on intrusion detection.**COB5:**To get insight on the applications of data analytics in intrusion detection.**MODULE I INTRODUCTION 9**

Cyber intrusion – Malware- Intrusion detection system – Intrusion detection networks– co-operation technologies and algorithms. Network Architecture design – Collaboration framework – Trust management – Robustness against common treats – SQL injection attacks - simulations and experimental results.

**MODULE II WIRELESS INTRUSION DETECTION SYSTEMS AND PREVENTION SYSTEMS 9**

Architecture – Data Collection – Intrusion Detection- Detection Methods - Correlation techniques –Evaluation. Host-based Intrusion Detection System – Network-Based Intrusion Detection System (IDS) / Intrusion Prevention System (IPS)- Signature-Based Detection-IDS/IPS System Architecture and Frame.

**MODULE III DETECTION APPROACHES 9**

Anomaly Detection – behavior based detection- Data Collection for Host-Based IDSs – Theoretical Foundation of Detection – Intrusion Response-. Examples of Commercial and Open Source IDSs work- Responses by IDPS to the Intrusions-Evasion Techniques

**MODULE IV DATA ANALYTICS ON INTRUSION DETECTION 9**

AI-Driven Analytics - Attack Evolution - Semantic Gap- Cluster and Classify- Graph Models- Botyacc- HOLMES- Real-Time Log Analytics- Entropy-Based Security Analytics - Deeplog - Frameworks and Context-Beehive: Large-Scale Log Analysis for Detecting Suspicious Activity in Enterprise Networks

**MODULE V APPLICATIONS****9**

Computer Attacks and Vulnerabilities- Deploying - Technical and Policy Considerations - Tools - Vulnerability Analysis or Assessment Systems- File Integrity Checkers - Honey Pot and Padded Cell Systems - ACID and Snort Snarf with Snort - Agent development for intrusion detection

**L – 45; TOTAL HOURS – 45****REFERENCES:**

- Chapman Flack, Mikhail J. Atallah , “Recent Advances in Intrusion Detection: Third International Workshop”, RAID 2000 Toulouse, Proceedings, 2002, Kindle Edition
- Suresh Kumar Mukhiya, Usman Ahmed, “Hands-On Exploratory Data Analysis with Python” 1st Edition, 2020, Packt Publishing.
- Chris Sanders, “Intrusion Detection Honeypots Paperback”, 2020, ISBN: 9781735188300, Applied Network Defense publishing.
- Dias, Luis &Correia, Miguel. (2020). Big Data Analytics for Intrusion Detection. 10.4018/978-1-5225-9611-0.ch014.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:**Describe the architecture design of various Intrusion detection networks.

**CO2:**Choose advanced detection Methods for solving research problems.

**CO3:**Compare the functioning of various detection approaches .

**CO4:**Analyze the data science methods in intrusion detection.

**CO5:**Develop the data science model in different platforms

**Board of Studies (BoS) :**

23<sup>rd</sup>BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

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

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

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

**Statement:** Data science for intrusion detection can be used to solve the world's most important problems, by solving security issues for reducing crime.



**SEMESTER VI**

<b>CSDX 621</b>	<b>PROCESS AUTOMATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To enrich the knowledge in Robotic Process Automation(RPA).

**COB2:** To acquire knowledge on sequence and control flow.

**COB3:** To learn the concept of data manipulation strategies.

**COB4:** To provide the working flow of handling the control systems.

**COB5:** To understand the various use cases of RPA.

**MODULE I      ROBOTICS PROCESS AUTOMATION      09**

What is Robotics Process Automation: Scope and Techniques of Automation - Robotic Process Automation – The Future of Automation.

**MODULE II      SEQUENCE, FLOW CHART AND CONTROL FLOW      09**

Sequence, Flow Chart and Control Flow: Sequencing the Workflow – Activities – Control Flow, Various Types of Loops and Decision Making, Step-by-step example using Sequence and Flow Chart - Step-by-step example using Sequence and Control Flow.

**MODULE III      DATA MANIPULATION      09**

Data Manipulation: Variables and Scope – Collections – Arguments – Purpose and use – Data Table usage with examples – Clipboard Management – File Operation with step-by-step example – CSV/Excel to data table and vice versa

**MODULE IV      TAKING CONTROL OF THE CONTROLS SYSTEM      09**

Taking Control of The Controls System: Finding and Attaching Windows – Finding the Control – Techniques for waiting for a control – Act on Controls – Mouse and Keyboard Activities – Working with UiExplorer – Handling events – Revisit Recorder – Screen Scraping – When to use OCR – Types of OCR available – How to use OCR – Avoiding Typical failure points.

**MODULE V      RPA USECASES      09**

RPA Usecases: RPA in Banking – Excel Automation – PDF Data Extraction & Automation – RPA Data Migration and Entry – Email Automation

**L – 45; TOTAL HOURS –45****TEXT BOOK:**

1. Alok Mani Tripathi., “Learning Robotic Process Automation”, Packt Birmingham, 3rd edition, United Kingdom, ISBN 13: 97817884709, 2018

**REFERENCES:**

1. Richard Murdoch, “Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant”, 1<sup>ST</sup> edition, Amazon Asia-Pacific Holdings Private Limited, ISBN 978-3-642-19156-5, 2019.
2. Srikanth Merianda, “Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation”, 1st Edition, Consulting Opportunity Holdings LLC, ISBN 948-4-532-19166-7, 2018.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Implement Robotic Process Automation and its features.

**CO2:** Design control laws for a simple robot.

**CO3:** Manage the data while working on the file operations.

**CO4:** Evaluate the whole process of the control mechanism of RPA.

**CO5:** Analyze the working performance of the RPA through various use cases.

**Board of Studies (BoS) :**

19th BOS of CSE held on 28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

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

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

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

**Statement :**

Promote inclusive and sustainable industrialization, Enhance research and upgrade the technology. Streamlines a system by removing human inputs, which decreases errors, increases speed of delivery, boosts quality, minimizes costs, and simplifies the business process.

<b>CSDX 622</b>	<b>APPLIED MACHINE LEARNING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To gain knowledge on various learning paradigms.

**COB2:** To acquire the importance of supervised learning techniques.

**COB3:** To learn the need for unsupervised learning techniques.

**COB4:** To provide the concepts of probabilistic learning.

**COB5:** To explore the inputs based on reinforced learning.

### **MODULE I INTRODUCTION 09**

Introduction, Examples of Various Learning Paradigms- Perspectives and Issues, Version Spaces- Finite and Infinite Hypothesis Spaces- PAC Learning- VC Dimension.

### **MODULE II SUPERVISED LEARNING 09**

Decision Trees: ID3- Classification and Regression Trees- Regression: Linear Regression- Multiple Linear Regression, Logistic Regression- Neural Networks: Introduction- Perceptron- Multilayer Perceptron- Support vector machines: Linear and Non-Linear- Kernel Functions- KNearest Neighbors.

### **MODULE III UNSUPERVISED LEARNING 09**

Bias-variance tradeoff- Bagging: Random Forest Trees- Boosting: Adaboost- Stacking-Introduction to clustering- Hierarchical: Agglomerative Clustering- Partitional: K - means clustering- Gaussian Mixture Models.

### **MODULE IV PROBABILISTIC LEARNING 09**

Bayesian Learning- Bayes Optimal Classifier- Naïve Bayes Classifier- Bayesian Belief Networks-Bayesian Learning- Bayes Optimal Classifier- Naïve Bayes Classifier- Bayesian Belief Networks.

### **MODULE V ANALYTICAL LEARNING AND REINFORCED LEARNING 09**

Perfect Domain Theories – EBG Remarks on Explanation Based Learning – Inductive-Analytical Approaches - FOCL Algorithm – Reinforcement Learning – Task – QLearning – Temporal Difference Learning-Relationship to Dynamic Programming, Case studies.

**L – 45; TOTAL HOURS –45**

**TEXT BOOKS:**

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India, 3<sup>rd</sup> Edition, ISBN : 978-3-16-148410-0, 2018.
2. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 3<sup>rd</sup> Edition, ISBN 948-4-11-167412, 2019.

**REFERENCES:**

1. Jiawei Han and Micheline Kamber and Jian Pei, "Data Mining – Concepts and Techniques", 3<sup>rd</sup> edition, Morgan Kaufman Publications, ISBN : 979318148501, 2016.
2. T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1<sup>st</sup> edition, ISBN:93552267413, 2020.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Identify the characteristics of machine learning that make it useful to solve real-world problems.

**CO2:** Apply appropriate supervised learning algorithms for analyzing the data for variety of problems.

**CO3:** Implement different unsupervised learning algorithms for analyzing the data.

**CO4:** Apply the probabilistic learning algorithm based on the scenarios.

**CO5:** Develop a model for new machine learning tasks based on reasoned argument.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO1	PSO2
CO1				H		H							M	
CO2				H		M							L	
CO3				M	H									M
CO4						H							L	
CO5			H		L								H	

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

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

Statement:

Applied machine learning techniques will help to promote Industrial growth and foster innovation

<b>CSDX 623</b>	<b>AGENT BASED INTELLIGENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>SYSTEM</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To provide overview on the fundamental concepts in the study intelligent agents.

**COB2:** To get familiar with the basic concepts, methods, techniques, and tools for the use of intelligent agents.

**COB3:** To learn about the fundamental principles and techniques employed in agent-based systems.

**COB4:** To provide the algorithms and their performance in agent-based intelligence system.

**COB5:** To learn about the agent-based applications deployed in Artificial Intelligence.

**MODULE I INTRODUCTION 09**

Definitions – History – Intelligence Agents – Structure – Environment – Basic Problem – Solving Agents – Formulating – Search Strategies – Intelligence search – Game playing as search.

**MODULE II KNOWLEDGE BASED AGENTS 09**

Representation – Logic – First order logic – Reflex Agent – Building a knowledge Base – General Ontology – Inference – Logical Recovery.

**MODULE III PLANNING AGENT 09**

Situational Calculus – Representation of Planning – Partial order Planning – Practical Planners – Conditional Planning – Replanning Agents.

**MODULE IV AGENTS AND UNCERTAINTY 09**

Acting under uncertainty – Probability Bayes Rules and use – Belief Networks – Utility Theory – Decision Network – Value of Information – Decision Theoretic Agent Design.

**MODULE V HIGHER LEVEL AGENT 09**

Learning agents – General Model – Inductive Learning – Learning Decision Trees – Reinforcement Learning – Knowledge in Learning – Communicative agents – Types of communicative agent – Future of AI.

**L –45 ; TOTAL HOURS –45**

**TEXT BOOK:**

1. Stuart Russell and Peter Norvig., "Artificial Intelligence – A Modern Approach", Prentice Hall, 4<sup>th</sup> edition, US Edition, ISBN-13. 978-0134610993, 2020.

#### REFERENCES:

1. Magdi S Mahmoud, "Multiagent system Introduction and Coordination control", CRC Press, 2nd Edition, ISBN : 9781000078107, 2020.
2. Nils. J. Nilsson, M., "Principles of Artificial Intelligence," Narosa Publishing House, ISBN : 0934613109, 2014.

#### COURSE OUTCOMES:

Students those who complete this course will be able to

**CO1:** Comprehend the agents and need of intelligence systems.

**CO2:** Analysis the impact of inference mechanisms through knowledgeable representation and reasoning.

**CO3:** Apply the learning algorithms to solve real world problems.

**CO4:** Analyze, design, implement and evaluate intelligent agent programs and systems of varying complexities.

**CO5:** Apply streaming algorithms and Coreset concept to analyze voluminous and high dimensional data.

#### Board of Studies (BoS) :

20<sup>th</sup> BoS of CSE held on 16.08.2022

#### Academic Council:

19<sup>th</sup> AC held on 29.09.2022

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

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

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

Statement:

It can enable strategic decision-making in business which in turn can lead to superior financial performance for organization.

<b>CSDX 624</b>	<b>HIGH PERFORMANCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>COMPUTING</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

**COB1:** To learn the concepts in grid computing.

**COB2:** To impart knowledge on distributed and parallel computing architecture.

**COB3:** To acquire knowledge on clusters and run parallel applications.

**COB4:** To familiarize with cloud computing service models.

**COB5:** To explore techniques and strategies for managing data effectively in cloud environments, including data storage, security, and access control.

### **MODULE I      GRID COMPUTING      09**

Data & Computational Grids – Grid Architectures and Its Relations To Various Distributed Technologies - Autonomic Computing - Examples Of The Grid Computing Efforts (IBM).

### **MODULE II      CLUSTER COMPUTING      09**

Introduction to cluster computing - Scalable Parallel Computer Architectures – cluster computer and its architecture – Classification - components for clusters – Network services - Communication software- Cluster Middleware and Single System Image - Resource Management and Scheduling.

### **MODULE III      CLUSTER SETUP AND ADMINISTRATION      09**

Cluster Setup & Its Advantages - Performance Models & Simulations - Networking Protocols & I/O - Messaging Systems - Process Scheduling - Load Sharing And Balancing - Distributed Shared Memory - Parallel I/O – Security – System monitoring – system tuning.

### **MODULE IV      CLOUD COMPUTING      09**

Defining clouds – cloud providers – consuming cloud services – cloud models: IaaS, PaaS, SaaS – Inside cloud – Administering cloud services – technical interface – cloud resources.

### **MODULE V      CLOUD NATURE      09**

Traditional data center – Cost of cloud data center – Scaling computer systems – Cloud workload – Managing data on clouds – Public, private



and hybrid clouds.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Hurwitz, Bllor, Kaufman, Halper, Cloud Computing for Dummies, Wiley India, ISBN: 9780470597422,2010.
2. Robert Robey," Parallel and High Performance Computing" Manning, ISBN: 9781638350385,2021.

**REFERENCES:**

1. J. Joseph & C. Fellenstien: 'Grid Computing ', Pearson Education. ISBN-13. 978-8131708859.
2. Rajkumar Buyya ,"High Performance Cluster Computing, Volume 1, Architecture and Systems" , Pearson Education. ISBN-10 : 0130137847

**COURSE OUTCOMES:**

On successful completion of the course, the student will be able to

**CO1:** Identify the basics of grid computing.

**CO2:** Analyze the distributed and parallel computing architecture.

**CO3:** Construct cluster setup and run parallel applications.

**CO4:** Apply the concepts of cloud computing service.

**CO5:** Illustrate the applications of trends in computing technology.

**Board of Studies(BoS):**

20<sup>th</sup> BoS of Department of  
CSE held on 16.08.2022

**Academic Council:**

19<sup>th</sup> Academic Council held on  
29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO1 1	PO 12	PSO1	PSO2
CO1				H		H							M	
CO2				H		M							L	
CO3				M	H									M
CO4						H							L	
CO5			H		L								H	

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

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and

productive employment and decent work for all.

Statement: By learning “High Performance Computing”, the students will be able to design and develop various applications using concepts of grid, cluster and cloud computing which in turn develop the economics sustainable and enormous employment opportunities.

<b>CSDX 625</b>	<b>HUMAN AND INTELLIGENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>SYSTEMS</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To explore various knowledge representation techniques.

**COB2:** To learn the methods of solving problems using rule based systems.

**COB3:** To gain knowledge on the fundamental concepts of lisp programming language.

**COB4:** To provide knowledge of Artificial Intelligence systems and real-time expert systems.

**COB5:** To impart knowledge on the qualitative reasoning and petri nets.

<b>MODULE I</b>	<b>KNOWLEDGE REPRESENTATION</b>	<b>09</b>
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Data and knowledge - Rules: Logical operations - Syntax and semantics of rules -Datalog rules ets -Objects, Frames, Semantic nets, Solving problems by reasoning: The structure of the knowledge base, The reasoning algorithm, Conflict resolution, Explanation of the reasoning.

<b>MODULE II</b>	<b>RULE BASEDSYSTEMS</b>	<b>09</b>
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Forward reasoning- Backward reasoning -Bidirectional reasoning- Search Methods: Depth-firsts earch -Breadth-first search - Hill climbing search - A\* search- Contradiction freeness – Completeness -Decomposition of knowledge bases: Strict Decomposition -Heuristic decomposition.

<b>MODULE III</b>	<b>LISP PROGRAMMING LANGUAGE</b>	<b>09</b>
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The fundamental data types in Lisp - Expressions and their evaluation - Lisp primitives - Simple examples in Lisp - The Prolog programming language - Expert system shells: Components of an expert system shell, Basic functions and services in an expert system shell.

<b>MODULE IV</b>	<b>REAL-TIME EXPERT SYSTEMS</b>	<b>09</b>
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The architecture of real-time expert systems- Synchronization and communication between real-time and intelligent subsystems - Data exchange between the real-time and the intelligent subsystems - Software engineering of real-time expert systems.

<b>MODULE V</b>	<b>QUALITATIVE REASONING AND PETRI NETS</b>	<b>09</b>
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Sign and interval calculus – Qualitative simulation - Qualitative physics - Signed directed graph (SDG) models - The Notion of Petri nets - The firing of transitions - Special cases and extensions - The state-space of Petri nets - Use of Petri nets for intelligent control – The analysis of Petri nets.

**L – 45; TOTAL HOURS –45**

**TEXT BOOK:**

1. T.J.M. Bench-Capon , "Knowledge Representation-An Approach to Artificial Intelligence", Elsevier Science, ISBN: 9781483297101, 2014.

**REFERENCES:**

1. Laxmidhar Behera, Indrani Kar, "Intelligent Systems and Control: Principles and Applications Paperback", OUP India publisher, ISBN:9780198063155, 2009.
2. Stuart Russell, "Human Compatible: AI and the Problem of Control ", Allen Lane Publishers, ISBN:0241335205 , 2019.

**COURSE OUTCOMES:**

Students those who complete this course will be able to

**CO1:** Comprehend knowledge representation and real-time decision-making.

**CO2:** Describe the attributes of various search techniques and the situations to which they are well-suited.

**CO3:** Implement lisp programming language.

**CO4:** Analyze data exchange between the real-time and the intelligent subsystems.

**CO5:** Apply qualitative simulation and analysis of Petri nets.

**Board of Studies (BoS) :**

20<sup>th</sup> BoS of CSE held on 16.08.2022

**Academic Council:**

19<sup>th</sup> AC held on 29.09.2022

	PO 1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	H				L								H	
CO2						H								H
CO3		H						M			M			
CO4													M	
CO5										H				

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

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

Statement:

Human Intelligent and systems can provide critical aid to the existing response techniques and make changes in the decision-making process in sustainable industrialization.

<b>CSDX 626</b>	<b>NATURAL LANGUAGE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>PROCESSING</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To provide the learning process of Natural Language Processing.

**COB2:** To impart the knowledge in sequences and trees.

**COB3:** To learn the semantics to understand the meanings.

**COB4:** To recognize the significance of pragmatics for natural language processing.

**COB5:** To explore how to design automated natural language generation and machine translation.

**MODULE I      LEARNING      09**

Introduction to Natural Language processing – Learning – Linear Text Classification – Non-linear classification – Linguistic Application of Classification – Learning without Supervision.

**MODULE II      SEQUENCES AND TREES      09**

Language models – Sequence Labeling – Applications of Sequence labeling – Formal Language Theory – Context Free parsing – Dependency parsing.

**MODULE III      MEANING      09**

Logical semantics – Predicate –Argument Statistics – Distributional and Distributed Semantics – Reference Resolution – Discourse.

**MODULE IV      APPLICATIONS      09**

Information Extraction – Machine Translation – Text generation – Numerical Optimization.

**MODULE V      NLP USING TOOLS      09**

Starting an NLP Project – Data Collection – Data Preprocessing – Feature Extraction – Model Development – Model Assessment – Model Deployment.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOK:**

1. Jacob Eisenstein ,” Introduction to Natural Language Processing”, MIT Press, ISBN 9780262042840, 0262042843,2019.

**REFERENCES:**

1. Sohom Ghosh, Dwight Gunning, "Natural Language Processing Fundamentals", Packt Publishing, ISBN 9781789955989, 178995598X, 2019.
2. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, ISBN 978-0-19-569232-7, 2008.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Interpret the basic concepts approaches to syntax and semantics in NLP.

**CO2:** Design the approaches to discourse the NLG system.

**CO3:** Analyze the machine learning translation for language processing.

**CO4:** Demonstrate the methods for statistical approaches to machine translation.

**CO5:** Develop Natural Language Processing projects using the tools.

**Board of Studies (BoS) :**

19<sup>th</sup> BOS of CSE held on  
28.12.2021

**Academic Council:**

18<sup>th</sup> AC held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1													M	
CO2			M											
CO3						M								M
CO4	H												M	
CO5					H									H

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

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

Statement:

By learning "Natural Language Processing ", the students are able to design and develop methods for language translation into machine language in various applications hence develop the economics sustainable and enormous employment opportunities.

<b>CSDX 627</b>	<b>GENERATIVE ARTIFICIAL INTELLIGENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 09</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

**COB1:** To study the fundamental concepts of Generative AI

**COB2:** To Learn the importance of Generative AI models

**COB3:** To gain knowledge on GANs for image and text generation

**COB4:** To get familiarized with prompt engineering and fine tuning.

**COB5:** To understand the importance of Generative AI techniques in specific domains.

**MODULE I INTRODUCTION TO GENERATIVE AI 9**

Introduction to Generative AI – Discriminative and Generative models – Implementing Generative models and Bayes' theorem – Why use Generative models – Style transfer and Image transformation – Challenges of Generative models

**MODULE II GENERATIVE AI MODELS 9**

ML Model Building Process-Data Collection and Pre-processing-Training and Evaluation Overview-Transfer Learning and Pre-trained Models-Advanced Generative AI Models-GAN Training Techniques-GAN Evaluation Techniques-Additional Considerations.

**MODULE III GENERATIVE ADVERSARIAL NETWORKS (GANs) 9**

Image generation with GANs-Style transfer with GANs- StyleGAN - Cycle GAN - Disco GAN - Recent Advancements in GANs and Style Transfer -Deepfakes with GAN-The rise of methods for text generation.

**MODULE IV PROMPTING AND CREATIVITY THROUGH GEN AI 9**

Prompt Engineering-Prompt Engineering Examples- Prompt Engineering Techniques -Fine Tuning-Fine Tuning Using Additional Data-Fine Tuning Model Parameters-Introduction to Generative AI Creativity Tools-Visual,Audio, Text Generators & Code Generators -Ethical Considerations

**MODULE V EMERGING APPLICATIONS OF GENERATIVE AI 9**

Generative AI for Healthcare – Clinical Administration Support – Clinical Decision Support –Generative AI for Media – Storytelling – Generative AI for Mobile Networks-Building Design and Economic Research.

**L – 45; TOTAL HOURS – 45**



**REFERENCES:**

1. Babcock, Joseph, and Bali, Raghav. Generative AI with Python and TensorFlow 2: Create Images, Text, and Music with VAEs, GANs, LSTMs, Transformer Models. United Kingdom, Packt Publishing, 2021.
2. Alto, Valentina. Modern Generative AI with ChatGPT and OpenAI Models: Leverage the Capabilities of OpenAI's LLM for Productivity and Innovation with GPT3 and GPT4. United Kingdom, Packt Publishing, 2023.
3. L. Reynolds and K. McDonell, "Prompt Programming for Large Language Models: Beyond the Few-Shot Paradigm," in Extended Abstracts of the 2021 CHI Conference on Human Factors in Computing Systems, May 2021.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Create generative models using frameworks like TensorFlow or PyTorch

**CO2:** Demonstrate data preprocessing and GAN modeling techniques.

**CO3:** Elaborate the fundamentals of prompt engineering and fine tuning.

**CO4:** Apply practical skills in utilizing generative AI for various creative applications.

**CO5:** Evaluate generative AI techniques in specific domains

**Board of Studies (BoS) :**

23<sup>rd</sup>BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

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

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

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

**Statement:** AI can be harnessed to generate innovative solutions, analyze complex data, track progress on SDG indicators, and identify patterns that can inform and support progress towards the SDGs as well as facilitate evidence based decision-making and targeted actions

<b>CSDX 629</b>	<b>EXPLORATORY DATA ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:** To understand the fundamental concepts of exploratory data analysis.

**COB2:** To learn the data indexing techniques using python.

**COB3:** To identify the different types of distribution variables and their characteristics.

**COB4:** To gain knowledge of time series analysis and its applications.

**COB5:** To equip the students with the necessary skills to conduct EDA effectively across various domains.

<b>MODULE I</b>	<b>EXPLORATORY DATA ANALYSIS</b>	<b>9</b>
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EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA - Visual Aids for EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

<b>MODULE II</b>	<b>EDA USING PYTHON</b>	<b>9</b>
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Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.

<b>MODULE III</b>	<b>UNIVARIATE &amp; BIVARIATE ANALYSIS</b>	<b>9</b>
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Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardizing – Inequality - Relationships between Two Variables - Percentage Tables - Analyzing Contingency Tables.

<b>MODULE IV</b>	<b>MULTIVARIATE AND TIME SERIES ANALYSIS</b>	<b>9</b>
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Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning – Time-based indexing – Visualizing – Grouping – Resampling.

<b>MODULE V</b>	<b>APPLICATIONS OF EDA</b>	<b>9</b>
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EDA in retail: Analyze sales data, inventory levels, and customer purchasing patterns – Healthcare: identify treatment patterns, treatment outcomes, and patient demographics. – Marketing: understand consumer behavior, preferences, and trends – Transportation: analyze traffic patterns, optimize route planning, and

improve transportation systems.

**L – 45; TOTAL HOURS – 45**

### REFERENCES:

1. Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020.
2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", First Edition, O Reilly, 2017.
3. Vineet Raina, Srinath Krishnamurthy, "Building an Effective Data Science Practice: A Framework to Bootstrap and Manage a Successful Data Science Practice", Apress, 2021.
4. Sanjeev J. Wagh, Manisha S. Bhende, Anuradha D. Thakare, "Fundamentals of Data Science", CRC Press, 2022.
5. Ronald K Pearson, "Exploratory data analysis using R", Chapman and Hall/CRC, 9781138480605 (ISBN10: 1138480606) 2018

### COURSE OUTCOMES :

Students who complete this course will be able to

**CO1:** Describe the significance of EDA in understanding and interpreting data..

**CO2:** Implement the data indexing techniques in data analysis tasks.

**CO3:** Analyze the contingency tables to explore relationships between categorical variables.

**CO4:** Create time series plots and interpret patterns in the data.

**CO5:** Apply Exploratory Data Analysis (EDA) across diverse domains to derive actionable insights.

### Board of Studies (BoS) :

23<sup>rd</sup>BoS of CSE held on 09.05.2024

### Academic Council:

22<sup>nd</sup> AC held on 04.09.2024

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

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

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

**Statement:** EDA involves analyzing various datasets related to industry, innovation, and infrastructure to understand trends, patterns, and challenges.

<b>CSDX 628</b>	<b>WEB ANALYTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

**COB1:** To learn Web analytics platforms and their evolution.

**COB2:** To gain knowledge of various Data sources and collection techniques.

**COB3:** To study the approaches to categorizing and interpreting qualitative data.

**COB4:** To explore the common metrics of web as well as KPI related concepts.

**COB5:** To introduce the popular web analytics tools and platforms.

### **MODULE I INTRODUCTION 09**

Definition, Process, Key terms: Site references, Keywords and Key phrases - Building block terms: Visit characterization terms, Content characterization terms, Conversion metrics –Categories: Offsite web, on site web – Web analytics platform – Web analytics evolution, Need for web analytics, Advantages, Limitations.

### **MODULE II DATA COLLECTION 09**

Click stream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing – Outcomes Data: Ecommerce, Lead generation, Brand/Advocacy and Support – Research data: Mindset, Organizational structure, Timing – Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.

### **MODULE III QUALITATIVE ANALYSIS 09**

Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations – Site Visits: Conducting a site visit, Benefits of site visits – Surveys: Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys – Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, Selecting optimal web analytic tool, Understanding clickstream data quality, Identifying unique page definition, Using cookies, Link coding issues.

### **MODULE IV WEB METRICS 09**

Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits

– Optimization (e-commerce, non-e-commerce sites): Improving bounce rates, Optimizing adwords campaigns – Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI – Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files & Cookies, Web Bugs.

## **MODULE V WEB ANALYTICS 2.0**

**09**

Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0 – Competitive intelligence analysis : CI data sources, Toolbar data, Panel data ,ISP data, Search engine data, Hybrid data – Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities – Google Analytics: Brief introduction and working, Adwords, Benchmarking – Categories of traffic: Organic traffic, Paid traffic – Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.

**L – 45; TOTAL HOURS – 45**

### **TEXT BOOKS:**

1. Derek Hansen, Ben Shneiderman, Marc A. Smith, Itai Himelboim, Analyzing Social Media Networks with NodeXL: Insights from a Connected World, 2/e, MK, ISBN: 9780128177570, 2020.
2. Brian Clifton, Advanced Web Metrics with Google Analytics, Wiley Publishing, 3rd Edition, ISBN: 978-1-118-16844-8, 2012.
3. Clifton B, Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc. 2nd ed, ISBN-13: 978-0470562314, 2010.
4. Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. 1st ed, ISBN: 978-0-470-52939-3, 2009.

### **REFERENCE:**

1. Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons, ISBN-13: 978-0471220725, 2002.

### **COURSE OUTCOMES:**

Students those who complete this course will be able to

**CO1:** Recognize the Web analytics platform and their evolution

**CO2:** Use the various Data Streams Data.

**CO3:** Illustrate the different ways of Data capturing and outline the

benefits.

**CO4:** Analysis the common metrics of web as well as KPI related concepts.

**CO5:** Apply various Web analytics versions in existence.

**Board of Studies (BoS) :**

20<sup>th</sup> BoS of CSE held on

16.08.2022

**Academic Council:**

19<sup>th</sup> AC held on

29.09.2022

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

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

Statement: On getting meaningful insight from the data through preprocessing techniques will promote sustainable industrialization and there by foster innovation.

<b>CSDX 630</b>	<b>TEXT ANALYTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:** To learn the natural language based unstructured data.

**COB2:** To acquire the domain knowledge of data in creating features for working with machine learning algorithms.

**COB3:** To provide the text documents into categories based on their content.

**COB4:** To explore the methods for identifying the topics that best describes the set of documents and generate meaningful insights.

**COB5:** To impart knowledge in a language and represent its emotional value.

<b>MODULE I</b>	<b>NATURAL LANGUAGE PROCESSING</b>	<b>09</b>
	<b>BASICS</b>	

Natural Language – Linguistics – Language Syntax and Structure – Semantics - Text Corpora – NLP - Text Analytics – Machine Learning – Deep Learning – Python and NLP.

<b>MODULE II</b>	<b>PROCESSING TEXT AND FEATURE</b>	<b>09</b>
	<b>ENGINEERING</b>	

Text Processing and Wrangling – Text Syntax and Structure – Feature Engineering:- Text Data, Preprocessing Text Corpus – Traditional Feature Engineering Models.

<b>MODULE III</b>	<b>TEXT CLASSIFICATION</b>	<b>09</b>
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Text Classification – Automated Text Classification – Data Retrieval – Preprocessing and Normalization – Building Train and Test Datasets – Feature Engineering Techniques – Classification Models – Evaluation.

<b>MODULE IV</b>	<b>TEXT SUMMARIZATION AND CLUSTERING</b>	<b>09</b>
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Keyphrase Extraction – Topic Modeling – Document Summarization – Information Retrieval – Similarity Measures - Text Similarity – Analyzing Term Similarity, Document Similarity – Document Clustering.

**MODULE V SEMANTIC AND SENTIMENT ANALYSIS 09**

Semantic Analysis – Exploring Wordnet – Word Sense Disambiguation – Named Entity Recognition – Analyzing Semantic Representations – Sentiment Analysis – Supervised Learning –Deep Learning Models – Analyzing Sentiment Causation.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOK:**

1. Dipanjan Sarkar, "Text Analytics with Python, A Practitioner's Guide to Natural Language Processing", Apress, Second Edition, 2021.

**REFERENCE:**

1. John Atkinson-Abutridy, "Text Analytics, An Introduction to the Science and Applications of Unstructured Information Analysis", CRC Press, 2022.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Work with different types of unstructured data related to natural language processing.

**CO2:** Identify the structure and feature of the text documents using feature engineering models for working with machine learning algorithms.

**CO3:** Perform text classification following the preprocessing techniques and evaluation methods.

**CO4:** Apply appropriate method for determining the topic of the document and word similarity in the contents.

**CO5:** Analyze customer feedback, survey feedbacks and product reviews using sentiment analysis.

**Board of Studies (BoS) :**

20<sup>th</sup> BoS of CSE held on  
16.08.2022

**Academic Council:**

19<sup>th</sup> AC held on 29.09.2022

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



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

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

Statement: The students will develop critical thinking and problem-solving skills, apply data-driven decision-making processes, and enhance their ability to communicate complex insights effectively. By the course's conclusion, students will possess a versatile skill set to work with natural language data, extract valuable insights, and contribute effectively to various fields, including data science, information retrieval, marketing, and sentiment analysis.

<b>CSDX 631</b>	<b>GRAPH THEORY AND ITS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>APPLICATIONS IN DATA SCIENCE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To get familiarize with graphs and their properties.

**COB2:** To understand graphs as modelling and analysis tool.

**COB3:** To explore modern applications of graph theory.

**COB4:** To learn various data structures with graph theory.

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

**MODULE I INTRODUCTION TO GRAPH THEORY 09**

Introduction - Graph Terminologies - Types of Graphs - Sub Graph- Multi Graph - Regular Graph - Isomorphism - Isomorphic Graphs - Sub-graph - Euler graph - Hamiltonian Graph - Graph Representation.

**MODULE II GRAPH CONNECTIVITY AND COLORUNG 09**

Connectivity and Separability -Spanning Trees – Fundamental Circuits – Spanning Trees in a Weighted Graph – Cut Sets – Properties of Cut Set – Network Flows -Isomorphism-Independence and Cliques - Factors and Factorization-Graph Colouring.

**MODULE III TREES 09**

Types of trees-Rooted Trees-Path Length in Rooted Trees-Spanning Trees, Fundamental Circuits-Spanning Trees- cut sets and cut vertices-Fundamental cut set-Minimum spanning tree.

**MODULE IV NETWORKS AND FLOWS 09**

Maximum Flow Problem - Minimum Cuts and Duality - Max-Flow Min-Cut Theorem - Algorithms for Maximum Flow - Minimum Cost Residual Networks - Optimality Conditions - Algorithms for Minimum Cost Flow

**MODULE V GRAPH DATA SCIENCE 09**

Graph and Network Science- Network Structure Representation-Graph Database-Case Studies.

**L –45 ; TOTAL HOURS –45**

**TEXT BOOK:**

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

**REFERENCES:**

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

**COURSE OUTCOMES:**

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

**CO1:** Formulate real time problems in terms of graphs.

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

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

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

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

**Board of Studies (BoS):**

20<sup>th</sup> BoS of CSE held on 16.08.2022

**Academic Council:**

19<sup>th</sup> AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2	PSO3
CO1					L										
CO2						M									
CO3		H						M						M	
CO4															
CO5										H					

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

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

Statement:

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

<b>CSDX 632</b>	<b>SPATIAL DATABASES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:**To learn the fundamental concepts of spatial databases.

**COB2:**To provide knowledge on how to extend the ER model with spatial concepts to effectively represent spatial information.

**COB3:**To explore the basic structure of SQL, including set operations and aggregate functions.

**COB4:**To learn query processing and optimization techniques specifically tailored for spatial databases.

**COB5:**To impart knowledge in spatial geometry to organizing spatial data.

<b>MODULE I</b>	<b>INTRODUCTION</b>	<b>09</b>
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Introduction to Spatial database -Spatial Data types- SDBMS -User classes of SDBMS - Multi layer architecture of SDBMS - GIS and SDBMS.

<b>MODULE II</b>	<b>SPATIAL CONCEPTS AND DATA MODELS</b>	<b>09</b>
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Conceptual model of spatial information: Field based model, Object based models- Operation on spatial objects-Dynamic spatial operations- Entity-Relationship model-Relational model -Mapping - Extending the ER model with spatial concepts.

<b>MODULE III</b>	<b>SPATIAL QUERY LANGUAGE</b>	<b>09</b>
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SQL Primer- Data Definition -Data Manipulation - Basic structure of SQL - Set operations - Aggregate Functions - Simple queries - Spatial Vs non spatial - Nested sub queries - Complex queries - Views -Trigger - OGIS standard for extending SQL -Example spatial SQL queries -Object relational SQL.

<b>MODULE IV</b>	<b>QUERY PROCESSING AND OPTIMIZATION</b>	<b>09</b>
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Spatial operations - Two-step query processing of object operations -Techniques for spatial selection - Algorithms for spatial Join operations - Spatial Query optimization - Spatial Index structures.

<b>MODULE V</b>	<b>DESIGN AND DEVELOPMENT</b>	<b>09</b>
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Exploring Spatial Geometry -Organizing spatial data - Spatial data relationships and functionalities of OracleSpatial and FOSS PostGIS DBMS - Application program and user Interfaces.

**L – 45; TOTAL HOURS – 45****TEXT BOOKS:**

1. Regina, Leo Hsu "PostGIS in Action, O'Reilly and Associates Inc., ISBN-13: 9781935182269, ISBN-10: 1935182269, 2011.
2. Philippe Rigaux, Michel Scholl, Agnes Voisard " Spatial Databases with application to GIS | Morgan Kaufmann, ISBN13: 9781558605886, ISBN10: 1558605886, 2002

**REFERENCES:**

1. Ravi Kothuri, Albert Godfrind, Euro Beinath "Pro Oracle Spatial for Oracle Database 11g , Apress , ISBN13 : 9788181288882, 2007.
2. Shashi Shekhar, Sanjay Chawla, Spatial Databases a Tour , Prentice Hall, 2007.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Apply the fundamentals of spatial databases.

**CO2:** Develop proficiency in using appropriate data models.

**CO3:** Explain the concepts and principles of spatial SQL.

**CO4:** Demonstrate the ability to optimize spatial queries .

**CO5:** Utilize application program interfaces (APIs) to develop custom applications.

**Board of Studies (BoS) :**

22<sup>nd</sup> BoS of CSE held on 17.08.2023

**Academic Council**

21<sup>st</sup> AC held on 23.12.2023

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

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

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

Statement: The students will be able to acquire skills on working with spatial databases for real time applications.

**SEMESTER VII**

<b>CSDX 521</b>	<b>SPEECH PROCESSING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG : 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:** To get familiar with the fundamentals of speech processing.

**COB2:** To learn various speech models.

**COB3:** To gain knowledge on phonetics and pronunciation processing.

**COB4:** To explore prosodic analysis, which involves the study of rhythm, intonation, and stress patterns in speech.

**COB5:** To impart knowledge on the concepts of speech recognition.

<b>MODULE I</b>	<b>INTRODUCTION</b>	<b>09</b>
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Introduction to Speech Processing - human and machine speech production - Models for speech production - Various types of speech sounds - Characteristics.

<b>MODULE II</b>	<b>SPEECH MODELING</b>	<b>09</b>
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Word classes and part of speech tagging – hidden markov model – computing likelihood: the forward algorithm – training hidden markov model – maximum entropy model – transformation-based tagging – evaluation and error analysis – issues in part of speech tagging – noisy channel model for spelling.

<b>MODULE III</b>	<b>SPEECH PRONUNCIATION AND SIGNAL PROCESSING</b>	<b>09</b>
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Phonetics – speech sounds and phonetic transcription – articulatory phonetics – phonological categories and pronunciation variation – acoustic phonetics and signals – phonetic resources – articulatory and gestural phonology.

<b>MODULE IV</b>	<b>SPEECH IDENTIFICATION</b>	<b>09</b>
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Speech synthesis – text normalization – phonetic analysis – prosodic analysis – diphone waveform synthesis – unit selection waveform synthesis – evaluation.

<b>MODULE V</b>	<b>SPEECH RECOGNITION</b>	<b>09</b>
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Stochastic processes - Markov processes - Hidden Markov modeling - Components of a HMM- training and building of HMMs: Viterbi algorithm - Baum-Welch algorithm - Implementation of a speech recognition system -

Time/space consideration - designing the interface - self-learning mechanism.

### L – 45; TOTAL HOURS – 45

#### TEXT BOOKS:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", ISBN : 13 ,9789332518414, ,9332518414-978 Person education,2013.
2. Kai-Fu Lee, "Automatic Speech Recognition: The Development of the SPHINX System ", The Springer International Series in Engineering and Computer Science, ISBN-13 : . 978-1461366249, 2013

#### REFERENCE:

1. Himanshu Chaurasiya, "Soft Computing Implementation of Automatic Speech Recognition", LAP Lambert Academic Publishing ,2010.

#### COURSE OUTCOMES :

Students who complete this course will be able to

**CO1:**Recognition of various speech sounds.

**CO2:**Analyze speech signals to derive new speech models.

**CO3:**Perform various language phonetic analysis.

**CO4:**Evaluate speech synthesis systems effectively.

**CO5:**Build a simple speech recognition/TTS system.

#### Board of Studies (BoS) :

18<sup>th</sup>BoS of CSE held on  
26.07.2021

#### Academic Council:

18 Ac held on 24.02.2022

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

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

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

Statement: The students can explore the recent advancement in the field of automatic speech recognition with a focus on discriminative and hierarchical models.



<b>CSDX 522</b>	<b>VISUAL DATA ANALYSIS AND MACHINE PERCEPTION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG :9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:**To understand the key concepts and techniques in visual data analysis.

**COB2:**To familiarize with the fundamentals of image processing techniques.

**COB3:**To gain knowledge on methodologies used for motion analysis.

**COB4:**To get insights on visual perception using machine learning and deep learning techniques.

**COB5:**To explore the applications of visual data analysis and machine perception.

**MODULE I VISUAL DATA AND IMAGE FORMATION 09**

Overview of Visual Data – Challenges in visual data analysis - Introduction to Computer Vision – Image Formation - Geometric primitives – 2D Transformations – 3D Transformations – 3D Rotations – 3D to 2D projections - Photometric image formation - Digital camera.

**MODULE II IMAGE PROCESSING 09**

Fundamentals of image processing – Image Transforms – Image filtering – Color image processing – Mathematical morphology – Image segmentation - Image descriptors and features - Points and patches –Edges – Lines.

**MODULE III MOTION ANALYSIS 09**

Feature-based Alignment – 2D, 3D feature-based alignment - Pose estimation - Image Stitching - Dense motion estimation - Optical flow - Layered motion - Parametric motion - Structure from Motion.

**MODULE IV MACHINE PERCEPTION 09**

Supervised learning for visual task– Convolutional Neural Networks – Transfer Learning and Fine tuning - Object detection -Artificial Neural Network for Pattern classification - Recurrent Neural Network – Generative models for visual data.

**MODULE V APPLICATIONS 09**

Applications of Visual data analysis and Machine perception– Performance-driven animation – Medical image segmentation – Augmented Reality - Motion estimation and object tracking – Face and facial expression recognition –

Gesture recognition – Image fusion.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Richard Szeliski," Computer Vision: Algorithms and Applications", Springer; 2nd Edition, ISBN-13: 9783030343712, 2022.
2. Manas Kamal Bhuyan," Computer Vision and Image Processing", CRC Press, ISBN: 9781351248389,2019.

**REFERENCES:**

1. E. R. Davies," Computer Vision: Principles, Algorithms, Applications, Learning", Elsevier Science, ISBN: 9780128095751,2017

**COURSES OUTCOMES:**

Students who complete this course will be able to

**CO1:** Describe the various orientations of image formation perspectives.

**CO2:** Apply image processing techniques to analyze and enhance visual data.

**CO3:** Develop systems for motion analysis and tracking objects.

**CO4:** Apply machine learning and deep learning methods to solve computer vision problems.

**CO5:** Compare the applications of computer vision in various domains

**Board of Studies (BoS) :**

23<sup>rd</sup>BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

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

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

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

**Statement:** The holistic understanding of the basic principles and techniques of image processing enable the computing devices to process, analyze and interpret visual data in the most prominent industries including agriculture, healthcare, transportation, manufacturing and retail.

<b>CSDX 524</b>	<b>REINFORCEMENT LEARNING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To understand the basic theory underlying reinforcement learning.

**COB2:** To explore Reinforcement Learning problems corresponding to different applications.

**COB3:** To gain knowledge on a range of Reinforcement Learning algorithms along with their strengths and weaknesses.

**COB4:** To explore reinforcement learning algorithms to solve real time problems.

**COB5:** To learn to optimize the models and report on the expected accuracy.

**MODULE I REINFORCEMENT LEARNING PRIMITIVES 09**

Introduction and Basics of RL- Defining RL Framework- Probability Basics: Probability Axioms -Random Variables - Probability Mass Function- Probability Density Function- Cumulative Distribution Function and Expectation- Introduction to Agents- Intelligent Agents – Problem Solving – Searching- Logical Agents.

**MODULE II MARKOV DECISION PROCESS AND DYNAMIC PROGRAMMING 09**

Markov Property-Markov Chains- Markov Reward Process (MRP) -Bellman Equations for MRP - Dynamic Programming: Policies (Evaluation, Improvement- Iteration Value Iteration) - Asynchronous Dynamic Programming- Generalized Policy Iteration- Efficiency of Dynamic Programming.

**MODULE III MONTE CARLO METHODS AND TEMPORAL DIFFERENCE LEARNING 09**

Monte Carlo: Prediction- Estimation of Action Values- Control and Control without Exploring Starts- Off-Policy Control- Temporal Difference Prediction: TD(0), SARSA: On Policy TD control- Q-Learning: Off-Policy TD control- Games, After states- and Other Special Cases.

**MODULE IV DEEP REINFORCEMENT LEARNING 09**

Deep Q-Networks- Double Deep-Q Networks (DQN, DDQN, Dueling DQN, Prioritized Experience Replay)- Policy Optimization in RL Introduction to Policy-based Methods- Vanilla Policy Gradient- REINFORCE Algorithm and

Stochastic Policy Search Asynchronous Actor-Critic and Asynchronous Advantage Actor Critic (A2C, A3C)- Advanced Policy Gradient (PPO, TRPO, DDPG).

## **MODULE V MULTI AGENT IN REINFORCEMENT LEARNING 09**

Multi-Agent Learning- Meta-learning- Partially Observable Markov Decision Process- Ethics in RL- Applying RL for Real-World Problems.

**L – 45; TOTAL HOURS –45**

### **TEXT BOOKS:**

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An Introduction", Second Edition, MIT Press, ISBN: 9780262039246 ,2019.
2. Russell, Stuart J., and Peter Norvig. "Artificial intelligence: a modern approach.", Pearson Education Limited, ISBN-13: 978-0136042594,2016.

### **REFERENCES:**

1. Ian Goodfellow, YoshuaBengio, and Aaron Courville. "Deep learning." MIT press, ISBN: 9780262035613, 2017.
2. Keng, Wah Loon, Graesser, Laura, "Foundations of Deep Reinforcement Learning: Theory and Practice in Python", Addison Wesley Data & Analytics Series, ISBN:0135172381 2020.
3. Francois Chollet, "Deep Learning with Python", Manning Publications, ISBN 9781617294433, 2017.
4. Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, ISBN 9781498770392 2018.

### **COURSE OUTCOMES:**

| Students who complete this course will able to

**CO1:** Analyze the importance of visualization in the data analytics solution

**CO2:** Build model a control task in the framework of Markov Decision Processes.

**CO3:** Identify stability/convergence and approximation properties of RL algorithms

**CO4:** Apply deep learning methods to RL problems in practice.

**CO5:** Develop an application using Reinforcement Learning for real world problems.

**Board of Studies (BoS) :**

20<sup>th</sup> BoS of CSE held on  
16.08.2022

**Academic Council:**

19<sup>th</sup> AC held on 29.09.2022

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

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

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

**Statement:**

Reinforcement learning enables to explore designs for machines that are effective in solving learning problems of scientific or economic interest, evaluating the designs through mathematical analysis or computational experiments.

**CSDX 525****FUZZY SYSTEMS****L T P C****SDG: 8****3 0 0 3****COURSE OBJECTIVES :**

**COB1:**To provide the fundamental concepts such as fuzzy sets, operations and fuzzy relations.

**COB2:**To learn about the fuzzification of scalar variables and the defuzzification of membership functions.

**COB3:**To familiarize the three different inference methods to design fuzzy rule based system.

**COB4:**4. To expose the fuzzy decision making through concepts and Bayesian decision methods.

**COB5:**5. To impart knowledge on different fuzzy classification methods.

**MODULE I FUZZY SETS AND RELATIONS 09**

Fuzzy sets - Membership functions, Fuzzy set operations, Properties of fuzzy sets. Classical and Fuzzy relations: Cartesian product, crisp relations-cardinality, operations and properties of crisp relations. Fuzzy relations-cardinality, operations, properties of fuzzy relations, fuzzy Cartesian product and composition, Fuzzy tolerance and equivalence relations, value assignments and other formats of the composition operation.

**MODULE II FUZZIFICATION AND DEFUZZIFICATION 09**

Fuzzification and Defuzzification: Features of the membership functions, various forms, fuzzification, defuzzification to crisp sets, - cuts for fuzzy relations, Defuzzification to scalars. Fuzzy logic and approximate reasoning, Other forms of the implication operation

**MODULE III FUZZY SYSTEMS 09**

Fuzzy Systems: Natural language, Linguistic hedges, Fuzzy (Rule based) System, Aggregation of fuzzy rules, Graphical techniques of inference, Membership value assignments: Intuition, Inference, rank ordering, Fuzzy Associative memories.

**MODULE IV FUZZY DECISION MAKING 09**

Fuzzy decision making: Fuzzy synthetic evaluation, Fuzzy ordering, Preference and consensus, Multi objective decision making, Fuzzy Bayesian, Decision method, Decision making under Fuzzy states and fuzzy actions.

**MODULE V FUZZY CLASSIFICATION****09**

Fuzzy Classification : Classification by equivalence relations-crisp relations, Fuzzy relations, Cluster analysis, Cluster validity, C-Means clustering, Hard C-Means clustering, Fuzzy C-Means algorithm, Classification metric, Hardening the Fuzzy C-Partition.

**L – 45; TOTAL HOURS – 45****TEXT BOOKS:**

1. Michael Voskoglou, Fuzzy Sets, Fuzzy Logic and Their Applications. N.p., MDPI AG, ISBN:9783039285204, 3039285203, 2020.
2. El Alaoui, MohElAlaoui, Mohamed. Fuzzy TOPSIS: Logic, Approaches, and Case Studies. United States, CRC Press, ISBN:9781000385755, 1000385752, 2021

**REFERENCE:**

1. Ross, Timothy J.. Fuzzy Logic with Engineering Applications, Fourth Edition. N.p., John Wiley & Sons (US), ISBN:9780470748510, 0470748516, 2017.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:**Examine the basic ideas of fuzzy sets, operations and properties of fuzzy sets and also about fuzzy relations.

**CO2:**Analyze the basic features of membership functions, fuzzification process and defuzzification process.

**CO3:**Design fuzzy rule based system.

**CO4:**Apply the combining fuzzy set theory with probability to handle random and non-random uncertainty, and the decision making process

**CO5:**Analyze and synthesize the fuzzy C-Means clustering algorithm.

**Board of Studies (BoS) :**

18<sup>th</sup>BoS of CSE held on  
26.07.2021

**Academic Council:**

18 Ac held on 24.02.2022

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

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

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

Statement: Fuzzy logic expert systems are useful analytical frameworks to evaluate such systems, and develop a model to formally evaluate progress towards sustainability targets based on diverse sets of indicators.



<b>CSDX 526</b>	<b>ARTIFICIAL INTELLIGENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG : 8</b>	<b>CHATBOT</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:** To learn the fundamental concepts and technologies behind Artificial Intelligence chatbots.

**COB2:** To familiarize with Natural Language Processing (NLP) techniques for chatbot development.

**COB3:** To gain knowledge on dialogue management approaches and strategies in chatbot systems.

**COB4:** To explore machine techniques and deep models for enhancing Artificial Intelligence chatbot capabilities.

**COB5:** To understand the ethical and social implications associated with Artificial chatbots.

**MODULE I INTRODUCTION TO CHATBOTS 09**

Introduction to AI and Natural Language Processing (NLP) – Basics of chatbot technology and its applications – Understanding the architecture of chatbots systems – Types of chatbots: rule-based, retrieval-based, and generative chatbots – Design principles for effective chatbot interactions.

**MODULE II NLP FUNDAMENTALS FOR CHATBOTS 09**

Introduction to Natural Language Understanding (NLU) and Natural Language Generation (NLG) – Text preprocessing techniques: tokenization, stemming, and lemmatization – Part-of-speech tagging and named entity recognition – Sentiment analysis and emotion detection for chatbots – Language modeling and text generation.

**MODULE III DIALOGUE MANAGEMENT FOR CHATBOTS 09**

Dialogue systems and dialogue state tracking – Rule-based and finite-state approaches to dialogue management – Slot filling and intent recognition in chatbot conversations – handling context and maintaining conversational state.

**MODULE IV LEARNING TECHNIQUES FOR AI CHATBOTS 09**

Introduction to machine learning and deep learning approaches to chatbot development - chatbots training and generation – Multimodal chatbots: incorporating images, videos, and other media.

**MODULE V      ETHICAL AND SOCIAL IMPLICATIONS OF AI      09**  
**CHATBOTS**

Ethical consideration in chatbot design and deployment – Bias and fairness issues in chatbot interactions – Privacy and data security concerns in chatbot systems – social impact and future directions of AI chatbots.

**L-45 ;TOTAL HOURS – 45**

**TEXT BOOK:**

1. Nazneen Akhter Shaikh, Khan Samrin Syed Zebanaaz, Saniya Raheen Patel, "Artificial Intelligence Based Chatbot Design", LAP LAMBERT Academic Publishing , ISBN: ,6202786713-978 620278671X,2020.

**REFERENCE:**

1. Lon Safko, "The Artificial Intelligence Chatbot: Unexpected Positive Consequences", Independently published ISBN: ,1070979656-978 1070979651,2019

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Comprehend the underlying architecture of chatbot systems.

**CO2:** Apply NLP techniques to preprocess and analyze text data for chatbot interactions.

**CO3:** Design and implement effective dialogue management strategies for chatbot systems.

**CO4:** Employ advanced techniques, such as deep learning models, for building intelligent chatbots.

**CO5:** Develop a forward-thinking perspective, envisioning novel applications and anticipating to meet future challenges and opportunities.

**Board of Studies (BoS) :**

22<sup>nd</sup> BoS of CSE held on 17.08.2023

**Academic Council:**

21<sup>st</sup> AC held on 23.12.2023

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

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

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

Statement: By learning this course, the student may be able to automate certain tasks with the help of chatbots and providing efficient customer support, thereby helping businesses operate more effectively leading to economic growth.

<b>CSDX 527</b>	<b>SOFT COMPUTING TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SGB 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:** To understand the basic concepts of soft computing.

**COB2:** To gain knowledge on fuzzy logic and its applications.

**COB3:** To learn the fundamentals of operations of Genetic algorithm.

**COB4:** To familiarize with the Artificial neural network concepts and its applications.

**COB5:** To introduce advanced models in soft computing.

<b>MODULE I</b>	<b>INTRODUCTION TO SOFT COMPUTING</b>	<b>08</b>
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Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, Some applications of Soft computing techniques.

<b>MODULE II</b>	<b>FUZZY LOGIC</b>	<b>09</b>
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Introduction to Fuzzy logic, Fuzzy sets and membership functions, Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences, Defuzzification techniques, Some applications of Fuzzy logic.

<b>MODULE III</b>	<b>GENETIC ALGORITHMS</b>	<b>09</b>
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Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques, Basic GA framework and different GA architectures, GA operators: Encoding, Crossover, Selection, Mutation, etc. Solving single-objective optimization problems using GAs.

<b>MODULE IV</b>	<b>ARTIFICIAL NEURAL NETWORKS</b>	<b>09</b>
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Biological neurons and its working, Simulation of biological neurons to problem solving, Different ANNs architectures, Training techniques for ANNs, Applications of ANNs to solve some real-life problems.

<b>MODULE V</b>	<b>ADVANCED MODEL IN SOFT COMPUTING</b>	<b>10</b>
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Genetic Algorithm based Back propagation Network, Fuzzy Logic Controlled Genetic Algorithms, Neuro-fuzzy hybrid systems, Extreme Learning Machine (ELM), Extended ELM, Random Forest Algorithm.

**L – 45; TOTAL HOURS – 45****TEXT BOOKS:**

1. S.N. Sivanandam , S.N. Deepa, “Principles of Soft Computing”, Wiley India Pvt. Ltd., 2nd Edition, 2011. ISBN-13 : 978-8126510757
2. N. P. Padhy, S.P. Simon, “Soft Computing with MATLAB Programming”, Oxford University Press, 2015. ISBN-13 : 978-0199455423

**REFERENCE:**

1. S. Rajasekaran, G. A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications”, PHI Learning Pvt. Ltd., 2017. ISBN: 9788120321861

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Comprehend soft computing techniques and its applications.

**CO2:** Identify and select suitable Soft Computing technologies to solve the problems.

**CO3:** Analyze various neural network architectures.

**CO4:** Apply suitable soft computing techniques for various applications.

**CO5:** Design the hybrid system for solving the real-life problem.

**Board of Studies (BoS) :**

18<sup>th</sup> BoS of CSE held on 26.07.2021

**Academic Council:**

18 AC held on 24.02.2022

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

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

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

Statement: The students can have productive employment and decent work by learning the Soft Computing Technique course.

**CSDX 528****SEMANTIC WEB**

L	T	P	C
3	0	0	3

**SDG :4****COURSE OBJECTIVES:****COB1:** To understand the need of semantic web in web services.**COB2:** To learn the methods to discover, classify and build ontology for more reasonable results in searching.**COB3:** To familiarize with small ontology that is semantically descriptive of chosen problem domain.**COB4:** To learn query language to collect data and gain practical experience.**COB5:** To impart knowledge on applications, that can access use and manipulate the ontology.**MODULE I INTRODUCTION TO SEMANTIC WEB 09**

Historical overview of the World Wide Web and its limitations - Introduction to the vision and goals of the Semantic Web - Understanding the principles of Linked Data - RDF data model: subject – predicate - object triples - Introduction to RDF serialization formats - An overview of key Semantic Web standards.

**MODULE II RDF AND LINKED DATA 09**

Deep dive into RDF syntax and triple representation- RDF vocabularies and ontologies-Concepts of URIs and IRIs and their importance in the Semantic Web-Principles and best practices of publishing and consuming Linked Data-Metadata extraction and embedding -Case studies of successful Linked Data projects.

**MODULE III ONTOLOGIES AND KNOWLEDGE REPRESENTATION 09**

Introduction to ontologies and their role in knowledge representation - Overview of the OWL language and its features - Ontology modeling and development methodologies - Reasoning with ontologies and ontology languages - Ontology alignment and integration techniques - Ontology reuse and modularization strategies

**MODULE IV SEMANTIC WEB TECHNOLOGIES 09**

In-depth exploration of SPARQL query language-Querying RDF data using SPARQL: basic and advanced queries - Introduction to semantic web services and their architecture - Implementing and consuming semantic web APIs - Showcase of real-world semantic web applications and use cases -

Hands-on experience with semantic web development frameworks and tools.

## **MODULE V                      ADVANCED TOPICS IN SEMANTIC WEB                      09**

Linked Data principles and technologies for interlinking datasets - Social semantic web and collaborative ontology development -Integration of semantic web with existing technologies -Overview of emerging semantic web standards and initiatives - Open research areas and challenges in the Semantic Web domain - Discussion on the future directions and potential impact of the Semantic Web.

**L – 45; TOTAL HOURS – 45**

### **TEXT BOOKS:**

1. Hendler, James, Fabien Gandon, and Dean Allemang. Semantic web for the working ontologist: Effective modeling for linked data, RDFS, and OWL. Morgan & Claypool, 2020. ISBN-10 1450376142
2. Liyang Yu, "A Developer's Guide to the Semantic Web", Springer, First Edition, 2011. ISBN-13 978-366243795

### **REFERENCE:**

1. Hebel, John, et al. Semantic web programming. John Wiley & Sons, 2011. ISBN-13. 978-0470418017.

### **COURSES OUTCOMES :**

Students who complete this course will be able to

**CO1:** Recognize the evolution of the World Wide Web and its limitations.

**CO2:** Apply the principles of Linked Data, to represent and exchange structured data on the web.

**CO3:** Design ontologies using the OWL language, for knowledge representation and inference.

**CO4:** Utilize SPARQL query language to retrieve information from RDF data.

**CO5:** Evaluate real-world applications and case studies of the Semantic Web.

### **Board of Studies (BoS) :**

18<sup>th</sup> BoS of CSE held on 26.07.2021

### **Academic Council:**

18 Ac held on 24.02.2022



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

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

#### SDG 4: Quality Education

Statement: The students will be proficient in querying RDF data using SPARQL and will be able to evaluate real-world applications that leverage Semantic Web technologies

<b>CSDX 529</b>	<b>EMOTIONAL INTELLIGENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:** To learn the fundamental characteristics of emotions.

**COB2:** To familiarize with the fundamental principles of emotional competencies.

**COB3:** To acquire conflict management skills to resolve disputes effectively.

**COB4:** To explore the differences between the Ability Model, Trait Model, Genos Model, Mixed Model, and Performance Model of EI.

**COB5:** To acquire knowledge on various real time applications in emotional intelligence.

**MODULE I                      INTRODUCTION TO EMOTIONAL                      09**  
**INTELLIGENCE**

Introduction - Nature and characteristics of Emotion - Component and types of Emotions - Relationship between Emotions - Functions of Emotion – Emotional awareness.

**MODULE II                      COMPONENTS                      OF                      EMOTIONAL                      09**  
**COMPETENCIES**

Introduction – Fundamental of emotional competencies -EC model – Principles of emotional competencies – Emotional expressions – Self-awareness – Self regulations – Recognition of EI.

**MODULE III                      CONFLICT MANAGEMENT AND LEADERSHIP                      09**

Conflict Management - Co-operation and collaboration – Leadership - Interpersonal Management - Problem Solving - Stress Tolerance- Stress awareness.

**MODULE IV                      MODELS OF EMOTIONAL INTELLIGENCE                      09**

Introduction – Objective - Ability Model of EI – Trait Model of EI -Genos Model of EI -Mixed Model of EI – Performance Model of EI – Assessment tools based on performance of EI.

**MODULE V                      APPLICATIONS                      OF                      EMOTIONAL                      09**  
**INTELLIGENCE**

Introduction - Significance of Emotional Intelligence - Application of EI –

Fostering Emotional Intelligence – Mediating Variables-Social emotional learning framework-Hedonic wellbeing- Eudaimonic well-being – Conflict well-being.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOK:**

1. Daniel Goleman, “Emotional Intelligence, Why It Can Matter More Than IQ”, Bloomberry Publisher, ISBN-PB:978-0-7475-2982-8, 25<sup>th</sup> Edition, 2020.

**REFERENCES:**

1. Dr. Travisbradberry, Jean Greaves, Patrick M. Lencioni, “Emotional Intelligence 2.0”, Talent Smart, ISBN:978-0-9743206-2-5, 2<sup>nd</sup> Edition, 2009.
2. Liz Wilson, Stephen Neale & Lisa Spencer-Arnell, “Emotional Intelligence”, Kogan Page India Private Limited, ISBN: 074945458X, 9780749454586, 2012

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Identify the characteristics of Emotional intelligence models that are useful to solve real-world problems.

**CO2:** Implement the different methodologies to create the applications using emotional competencies.

**CO3:** Analyze the concept of conflict management and leadership.

**CO4:** Design and deploy the various assessment tools in EI.

**CO5:** Construct the various foster applications of EI and its mediating variable on well-being.

**Board of Studies (BoS) :**

18<sup>th</sup> BoS of CSE held on 26.07.2021

**Academic Council:**

18 Ac held on 24.02.2022

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

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

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

Statement: By learning emotional intelligence, students are able to acquire knowledge on creation of various skills for upliftment like leadership, conflict management, stress management.

<b>CSDX 530</b>	<b>DEEP LEARNING TECHNIQUES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To understand the theoretical foundations, algorithms and methodologies of Neural Network.

**COB2:** To provide the practical knowledge in handling and analyzing real world applications.

**COB3:** To learn the topics such as convolution neural networks, recurrent neural networks, training deep networks and high-level interfaces.

**COB4:** To familiarize with the fundamental concepts of artificial neural networks.

**COB5:** To study the complexity of deep learning algorithms and their limitations.

<b>MODULE I</b>	<b>INTRODUCTION TO DEEP LEARNING</b>	<b>09</b>
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Learning algorithms- Maximum likelihood estimation- Building machine learning algorithm- Neural Networks Multilayer Perceptron- Back-propagation algorithm and its variants Stochastic gradient decent- Curse of Dimensionality.

<b>MODULE II</b>	<b>DEEP LEARNING ARCHITECTURES</b>	<b>09</b>
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Machine Learning and Deep Learning- Representation Learning- Width and Depth of Neural Networks- Activation Functions: RELU- LRELU- ERELU- Unsupervised Training of Neural Networks -Restricted Boltzmann Machines- Auto Encoders- Deep Learning Applications.

<b>MODULE III</b>	<b>DEEP LEARNING NETWORKS</b>	<b>09</b>
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Introduction – Historical context of Deep Learning – Classes of Deep Learning Network – Deep Networks for Unsupervised learning – Deep Networks for Supervised learning – Hybrid Deep Networks.

<b>MODULE IV</b>	<b>CNN ARCHITECTURE &amp; SEQUENCE MODELLING</b>	<b>09</b>
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Architectural Overview-Motivation - Layers- Filters- Parameter sharing-Regularization, Popular CNN Architectures: ResNet- AlexNet – Applications. Recurrent Neural Networks- Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN- Long Short Term Memory Networks - Deep Belief networks- Boltzmann

Machines, Deep Boltzmann Machine, Generative Adversarial Networks.

## **MODULE V PRACTICAL METHODOLOGY AND 09 APPLICATION**

Cross Validation, Feature Selection, Regularization - Baseline Models - Selecting Hyper parameters - Debugging Strategies - Example: Multi-Digit Number Recognition – Applications - Computer Vision, Speech Recognition and Natural Language Processing – Other Applications.

**L – 45; TOTAL HOURS – 45**

### **TEXT BOOK:**

1. Michelucci, Umberto, "Advanced Applied Deep Learning: Convolutional Neural Networks and Object Detection", Apress, First Edition, ISBN: 9781484249765, 1484249763, 2019.

### **REFERENCES:**

1. Gibson, A., Patterson, J. "Deep Learning: A Practitioner's Approach. Taiwan: O'Reilly Media", First Edition, ISBN: 9781491914236, 1491914238, 2017.
2. YuxiLiu, Saransh Mehta, "Hands on Deep learning Architectures with Python", Packt Publishing Ltd, First Edition, ISBN: 9781788998086, 2019.
3. Bert Moons, Daniel Bankman, Marian Verhelst, "Embedded Deep Learning", Springer, First Edition, ISBN: 9783319992228, 2019.

### **COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Identify the characteristics of deep learning models that are useful to solve real-world problems.

**CO2:** Implement the different methodologies to create the applications using deep nets.

**CO3:** Analyze the concept of Deep Learning networks.

**CO4:** Design and deploy the CNN architectures.

**CO5:** Construct the complete speech reorganization system.

### **Board of Studies (BoS) :**

19th BOS of CSE held on 28.12.2021

### **Academic Council:**

18th AC held on 24.02.2022

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

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

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

Statement:

By learning “Deep Learning Algorithm And Architectures”, the students are able to develop deep learning models and apply them to real world complex problems which in turn lead to economic growth and productive employment and decent work.

**CSDX 531****COGNITIVE ANALYTICS****L T P C****SDG: 9****3 0 0 3****COURSE OBJECTIVES:****COB1:** To familiarize with the foundations of cognitive analytics.**COB2:** To understand the components of a cognitive system.**COB3:** To provide techniques for building a cognitive application.**COB4:** To provide the underlying advanced analytics that support the development of a cognitive system.**COB5:** To gain knowledge on building a cognitive application.**MODULE I THE FOUNDATION OF COGNITIVE ANALYTICS 09**

Introduction – Uses of Cognitive Systems- Gaining Insights from Data – Artificial Intelligence as the Foundation of Cognitive Computing – Elements of a Cognitive System – Understanding Cognition.

**MODULE II DESIGN PRINCIPLES FOR COGNITIVE SYSTEMS 09**

Components of a Cognitive System – Building the Corpus – Bringing Data into the Cognitive System – Machine Learning – Hypotheses Generation and Scoring – Presentation and Visualization Services.

**MODULE III NATURAL LANGUAGE PROCESSING IN SUPPORT OF A COGNITIVE SYSTEM 09**

The Role of NLP in a Cognitive System - Semantic Web – Applying Natural Language Technologies to Business Problems – Big Data and Cognitive Computing.

**MODULE IV APPLYING ADVANCED ANALYTICS TO COGNITIVE COMPUTING 09**

Key Capabilities in Advanced Analytics – Using Advanced Analytics to Create Value – Impact of Open Source Tools on Advanced Analytics – Watson a Cognitive System- Preparing Watson for Commercial Applications - The Components of DeepQA Architecture.

**MODULE V THE PROCESS OF BUILDING A COGNITIVE APPLICATION 09**

The Emerging Cognitive Platform –Defining the Objective- Defining the



Domain- Understanding the Intended Users and Defining their Attributes- Defining Questions and Exploring Insights-Creating and Refining the Corpora-Training and Testing.

**L –45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. High Rob,” Cognitive Computing with IBM Watson”, Packt Publishing Limited, ISBN-9781788478298, 1788478290, 2019.
2. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles, “Cognitive Computing and Big Data Analytics”, Wiley, ISBN-9781118896624, 2015.

**REFERENCES:**

- 1 Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles , “Cognitive Computing and Big Data Analytics”, McGraw Hill Education, Wiley ,1st edition, ISBN-10 : 9781118896624, 2015.
- 2 Chiranjil Lal Chowdhary , Mahasweta Sarkar , Sanjaya Kumar Panda, “Cognitive Computing Using Green Technologies: Modeling Techniques and Applications”, CRC Press, ISBN-10: 0367487969, 2021.

**COURSE OUTCOMES:**

Students who complete this course will be able to

**CO1:** Interpret the distinguishing features of a cognitive computing system and how they work.

**CO2:**Apply the design principles for cognitive computing.

**CO3:** Comprehend the use of Natural Language Processing in cognitive computing.

**CO4:** Analyze the key components of advanced analytics.

**CO5:** Apply techniques for building a cognitive application.

**Board of Studies (BoS) :**

19th BOS of CSE held on  
28.12.2021

**Academic Council:**

18th AC held on 24.02.2022

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

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

SDG 9: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: By learning this course, the students will be able to analyse the problem and build cognitive computing system which promote sustainable economic growth and productive employment.

<b>CSDX 532</b>	<b>PREDICTIVE ANALYTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To comprehend the idea of data cleansing.

**COB2:** To gain knowledge on various predictive models.

**COB3:** To learn the importance of classification and regression techniques.

**COB4:** To explore the various analytical models.

**COB5:** To provide knowledge on persuasion by the numbers.

**MODULE I DATA CLEANSING 09**

Data Mining Process – KDD Process Model – Challenges – Sampling – Data processing – Segmentation – Outlier detection

**MODULE II PREDICTIVE MODELS 09**

Model Development Techniques – Clustering Models – Rule set Models –K Nearest Neighbors – Decision trees – Neural Network Model – Regression Models – Regression Trees – Classification & Regression Trees (CART) – Logistic Regression – Multiple Linear Regression Scorecards – Support Vector Machines

**MODULE III MODEL EVALUATION 09**

Rule Induction – Using CHAID – Automating Models for Categorical and Continuous targets – Model Validation and Comparison – Meta-level Modeling – Deploying Model – Assessing Model Performance – Updating a Model.

**MODULE IV ENSEMBLE EFFECT 09**

crowd sourcing – Super charging- Netflix Case study

**MODULE V PERSUASION BY THE NUMBERS 09**

Telner- U.S Bank-Obama Campaign- Engineered Influence – Case Studies

**L –45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. Han, J., Kamber, M., & Pei, J., "Data mining concepts and techniques", 3<sup>rd</sup> edition. The Morgan Kaufmann Series in Data Management Systems, 5(4), 83– 124. ISBN: 978-9380931913,

2011.

### REFERENCES:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning– Data Mining, Inference, and Prediction", 2<sup>nd</sup> Edition, Springer Verlag. ISBN: 978-0387848570, 2009.
2. Ian H. Witten, Eibe Frank, "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann Series in Data Management Systems, Morgan Kaufmann, 3<sup>rd</sup> Edition. ISBN: 978-0123748560, 2011.

### COURSE OUTCOMES:

Students who complete this course will be able to

**CO1:** Comprehend the fundamental concepts of data analytics.

**CO2:** Recognize and apply appropriate regression techniques.

**CO3:** Enhance the performance of the models and improve the outcomes.

**CO4:** Analyze ensemble effect through case studies.

**CO5:** Assess persuasion by numbers through case studies.

### Board of Studies (BoS) :

19th BOS of CSE held on 28.12.2021

### Academic Council:

18th AC held on 24.02.2022

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

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

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

Statement:

This course can help students to build the predictive analytics skills that leads to sustainable economic growth, full and productive employment.

<b>CSDX 533</b>	<b>TIME SERIES ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES :**

**COB1:** To learn the fundamental concepts needed to characterize time series.

**COB2:** To acquire knowledge on the basic ideas of stationarity, non stationarity and autocorrelation function of time series processes.

**COB3:** To familiarize with the concept in Bayesian statistics.

**COB4:** To explore seasonal ARIMA models to handle seasonal patterns effectively.

**COB5:** To impart knowledge in analyzing cross-correlation functions.

### **MODULE I FUNDAMENTAL CONCEPTS 09**

Stochastic processes – autocovariance and autocorrelation functions – Partial autocorrelation function – Estimation of the mean, autocovariances and autocorrelations – Linear difference equations.

### **MODULE II STATIONARY AND NON STATIONARY TIME SERIES MODELS 09**

Autoregressive processes – Moving average processes - auto regressive moving average processes - Nonstationarity in the mean – ARIMA- Non stationarity in the variance and autocovariance.

### **MODULE III STOCHASTIC MODEL IDENTIFICATION AND PARAMETER ESTIMATION 09**

Objectives of identification – Identification techniques – Estimates of the parameters - Model multiplicity – Study of likelihood and sum of squares functions – Nonlinear estimation – Estimation using Bayes theorem.

### **MODULE IV ANALYSIS OF SEASONAL TIME SERIES 09**

Parsimonious Models For Seasonal Time Series - Representation Of The Airline Data - Some Aspects Of More General Seasonal Arima Models - Structural Component Models And Deterministic Seasonal Components - Regression Models With Time Series Error Terms.

### **MODULE V TRANSFER FUNCTION MODELS 09**

Single input transfer function models – Cross Correlation function – Construction of Transfer function models – Forecasting using transfer

function models – Bivariate frequency domain analysis – Cross spectrum.

**L – 45; TOTAL HOURS – 45**

**TEXT BOOKS:**

1. George E.P.Box, Gwilym M.Jenkins, Gregory C.Reinsel, Greta M.:Liung, "Time Series Analysis", Forecasting and Control, Fifth edition, John Wiley & Sons, 2016.
2. Paul S.P.Cowpertwait, Andrew V.Meltcalfe, "Introductory Time Series with R", Springer, 2009.

**REFERENCES:**

1. Peter J.Brockwell, Richard A.Davis, "Introduction to Time Series and Forecasting", Second Edition, Springer. 2002.
2. Chris Chatfield," The Analysis of Time Series an Introduction" Fifth edition, Chapman & Hall/ CRC.
3. James D.Hamilton, "Time Series Analysis", Princeton University Press, UK. 1994.
4. William W.S.Wei, "Time Series Analysis", Univariate and Multivariate Methods, Second edition, Pearson Education. 2006

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Explain the fundamental concepts needed to characterize time series.

**CO2:** Comprehend the importance of stationary and non-stationary time series models.

**CO3:** Apply the stochastic model identification and parameter estimation.

**CO4:** Develop a strong understanding of seasonal time series data and its characteristics.

**CO5:** Interpret the cross spectrum effectively in the transfer function model.

**Board of Studies (BoS) :**

22<sup>nd</sup> BoS of CSE held on 17.08.2023

**Academic Council**

21<sup>st</sup> AC held on 23.12.2023

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

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

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

Statement: This course empowers learners with the tools they need to become proficient time series analysts and data-driven decision-makers.

<b>CSDX 534</b>	<b>DATA SCIENCE AND BIOINFORMATICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:** To learn data operation and toolboxes for data acquisition.

**COB2:** To familiarize with data processing procedures and hypothesis testing.

**COB3:** To acquire basic knowledge on machine learning.

**COB4:** To explore various biological data and its annotated sequence databases.

**COB5:** To utilize genome annotation and gene prediction for real-life scenarios.

<b>MODULE I</b>	<b>DATA ACQUISITION</b>	<b>09</b>
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Introduction, Toolboxes: Python, fundamental libraries for data scientists. Integrated Development Environment(IDE). Data operations: reading, selecting, filtering, manipulation, sorting, grouping, rearranging, ranking and plotting.

<b>MODULE II</b>	<b>DATA PROCESSING</b>	<b>09</b>
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Descriptive statistics, data preparation. Exploratory data analysis, data summarization, data distribution, measuring asymmetry. Sample and estimated mean, variance and standard score. Statistical inference frequency approach, variability of estimates, hypothesis testing using confidence intervals, using p values.

<b>MODULE III</b>	<b>MACHINE LEARNING</b>	<b>09</b>
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Supervised learning: First step, learning curves, training-validation and test. Learning models generalities, support vector machines, random forest. Examples.

<b>MODULE IV</b>	<b>BIOLOGICAL DATA AND DATABASES</b>	<b>09</b>
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The form of biological information. Retrieval methods for DNA sequence, protein sequence and protein structure information. Format and Annotation – Annotated sequence databases.



**MODULE V APPLICATIONS****09**

Genome Annotation and Gene Prediction, ORF finding, Phylogenetic Analysis: Comparative genomics, orthologs, paralogs. Genome analysis – Genome annotation.

**L – 45; TOTAL HOURS – 45****TEXTBOOKS:**

1. Laura Igual, Santi Segui, "Introduction to Data Science a Python approach to concepts, Techniques and Application", Springer International Publication, 2017, ISBN:978-3-319-50017-1.
2. David Taieb, "Data Analysis with Python A Modern Approach", Packt Publication, 2018 ISBN-9781789950069
3. Arthur M. Lesk, "Introduction to Bioinformatics", Oxford University Press, Fifth Edition, 2019, ISBN: 978-0-19-879414-1.

**REFERENCES:**

1. Armando Fandango, "Python Data Analysis", Second Edition, Packt Publication, 2017, ISBN: 978-1-78712-748-7.
2. Dan Gusfield, "Algorithms on Strings, Trees and Sequences", Cambridge University Press, 1997, ISBN: 978-0-521-58519-4
3. Richard Durbin, sean R. Eddy, Anders Krogh, Graeme Mitchison, "Biological Sequence Analysis Probabilistic Models of proteins and nucleic Acids", Cambridge University Press, 1998, ISBN: 9781139457392.
4. David W. Mount, "Bioinformatics Sequence and Genome Analysis", Cold Spring Harbor Laboratory Press, Second Edition, 2004, ISBN: 0-87969-687-7.

**COURSE OUTCOMES :**

Students who complete this course will be able to:

- CO1:** Describe Data Science and its skill sets needed for data acquisition.
- CO2:** Illustrates exploratory data analysis and hypothesis testing using confidence intervals for data processing.
- CO3:** Realize the basics of supervised learning and support vector machines.
- CO4:** Assess biological data sequence and its annotated databases.
- CO5:** Develops Phylogenetic Analysis and Genome annotations for real time applications.

**Board of Studies (BoS) :**18<sup>th</sup> BoS of CSE held on 26.07.2021**Academic Council:**

18 Ac held on 24.02.2022

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

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

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

**Statement:** The students can have productive employment and decent work by learning Bioinformatics based Data Sciences.

<b>CSDX 535</b>	<b>MALWARE ANALYSIS IN DATA SCIENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:** To understand the fundamentals of malware.

**COB2:** To study the protected static and dynamic malware analysis environment.

**COB3:** To learn various malware behavior monitoring tools.

**COB4:** To comprehend the role of machine learning in cyber security.

**COB5:** To gain knowledge on the concepts of big data analytics in malware analysis.

<b>MODULE I</b>	<b>INTRODUCTION</b>	<b>9</b>
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Introduction to malware – OS security concepts – malware threats – evolution of malware – malware types - viruses – worms – rootkits – Trojans – Bot spyware – adware – logic bombs – malware analysis – static malware analysis – dynamic malware analysis.

<b>MODULE II</b>	<b>STATIC AND DYNAMIC ANALYSIS</b>	<b>9</b>
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X86 Architecture – Main Memory – Instructions – Opcodes and Endianness – Operands –Registers – Simple Instructions – The Stack – Conditionals –Branching – Rep Instructions –Antivirus Scanning – Fingerprint for Malware - Live and dead malware analysis – analyzing traces of malware – system calls – api-calls – registries– network activities. Anti-dynamic analysis techniques – runtime-evasion techniques – Malware Sandbox.

<b>MODULE III</b>	<b>MALWARE FUNCTIONALITY</b>	<b>9</b>
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Downloader – Backdoors – Credential Stealers – Persistence Mechanisms –Privilege Escalation – Covert malware launching – Launchers – Process Injection – Process Replacement – Hook Injection – Detours – APC injection.

<b>MODULE IV</b>	<b>MACHINE LEARNING IN MALWARE DETECTION</b>	<b>9</b>
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Overview – Feature extraction for malware analysis – Data preprocessing techniques – Supervised - Unsupervised learning approaches to detect malware – Evaluation metrics for machine learning models – Case studies on malware classification.

**MODULE V BIG DATA ANALYTICS FOR MALWARE INVESTIGATION 9**

Introduction – Handling large-scale malware datasets – Distributed computing frameworks for malware analysis – visualization techniques for malware behavior analysis – Real-time analytics for proactive threat detection – Case studies – Ethical considerations.

**L – 45; TOTAL HOURS – 45**

**REFERENCES:**

1. Dylan Barker “Malware Analysis Techniques”, Packt Publishing, ISBN: 978-1839212277, 2021.
2. Clarence Chio, David Freeman, “Machine Learning and Security”, O'Reilly Media, Inc. ISBN: 9781491979907, 2018.
3. Joel Grus, “Data Science from Scratch: First Principles with Python”, O'Reilly Media, 1st Edition, ISBN: 9781491901427, 2015.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Demonstrate a comprehensive understanding of malware fundamentals.

**CO2:** Analyze the malware threats to evade detection in run time environments

**CO3:** Examine the executable formats, Windows internals and API, and analysis techniques.

**CO4:** Perform data preprocessing, modeling and validation.

**CO5:** Apply real-time analytics for proactive threat detection.

**Board of Studies (BoS) :**

23<sup>rd</sup>BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

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

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

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

**Statement:** This course aligns with SDG 9 by fostering innovation in cyber security, equipping students with skills in advanced malware analysis techniques, machine learning, and big data analytics to contribute to the development of resilient and secure digital infrastructure.

<b>CSDX 536</b>	<b>IMAGE AND VIDEO ANALYTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES :**

**COB1:** To understand the basics of image processing techniques for computer vision.

**COB2:** To learn the techniques used for image pre-processing.

**COB3:** To acquire the knowledge about various object detection techniques.

**COB4:** To understand the various Object recognition mechanisms.

**COB5:** To elaborate on the video analytics techniques.

<b>MODULE I</b>	<b>INTRODUCTION</b>	<b>9</b>
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Computer Vision – Image representation and image analysis tasks – Image representations -digitization – properties – color images – Data structures for Image Analysis – Levels of image data representation – Traditional and Hierarchical image data structures.

<b>MODULE II</b>	<b>IMAGE PRE-PROCESSING</b>	<b>9</b>
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Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative- Scale in image processing - Canny edge detection -Parametric edge models -Local pre-processing in the frequency domain - Line detection by local pre- processing operators - Image restoration

<b>MODULE III</b>	<b>OBJECT DETECTION USING MACHINE LEARNING</b>	<b>9</b>
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Object detection- Object detection methods – Deep Learning framework for Object detection bounding box approach-Intersection over Union (IoU) -Deep Learning Architectures-R-CNN-Faster R-CNN-You Only Look Once(YOLO)-Salient features-Loss Functions-YOLO architectures

<b>MODULE IV</b>	<b>FACE RECOGNITION AND GESTURE RECOGNITION</b>	<b>9</b>
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Face Recognition-Introduction-Applications of Face Recognition-Process of FaceRecognition-Deep Face solution by Facebook-FaceNet for Face Recognition-Implementation using FaceNet-Gesture Recognition.

<b>MODULE V</b>	<b>VIDEO ANALYTICS</b>	<b>9</b>
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Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem-ResNet architecture-ResNet and skip connections-Inception Network-GoogleNet architecture Improvement in Inception v2-Video analytics-ResNet and Inception v3

**L – 45; TOTAL HOURS – 45****REFERENCES:**

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis, and Machine Vision, 4th edition, Thomson Learning, 2013.
2. VaibhavVerdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021.
3. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer VerlagLondon Limited,2011.

**OUTCOMES :**

Students who complete this course will be able to

**CO1:**Describe the basics of image processing techniques for computer vision and video analysis.

**CO2 :**Analyze the techniques used for image pre-processing

**CO3 :**Implement the object detection techniques using machine learning models.

**CO4:** Apply the various face recognition mechanisms.

**CO5:** Develop real time applications based on deep learning-based video analytics.

**Board of Studies (BoS) :**

23<sup>rd</sup>BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
<b>CO1</b>	H	M	L						L	L			H	
<b>CO2</b>	M	H	M	L						L			M	
<b>CO3</b>	M	M	H	M	H				M				H	H
<b>CO4</b>	H		M						M				L	H
<b>CO5</b>	H	M	H	H	M				H	L	H	H		H

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

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

**Statement:** The students can have productive employment and decent work by learning the Image Processing and Video Analytics course.

<b>CSDX 537</b>	<b>BAYESIAN DATA ANALYSIS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**SDG: 9**

**COURSE OBJECTIVES:**

**COB1:** To understand the principles and applications of Bayesian inference.

**COB2:** To learn Bayesian data analysis, theoretical foundations and practical applications.

**COB3:** To study advanced computational techniques and regression models used in data analysis and predictive modeling

**COB4:** To gain knowledge on nonlinear and nonparametric modeling techniques for analyzing complex relationships in data.

**COB5:** To acquire practical experience in applying theoretical concepts.

**MODULE I FUNDAMENTALS OF BAYESIAN INFERENCE 9**

Basics of Bayesian paradigm with some examples - A brief review of probability theory - Bayes' theorem and its implications- Introduction to Bayesian inference – Single parameter models – Introduction to multiparameter models – Asymptotics and connections to non- Bayesian approaches – Hierarchical models.

**MODULE II FUNDAMENTALS OF BAYESIAN DATA ANALYSIS 9**

Summarizing posterior - Conjugate priors - Objective Bayes - Bayesian computing- Diagnosing and improving convergence - Bayesian linear models - Model checking – Evaluating, comparing and expanding models – Modeling accounting for data collection – Decision analysis.

**MODULE III ADVANCED COMPUTATION & REGRESSION MODELS 9**

Introduction to Bayesian computation – Basics of Markov chain simulation - computationally efficient Markov chain simulation – Modal and distributional approximations. Introduction to regression model – hierarchical linear model – generalized linear models – models for robust inference – models for missing data.



**MODULE IV NON LINEAR AND NON PARAMETRIC MODELS 9**

Bayesian model comparisons - Bayesian Information Criterion (BIC) - Deviance Information Criterion (DIC) - Bayes factors - cross validation - Posterior Predictive Checks (PPC) - Parametric nonlinear models - Polynomial – Basic function model – Gaussian process model – finite mixture models – - Bayesian Neural Networks - Dirichlet process model - model evaluation and selection.

**MODULE V APPLICATIONS AND CASE STUDY 9**

Features approaches in a wide area of application – health- the environment- genetics- information science- medicine- biology- industry and remote sensing - Case studies in Bayesian statistical modeling and analysis using real world problems.

**L – 45 ; TOTAL HOURS – 45**

**REFERENCES:**

1. Brian J. Reich, Sujit K. Ghosh, "Bayesian Statistical Methods" Chapman and Hall/CRC, 2019.
2. Jean-Michel Marin and Christian P. Robert, Bayesian Essentials with R 2014, Springer.
3. Andrew Gelman, John Carlin, Hal Stern, David Dunson, Aki Vehtari, and Donald Rubin, Bayesian Data Analysis, Chapman and Hall/CRC., 2013
4. Peter D. Hoff, A First Course in Bayesian Statistical Methods Springer, 2009.
5. K. Ghosh, Mohan Delampady, Tapas Samanta, "An Introduction to Bayesian Analysis", Springer 2006.

**COURSE OUTCOMES:**

**CO1:** Develop the skills necessary to formulate and analyze Bayesian models.

**CO2:** Implement the Bayesian techniques to analyze complex datasets and quantify the uncertainty.

**CO3:** Evaluate model performance; diagnose potential issues, decisions to improve model accuracy.

**CO4:** Apply the variety of nonparametric methods to intricate data patterns effectively.

**CO5:** Analyze complex problems in different industries and disciplines.

**Board of Studies (BoS) :**

23<sup>rd</sup> BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

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

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

**SDG 9:** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

**Statement:** The students can have productive employment by mastering the feature engineering techniques and applying them to design, and create dynamic, efficient features for machine learning application.

<b>CSDX 538</b>	<b>FEATURE ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 9</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES :**

**COB1:**To learn the unique features from the dataset in order to build powerful machine learning systems.

**COB2:**To get familiar with different feature analysis techniques.

**COB3:**To acquire knowledge of handling categorical features through imputation and encoding.

**COB4:**To understand the importance of feature selection when building a machine learning model.

**COB5:**To comprehend data in-depth and derive powerful data insights to build machine learning models.

**MODULE I INTRODUCTION TO FEATURE ENGINEERING 9**

Importance of feature engineering--Feature Types-Feature engineering procedures-Handling Missing data-Normalization and Scaling-Reducing Dimensionality-Feature Engineering Automation-Bio Inspired Optimization Algorithms-Evaluation Metrics- Feature Engineering Tools

**MODULE II FEATURE REPRESENTATION 9**

Scalars, Vectors and spaces- Dealing with Counts -Binarization-Quantization or Binning- Log Transformation- Feature Scaling or Normalization- Min-Max Scaling, Standardization (Variance Scaling)-Normalization- interaction Features- Deep Learning For Feature Representation

**MODULE III TEXT AND CATEGORICAL FEATURES 9**

Bag-of- X: Turning Natural Text into Flat Vectors- Filtering for cleaner Features- Atoms of Meaning: From words to n-Grams to Phrases- TF-Idf: A simple twist on Bag-of-words- Deep Dive- Encoding Categorical Variables- Dealing with Large Categorical Variables.

**MODULE IV FEATURE ENGINEERING TECHNIQUES 9**

Feature Selection and Evaluation- Search Based and Correlation Based Feature Selection Frameworks -Stable Feature Selection-Online Feature Selection-Distributed Feature Selection-Multi Source - MultiView and Multi Label Feature Selection-Privacy Preserving Feature selection-Filter vs Wrapper vs Embedded methods for feature selection

**MODULE V CASE STUDIES****9**

Healthcare diagnosis-Social Media Analysis-Computer Vision: Object Recognition  
 -Time series Analysis- Social Bot Detection- Online Bot Detection Frameworks-  
 Feature Generation and Engineering for Software Analysis-Features for Defect  
 Prediction-Features for Crash Release Prediction for Apps- Feature Engineering  
 for Twitter Based Applications

**L – 45; TOTAL HOURS – 45****REFERENCES:**

1. Guozhu Dong, Huan Liu, "Feature Engineering for Machine Learning and Data Analytics" 1st Edition, Taylor & Francis, ISBN 9780367571856, 0367571854, 2020
2. SinanOzdemir, "Feature Engineering Bookcamp", Manning Publishing,ISBN 9781638351405,2022
3. Pablo Duboue, "The Art of Feature Engineering Essentials for Machine Learning", ISBN:9781108709385,Cambridge University Press,2020

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Apply feature selection techniques in practice and evaluate performance.

**CO2:** Analyze the feature representation techniques to select the best when building a machine learning model.

**CO3:** Transform categorical variables into numbers while capturing meaningful information.

**CO4:**Design efficient features for real time machine learning applications.

**CO5:**Develop their skill set to preprocess data and build more powerful machine learning models.

**Board of Studies (BoS) :**

23rd BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

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

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

**SDG 9:** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

**Statement:** The students can have productive employment by mastering the feature engineering techniques and applying them to design, and create dynamic, efficient features for machine learning application.

<b>CSDX 539</b>	<b>DISTRIBUTED COMPUTING FOR ARTIFICIAL INTELLIGENCE AND DATA SCIENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG</b>	<b>9</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To understand the principles of distributed computing and their relevance to AI and data science..

**COB2:** To explore the high-performance computing architectures of distributed computing systems.

**COB3:** To learn techniques for optimizing AI algorithms in distributed systems

**COB4:** To understand distributed data visualization and exploration.

**COB5:** To gain experience in applying distributed computing tools to solve real-world AI and Data Science problems.

**MODULE I INTRODUCTION TO DISTRIBUTED COMPUTING 9**

Introduction- Challenges of distributed computing and its importance in AI and data science - Limitations of Single-Machine Processing - Benefits of Distributed Computing: Scalability, Fault Tolerance - Types of Distributed Systems: Cluster Computing, Cloud Computing

**MODULE II DISTRIBUTED SYSTEM ARCHITECTURES 9**

High-Performance Computing (HPC) Clusters -Key Properties of HPC Architectures – Parallel Architecture Families(Flynn's Taxonomy)- Enabling Technology – Vector and Pipelining- Master-Slave Architecture - MapReduce Paradigm -Distributed File Systems (HDFS) -Message Passing Interface (MPI).

**MODULE III OPTIMIZATION TECHNIQUES IN DISTRIBUTED AI 9**

Parallelization and distributed optimization algorithms - Model compression and quantization for distributed deployment -Dynamic resource allocation and load balancing - Distributed AI for large-scale data analytics - AI-driven decision-making in distributed systems.

**MODULE IV DISTRIBUTED DATA SCIENCE 9**

Scalable data preprocessing and feature engineering - Distributed data visualization and exploration- Distributed analytics and querying (e.g., Spark SQL, Presto) - Apache Kafka - and Apache Flink Real-time data processing with distributed streaming frameworks.

## MODULE V APPLICATIONS OF DISTRIBUTED COMPUTING IN AI AND DATA SCIENCE 9

Applications of Data Science- Technologies for visualization- Bokeh (Python), recent trends in various datacollection and analysis techniques- various visualization techniques-application development methods ofused in data science.

**L – 45; TOTAL HOURS – 45**

### COURSE OUTCOMES:

Students who complete this course will be able to

CO1: Describe the functionalities and challenges of distributed systems.

CO2: Design and implement efficient distributed algorithms for solving computational problems.

CO3: Apply how to optimize AI algorithms for resource-constrained distributed environments.

CO4: Implement distributed computing frameworks and technologies to solve real-world problems.

CO5: Develop critical thinking skills in the context of distributed computing.

### Board of Studies (BoS) :

23rd BoS of CSE held on 09.05.2024

### Academic Council:

22<sup>nd</sup> AC held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	M		M		M		L	M				M	
CO2	H	M	M	M		L	L		M				M	L
CO3		M		H							L		H	
CO4		H				M			M	L				M
CO5	M	M	H	M	H			L	L	L			L	H

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

**SDG 9:** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

Statement: The students can have productive employment by mastering the feature engineering techniques and applying them to design, and create dynamic, efficient features for machine learning application.

<b>CSDX 540</b>	<b>SECURE DATA SCIENCE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG 8</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

**COB1:** To understand fundamental security concepts and their relevance to data science.

**COB2:** To provide students with a comprehensive understanding of data mining techniques and their application in cybersecurity and privacy.

**COB3:** To learn the stream analytics techniques and their application in real-time malware detection.

**COB4:** To familiarize with the concepts of adversarial machine learning and its relevance to cybersecurity.

**COB5:** To understand the various access control methods and models.

### **MODULE I DATA SCIENCE AND SECURITY 9**

Supporting technologies for secure data science-Security concepts - Security and privacy enhanced Data Science-Data Privacy Regulations-Secure data handling practices-Emerging applications of Secure Data Science-Common security threats in data science projects-Case studies.

### **MODULE II DATA MINING AND SECURITY 9**

Data Mining Techniques-Data Mining, Cyber Security and Privacy-Secure data mining in cloud environments-Issues in Big Data Security and Privacy- Design of the Data Mining Tool -Data Mining Applications in Security.

### **MODULE III DATA SCIENCE FOR CYBER SECURITY 9**

Overview of data science and its applications in cybersecurity-Role of data science in cybersecurity threat detection and prevention-Malicious Executables-Stream Analytics for Malware detection-Exploratory data analysis techniques for cybersecurity datasets

### **MODULE IV SECURITY AND PRIVACY ENHANCED DATA SCIENCE 9**

Adversarial Support Vector Machine Learning- Adversarial Attack Models-Adversarial Learning Using Relevance Vector Machine - Privacy Preserving Decision Trees-Techniques for privacy-preserving data analysis-privacy and its applications



**MODULE V ACCESS CONTROL AND DATA SCIENCE 9**

Secure Cloud Query Processing Based on Access Controls-Access Control Models - Access Control-Based Assured Information Sharing -Ethical considerations in access control and data science.

**L – 45; TOTAL HOURS – 45**

**REFERENCES:**

1. Secure Data Science Integrating Cyber Security and Data Science, Bhavani Thuraisingham; Murat Kantarcioglu; LatifurKhan,CRC Press,2021, First Edition,ISBN-9780367534103
2. Cybersecurity Data Science: Best Practices in an Emerging Profession, Scott Mongeau, AndrzejHajdasinski, Springer Nature 2021, ISBN -9783030748968.
3. Data Science For Cyber-security,Nicholas A Heard, Niall M Adams, Patrick Rubin-Delanchy, MellisaTurcotte,World Scientific Publishing,2018,ISBN – 9781786345653.

**COURSE OUTCOMES :**

Students who complete this course will be able to

**CO1:** Implement secure data handling practices to protect sensitive data in real world applications.

**CO2:** Apply appropriate data mining technique to secure data in the cloud.

**CO3:** Perform exploratory data analysis on cybersecurity datasets to identify patterns and anomalies.

**CO4:**Summarize the different techniques for privacy preserving data analysis and adversarial learning.

**CO5:**Evaluate access control solutions and select appropriate mechanisms based on security and privacy requirements.

**Board of Studies (BoS) :**

23<sup>rd</sup>BoS of CSE held on 09.05.2024

**Academic Council:**

22<sup>nd</sup> AC held on 04.09.2024

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	H	M	M	M	M			M	M			H	M
CO2	H	H	H	H		M	L		M				H	M
CO3	H	H	H		M	M	L		H				H	M
CO4	H	H	H	H		M			M				H	M
CO5	H		H	H	M	H	M	L	M	L	L	H	H	H

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

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

**Statement:** The students can have productive employment and decent work by learning the Image Processing and Video Analytics course.

**PHYSICS ELECTIVE**

<b>PHDX 01</b>	<b>NON DESTRUCTIVE TESTING OF</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>	<b>MATERIALS</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To understand the importance, principle, concept and inspection methods of various surface NDT methods and develop the skills of interpretation of results effectively.

**COB2:** To study the working and instrumentation of thermography and eddy current testing methods and apply to interpret the results and investigate the possible defects.

**COB3:** To get full exposure about principle, instrumentation and standards of various radiographic NDT methods and improve the skill to identify the defects suitably.

**COB4:** To get deep insight into the principle, types of waves, instrumentation, standards, and calibration methods of ultrasonic NDT methods.

**COB5:** To understand the importance, principle, concept and inspection methods of various surface NDT methods and develop the skills of interpretation of results effectively.

**MODULE I      SURFACE NDT METHODS      7**

Liquid Penetrant Inspection – Principles, Types of dye and methods of application, developers, advantages and limitations of various methods, Interpretation of results. Magnetic Particle Inspection- Magnetic particle testing, Basic theory of magnetism, Magnetization methods, Interpretation of field indicators, Particle application, Inspection, Residual magnetism Principles and methods of demagnetization.

**MODULE II      THERMOGRAPHY AND EDDY CURRENT TESTING      7**

Thermography- Principles, Contact and non contact inspection methods, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Applications, advantages, Limitations, Interpretation/Evaluation.

**MODULE III      RADIOGRAPHY      8**

Principle, interaction of X-Ray with matter, imaging, film and film less

techniques, types and use of filters and screens, geometric factors, Inverse square law, characteristics of films -graininess, density, speed, contrast, characteristic curves. Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Digital Radiography.

#### **MODULE IV      ULTRASONIC TESTING**

**8**

Ultrasonic Testing: Basic principles of sound propagation, types of sound waves, Principle of UT, methods of UT, their advantages and limitations, Piezoelectric Material, Various types of transducers/probe, Calibration methods, use of standard blocks, technique for normal beam inspection.

**L – 30; Total Hours –30**

#### **TEXT BOOKS:**

1. ASM Metals Handbook, Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 200, 2018.
2. Baldev Raj, T.Jayakumar, M.Thavasimuthu Practical Non-Destructive Testing, Narosa Publishing House, 2014.

#### **REFERENCES:**

1. Ravi Prakash, Non-Destructive Testing Techniques, 1st revised edition, New Age International Publishers, 2010.
2. Paul E Mix, Introduction to Non-destructive testing: a training guide, Wiley, 2nd Edition New Jersey, 2005.
3. Charles, J. Hellier, Handbook of Nondestructive evaluation, McGraw Hill, New York 2001.
4. B.P.C. Rao, Practical Eddy Current Testing, Alpha Science International Limited (2006).

#### **COURSE OUTCOMES:**

**CO1:** demonstrate the importance, principle, concept and inspection methods of various surface NDT methods and apply the same to interpret the results effectively.

**CO2:**comprehend the ideas behind working of thermography and eddy current testing methods and apply them to interpret the results of testing and analyse the defects and problem.

**CO3:**grasp the fundamental principles and standards of various radiographic NDT methods and utilise them to identify the defects and defect location suitably.

**CO4:**assimilate the ideas concerning the principle, types of waves, instrumentation, standards, calibration methods of ultrasonic NDT methods and identify the areas for their application.

**Board of Studies (BoS) :**

BOS of Physics was held on  
21.6.21

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

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

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

<b>PHDX 02</b>	<b>MATERIALS SCIENCE FOR</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>	<b>ENGINEERING</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To impart knowledge on the fundamentals of materials science and engineering.

**COB2:** To provide a basis for understanding properties and applications of dielectric materials.

**COB3:** To expose the students to different classes of materials, their properties, structures and imperfections

**COB4:** To aid the teaching learning process through relevant illustrations, animations, web content and practical examples

**MODULE I CLASSIFICATION OF MATERIALS 6**

Concept of amorphous, single crystals and polycrystalline materials, crystallinity and its effect on physical properties, metal, ceramic, polymers, classification of polymers, structure and properties, additives for polymer products, effect of environment on materials, composites

**MODULE II PROPERTIES OF MATERIALS 10**

Mechanical Properties: Stress-strain response of metallic, ceramic and polymer materials, yield strength, tensile strength and modulus of elasticity, toughness, plastic deformation, fatigue, creep and fracture- Electronic Properties: Free electron theory, Fermi energy, density of states, band theory of solids, semiconductors, Hall effect, dielectric behaviour, piezo, ferro, pyroelectric materials - Magnetic Properties: Origin of magnetism in metallic and ceramic materials, para-magnetism, diamagnetism, ferro and ferrimagnetism- Thermal Properties: Specific heat, thermal conductivity and thermal expansion, thermoelectricity- Optical Properties: Refractive index, absorption and transmission of electromagnetic radiation in solids, electro-optic and magneto-optic materials.

**MODULE III CRYSTALLOGRAPHIC STRUCTURES AND IMPERFECTIONS 7**

Crystal symmetry, point groups, space groups, indices of planes, close packing in solids, bonding in materials, coordination and radius ratio concepts, point defects, dislocations, grain boundaries, surface energy and equilibrium shapes of crystals.

**MODULE IV THERMODYNAMICS AND KINETICS****7**

Phase rule, phase diagrams, solid solutions, invariant reactions, lever rule, basic heat treatment of metals, solidification and phase transformations, Fick's laws of diffusion, mechanisms of diffusion, and temperature dependence of diffusivity.

**L – 30; Total Hours–30****TEXT BOOKS:**

1. Nanotechnology: An introduction to nanostructuring techniques by Michael Köhler and Wolfgang Fritzsche, Wiley-VCH; 2Rev Ed edition, 2007.

**REFERENCES:**

1. William D. Callister, Jr., David G. Rethwisch, Materials Science and Engineering, Edition 9, Wiley, 2014.
2. Michael F. Ashby, David R.H. Jones, Engineering Materials 1 An Introduction to Properties, Applications and Design · Volume 1, Elsevier Science, 2012
3. Michael F. Ashby, David R.H. Jones, Engineering Materials 2: An Introduction to Microstructures, Processing and Design · Volume 2, Elsevier Science, 2013
4. Reza Abbaschian, Robert E. Reed-Hill, Physical Metallurgy Principles - SI Version, Cengage Learning, NY, 2009
5. "Encyclopedia of Polymer Science and Technology" 3<sup>rd</sup> Edition, Vol.1-12, Wiley Interscience, 2003

**COURSE OUTCOMES**

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

**CO1:**Select suitable material for specific application.

**CO2:** Analyse crystallographic structure of metals and their imperfections.

**CO3:** Develop metal alloys with varying properties by selecting suitable heat treatment

**CO4:** Correlate the various properties of material with their structure.

**Board of Studies (BoS) :**

BOS of Physics was held on 21.6.21

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

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

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.



<b>PHDX 03</b>	<b>BIOMATERIALS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To gain basic knowledge in classification of biomaterials and their properties.

**COB2:** To provide a basis for understanding properties of metallic implant materials.

**COB3:** To enable the students to correlate theoretical principles with practical applications.

**COB4:** To help students understand biocompatibility & toxicological screening of biomaterials

**MODULE I INTRODUCTION TO BIOMATERIALS 8**

Introduction: Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Surface properties of materials, physical properties of materials, mechanical properties-Materials for biophotonic applications.

**MODULE II IMPLANT MATERIALS 10**

Metallic implants: Stainless steels, Co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion-ceramic implants : bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics-Polymer implants: Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin.

**MODULE III BIOCOMPATIBILITY AND TOXICOLOGICAL SCREENING OF BIOMATERIALS 6**

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situ-implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests.

**MODULE IV                      PRACTICAL                      ASPECTS                      OF 6  
BIOMATERIALS**

Preparation of biomaterials - Microscopic study & analysis of different biomaterials- alginate – material preparation and characterization - Testing of various biomaterials- case studies on industrial and clinical applications of biomaterials.

**L – 30; Total Hours –30**

**TEXT BOOKS:**

1. Myer Kutz, Standard Handbook of Biomedical Engineering and Design, McGraw Hill, 2003
2. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. Implant biomaterials: A comprehensive review, World Journal of Clinical Cases, 2015.

**REFERENCES:**

1. John Enderle, Joseph D. Bronzino, Susan M. Blanchard, Introduction to Biomedical Engineering, Elsevier, 2005.
2. Park J.B., Biomaterials Science and Engineering, Plenum Press, 2007.
3. A.C Anand, J F Kennedy, M.Mirafteb, S.Rajendran, Woodhead Medical Textiles and Biomaterials for Healthcare, Publishing Limited 2006.
4. D F Williams, Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive Treatment Volume, VCH Publishers 1992.

**COURSE OUTCOMES:**

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

- CO1:** differentiate common use of biomaterials as metals, ceramics, polymers and apply them to classify its chemical structure, properties and morphology.
- CO2:** comprehend ideas involving general properties of implant materials and apply the same to identify the benefits of implant materials.
- CO3:** attain knowledge about the biocompatibility & toxicological screening of biomaterials and realize its usage in real life.

**CO4:** reflect upon the practical ideas of using biomaterials

**Board of Studies (BoS) :**

BOS of Physics was held on 21.6.21

**Academic Council:**

17<sup>th</sup> AC held on

15.07.2021

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

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

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

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

<b>PHDX 04</b>	<b>OPTICAL FIBRE COMMUNICATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To facilitate the knowledge about optical fibres and its transmission characteristics.

**COB2:** To make the students to learn about LED and laser diodes.

**COB3:** To make the students understand the various types of optical Receivers and sensors.

**COB4:** To enrich the knowledge on optical amplifiers and networks.

**MODULE I INTRODUCTION TO OPTICAL FIBRES 7**

Optical fibre – Principle and propagation of light in optical fibre – Numerical aperture and acceptance angle – Types of optical fibres – Attenuation – Absorption, Scattering losses, Bending losses and Dispersion in Optical fibres – Fiber Connectors and Couplers.

**MODULE II FIBER OPTICAL SOURCES 7**

Light Emitting Diodes (LED) – power and efficiency - double hetero LED – LED structure - LED characteristics – Semiconductor Lasers diode, Homojunction and Heterojunction laser diodes - Optical processes in semiconductor lasers - applications.

**MODULE III FIBER OPTICAL RECEIVERS AND SENSORS 8**

Photo detectors - photodiodes - phototransistors - noise characteristics - PIN diode Avalanche Photodiode (APD) characteristics - APD design of detector arrays – Charged Couple Device - Solar cells - Materials and design considerations, Thin film solar cells, amorphous silicon solar cells - Fiber optic sensors: Intrinsic and Extrinsic sensors, amplitude, phase, wavelength and polarization modulation.

**MODULE IV OPTICAL AMPLIFIERS AND NETWORKS 8**

Optical amplifiers, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers - Optical Networks: Basic networks, SONET/SDH, WDM Networks, Nonlinear effects on network performance, Performance of WDM + EDFA systems, Solitons, Optical CDMA, Ultrahigh capacity networks.

**L – 30; Total Hours –30**

**TEXT BOOKS:**

1. Gerd Keiser, Optical Fiber Communication, 3rd Edition, McGraw-Hill International, Singapore, 2013.

**REFERENCES:**

- 1 Govind P. Agrawal, Fiber-Optic Communication Systems (Wiley Series in Microwave and Optical Engineering) , Wiley 4th Edition, 2010.
- 2 J. Senior, Optical Communication, Principles and Practice, Prentice Hall of India, 3rd Edition, 2010.
- 3 D. C. Agrawal, Fiber Optic Communication, S.Chand& Co Ltd., 2005.
- 4 Rajiv Ramaswami, KumarSivarajan, Galen Sasaki, Optical Networks: A Practical Perspective, 3rd Edition, Morgan Kaufmann, 2009.
- 5 B. Culshaw, Optical Fiber Sensing and Signal Processing, Peter Peregrinus Ltd, 2014.

**COURSE OUTCOMES:**

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

- CO1:** realize basics of optical fiber and differentiate various modes and configurations.
- CO2:** understand and assimilate the working principle of LED and Diode Laser.
- CO3:** select suitable photodetectors/sensors for different types of applications.
- CO4:** analyze the mechanism of optical amplifiers and analyze optical networks.

**Board of Studies (BoS) :**

BOS of Physics was held on 21.6.21

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

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

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

<b>PHDX 05</b>	<b>SEMICONDUCTOR PHYSICS FOR INFORMATION TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**SDG: 4**

**COURSE OBJECTIVES:**

**COB1:** To understand the physics of semiconductor devices

**COB2:** To gain knowledge on various methods involved in nanofabrication of semiconductor devices

**COB2:** To study the working principle of optoelectronic devices and various display devices

**COB4:** To get insight to different types of data storage technologies

**MODULE I INTRODUCTION TO SEMICONDUCTOR DEVICES 6**

Semiconductors: N and P type, PN junction diode under forward and reverse bias — Zener diode, Schottky diode – Tunnel diode – bipolar junction transistor (BJT) - metal–oxide–semiconductor field-effect transistor (MOSFET), CMOS- concepts and fabrication.

**MODULE II FABRICATION OF SEMICONDUCTOR DEVICES 6**

Deposition of Semiconductor thin films – molecular beam epitaxy (MBE), chemical vapour deposition (CVD), pulsed laser deposition (PLD), magnetron sputtering, Types of lithography: Photo/ultraviolet /Electron-beam/Focused ion beam, Dip pen nanolithography, Etching process :Dry and Wet etching

**MODULE III OPTOELECTRONIC DEVICES 10**

Light Emitting Diodes (LED) - double hetero LED structure - LED characteristics - White LED – Applications, Semiconductor Lasers, Homojunction and Heterojunction laser diodes - Optical detection – PIN and avalanche photodiodes, Applications: Optical mouse, traffic lights, Luminescence, Cathode Luminescence, Electro Luminescence, Transparent Conductors, Liquid crystal displays – Dynamic scattering and Twisted nematic display, Display Glasses, Organic LEDs display, Charge-coupled devices (CCD), Inorganic Semiconductor TFT Technology, Organic TFT Technology; Flexible Displays, Touch Screen Technology.

**MODULE IV MEMORY STORAGE DEVICES 8**

Introduction to memory storage, Resistive Random Access Memory (ReRAM), Phase Change Memory (PCM); Magnetoresistive Random Access Memory (MRAM)- Giant Magnetoresistance (GMR), Tunnel Magnetoresistance (TMR),

Ferroelectric Random Access Memory (FeRAM); Comparison and future directions, Hardware circuits, working analysis.

**L – 30; Total Hours –30**

**TEXT BOOKS:**

1. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate(Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 3<sup>rd</sup> Edition, 2018
2. Chris Mack, Fundamental Principles of Optical Lithography: The Science of Microfabrication, Wiley, 2008
3. D. S. Dhaliwal et al., Prevail :Electron projection technology approach for next-generation lithography, IBM Journal Res. & Dev. 45, 615, 2001.

**REFERENCES:**

1. V.K. Mehta, Rohit Mehta, Principles of Electronics (Multicolour Edition) S. Chand Publishers, 10th Rev. Edn. 2006 Edition
2. Albert Malvino, David J. Bates Electronic Principles (SIE), McGraw Hill, 7th Edition, 2017
3. U. Mishra, J. Singh, Semiconductor Device Physics and Design, Springer, 2014
4. S.M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, Wiley Publishers, 3ed 2008.
5. Bhattacharya Pallab, Semiconductor Optoelectronic Devices, Second Edition, By Pearson 2017
6. Joseph A. Castellano, Handbook of Display Technology, Springer, 1992
7. Yoshio Nishi, Advances in Non-volatile Memory and Storage Technology, Elsevier 2014

**COURSE OUTCOMES:**

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

**CO1:**understand the physics of semiconductor devices and identify its significance towards information technology (IT).



**CO2:** gain insight into various fabrication techniques towards the realization of nano-dimensional semiconductor devices.

**CO3:** attain knowledge on working principles of optoelectronic devices and display technologies and can recognize their importance in commercial applications.

**CO4:** learn the principle of data storage and its application towards futuristic memory technology.

**Board of Studies (BoS) :**

BOS of Physics was held on 21.6.21

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

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

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

<b>PHDX 06</b>	<b>SENSORS AND ACTUATORS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>	<b>(</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To understand the basic concept of sensors towards detection of pressure, position, velocity and temperature.

**COB2:** To avail knowledge on sensor which are sensitive to light, magnetic field, and acoustic waves

**COB3:** To study the different types of fabrication techniques towards realization of various sensors.

**COB4:** To get introduced towards MEMS technology and various actuators.

**MODULE I INTRODUCTION TO SENSORS: PRESSURE, POSITION, VELOCITY AND TEMPERATURE 8**

Introduction to sensors – working principles– classification – static and dynamic characteristics, Error Analysis, Pressure sensors – strain gauge, piezoelectric force sensor, vacuum sensors, Position sensor -Proximity sensor, Capacitive, Inductive and displacement sensor, velocity and acceleration sensors, Temperature sensor-thermocouples- thermistors- Thermo-EMF Sensors, metal Junction and metal Semiconductor junction types.

**MODULE II SENSORS : LIGHT, MAGNETIC FIELD AND ACOUSTIC 8**

Photoconductors- Optical Detectors - Photodiodes, Phototransistors, Optical encoder-Charge Coupled Device (CCD), Fabry Perot sensor, Hall effect, magneto resistive, magneto strictive sensors, Acoustic sensors- microphones-resistive, capacitive, piezoelectric, fiber optic, solid state - electret microphone.

**MODULE III SENSORS FABRICATION TECHNIQUES 7**

Fabrication techniques – molecular beam epitaxy (MBE), chemical vapour deposition (CVD), pulsed laser deposition (PLD), magnetron sputtering, Types of lithography: Photo/ultraviolet /Electron-beam/Focused ion beam, Dip pen nanolithography, Etching process :Dry and Wet etching

**MODULE IV MICROSYSTEMS AND ACTUATORS 7**

Microelectro-mechanical systems (MEMS) - RF- MEMS, Micro fabrication

and Applications, Classification of transducers: electrostatic, piezoelectric, thermal, Microsystem design and fabrication. working principles of Actuators. Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications Solid-state switches, relays Solenoids, D.C. Motors, A.C. Motors, Stepper motors. Shape memory alloy actuators.

**L – 30; Total Hours –30**

**TEXT BOOKS:**

1. Jacob Fraden, Hand Book of Modern Sensors: physics, Designs and Applications, 3rd edition, Springer, New York, 2015.
2. Jon. S. Wilson, Sensor Technology Hand Book, 1st edition, Elsevier, Netherland, 2011.
3. John G Webster, Measurement, Instrumentation and sensor Handbook, 2nd edition, CRC Press, Florida, 2014.

**REFERENCES:**

1. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate (Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 3<sup>rd</sup> Edition, 2018
2. Chris Mack, Fundamental Principles of Optical Lithography: The Science of Microfabrication, Wiley, 2008
3. D. S. Dhaliwal et al., PREVAIL :Electron projection technology approach for next-generation lithography, IBM Journal Res. & Dev. 45, 615, 2001.
4. Tai-Ran Hsu, MEMS & Microsystem, Design and Manufacture, 1st ed., McGraw Hill India, New Delhi, 2017.
5. MassoodTabibArar, Microactuators – Electrical, Magnetic Thermal, Optical, Mechanical, Chemical and Smart structures, 1st ed., Kluwer Academic publishers, New York, 2014.

**COURSE OUTCOMES:**

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

**CO1:** get exposed to various types of sensors and apply the ideas to distinguish between pressure, position, velocity and temperature based sensors

**CO2:** familiarize towards light, magnetic field, and acoustic based sensors and recognize their importance in commercial applications.

**CO3:** gain insight into various fabrication techniques towards the realization of sensors

**CO4:** apply the ideas to conceptualize MEMS technology and different actuators in engineering field

**Board of Studies (BoS) :**

BOS of Physics was held on 21.6.21

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

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

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

<b>PHDX 07</b>	<b>FUNDAMENTALS OF</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4</b>	<b>NANOTECHNOLOGY AND ITS</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
	<b>APPLICATIONS</b>				

**COURSE OBJECTIVES:**

**COB1:**To introduce the basic concepts of Nanoscience through quantum mechanical theories and solid state physics.

**COB2:**To provide knowledge about the various synthesis methods applicable to different nano materials

**COB3:**To enrich the knowledge of students in various characterisation techniques.

**COB4:**To provide knowledge on applications of polymer based nano materials in various fields.

**MODULE I BASICS OF NANO SCIENCE 7**

Introduction to Nanoscience & Nanotechnology: Review of classical mechanics – overview Quantum Mechanics. Background to nanoscience and nanotechnology - scientific revolutions - nanosized effects – surface to volume ratio – atomic structure – molecular and atomic size - quantum effects - formation of nano sized particles – energy at the nanoscale.

**MODULE II SYNTHESIS OF NANOMATERIALS 8**

Nanomaterial Fabrication: Bottom-up vs. top-down - Preparations of Nanomaterials by mechanical and physical methods : – High energy ball milling – melt quenching and annealing – vapour deposition – Pulsed laser deposition – Magnetron sputtering - Microwave plasma evaporation. Chemical Methods of Preparation : Sol-gel method –Electrodeposition – Electrospinning. Arc method for carbon nanotubes – nanofibres and rods – synthesis of Graphene- Handling of nano particles - Health hazards – Precautions.

**MODULE III CHARACTERIZATION OF NANOMATERIALS 8**

Characterisation of Nanomaterials: XRD – particle size determination - SEM - FESEM - TEM – AFM – Nanoindenter – UV-VIS spectroscopy – FTIR, FT-Raman, Photoluminescence, NMR, ESR - Dielectric characterization – Magnetic characterization

**MODULE IV APPLICATION OF NANO MATERIALS 7**

Applications of Carbon based nanomaterials (CNT, CNF, Graphene) -

Biosensor (principle, component, types, applications) - agriculture (nano-fertilizers, herbicides, nano-seed science, nano-pesticides) and food Systems (encapsulation of functional foods, nano-packaging) – Nano - electronics, Nano-optics.

**L – 30; Total Hours –30**

**TEXT BOOKS:**

1. Nanotechnology: An introduction to nanostructuring techniques by Michael Köhler and Wolfgang Fritzsche, Wiley-VCH; 2Rev Ed edition, 2007.

**REFERENCES:**

1. Nanotechnology: basic science and emerging technologies by Mick Wilson, KamaliKannangara, Geoff Smith, and Michelle Simmons, Chapman & Hall/CRC; I edition, 2002.
2. Handbook of NanoScience, Engineering and Technology by Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., CRC Press, 2012.
3. Nanocomposite Science and Technology by P. M. Ajayan, L. S. Schadler, P. V. Braun, WILEY-VCH Verlag GmbH, 2003.
4. Nanotechnology Applications in Agriculture – C.R. Chinnamuthu, B.Chandrasekaran and C. Ramasamy – 2008.

**COURSE OUTCOMES:**

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

- CO1:**understand basic principles of nanomaterials and apply them to differentiate the significance of nanomaterials compared to bulk materials.
- CO2:**familiarize the various synthesis methods of nanomaterials and compare them with the preparation of materials in bulk form.
- CO3:**get useful ideas about characterization techniques and differentiatedifferent techniques.
- CO4:** understand the various applications of nanomaterilas and realize the role of nanomaterials in various fields

**Board of Studies (BoS) :**

BOS of Physics was held on 21.6.21

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

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

Statement: The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

**CHEMISTRY ELECTIVE**

<b>CHDX 01</b>	<b>CHEMISTRY OF CONSTRUCTION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>MATERIALS</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

To impart knowledge on

**COB1:** the chemistry of cement and concrete

**COB2:** the properties of steel and mechanism of corrosion

**COB3:** the quality of water and its impact on concrete

**COB4:** the analytical techniques for concrete research

**MODULE I CHEMISTRY OF CEMENT AND CONCRETE 8**

Cement - chemical composition - Bogue's compounds - hydration of cement - hydrated products - influence of hydrated products on properties of cement - types of cement - microstructure of aggregate phase and hydrated cement paste - Interfacial transition zone in concrete : significance and microstructure

**MODULE II CHEMISTRY OF STEEL AND CORROSION 8**

Steel for construction - chemical composition - types of steels - influence of chemical composition on properties. Corrosion of steel - mechanism of corrosion of steel in water and concrete medium - types of corrosion of steel associated to civil engineering. Corrosion prevention and control : coatings & inhibitors - working mechanism. Cathodic protection to steel : Concept - working mechanism - sacrificial anodes

**MODULE III WATER CHEMISTRY FOR CONCRETE 7**

Water quality parameters – pH, solids, hardness, alkalinity, chloride and sulphates in water and their determination- Water quality for building construction – Effect of water impurities on concrete strength and durability- Carbonate and Sulphate attack-Chloride attack –Alkali-Silica reactions in concrete-Case studies

**MODULE IV ANALYTICAL TECHNIQUES FOR CONCRETE RESEARCH 7**

Analytical techniques for cement concrete research - FITR spectroscopy - SEM - XRD - Cyclic voltammetry (CV) - Thermo-gravimetric analysis (TGA) and Differential thermal analysis (DTA) - Advanced chloride and water analysis techniques.



**L – 30; Total Hours –30****TEXT BOOKS:**

1. WieslawKurdowski, Cement and Concrete Chemistry, Springer Netherlands, 2014.

**REFERENCES:**

1. P.C Jain and Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd.,New Delhi , 2013.
2. S SUMare and S S Dara, A text Book of Engineering Chemistry, S. Chand and Company Ltd, New Delhi, 2014.
3. M.G. Fontana and N.G. Green, Corrosion Engineering, McGraw Hill Book Company,NewYork, 1984.
4. B. Sivasnagar, Engineering Chemistry, Tata McGrow - Hill Publication Limited, New Delhi,second reprint 2008.
5. P. Kumar Mehta and Paulo J.M. Moteiro, "Concrete : Microstructure, Properties and Materials", McGraw Hill Education (India) Pvt. Ltd., 4th Edition, New Delhi, 2014
6. APHA Standard Methods for the Examination of Water & Wastewater, American Public Health Association, USA, 2005.

**COURSE OUTCOMES:****CO1:** Explain the properties of cement and concrete**CO2:**Describe the properties of steel, mechanism of corrosion and its prevention**CO3:** Enumerate the impact of water quality on the concrete**CO4:**Elaborate the principle, instrumentation and applications of various analytical techniques for concrete research**Board of Studies (BoS) :**11<sup>th</sup>BoS of Chemistry held on 17.06.2021**Academic Council:**17<sup>th</sup> AC held on 15.07.2021

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

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

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

<b>CHDX 02</b>	<b>CHEMISTRY OF MATERIALS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>AND ELECTROCHEMICAL DEVICES</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

The students will be conversant with

**COB1:** concepts of corrosion, types and various methods to control corrosion.

**COB2:** the chemicals, chemical reactions, construction and working of different batteries and fuel cells.

**COB3:** the types, properties and manufacture of refractories and abrasives.

**COB4:** types, functions of lubricants and mechanism of lubrication.

**MODULE I                      CORROSION AND ITS CONTROL                      8**

Types of corrosion - chemical corrosion – electrochemical corrosion – galvanic corrosion – differential aeration corrosion - factors influencing rate of corrosion.

Corrosion control – selection of materials - cathodic protection: sacrificial anode - corrosion inhibitors – paints: constituents & functions – treatment of metal surface for inorganic coatings - metallic coatings: hot dipping: galvanizing and tinning – electroplating – electroless plating.

**MODULE II                      ELECTROCHEMICAL DEVICES                      8**

Electrochemical cell, electrolytic cell - introduction to batteries – classification – primary: dry alkaline – secondary: lead–acid, nickel–cadmium and lithium batteries, Fuel cells – classification based on temperature and electrolyte - hydrogen–oxygen fuel cell, applications – solar cells: construction and working – dye sensitised solar cells.

**MODULE III                      REFRACTORIES AND ABRASIVES                      7**

Refractories: Introduction - refractory - classification – based on chemical nature - characteristic and selection of good refractory - properties of refractories: refractoriness - refractoriness under load - thermal spalling - porosity and dimensional stability – general manufacture of refractory – components, properties and uses of: silica, magnesite, zirconia refractories - super refractories - application of refractories.

Abrasives: classification - Moh's scale – properties - natural abrasives: diamond, corundum, emery, garnet, quartz - synthetic abrasives: preparation, properties and uses: carborundum, alundum, boron carbide

(norbide), tungsten carbide, zirconium silicate – grinding wheel – abrasive paper and cloth - Rockwell scale test - knoop hardness test.

#### **MODULE IV LUBRICANTS**

**7**

Introduction – functions of lubricant- mechanism of lubrication - classification of lubricant – selection of lubricants - lubricating oils - properties of lubricant: viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue - semisolid: grease (sodium, calcium, lithium, aluminium) - solid lubricant: graphite, graphene, molybdenum disulphide – lubricating emulsions - cutting fluids – synthetic and semi-synthetic lubricants.

**L – 30; Total Hours – 30**

#### **TEXT BOOKS:**

1. Jain P.C and Monika Jain, *Engineering Chemistry*, Dhanpat Rai Publishing Co., New Delhi. 2016.

#### **REFERENCES:**

1. E. McCafferty, *"Introduction to Corrosion Science"* Springer, May 2010.
2. Tulika Sharma *"Electrochemical devices"* LAP Lambert Academic Publishing, 2011.
3. Jeffry S Gaffney, Nancy A Marley *General chemistry for engineers*, Elsevier, 2018.
4. Don M Pirro, Martin Webster, EkkehardDaschner *"Lubrication Fundamentals"*, Taylor & Francis Gp,LLC, 2016.
5. Theo Mang, Wilfred Dresel *"Lubricants and Lubrication"* Wiley-VCH, 2017

#### **COURSE OUTCOMES:**

The students will be able to

**CO1:**apply specific methods to control corrosion of different materials.

**CO2:** illustrate the construction and working of different types of cells, batteries and fuel cells.

**CO3:** compare the properties and devise a method of manufacture of refractories and abrasives.

**CO4:** analyze and choose the right type of lubrication based on the type of machines.

**Board of Studies (BoS) :**

11<sup>th</sup>BoS of Chemistry held on  
17.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

SDG 9: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

<b>CHDX 03</b>	<b>CHEMISTRY AND INSTRUMENTATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>FOR ELECTRICAL AND ELECTRONIC APPLICATIONS</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** Synthesis, properties and applications of electrical and electronic devices.

**COB2:** Classification and types of fuel cells.

**COB3:** Types of sensors and their applications.

**COB4:** Principle, instrumentation and applications of analytical techniques.

**MODULE I ELECTRICAL AND ELECTRONIC DEVICES 7**

Solar Cell- Si solar cell, quantum dot solar cell, LCD : components, liquid crystals and their composition, electrodes – OLEDs: components, synthesis and modification of small molecules, polymers, phosphors - FRP-synthesis, properties and electrical applications - Solders : composition and uses – Capacitors : synthesis and modification of capacitor materials, fabrication.

**MODULE II FUEL CELLS 7**

Difference between batteries and fuel cells - classification of fuel cell (based on temperature and electrolyte) – principle, characteristic features, advantages, disadvantages and applications of polymer electrolyte membrane or proton exchange membrane fuel cell (PEMFC), direct methanol fuel cell (DMFC), alkaline fuel cell (AFC), phosphoric acid fuel cell (PAFC), molten carbonate fuel cell (MCFC), and solid oxide fuel cells (SOFC) microbial fuel cell, - hydrogen storage materials, challenges in using hydrogen as a fuel.

**MODULE III SENSORS 7**

Definition, receptor, transducer, classification of chemical sensors based on operating principle of transducer, Ion-selective electrodes, Conductometric gas sensors (chemoresistors), Electrochemical sensors, Potentiometric MOSFET gas sensor, Touch sensors (oximeter, glucometer), Chemocapacitors, Biochips and microarray.

**MODULE IV ANALYTICAL TECHNIQUES 9**

Voltammetry: cyclic voltammetry, electrogravimetry - principle, instrumentation and applications of: UV-Vis spectrophotometry, Atomic emission spectroscopy- Photoluminescence spectrophotometry, atomic absorption spectrophotometry – FT-IR spectroscopy, Raman spectroscopy, TGA-DTA analyzer, TEM.

**L – 30 ; Total Hours –30****TEXT BOOKS:**

1. P.C. Jain & Monica Jain, Engineering Chemistry, Dhanpatrai Publishing Company (P) Ltd., New Delhi (2016).

**REFERENCES:**

1. K.M. Gupta & Nishu Gupta, Advanced electrical and electronic materials: process and applications, Wiley-Scrivener (2015).
2. S. Vairam, P. Kalyani and Suba Ramesh, Engineering Chemistry, Wiley India Ltd., New Delhi (2011).
3. B. Viswanathan & M. Aulice Scibioh, Fuel Cells: Principles and Applications, University Press (2008).

**COURSE OUTCOMES:**

**CO1:** Illustrate the construction and applications of electrical and electronic devices.

**CO2:** Classify the fuel cells and elaborate the different types of fuel cells.

**CO3:** Explain the different types of sensors and their applications.

**CO4:** State the principle and illustrate the instrumentation of various analytical techniques.

**Board of Studies (BoS) :**

11<sup>th</sup>BoS of Chemistry held on  
17.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

<b>CHDX 04</b>	<b>FUNCTIONAL MATERIALS AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 11, 12</b>	<b>APPLICATIONS</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
	<b>(CSE – cyber security, AI, IOT, IT)</b>				

**COURSE OBJECTIVES:**

To make the students conversant with

**COB1:** specific materials for hardware components fabrication, data storage and their related properties

**COB2:** selection of advanced materials for various current applications

**COB3:** materials for the fabrication of sensors

**COB4:** essential characterization techniques and software tools with chemistry background

### **MODULE I                      MATERIALS FOR HARDWARE AND DATA 7 STORAGE**

Specific materials for electrical and electronic gadgets-computers, instruments (Semiconductors-N, S doped Silicon, CdX QDs, metal nano and other applications). Networking of networks and connecting devices - materials used in robotic construction (metal alloys, kevlar, biodegradable smart materials). Data storage and magnetic hard disk and devices- pendrive (flash memory-ferro magnetic and super paramagnetic materials, optical discs). Nanomaterials to enhance the lifetime and storage of CD, DVD and BD (Nano incorporated Polycarbonate, Al and lacquer) - Nanomaterials and small molecules for data storage.

### **MODULE II                      ADVANCED                      MATERIALS                      AND 8 APPLICATIONS**

Materials for 3D printing (Nylon, ABS, PLA, Ti, Au and Ag). Solar panels function monitoring-IOT enabled (crystalline Si, organometallics) – Displays and LCD, LEDs and its types-OLEDs (Group III-V materials). RGB analysis -sensing and TV/system screen (QDs and anthocyanins). Semiconductor chemistry for VLSI processing technology (metalloid staircase, Si, Ge, GaAs)-materials for inkjet printable circuit board (nanocarbon based) - Right material for signal speed and right thermal coefficient of expansion - Remote sensing (photodetectors and radiometers). Solder:-Lead based solder - issues and alternative for lead free solder (Conductive inks).

### **MODULE III                      MATERIALS                      FOR                      FABRICATION                      OF 8 SENSORS**



Wireless Sensors – Introduction to sensors (chemo/bio/gas sensors)- Wearable/touch sensors-Components - selection of materials - Device fabrication and function monitoring - wireless, Smartphone based and IOT enabled-Properties of materials, anti-corrosive, water proof, insulation and lamination. Robotics in surgery, gene coding and molecular modelling. Biochips and DNA microarray chips(fluorescent dyes, glass/nylon).

#### **MODULE IV                      ANALYTICAL TECHNIQUES AND SOFTWARE    7 SOLUTIONS**

Characterization tools – UV-Visible (DRS), FT-IR, SEM, TEM, AFM, TG-DTA and XRD (Principle and applications only). Introduction to softwares- ChemOffice, Image J, Origin - Molecular modelling, comparison of old drug structures with new, drug designing-drug for COVID-19 and drug delivery. Molecular docking (drug interaction in a human body).

**L – 30; Total Hours –30**

#### **TEXT BOOKS:**

1. P. Roy, S.K. Srivastava, Nanomaterials for Electrochemical Energy Storage Devices (Book), John Wiley & Sons, 2019.
2. K. Brun, T. Allison, R. Dennis, Thermal, Mechanical, and Hybrid Chemical Energy Storage Systems (Book), Elsevier, 2000.

#### **REFERENCES:**

1. B.J. Cafferty, A.S. Ten, M.J. Fink, S. Morey, D.J. Preston, M. Mrksich, G.M. Whitesides, Storage of Information Using Small Organic Molecules, ACS Central Science, 2019, 5, 911–916.
2. Nabeel Ahmad P. Gopinath and Rajiv Dutta, 3D Printing Technology in Nanomedicine (Book), Elsevier, 2019.
3. AaftaabSethi, Khusbhoo Joshi, K. Sasikala and MallikaAlvala, Molecular Docking in Modern Drug Discovery: Principles and Recent Applications, IntechOpen, (2019), DOI: 10.5772/intechopen.85991.
4. W-L. Xing, J. Cheng, Frontiers in Biochip Technology, Springer, 2006.
5. Sulabha K. Kulkarni, Nanotechnology: Principles and Practices, 3rd Edition, Springer, 2015.

**COURSE OUTCOMES:**

The students will be able to

**CO1:** identification of suitable materials in electronic gadgets and data storage systems.

**CO2:** application of specific functionalized materials for advanced applications

**CO3:** choose appropriate materials for fabricating the different types of sensors

**CO4:** hands on experience of software and exposure to material properties

**Board of Studies (BoS) :**

15<sup>th</sup>BoS of Department of Chemistry  
held on 15.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

SDG : 11 & 12

Statement: Identification of suitable materials towards the manufacturing of electronic gadgets and data storage systems without much affecting the natural resources and application of the fabricated devices to the sustainable cities and communities.

<b>CHDX 05</b>	<b>CHEMISTRY OF FUELS,</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>	<b>COMBUSTION AND LUBRICANTS</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

The students will be conversant with

**COB1:**types, composition and process of manufacture of solid, liquid and gaseous fuels.

**COB2:**determination of calorific value and calculation of GCV and NCV.

**COB3:**types, concepts of corrosion and different methods for control of corrosion.

**COB4:**types, functions of lubricants and mechanism of lubrication.

**MODULE I      FUELS      8**

Introduction – classification of fuels – calorific value – characteristics of a good fuel – comparison of solid, liquid and gaseous fuel – solid fuels – coal – ranking of coal – proximate analysis of coal – pulverised coal – metallurgical coke – manufacture of coke (Otto Hoffman) – Liquid fuel – petroleum – refining of petroleum – cracking – fixed bed catalytic cracking - synthetic petrol – Fischer-Tropsch process – biodiesel - Gaseous fuel – CNG – LPG – Biogas – producer gas – water gas

**MODULE II      COMBUSTION      8**

Introduction – calorific value - Calorific value: Gross and net calorific value - Bomb Calorimeter - Gas calorimeter - Definition of combustion – theoretical calculation of calorific values (Dulong's formula) - Gross and net calorific values (problems) - air-fuel ratio - minimum requirement of air for complete combustion of fuels (problems) — Analysis of flue gas - Orsat's gas analysis method

**MODULE III      CHEMISTRY OF CORROSION      7**

Types of corrosion - chemical corrosion – electrochemical corrosion – galvanic corrosion – differential aeration corrosion - factors influencing rate of corrosion.

Corrosion control – selection of materials - cathodic protection: sacrificial anode - corrosion inhibitors – paints: constituents & functions – treatment of metal surface for inorganic coatings - metallic coatings: hot dipping: galvanizing and tinning – electroplating — electroless plating.

**MODULE IV LUBRICANTS****7**

Introduction – functions of lubricant- mechanism of lubrication - classification of lubricant – selection of lubricants - lubricating oils- properties of lubricant: viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue - semisolid: grease (sodium, calcium, lithium, aluminium) - solid lubricant: graphite, graphene, molybdenum disulphide – lubricating emulsions - cutting fluids – synthetic and semi-synthetic lubricants.

**L – 30; Total Hours – 30****TEXT BOOKS:**

Jain P.C and Monika Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Co., New Delhi. 2016.

**REFERENCES:**

1. Stephen R Turns, “An Introduction to Combustion: Concepts and Applications”, McGraw Hill Education, July 2017,
2. Samir Sarkar, “Fuels and Combustion”, University Press, 2009
3. Dipak K Sarkar “Thermal power plant: Design and operations – Chapter-3”, Elsevier, 2015.
4. E. McCafferty, “Introduction to Corrosion Science” Springer, May 2010.
5. Don M Pirro, Martin Webster, Ekkehard Daschner “Lubrication Fundamentals”, Taylor & Francis Gp, LLC, 2016.
6. Theo Mang, Wilfred Dresel “Lubricants and Lubrication” Wiley-VCH, 2012 2nd Edition, India, 2012. (ISBN 13: 9788131704370)

**COURSE OUTCOMES:**

The students will be able to

**CO1:** compare and interpret the different purpose of application, composition, and calorific value of different fuels.

**CO2:** calculate the minimum amount of air required, GCV and NCV for the combustion of the fuels.

**CO3:** apply specific methods to control corrosion of different materials.

**CO4:** analyze and choose the right type of lubrication based on the type of machines.

**Board of Studies (BoS) :**

11<sup>th</sup>BoS of Chemistry held on  
17.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

## SDG 9: Industry, Innovation &amp; Infrastructure

The holistic understanding of the materials used as fuels and lubricants and devices towards sustainable solutions for the advances in mechanical systems.

<b>CHDX 06</b>	<b>INSTRUMENTAL METHODS OF</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG4</b>	<b>POLYMER ANALYSIS</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

To impart knowledge on

**COB1:** to impart knowledge on spectroscopic analysis of polymers.

**COB2:** to equip with the knowledge of optical methods and X-ray diffraction methods for understanding the morphology and orientation of molecules

**COB3:** to develop an understanding on separation of various mixtures by different chromatographic techniques.

**COB4:** to understand the chemical elemental structure of polymers by NMR and mass spectroscopic technique.

**MODULE I      ULTRAVIOLET, VISIBLE AND IR SPECTROSCOPY      9**

Principle- Instrumentation-Double beam spectrophotometers – single beam spectrophotometers -sources of radiation – Detectors – I operational procedure – qualitative and quantitative analysis – applications in polymer analysis.

Fourier Transform Infrared Spectroscopy -principle- instrumentation – optical materials – sources- detectors – typical spectrophotometers — calibration and standardization – sample preparation - analysis – interpretation of FTIR spectra-principle of identification and characterization of polymers using IR

**MODULE II      NMR SPECTROSCOPY      7**

Fundamental concepts – chemical shift – spin –spin- coupling. Instrumentation - data acquisition and spectral interpretation. Solid state NMR (magic angle), Applications of NMR and FT NMR in the characterization of polymers

**MODULE III      CHROMATOGRAPHY AND THERMAL ANALYSIS      7**

Thermal analysis: DSC, TG/DTA, TMA, DMA, DETA with examples. gel permeation chromatography (GPC) – High pressure liquid chromatography (HPLC) – Thin layer chromatography (TLC - Gas chromatography (GC) – sample preparation. Chromatographic process and instrumentation – compositional separation and detectors – various types – Analyses. The uses and applications of various chromatographic techniques – pyrolysis gas chromatography.

**MODULE IV      X-RAY DIFFRACTION & NEWTON SCATTERING      7**

Principle & basic concept of absorption of X-rays- monochromatic X-ray sources – X-ray detectors - Instrumentation – Experimental technique -Analysis by X-ray

absorption. Absorption apparatus – X-ray diffraction – Diffraction apparatus.  
Application to polymer analysis.

**L - 30; Total Hours – 30**

### TEXT BOOKS

1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch “Principles of Instrumental Analysis” 7th edition, Publisher Cengage Learning ,2016
2. Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan, “Introduction to Spectroscopy” 5<sup>th</sup> edition, Publisher Cengage Learning ,2015
3. Yang, Rui “Analytical methods for polymer characterization” CRC Press, 2018.
4. Joseph D. Menczel, R. Bruce Prime “Thermal analysis of polymers: fundamentals and applications” John Wiley, 2019.

### REFERENCES:

1. Galen W. Euring, “Instrumental methods of chemical analysis”, McGraw Hill International editions, New York, 1985.
2. B.J. Hunt & Ml Jones Blackie, “Polymer Characterisation”, Academic professional, London, 1997.
3. Hubert Lobo, Jose V.B.Bonilla, “Handbook of Plastic analysis” , Marcel Dekker inc, New York, 2003.
4. RA pethrick& JV Daukins, “Modern techniques for polymer characterization” , John Wiley & sons Chichester, UK, 1999.
5. D. Campbell and R. White, “Polymer characterization”, Chapman & Hall, London 1989.
6. Arza Seidel, “Characterization and Analysis of Polymers”, John wiley and sons, New jersey, 2008.
7. Nicholas P. Cheremisinoff, “Polymer Characterization: Laboratory Techniques and Analysis”, Noyes publications, New jersey, 1996.
8. John M Chalmers, Robert J Meier, “Molecular characterization and analysis of polymers” Elsevier, 2008

### COURSE OUTCOMES

**CO1:** Gaining knowledge on principles of various instruments

**CO2:** Understand about various characterization techniques

**CO3:** Interpretation the polymer by different techniques

**Board of Studies (BoS) :**

11<sup>th</sup>BoS of Chemistry held on

17.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

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

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

SDG 4: Aims at ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all.

This course will provide deep knowledge on analysis of polymers using different instrumental methods.



<b>CHDX 07</b>	<b>MEDICINAL CHEMISTRY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 9</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

To impart knowledge on

**COB1:**The basic factors governing drug design.

**COB2:**The software tools for molecular docking.

**COB3:**The synthetic pathway of antinfective, antineoplastic, cardiovascular and steroidal drugs.

**COB4:**The mode of action and side effects of synthetic drugs.

**MODULE I INTRODUCTION TO DRUG DESIGN 7**

Development of new drugs: Procedure followed in drug design – Literature survey - Search for Active Pharmaceutical Ingredient(s) - Molecular modification – Types of pharmaceutical form / mode of administration, Chemical Characterization of Medicinal Drugs - Molecular docking.

**MODULE II ANTIINFECTIVE DRUGS 8**

Synthesis, mode of action and side effect of Dapsone and Clofazimine (antileprotic) – Isoniazid, Rifampicin, Pyrazinamide and Ethambutol (antitubercular) – Fluconazole and griseofulvin (antifungal) – Chloroquine and Primaquine (antimalarial) - Semisynthetic penicillin, Streptomycin, Ciprofloxacin (Antibiotics) - Nevirapine and Zidovudine (Antiviral)

**MODULE III ANTINEOPLASTIC AND CARDIOVASCULAR DRUGS 8**

Synthesis, mode of action and side effect of Mechlorethamine, Cyclophosphamide, Melphalan, Fluorouracil, 6-Mercaptopurine (Antineoplastic) – Sorbitrate, methylprednisolone, Methyldopa, quinidine (Cardiovascular).

**MODULE IV STEROIDS AND RELATED DRUGS 7**

Synthesis, uses and mode of action - (A) Androgens -testosterone (B) Estrogens and progestational agents – progesterone, (C) Adrenocorticoids – prednisolone, dexamethasone, Remdesivir (D) Glucocorticoids – Cortisol (E) Anabolic steroids - nandrolone, oxandrolone (F) Neurosteroids – allopregnanolone.

**L – 30; Total Hours –30**

**TEXT BOOKS:**

1. An Introduction to Drug Design, S. N. Pandeya and J. R. Dimmock, New

Age International, 1997.

2. Burgers's Medicinal Chemistry and Drug Discovery, Fifth Edition; M. E. Wolff, John Wiley and Sons, 1996.
3. The organic chemistry of drug design and drug action, R. B. Silverman and M. W. Holladay, Academic Press, 3<sup>rd</sup> Edition, 2014.
4. Introduction to medicinal chemistry: How Drugs Act and Why, A. Gringuage, Wiley-VCH, 1996.
5. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry; Eleventh Edition; Lippincott Williams & Wilkins, 2004.

#### REFERENCES:

1. Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley, 2<sup>nd</sup> Edition 2008.

#### COURSE OUTCOMES:

**CO1:** Carry out searches to retrieve information relevant to the development of a new drug.

**CO2:** Describe and justify the role and importance of the various disciplines involved in the different phases of drug discovery and development.

**CO3:** Explain how synthetic methods are used to make early decisions in the drug discovery and development.

**CO4:** Elaborate the mode of action and side effect of the drugs.

#### Board of Studies (BoS) :

11<sup>th</sup>BoS of Chemistry held on  
17.06.2021

#### Academic Council:

17<sup>th</sup> AC held on 15.07.2021

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

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

### SDG 9 : Industry, Innovation & Infrastructure

Understanding of drugs preparation and usage in sustainable method reduces unwanted side effects and help to environments.

**HUMANITIES ELECTIVE –I  
(SEMESTER III)**

<b>SSDX 01</b>	<b>ENGINEERING ECONOMICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 4, 8, 9,12</b>	<b>AND MANAGEMENT</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**COURSE OBJECTIVES:**

**COB1:** To present the major concepts and techniques of engineering economic analysis that is needed in the decision making process by providing insights to the basic microeconomic concepts of demand, supply and equilibrium.

**COB2:** To generate theoretical knowledge and understanding of macroeconomic aggregates such as national income and inflation and the major challenges associated with the measurement of these aggregates.

**COB3:** To develop analytical and critical thinking skills on money, banking and public finance and use them to judge the appropriateness of economic development and policy options.

**COB 4:** To introduce the basic concepts of management and planning and highlight the contribution of planning to the attainment of organization's objectives.

**COB 5:** To apprise the students about important management concepts and create awareness about the corporate social responsibilities and ethical aspects.

**MODULE I                                      DEMAND AND SUPPLY ANALYSIS                                      9**

Introduction to Engineering Economics – Engineering efficiency – Economic efficiency - Scope of Engineering Economics, Engineers' contributions to economic growth- Problem solving and decision making - Laws of Demand and Supply - Difference between Microeconomics and Macroeconomics - Equilibrium between Demand and Supply, Elasticity of Demand - Pricing strategies.

**MODULE II                                      NATIONAL INCOME AND INFLATION                                      8**

Concepts of National Income and measurement – GDP Growth Rate - Importance and difficulties of estimating National Income in India - Aggregate demand and aggregate supply, Macroeconomic equilibrium – Meaning of Inflation, its types causes and preventive measures.

**MODULE III MONEY, BANKING AND PUBLIC FINANCE 10**

Money – Meaning, types, functions, importance - Commercial Banks - Central Bank - Monetary Policy – meaning, objectives, Methods of Credit Control By RBI, Government Budget – Government revenue and expenditures – Fiscal policy - Its objectives, instruments and limitations - Deficit Financing - The Fiscal Responsibility and Budget Management Act, 2003 (FRBMA) – Economic Reforms in India – LPG Policy.

**MODULE IV PRINCIPLES OF MANAGEMENT AND PLANNING 8**

Nature of management and its process - Importance of Management- Functions and Principles of Management - Nature, Purpose and Kinds of Planning.

**MODULE V ENGINEERING MANAGEMENT 10**

Strategic Management-Manager and Environment - Globalization and Technology Intermediation, Corporate Social Responsibility of business - meaning, importance, arguments for and against Corporate Social Responsibility - Business Ethics- Role of Ethics in Engineering Practice- meaning, importance - State intervention in business - Pros and Cons of intervention.

**L – 45 ; Total Hours – 45**

**TEXT BOOKS:**

1. Krugman, P, Wells, R, and Graddy, K., "Essentials of Economics", Worth Publishers, 4th Edition, New York, 2016.
2. Hussain, Moon Moon, "Economics for Engineers", Himalaya Publishing House, 1<sup>st</sup> Edition, New Delhi, India, 2015.

**REFERENCES:**

1. Andrew Gillespie, "Foundations of Economics", OUP Oxford, England, 2007.
2. Acemoglu, D., Laibson, D., & List, J., "Microeconomics", Pearson Education, 2nd Edition, Boston, 2017.
3. Brinkman John , "Unlocking the Business Environment", Routledge, 1<sup>st</sup> Edition, London, United Kingdom, 2010.( ISBN 9780340942079)
4. Cleaver Tony, "Economics: The Basics", Routledge, 3<sup>rd</sup> Edition,

London, United Kingdom, 2014.

5. H. L. Ahuja, "Macroeconomics", S Chand Publishing; Twenty Edition, New Delhi, India, 2019.
6. Koutsoyiannis A, "Modern Microeconomics", Palgrave Macmillan, 2nd Edition, U.K, 2003.
7. R.A. Musgrave and P.B. Musgrave, "Public Finance in Theory and Practice" , McGraw Hill Education India, Fifth Edition, India, 2017.
8. Mell Andrew and Walker Oliver, "The Rough Guide to Economics", Rough Guide Ltd, 1<sup>st</sup> Edition, London, 2014.
9. R. Paneerselvam, "Engineering Economics", PHI Publication, 2nd Edition, New Delhi, India, 2014.
10. Robbins S.P. Decenzo David A and Coulter, "Fundamentals of Management: Essential Concepts and Applications", Pearson Education, 9<sup>th</sup> Edition, London, England, 2014.

#### **COURSE OUTCOMES:**

On successful completion of this course, students will be able to

**CO1:**interpret the forces driving demand and supply and their impact on market conditions.

**CO2:**demonstrate various dimensions of macroeconomic variables like national income, money supply, employment, etc. in analyzing the effects on business.

**CO3:**explicate the different aspect of Governmental activities and their rationality and describe how they can be pursued through fiscal and monetary policy.

**CO4:**develop skills to plan, organize, direct and control the resources of the organization for obtaining common objectives or goals.

**CO5:** augment managerial skills and adopt ethical practices in various functional areas and engineering practices.

#### **Board of Studies (BOS) :**

5<sup>th</sup>BoS of SSSH held on 29.12.2021

#### **Academic Council:**

18<sup>th</sup> Academic council held on  
24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1		H	H	M		H	H				H	H
CO2		H	M			M					H	H
CO3			M	M		H	H		H			H
CO4						M	H	H	M		M	H
CO5						M	H	H	M		M	H

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

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

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

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

**SDG 12:** Ensure sustainable consumption and production patterns.

Inclusive and equitable quality education can make a critical difference to production patterns, consumer understanding of more sustainably produced goods, promote inclusive and sustainable economic growth along with productive employment and decent work for all.

<b>SSDX 02</b>	<b>SOCIOLOGY OF SCIENCE AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 17</b>	<b>TECHNOLOGY</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

**COB1:** To recognize and define the basic concepts of society and the ways in which sociologists use these concepts in constructing explanations for individual and group problems.

**COB2:** To illustrate the convergence and divergence of sociology with engineering subjects in terms of the subject matter, nature and scope of the discipline and its approach.

**COB3:** To demonstrate the relationship between science, technology and society.

**COB4:** To understand the issues relating to science, technology and change in India both in the historical and globalization contexts.

**COB5:** To appraise the impact of science and technology on different socio-cultural institutions and processes.

### **MODULE I INTRODUCTION 8**

Sociology - Definition, scope and importance, relationship with other social sciences - Major theoretical perspectives: Functionalism, Conflict Theorizing and Interactionism - Elements of social formation - Society, Community, Groups and Association - Institutions, family and kinship, religion, education, politics - Social process - Associative Social Process - Co-operation, Accommodation and Assimilation - Dissociative Social Process - Competition and Conflict.

### **MODULE II INDIVIDUAL AND SOCIETY 9**

Culture - characteristics, functions, types, cultural lag and civilization - Socialization – process, stages, agencies and anticipatory socialization - Social Control - characteristics, importance, types and agencies - Social stratification. - Meaning, forms - caste and class.

### **MODULE III SCIENCE, TECHNOLOGY AND SOCIETY 9**

Relationship between society and science and vice-versa - Science as a social system - Norms of science - Relationship between science and technology - History of modern science in India – colonial–independence and post-independence science - Science education in contemporary India – primary level to research level - Performance of universities in the development of technology - Interrelationship between industry and



universities.

#### **MODULE IV SCIENCE, TECHNOLOGY AND SOCIAL ISSUES 10**

Technology, media, identity and global society - Conformity and deviance and role of science and technology - Technology and development issue - S&T and sustainable development -Role of science and technology in the creation of environmental crisis - Social inequality, social exclusion and digital divide - Science, technology and ethical issues -Gender and technology.

#### **MODULE V GLOBALIZATION, SCIENCE, TECHNOLOGY AND CHANGE 9**

Social Change - nature, direction, forms - Technology and rate of social change – Globalization - characteristics, historical and social context- Social consequences of science and technology on civil society - Globalization - Liberalization - Their impact on Indian science and technology - WTO and issues related to intellectual property rights - MNCs and Indian industry.

**L – 45; Total Hours – 45**

#### **TEXT BOOKS:**

1. Giddens A. "Sociology" Wiley India Pvt. Ltd 2017
2. Heald Haralambos, R.M "Sociology Themes and Perspectives", Oxford, New Delhi-92. 2014
3. Sergio Sismondo. An Introduction to Science and Technology Studies Malden: Wiley Blackwell.2010
4. R.K. Merton, Sociology of Science, Theoretical and Empirical Investigations, University of Chicago Press, 1973.

#### **REFERENCES:**

1. Atal Yogesh, "Changing Indian Society" Rawat Publications, Jaipur, 2006.
2. Bilton, T. et al "Introductory Sociology", Palgrave, New York. 2002
3. Das Gupta, Samir and "An Introduction to Sociology", Pearson, Delhi. 2012.
4. Francis Abraham M. "Contemporary Sociology: An Introduction to Concepts and Theories", New Delhi, Oxford University Press. 2014

5. Inkless, A, "What is Sociology", Prentice Hall, New Delhi. 1987
6. Tumin, Melvin M "Social Stratification", Prentice Hall, New Delhi. 1969.

### COURSE OUTCOMES:

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

**CO1:** recognize the fundamental tenets of Sociology.

**CO2:** interpret the relationship between individual and society in a sociological perspective.

**CO3:** categorize and constructively identify their own assumptions about the relationships among society, science and technology

**CO4:** appraise the dynamics of human society with special reference to the science, technology and contemporary trends of globalization.

**CO5:** able to link and reflect on current and ongoing sociological debates on development and role of technology.

### Board of Studies (BOS) :

5<sup>th</sup>BoS of SSSH held on 29.12.2021

### Academic Council:

18<sup>th</sup> Academic council held on  
24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H			H	H	M	L	H	L	
CO2			M			H	H	M	H	H	M	L
CO3			H	M	H	H	M		M	H	H	M
CO4			M			H	H	L	L	M	H	H
CO5			M			H				M		L

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

SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

To inculcate knowledge and socialize youth in building participation, institutions and partnership for inclusive development for the implementation of sustainable development goals.

<b>SSDX 03</b>	<b>INDUSTRIAL ECONOMICS AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8 and 9</b>	<b>MANAGEMENT</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

**COB1:** To provide a wholesome idea about the concept of industrial economics and identify the classifications of firms based on ownership and control.

**COB2:** To impart theoretical and analytical knowledge on the different market structures, pricing practices and government policies.

**COB3:** To equip the students with the framework that will be useful for applying economic models in business strategy, competition policy and regulations.

**COB4:** To understand the importance of Industrial Policy in the development of Industries in India.

**COB5:** To elucidate industrial growth in India by examining its performance and problems in industrial sector.

### **MODULE I INTRODUCTION TO INDUSTRIAL ECONOMICS 9**

Definition and scope of industrial economics - Concept and importance of industry; Concept and organization of a firm - Classification of firms based on ownership - sector (industries, formal vs. Informal) - size and use - based classification - Separation of ownership and control - Localization of industries .

### **MODULE II MARKET STRUCTURE 9**

Perfect Competition – Imperfect Competition: Monopoly – Monopolistic – Oligopolistic Strategy, Cartels, Cournot Kinked Demand and Price Leadership – Measurement of economic concentration – Policy against monopoly and restrictive trade practices – Competition Law – Pricing Practices: Objectives – Determinants – Pricing Methods – Government Policies and Pricing.

### **MODULE III PRODUCTION ECONOMICS AND THEORY OF FIRM 9**

Production and Production function – Types, Factor Inputs – Input-Output Analysis, Undifferentiated Products - Cournot, Stackelberg, Dominant firm model, Bertrand-Heterogeneous products - Chamberlin's small and large number case - Kinked demand curve theory - Bain's limit pricing – Production Possibility Frontier.

**9**

### **MODULE IV INDUSTRIAL POLICY**

Industrial Policy: Industrial Policy in India -1948, 1956, 1977, 1980, 1990, 1991 - Industrial Performance after Independence.

**MODULE V INDUSTRIAL GROWTH IN INDIA 9**

Trends and prospects - Public enterprises; efficiency - Productivity and performance constrain - Small scale industries: definition, role - Policy issues and performance - Capacity utilization - Industrial sickness and Exit - Technology transfer - Privatization.

**L – 45 ; Total Hours – 45**

**TEXT BOOKS:**

1. Barthwal R R “Industrial Economics: An Introductory Textbook”, New Age International Pvt. Ltd Publishers, 2017
2. P.J. Devine, N. Lee, R.M. Jones, W.J. Tyson, “An Introduction to Industrial Economics”, Routledge.2019.

**REFERENCES:**

1. Ferguson, Paul R. and Glenys J. Ferguson, “Industrial Economics - Issues and Perspectives”, Macmillan, London. 1994
2. Gregory Mankiw “Principles of Microeconomics”, Havcourt Asia Publishers, 2001.
3. Mohanty Binode Ed. “Economic Development Perspectives”, Vol. 3, Public Enterprises and Performance, Common Wealth Publishers, New Delhi, 1991
4. Mote and Paul “Managerial Economics, Tata McGraw Hill, 2001
5. Peterson and Lewis “Managerial Economics”, 4th Ed., Prentice Hall, 2004

**COURSE OUTCOMES:**

**CO1:** Develop knowledge on the concept and organization of firms and the implications of the separation of ownership and control.

**CO2:** Acquire familiarity with various market structures and formulate appropriate pricing strategies.

**CO3:** Think analytically using various economic models concerning market structures and apply them to the real world of industry.

**CO4:** To compare the various Industrial Policies introduced in India and recognize the role of these policies in making required industrial development in India.

**CO5:** Clearly diagnose and illustrate the challenges in industrial economy in India and develop effective and comprehensive solution on them.

**Board of Studies (BoS) :**

Mention details of BoS

5<sup>th</sup>BoS of SSSH held on 29.12.2021**Academic Council:**18<sup>th</sup> Academic council held on

24.02.2022

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

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

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

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

A comprehensive and holistic approach towards the way for sustainable development and economic growth through the inclusive economic strategy and thereby to reduce the poverty, hunger among people by familiarizing them industry and its importance as survival strategy for earning decent standard of living.

<b>SSDX 04</b>	<b>DYNAMICS OF INDIAN SOCIAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 10, 16</b>	<b>STRUCTURE</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **COURSE OBJECTIVES:**

**COB1:** To provide knowledge on the components of the Indian social structure.

**COB2:** To learn the nature and contemporary structure of Indian social institutions.

**COB3:** To sensitize students about social stratification in Indian Society.

**COB4:** To create awareness about the social problems occurring in contemporary India.

**COB5:** To explicate the changing institutions, the processes, the agents and the interventions that brings about change in the Indian society.

### **MODULE I INDIAN SOCIAL STRUCTURE 9**

Demographic composition - Racial, religious, ethnic and linguistic -Types of communities - rural, urban, agrarian and tribal - Social backwardness - OBC, SC, ST and EWS - Indian minorities- religious, ethnic, linguistic and LGBT.

### **MODULE II INDIAN SOCIAL INSTITUTIONS 9**

Family - types, characteristics, functions of family - Joint Family- definition features, functions of joint family , dysfunctions of joint family, disintegration of joint family – Marriage - definition, characteristics, marriage as sacrament or contract.

### **MODULE III SOCIAL STRATIFICATION IN INDIA 9**

Social stratification - Concept of hierarchy - inequality, meaning and characteristics - Social Stratification and Social Mobility - Functions of Social Stratification - Caste, definition, principles, contemporary changes, dominant caste - Caste - class interface - Religious minorities.

### **MODULE IV SOCIAL PATHOLOGY 9**

Social Problem - nature, social disorganization - Population explosion-causes, effects, relationship with development - Child Labour- causes, magnitude and consequences – Unemployment - nature, types, causes and effects - Gender issues - social status of women, violence against women and women in work place - Contemporary issues - communalism, terrorism and corruption.

**MODULE V SOCIAL CHANGE IN INDIA****9**

Socio-cultural change - Sanskritization – Westernization - Secularization, Modernization - Processes of Social change - Industrialization – Urbanization – Globalization - Social movement - concept, characteristics, functions - New social movement-Women and Environment movement.

**L – 45; Total Hours –45****TEXT BOOKS:**

1. Sharma,K.L., “Indian Social Structure and Change”, Jaipur: Rawat Publications, 2008.
2. Ahuja Ram., “Social Problems in India”, Rawat Publication: New Delhi, 2014.
3. Ahuja Ram., “Society in India”, Rawat Publication: New Delhi, 2014.

**REFERENCES:**

1. Atal Yogesh, “Changing Indian Society” Rawat Publications, Jaipur, 2006.
2. Dube S.C., “India's Changing Villages: Human Factors in Community Development”, London, Routledge and Kegan Paul, 2003.
3. Hasnain N., “Indian Society: Themes and Social Issues”, Mc Graw Hill, 2019.
4. Jayapalan, N., “Indian Society and Social Institutions” Atlantic Publishers, 2001.
5. Pandey Vinita., “Indian Society and Culture”, Rawat Publications, New Delhi, 2016
6. Rao Sankar., “Sociology of Indian Society”, S. Chand Publisher, New Delhi, 2004.

**COURSE OUTCOMES:**

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

**CO1:** explain about the social structure and social institutions that constitute society in India.

**CO2:** differentiate the various categories of inequalities and their challenges.

**CO3:** describe the social stratification and its impact in society.

**CO4:** analyze the social problems encountered in contemporary India.

**CO5:** correlate the various forms and trends of the social change in Indian society and realize the relevance of their role in bringing about development.

**Board of Studies (BoS) :**

5<sup>th</sup> BoS of SSSH held on 29.12.2021

**Academic Council:**

18<sup>th</sup> Academic council held on  
24.02.2022

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H			H	M			M		
CO2			M			M	H	L				H
CO3			M			M	H	L				H
CO4			H			H	H		M			M
CO5			H		H	M	H	M		H		H

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

SDG 10: Reduce inequality within and among countries.

SDG16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

To sensitize and impart pertinent knowledge to youths to combat the contemporary issues and challenges facing Indian society in order to remedy its social pathos and injustices in the path of achieving sustainable development in India.



## HUMANITIES ELECTIVE – II (VI Semester)

<b>SSDX 11</b>	<b>ECONOMICS OF SUSTAINABLE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 1-17</b>	<b>DEVELOPMENT</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

### COURSE OBJECTIVES:

**COB1:** To inculcate the knowledge base on sustainable development with a view to balance our economic, environmental and social needs, allowing prosperity for now and future generations.

**COB2:** To develop a capacity to undertake a theoretically grounded analysis of environment issues and identify and describe what the United Nations and other governing bodies are doing to assist in a more sustainable world.

**COB3:** To have an insight of the emerging debate about reconciling ecological sustainability with poverty alleviation in the context of globalization and development.

**COB4:** To establish a clear understanding of the policy instruments of sustainable development.

### **MODULE I                      CONCEPT OF SUSTAINABLE DEVELOPMENT                      8**

Evolution of the Concept – Rio Summit and sustainable development - various definitions of sustainable development - Components of sustainable development: Social, environmental and economic components – Sustainable Development Goals – Quality education, Gender equality, innovation and infrastructure, peace and justice - Sustainable engineering practices.

### **MODULE II                      NEED FOR SUSTAINABLE DEVELOPMENT                      6**

Need for sustainability – Global environmental challenges: population growth, resource depletion, pollution, energy use, climate change, pollution, growing water scarcity, other urban problems, loss of biodiversity, hazardous wastes disposal.

International responses to environmental challenges - Global policy such as Kyoto Protocol, Paris Agreement, Montreal Protocol, Basel Convention.

Community Participation in Sustainable Development, Common Property Resource Management, Innovation, Industry and Sustainable Development.

### **MODULE III                      GLOBALIZATION                      AND                      ENVIRONMENT                      7** **SUSTAINABILITY**

Impact of Globalization on sustainable development, Co - existence of globalization and Environment sustainability - Globalization and Global Governance.

Green economy - Renewable energy, sustainable transport, sustainable construction, land and water management, waste management.

#### **MODULE IV                      POLICIES FOR ACHIEVING SUSTAINABLE DEVELOPMENT                      9**

Principles of environmental policy for achieving sustainable development: precautionary principle and polluter pays principle – Business Charter for Sustainable Development.

Policy instruments for sustainable development: direct regulation – market based pollution control instruments such as pollution tax, subsidy, pollution permits.

**L –30 ; TOTAL HOURS – 30**

#### **TEXT BOOKS:**

1. Peter P. Rogers, Kazi F. Jalal, John A. Boyd, “An Introduction to Sustainable Development”, Glen Educational Foundation, 1<sup>st</sup> Edition, England, UK, 2008.
2. Sayer, J. and Campbell, B, “The Science of Sustainable Development: Local Livelihoods and the Global Environment” (Biological Conservation, Restoration & Sustainability), Cambridge University Press, London, 2003.

#### **REFERENCES:**

1. Anderson, David A, “Environmental Economics and Natural Resource Management”, Routledge, 3<sup>rd</sup> edition, England, UK, 2010.
2. Berck, P., “The Economics of the Environment”, New Delhi: Pearson India, 2015.
3. Karpagam M, “Environmental Economics: A Textbook.pdf”, Sterling Publishers Pvt. Ltd, New Delhi, 2021.
4. Kumar, Pushpam, “Economics of the Environment and Development”, Ane Book Publication, New Delhi, India, 2009.
5. Karpagam M and Jaikumar Geetha, “Green Management Theory and Applications”, Ane Books Pvt. Ltd, New Delhi, India, 2010.

6. Sengupta Ramprasad, "Ecology and Economics: An Approach to Sustainable Development", Oxford University Press, New Delhi, 2004.
7. Muthukrishna, S, "Economics of Environment", PHI Learning Pvt. Ltd., New Delhi, India, 2010.

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

**CO1:** Develop awareness of the ethical, economic, social and political dimensions that influence sustainable development.

**CO2:** Clearly articulate their views and beliefs with regards to environmental issues.

**CO3:** Identify and describe the major economic forces that shape our approach to the environment issues and demonstrate responsible globalization through global governance.

**CO4:** Account for strategies, international agreements and major policy instruments for a sustainable use of resources and ecosystem services.

**Board of Studies (BoS) :**

4<sup>th</sup>BoS of SSSH held on 28.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1		H	H		H	H	H		H		H	H
CO2			H			H	H		H		H	H
CO3	M	M	H			H	H		H		H	H
CO4			H			H	H	H	H		H	H

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

SDG 1: End poverty in all forms and everywhere.

SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

SDG 3: Ensure healthy lives and promote well-being for all at all ages

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

SDG 5: Achieve gender equality and empower all women and girls

SDG 6: Ensure availability and sustainable management of water and sanitation for all.

SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all.

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

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

SDG 10: Reduce income inequality within and among countries

SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable.

SDG 12: Ensure sustainable consumption and production patterns

SDG 13: Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.

SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

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.

SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

The holistic understanding of all the 17 SDGs aims to end poverty, ensure prosperity, and protect the planet.

<b>SSDX 12</b>	<b>SOCIOLOGY OF INDUSTRIAL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8, 9</b>	<b>RELATION</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

### COURSE OBJECTIVES:

**COB1:** To familiarize sociological approaches and perspectives to understand the social relationship in manufacturing industries and corporate sector.

**COB2:** To highlight the structure and functions of industrial organizations

**COB3:** To explicate the dynamics of organizational behavior, leadership and communication.

**COB4:** To provide an overview in labour legislation and labour welfare

### MODULE I INTRODUCTION 7

Sociology of Industrial relation - definition, scope and importance - Theoretical approaches- scientific management, human relations approach, theory of bureaucracy- Fordism and post-fordism - Production system- concept and characteristics of factory system - automation and rationalization -The Industrial Employment (Standing Orders) Act, 1946 Industrial conflict- strike, lockout and trade unions- Emerging role of trade unions in India.

### MODULE II INDUSTRIAL ORGANIZATION 7

Formal organization- definition, features, utility - Informal organization- definition, characteristics, types and relevance - Structure of industrial organization- features and functions of line organization, characteristics and roles of staff organization, distinction- Industrial hierarchy-white collar, blue collar, supervisors and managers.

### MODULE III DYNAMICS OF INDUSTRIAL RELATIONS 7

Group dynamics- Definition, Group behaviour model - Group decision making process, group cohesiveness - Leadership- definitions, style and effective supervision- Communication- concepts, types, model barriers - Job satisfaction- nature, employee compensation and job satisfaction. Grievance Handling and Disciplinary Action, Code of Conduct, Industrial Relations in changing scenario, Employers' organisations.

## **MODULE IV                      LABOUR LEGISLATION AND LABOUR 9 WELFARE**

**Labour Legislation**-Objectives, Principles, Classification and Evolution. International Labour Organisation. Social Justice and Labour Legislation, Indian Constitution and Labour Laws- The Factories Act, 1948, The Inter-state Migrant Workmen Act, 1979, The Contract Labour (Regulation and Abolition) Act, 1970, The Child Labour (Prohibition and Regulation) Act, 1986. Labour welfare-Concept, Scope, Types, and Principles, Industrial Health and Hygiene, Industrial Accidents and safety, Occupational Diseases. Social Security-Concept and Scope, Social Assistance and Social assurance.

**L – 30; TOTAL HOURS –30**

### **TEXT BOOKS:**

1. Mamoria ,Gankar., “Dynamics of Industrial relations”, Himalaya Publishing House,Mumbai, 2007.
2. Narender Singh ., “Industrial Sociology”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.  
  
Kumar., “Industrial Sociology”, Lakshmi Narain Agrawal Publishers, Agra, 2019.
3. SharmisthaBhattacharjee, “Industrial Sociology”, Aavishkar Publishers, Jaipur, 2016.

### **REFERENCES:**

1. Bhatnagar M., “Industrial Sociology”,S. Chand Publications, New Delhi, 2012.
2. MisraRajan., “Industrial Sociology”, University Science Press (An Imprint of Laxmi Publications Pvt. Ltd.), New Delhi, 2013.
3. Newstorm W John, “Organizational Behavior”, Mc. Graw Hill Publishing Co., New Delhi, 2006.
4. Nina, Bandlej (ed)., “Economic Sociology of Work”, Bingley: Emerald Group Publishing Ltd, 2009.
5. Richard Brown, John Child, S.R. Parker, “The Sociology of Industry”, Routledge Publisher, 2015.
6. Sushil Kumar Saxena, Satish Mittal, “Industrial Sociology”,Common

Wealth Publishers, 2012.

7. Watson, Tony, "Sociology, Work and Industry (5th edition), Oxon: Routledge, 2008.

### COURSE OUTCOMES:

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

**CO1:** Understand the sociological perspectives for dealing with social relationships in production and service organizations.

**CO2:** Have deeper knowledge in structure of authority, roles and responsibility in organizational settings.

**CO3:** Assess the role of leadership, communication and behavioral acumen to govern the organization.

**CO4:** Describe the importance of labour legislation and labour welfare

### Board of Studies (BoS) :

4<sup>th</sup>BoS of SSSH held on 28.06.2021

### Academic Council:

17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H						M	H		M
CO2						M	L	M	M		H	M
CO3			M			M		M	H	H	H	M
CO4						H						H

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

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

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

The holistic understanding of industrial relations leads to equal access to opportunity, and equal pay for work of equal value for male and female contributions is necessary for gender equality as well as for inclusive economic growth. Explore work opportunities, understand career processes and appreciate the meaning and purpose of work in people's lives which leads to decent work and safe working practices.

<b>SSDX 13</b>	<b>PROFESSIONAL ETHICS AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>HUMAN VALUES</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To render basic insights and inputs to the students to inculcate human values to grow as responsible human beings with a proper personality.

**COB2:** To create awareness on senses of engineering ethics.

**COB3:** To inculcate knowledge and exposure on safety and risk, risks benefit analysis and professional rights.

**COB4:** To instill social values and loyalty and to appreciate the rights of others

<b>MODULE I</b>	<b>HUMAN VALUES</b>	<b>7</b>
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Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

<b>MODULE II</b>	<b>ENGINEERING ETHICS</b>	<b>7</b>
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Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - Theories about right action - Self-interest - Customs and Religion - Uses of ethical theories - Valuing Time – Co-operation – Commitment.

<b>MODULE III</b>	<b>SAFETY, RESPONSIBILITIES AND RIGHTS</b>	<b>8</b>
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Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

<b>MODULE IV</b>	<b>CONTEMPORARY ISSUES</b>	<b>8</b>
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Globalisation-Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting



Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Ethics-Ethics and codes of business conduct in MNC.

**L – 30; TOTAL HOURS –30**

**TEXT BOOKS:**

1. Govindarajan M, Natarajan S, Senthil Kumar V. S., "Engineering Ethics", Prentice Hall of India, New Delhi, 2019.
2. Kiran. D R, "Professional Ethics and Human Values", Mc Graw Hill Publishers, New Delhi, 2013.
3. Naagarazan R.S., "Professional Ethics and Human Values", New Age International Publishers, New Delhi, 2006.
4. R Sangal, RR Gaur and G P Bagaria, "Foundational Course in Human Values & Professional Ethics", Excel Books, India, 2010.

**REFERENCES:**

1. Charles D. Fleddermann , "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins., "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, United States, 2000.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
6. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York, 2010.
7. Subramanian. R, "Professional Ethics - Includes Human Values", Oxford HED Publishers, 2017.\

**COURSE OUTCOMES:**

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

**CO1:** Apply moral and ethical values scrupulously that ought to guide the engineering profession.

**CO2:** Understand the ethical issues related to engineering aspects.

**CO3:** Assess safety and risk and execute risk benefit analysis.

**CO4:** Become responsible engineers, experimenters, researchers or businessmen

**Board of Studies (BoS) :**

4<sup>th</sup>BoS of SSSH held on 28.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H				H	H				M
CO2			M			M		H		H	M	
CO3			M		M	H		H				H
CO4			L				H	H	H		M	M

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

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

Holistic understanding of professional ethics explores work opportunities, understand career processes and appreciate the meaning and purpose of work in people's lives leading to a decent work and safe working practices and environments.

<b>SSDX 14</b>	<b>GENDER, TECHNOLOGY AND</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>SDG: 8</b>	<b>DEVELOPMENT</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**COURSE OBJECTIVES:**

**COB1:** To conceptualize what is gender and sex and draw a line of distinction between the two.

**COB2:** To develop students' sensibility to the difference in gender roles, responsibilities, rights and injustice.

**COB3:** To reflect critically on the ways in which new technologies have sharpened and/or blurred gender difference.

**COB4:** To develop an insight to the gender and development with the paradigm shift from time to time.

<b>MODULE I</b>	<b>UNDERSTANDING GENDER</b>	<b>7</b>
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Basic Concepts: Sex/Gender, Gender roles, Gender socialization, - Construction of Gender- Making Women, Making Men Gender stereotyping, Femininity and Masculinity, Patriarchy, Heteronormativity, LGBTIQ - Theoretical Background to gender and feminist thinking: Liberal, Radical, Marxist, Socialist, Post-modern Feminism.

<b>MODULE II</b>	<b>GENDER ROLES AND GENDER INJUSTICE</b>	<b>7</b>
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Gender Roles and Relations-Types of Gender Roles Gender Roles and Relationships Matrix. Health conditions, Sex Ratio, Education: Literacy & Gender Bias - Work Related Issues: Existing Prejudices, gender Related Violence, Gender Discrimination - Political participation: Lack of women's representation - Economic Conditions- Social Conditions: divorce, rape, domestic violence.

<b>MODULE III</b>	<b>GENDER, TECHNOLOGY AND CHANGE</b>	<b>8</b>
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A historical perspective – Technology as masculine culture – Household technology – medical technology: New Reproductive technologies – Impact of Technological Change on Women. The Digital Divide: Unequal Access, Unequal Effects – Outcome and impact of ICT's Policies and projects for women. How gender influences technologies and the social organization of scientific and technical workspaces.

<b>MODULE IV</b>	<b>GENDER AND DEVELOPMENT</b>	<b>8</b>
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Gender, Governance and Sustainable Development - Women's role in

Development - Women in Development (WID), Women and Development (WAD) - Gender and Development (GAD); Gender Mainstreaming and Gender Budgeting - Gender and Human Rights

**L – 30; TOTAL HOURS –30**

**TEXT BOOKS:**

1. Bhasin, Kamala., "Understanding Gender", New Delhi: Kali for Women, 2000.
2. John, Mary E., "Gender and Development in India, 1970-90's: Some reflections on the constitutive role of context' Chaudhuri, Maitrayee. (ed.) Feminism in India", New Delhi: Kali for women. pp. 246-258, 2004.
3. Menon, Nivedita, "Embodying the Self: Feminism, Sexual Violence and the Law" in Partha Chatterjee and Pradeep Jeganathan (ed)- Subaltern Studies XI: Community, Gender and Violence", Permanent Black and Ravi Dayal, 2000.
4. Gender and Technology: A reader ., Edited by Nina E. Lerman, Ruth Oldenziel, and Arwen P. Mohun, John Hopkins University Press, Baltimore , 2003.

**REFERENCES:**

1. Lourdes Beneria , GünseliBerik , Maria Floro ., "Gender, Development and Globalization: Economics as if All People Mattered", 2nd edition , Routledge, 2015.
2. Moser, Caroline, "Gender Planning and Development: Theory, Practice and Training", Routledge, 1993.
3. Rege, Sharmila., "Sociology of Gender: The Challenge of Feminist Sociological Knowledge", Sage publications: New Delhi, 2003.
4. Jain S.C., Women and Technology, Rawat Publication, Jaipur Begh, 1985.

**COURSE OUTCOMES:**

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

**CO1:** Distinguish important concepts related to gender in contemporary society.

**CO2:** Interpret the gender discrimination works in our society and how to counter it.

**CO3:** Illustrate how the intersection of gender and technology involves gender shaping technology and technology shaping gender.

**CO4:** Apply gender sensitive perspective on development and human rights.

**Board of Studies (BoS) :**

4<sup>th</sup>BoS of SSSH held on 28.06.2021

**Academic Council:**

17<sup>th</sup> AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H			H	H		H		H	L
CO2			H			H	M			H		L
CO3			H			H	H	H			M	H
CO4			H			H	H		H			H

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

SDG 5: Achieve gender equality and empower all women and girls

To imbibe gender concern and gender perspective in the invention, and application of technology, planning and designing production and innovating strategies for engendering gender equality.