



**Regulations 2017
Curriculum and Syllabi**

(Amendments updated upto July 2021)

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



**REGULATIONS 2017
CURRICULUM AND SYLLABI
(Amendments updated upto July 2021)**

**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 extra – curricular activities
- To make the students industry ready and to enhance their employability through training and internships.
- To improve department industry collaboration through interaction including participation in professional society activities, guest lecturers and industrial visit.

PROGRAMME EDUCATIONAL OBJECTIVES

- 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 - 2017
B.TECH. DEGREE PROGRAMMES
(With Amendments incorporated upto June 2020)
(Under Choice Based Credit System)

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 Programmelike Civil Engineering, Mechanical Engineering, etc.,
- iii) **"Course"** means theory / practical / laboratory integrated theory / mini project / seminar / internship / project and any other subject that is normally studied in a semester like Mathematics, Physics, Engineering Graphics, Fluid Mechanics, etc.,
- iv) **"Institution"** means B.S.Abdur Rahman Crescent Institute of Science and Technology.
- v) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of B.S.Abdur Rahman Crescent Institute of Science and Technology.
- vi) **"Dean (Student Affairs)"** means the Dean (Students Affairs) of B.S.Abdur Rahman Crescent Institute of Science and Technology.
- vii) **"Controller of Examinations"** means the Controller of Examination of B.S.Abdur Rahman Crescent Institute of Science and Technology who is responsible for conduct of examinations and declaration of results.

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) Candidates for admission to the third semester of the eight-semester B.Tech.programme under lateral entry scheme shall be required to have passed the Diploma examination in Engineering / Technology of the Department of Technical Education, Government of Tamil Nadu or any other examination of any other authority accepted by the Institution as equivalent thereto.

2.2 Notwithstanding the qualifying examination the candidate might have passed, 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 Mathematics, Physics and Chemistry on the standards prescribed for Ten plus Two academic stream.

2.3 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Institution 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.

B.TECH. DEGREE PROGRAMMES:

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

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 Sciences (BS)
- ii) Humanities & Social Sciences (HS)
- iii) Management Sciences (MS)
- iv) Engineering Sciences Fundamentals (ESF)
- v) Engineering Core Courses (EC)
- vi) Professional Electives (PE)
- vii) General Electives (GE)
- viii) Workshop practice, laboratory work, industrial training, seminar presentation, project work, etc.

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
- 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., of total number of credits not exceeding 26.

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

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 ordinarily 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 student).

5.2 Each semester shall consist of a minimum of 90 working days.

5.3 Semester end examination shall normally follow within a week after the last working day of the semester.

6.0 CLASS ADVISOR AND FACULTY ADVISOR

6.1 CLASS ADVISOR

A faculty member shall be nominated by the HoD 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.

6.2 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.

7.0 COURSE COMMITTEE

7.1 Each common theory course offered to more than one group of students shall have a “Course Committee” comprising all the teachers teaching the common course with one of them nominated as course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The Course Committee shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the Course Committee may also prepare a common question paper for the test(s).

8.0 CLASS COMMITTEE

A class committee comprising faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman is constituted branch wise and semester wise

8.1 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.

8.2 The composition of the class committee for each branch from 3rd to 8th 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) Faculty members of all 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

8.3 The class committee shall meet at least three times during the semester. The first meeting shall be held within two weeks from the date of commencement of classes, in which the nature of continuous assessment for various courses and the weightages for each component of assessment shall be decided for the first and second assessment. The second meeting shall be held within a week after

the date of first assessment report, to review the students' performance and for follow up action.

- 8.4 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.
- 8.5 The third meeting of the class committee, excluding the student members, shall meet within 5 days from the last day of the semester end examination to analyze the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the concerned course coordinator.

9.0 REGISTRATION AND ENROLLMENT

- 9.1 The students of first semester shall register and enroll at the time of admission by paying the prescribed fees.
- 9.2 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.

10.0 COURSE CHANGE / WITHDRAWAL

10.1 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.

10.2 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.

11.0 TEMPORARY BREAK OF STUDY FROM PROGRAMME

A student may be permitted by the Dean (Academic Affairs) to avail temporary break of study from the programme up to a maximum of two semesters for reasons of ill health or other valid grounds. A student can avail the break of study before the start of first continuous assessment test of the ongoing semester. However the total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 5.1). If any student is debarred for want of attendance or suspended due to any act of indiscipline, it shall not be considered as break of study. A student who has availed break of study has to rejoin in the same semester only.

12.0 CREDIT LIMIT FOR ENROLLMENT & MOVEMENT TO HIGHER SEMESTER

12.1 A student can enroll for a maximum of 32 credits during a semester including Redo / Pre-do Courses.

12.2 The minimum earned credit required to move to the higher semester shall be

- Not less than 20 credits, to move to the 3rd semester
- Not less than 40 credits, (20 for lateral entry) to move to the 5th semester
- Not less than 60 credits, (40 for lateral entry) to move to the 7th semester

13.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

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

Assessments	Course Coverage in Weeks	Duration	Weightage of Marks
Assessment 1	1 to 6	1.5 hours	25%
Assessment 2	7 to 12	1.5 hours	25%
Semester End Examination	Full course	3 hours	50%

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

13.3 Every practical course shall have 60% weightage for continuous assessments and 40% for semester end examination. However a student should have secured a minimum of 50% marks in the semester end practical examination for the award of pass grade.

13.4 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 component 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 component shall be through continuous assessment.

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

13.6 In the case of Industrial training, 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 organisation. The weightage for Industry internship report shall be 60% and 40% for viva voce examination.

13.7 In the case of project work, 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. 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.

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

13.9 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 be ignored.

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 Laboratory component.

14.0 SUBSTITUTE EXAMINATIONS

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

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

15.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

- 15.1** A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% (for genuine reasons such as medical grounds or representing the in approved events etc.) 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. The cases in which the student is awarded “I” grade, shall register and repeat the course when it is offered next.
- 15.2** 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 that 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 School. Thereupon, the Dean (Academic Affairs) shall announce the names of such students prevented from writing the semester end examination in each course.
- 15.3** A student who has obtained ‘I’ grade in all the courses in a semester is not permitted to move to next higher semester. Such student shall repeat all the courses of the semester in the subsequent academic year.
- 15.4** A student should register to redo a core course wherein “I” or “W” grade is awarded. If the student is awarded, “I” or “W” 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 Head of the Department / Dean of School.
- 15.5** 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 in the evening when the course is offered by the department. Marks scored in the continuous assessment during the redo classes shall be considered for grading along with the marks scored in the semester end (redo) examination. If any student obtained “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.
- 15.6** 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.

16.0 REDO COURSES

- 16.1** A student can register for a maximum of two redo courses per semester in the evening after regular college hours, if such courses are offered by the concerned department. Students may also opt to redo the courses offered during regular semesters.
- 16.2** The Head of the Department with the approval of Dean Academic Affairs may arrange for the conduct of a few courses during the evening, depending on the availability of faculty members and subject to a specified minimum number of students registering for each of such courses.
- 16.3** The number of contact hours and the assessment procedure for any redo course shall be the same as those during regular semesters except that there is no provision for any substitute examination and withdrawal from an evening redo course.

17.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

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

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

"W" denotes withdrawal from the course.

"I" denotes inadequate attendance and hence prevention from semester end examination

"U" denotes unsuccessful performance in the course.

"AB" denotes absence for the semester end examination.

- 17.2** 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.

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

17.4 Within one week from the date of declaration of result, a student can apply for reevaluation of his / her semester end theory examination answer scripts of one or more courses, on payment of prescribed fee, through proper application to Controller of Examination. Subsequently the Head of the Department/ Dean of School offered the course shall constitute a reevaluation committee consisting of Chairman of the Class Committee as Convener, the faculty member of the course and a senior member of faculty knowledgeable in that course. 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.

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

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

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

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

Where n = number of courses

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

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

"U", "I", "AB" 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

17.6 After successful completion of the programme, the Degree shall be awarded 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 semester for normal entry and 6 semesters for lateral entry
First Class	6.50 and above and completing the programme within a maximum of 10 semester for normal entry and 8 semesters for lateral entry
Second Class	Others

However, to be eligible for First Class with Distinction, a student should not have obtained 'U' or 'I' grade in any course during his/her study and should have completed the U.G. programme within a minimum period (except break of study). To be eligible for First Class, a student should have passed the examination in all the courses within the specified minimum number of semesters reckoned from his/her commencement of study. For this purpose, the authorized break of study is not counted. The students who do not satisfy the above two conditions shall be classified as second class. For the purpose of classification, the CGPA shall be rounded to two decimal places. For the purpose of comparison of performance of students and ranking, CGPA will be considered up to three decimal places.

18.0 ELECTIVE CHOICE:

18.1 Apart from the various elective courses listed in the curriculum for each branch of specialization, the student can choose a maximum of two electives from any other specialization under any department, during the entire period of study, with the approval of the Head of the parent department and the Head of the other department offering the course.

18.2 ONLINE / SELF STUDY COURSES

Students are permitted to undergo department approved online courses under SWAYAM up to 20% 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.

19.0 SUPPLEMENTARY EXAMINATION

Students of final year 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 can also apply for supplementary examination for a maximum of three courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results in both Odd and Even Semester.

20.0 PERSONALITY AND CHARACTER DEVELOPMENT

20.1 All students shall enroll, on admission, in any of the personality and character development programmes such as NCC, NSS, NSO, YRC, Rotaract, etc., and undergo related activities during the period of study.

21.0 DISCIPLINE

21.1 Every student is expected to observe disciplined and decorous behaviour both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

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

22.0 ELIGIBILITY FOR THE AWARD OF DEGREE

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

- i) successfully completed all the required courses specified in the programme curriculum and earned the number of credits prescribed for the specialization, within a maximum period of 14 semester (12 semesters for lateral entry) from the date of admission, including break of study
- ii) no dues to the Institution, Library, Hostels, etc.
- iii) no disciplinary action pending against him/her.

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

23.0 MINOR DEGREES OFFERED FOR STUDENTS ADMITTED FROM THE ACADEMIC YEAR 2020- 21

23.1 The students admitted in the following B.Tech. Programmes from the academic year 2020 – 21 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

<ul style="list-style-type: none"> • Electronics and Instrumentation Engineering 	<ul style="list-style-type: none"> • Computer Science and Engineering
<ul style="list-style-type: none"> • Information Technology 	<ul style="list-style-type: none"> • Artificial Intelligence and Data Science
<ul style="list-style-type: none"> • Computer Science and Engineering (IoT) 	<ul style="list-style-type: none"> • Computer Science and Engineering(Cyber Security)

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

Sl. No.	Minor Degree (Optional)	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 & Electronics Engg. Electronics & Instrumentation Engg.
6.	Virtual and Augmented Reality	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical & Electronics Engineering Electronics & Instrumentation Engg. Electronics & Communication Engg.
7.	Sensor Technology	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical & Electronics Engg.
8.	Robotics	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Civil Engineering Biotechnology Electrical & Electronics Engg.

		Electronics & Instrumentation Engg.
9.	3D Printing	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Biotechnology Electrical & Electronics Engg. Electronics & Instrumentation Engg. Electronics & Communication Engg.
10.	Electric Vehicles	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Civil Engineering Biotechnology Electronics & Communication Engg.
11.	Industrial Automation	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electronics & Communication Engg.
12.	GIS and Remote Sensing	Artificial Intelligence and Data Science Computer Science & Engg. (Cyber Security) Computer Science & Engineering (IoT) Computer Science & Engineering Information and Technology Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering

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

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

23.4 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.

24.0 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.

**B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE
AND TECHNOLOGY
B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
CURRICULUM & SYLLABUS, REGULATIONS 2017**

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC 1181	Differential Calculus and Geometry	3	1	0	4
2.	HS	ENC 1181/ ISC 1181/ LNC 1181/ LNC 1182/ LNC 1183	English / Arabic / Mandarin / German / Japanese	3	0	0	3
3.	BS	PHC 1182	Physics I	3	0	2	4
4.	ESF	GEC 1101	Engineering Graphics	2	0	2	3
5.	ESF	GEC 1102	Engineering Design	2	0	0	2
6.	ESF	GEC 1103	Basic Engineering Practices Laboratory	0	0	2	1
7.	EC	CSC 1151	Programming in C and C++	3	0	2	4
8.	EC	CHC 1184	Chemistry for Data Storage and Transmission	2	0	2	3
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SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC 1283	Partial Differential Equations and Transforms	3	1	0	4
2.	BS	-	Physics Elective	2	0	2	3
3.	ESF	GEC 1211	Basic Engineering Mechanics	3	1	0	4
4.	BS	GEC 1212	Environmental Studies	2	0	0	2
5.	EC	CSC 1251	Introduction to Artificial Intelligence	3	0	0	3
6.	EC	CSC 1252	Programming in Python Language	3	0	0	3
7.	EC	CSC 1253	Digital Logic Design	3	0	2	4
8.	EC	CSC 1254	Python Programming Laboratory	0	0	2	1

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SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC 2181	Statistics	3	1	0	4
2.	HS	-	Humanities Elective I	2	0	0	2
3.	HS	ENC 2181	Oral Communication	0	0	2	1
4.	EC	CSC2151	Foundations of Data Structures	3	1	0	4
5.	EC	CSC 2152	Fundamentals of Operating System	3	0	0	3
6.	EC	CSC 2153	Principles of Software Engineering	3	0	0	3
7.	EC	CSC 2154	Database Management and SQL	3	0	0	3
8.	EC	CSC 2155	Foundations of Data Structures Laboratory	0	0	2	1
9.	EC	CSC 2156	Database Management and SQL Laboratory	0	0	2	1
							22

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC2281	Probability	3	1	0	4
2.	HS	-	Humanities Elective II	2	0	0	2
3.	HS	ENC 2281	Written Communication	0	0	2	1
4.	EC	CSC 2251	Networking Methodologies	3	0	2	4
5.	EC	CSC 2252	Algorithmic Design Techniques	3	1	0	4
6.	EC	CSC 2253	Knowledge Engineering	3	0	0	3
7.	EC	CSC 2254	Data warehousing and Data Mining	3	0	0	3
8.	EC	CSC 2255	Algorithmic Design Techniques Laboratory	0	0	2	1
9.	EC	CSC 2256	Data Mining Tools Laboratory	0	0	2	1

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SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	MS	MSC 3181 MSC 3182	CEO and Leadership Training / Social Entrepreneurship	3	0	0	3
2.	GE	-	General Elective I	3	0	0	3
3.	HS	ENC3181	Communication and Soft Skill - I	0	0	2	1
4.	EC	CSC 3151	Essentials of Data Science	2	0	0	2
5.	EC	CSC 3152	Artificial Neural Networks	3	0	0	3
6.	EC	CSC 3153	Cloud Computing Services	2	0	0	2
7.	EC	CSC 3154	Data Visualization	3	0	0	3
8.	EC	CSC 3155	Pattern Recognition	3	0	0	3
9.	EC	CSC 3156	Machine Learning Techniques	3	0	0	3
10.	EC	CSC 3157	Machine Learning Laboratory	0	0	2	1
11.	EC	CSC 3158	Data Visualization Laboratory	0	0	2	1

25**SEMESTER VI**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	EF	MSC 3181 MSC 3182	CEO and Leadership Training / Social Entrepreneurship	3	0	0	3
2.	BS	MAC 3281	Statistical Methods for Data Analysis	2	0	0	2
3.	HS	ENC3281	Communication and Soft Skill - II	0	0	2	1
4.	EC	CSC 3251	Data Analytics	3	0	0	3
5.	EC	CSC 3252	IoT and Applications	3	0	0	3
6.	EC	CSC 3253	Exploratory Data Analysis	3	1	0	4
7.	EC	CSC 3254	Natural Language Processing	3	0	0	3
8.	EC	CSC 3255	Data and Network Security	3	0	0	3

B.Tech.		Artificial Intelligence and Data Science		Regulations 2017			
9.	EC	CSC 3256	Data Analytics Laboratory	0	0	2	1
10.	EC	CSC 3257	Mobile App Laboratory	0	0	2	1
							24

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	GE	-	General Elective II	3	0	0	3
2.	EC	CSC 4151	Software Project Management Techniques	3	0	0	3
3.	EC	CSC 4152	Predictive Analytics	2	0	0	2
4.	EC	CSC 4153	Deep Learning Algorithm and Architectures	3	1	0	4
5.	EC	CSC 4154	Model Deployment Laboratory	0	0	2	1
6.	EC	CSC 4155	Internship				1
7.	PE	-	Programme Elective ^{##1}				9**
							23

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	EC	CSC 4251	Project Work	0	0	24	12

Total credits – 177

* Industrial training will be undertaken during Third year summer vacation. The credit will be awarded in the 7th Semester.

ELECTIVE LIST**SEMESTER VII****Programme Elective ##1****(3+3+3*)****Elective 1**

No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	CSCX 501	IoT Architecture and Protocol	3	0	0	3
2.	PE	CSCX 502	Intelligent Information Retrieval	3	0	0	3
3.	PE	CSCX 503	Advanced SAS Programming	3	0	0	3
4.	PE	CSCX 504	Advanced Python for Datascience	3	0	0	3
5.	PE	CSCX 505	Web and Social Media Mining	3	0	0	3
6.	PE	CSCX 506	Statistics for Business Analytics	3	0	0	3
7.	PE	CSCX 507	Automata Theory	3	0	0	3
8.	PE	CSCX 508	Web and Social Media Analytics	3	0	0	3
9.	PE	CSCX 509	Advanced Artificial Intelligence Systems	3	0	0	3
10.	PE	CSCX 510	Cognitive Analytics	3	0	0	3

Elective 2

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	CSCX 511	Secure Cloud Computing	3	0	0	3
2.	PE	CSCX 512	Security Risk Assessment and Management	3	0	0	3
3.	PE	CSCX 513	Information Security	3	0	0	3
4.	PE	CSCX 514	Information Security and Legal Compliance	3	0	0	3
5.	PE	CSCX 515	Cyber Crime and Computer Ethics	3	0	0	3
6.	PE	CSCX 516	Secure Web App	3	0	0	3

B.Tech.	Artificial Intelligence and Data Science			Regulations 2017			
7.	PE	CSCX 517	Database Security and Auditing	3	0	0	3
8.	PE	CSCX 518	Block Chain	3	0	0	3
9.	PE	CSCX 519	Ethics in Data Science	3	0	0	3
10.	PE	CSCX 520	Computer Security	3	0	0	3
							3

Elective 3

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	CSCX 521	Applied Machine Learning	3	0	0	3
2.	PE	CSCX 522	Expert System	3	0	0	3
3.	PE	CSCX 523	Robotics and Intelligent Systems	3	0	0	3
4.	PE	CSCX 524	Agent Based Intelligent System	3	0	0	3
5.	PE	CSCX 525	Process Automation	3	0	0	3
6.	PE	CSCX 526	Information Technology	3	0	0	3
7.	PE	CSCX 527	Biometric Systems	3	0	0	3
8.	PE	CSCX 528	Human and Intelligent Systems	3	0	0	3
9.	PE	CSCX 529	Graph Theory and its Applications in Data Science	3	0	0	3
10.	PE	CSCX 530	Business Intelligence	3	0	0	3
11.	PE	CSCX 531	Digital Image Processing	3	0	0	3
							3

***- Student has to take either 3 Credit or 2+1 Credits**

**** - Sum of the credits of the electives**

**Physics Elective Courses
(To be offered in II Semester)**

Sl. No.	Course Code	Course Title	L	T	P	C
1.	PHCX 01	Fundamentals of Engineering Materials	2	0	2	3
2.	PHCX 02	Heat and Thermodynamics	2	0	2	3
3.	PHCX 03	Introduction to Nanoscience and Technology	2	0	2	3
4.	PHCX 04	Lasers and their Applications	2	0	2	3
5.	PHCX 05	Materials Science	2	0	2	3
6.	PHCX 06	Non-Destructive Testing	2	0	2	3
7.	PHCX 07	Properties of Matter and Acoustics	2	0	2	3
8.	PHCX 08	Properties of Matter and Nondestructive Testing	2	0	2	3
9.	PHCX 09	Semiconductor Physics and Optoelectronics	2	0	2	3

**Humanities Elective I
(To be offered in III Semester)**

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX 01	Fundamentals of Economics	2	0	0	2
2.	SSCX 02	Principles of Sociology	2	0	0	2
3.	SSCX 03	Sociology of Indian Society	2	0	0	2

Humanities Elective II
(To be offered in IV Semester)

Sl. No.	Course Code	Course Title	L	T	P	C
1.	SSCX 04	Economics of Sustainable Development	2	0	0	2
2.	SSCX 05	Industrial Sociology	2	0	0	2
3.	SSCX 06	Law for Engineers	2	0	0	2

General Elective
Group I Courses
(To be offered in V semester)

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX 101	Disaster Management	Civil
2.	GECX 102	Total Quality Management	Mechanical
3.	GECX 103	Energy Studies	Mechanical
4.	GECX 104	Robotics	Mechanical
5.	GECX 105	Transport Management	Automobile
6.	GECX 106	Control Systems	EEE
7.	GECX 107	Introduction to VLSI Design	ECE
8.	GECX 108	Plant Engineering	EIE
9.	GECX 109	Network Security	CSE
10.	GECX 110	Knowledge Management	CSE
11.	GECX 111	Cyber Security	IT
12.	GECX 112	Genetic Engineering	LS
13.	GECX 113	Fundamentals of Project Management	CBS

Sl. No.	Course Code	Course Title	Offering Department
14.	GECX 114	Operations Research	Mathematics
15.	GECX 115	Nano Technology	Physics / Chemistry
16.	GECX 116	Vehicle Maintenance	Automobile
17.	GECX 117	Fundamentals of Digital Image Processing	ECE

**Group II Courses
(To be offered in VII semester)**

Sl. No.	Course Code	Course Title	Offering Department
1.	GECX 201	Green Design and Sustainability	Civil
2.	GECX 202	Appropriate Technology	Civil / Mechanical
3.	GECX 203	Engineering System Modelling and Simulation	Mechanical
4.	GECX 204	Value Analysis and Engineering	Mechanical
5.	GECX 205	Industrial Safety	Mechanical
6.	GECX 206	Advanced Optimization Techniques	Mechanical
7.	GECX207	MATLAB Simulation	EEE
8.	GECX 208	Embedded Systems and its Applications	ECE
9.	GECX 209	Usability Engineering	CSE
10.	GECX 210	Supply Chain Management	CBS
11.	GECX 211	Systems Analysis and Design	CA
12.	GECX 212	Advanced Materials	Physics & Chemistry
13.	GECX 213	National Service Scheme	School of Humanities

Sl. No.	Course Code	Course Title	Offering Department
14.	GECX 214	Automotive Pollution and Control	Automobile
15.	GECX 215	Motor Vehicle Act, Insurance and Policy	Automobile
16.	GECX 216	Principles of Communication Systems	ECE
17.	GECX 217	Lean Management	Civil
18.	GECX 218	Spatial Data Modeling & Analysis	Civil
19.	GECX 219	Advanced Entrepreneurship	MBA
20.	GECX 220	Electric Vehicles	EEE
21.	GECX 221	Artificial Intelligence and Evolutionary Computing using MATLAB	EEE

MODULE V ORDINARY DIFFERENTIAL EQUATIONS 8+2

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

**MODULE VI APPLICATIONS OF ORDINARY DIFFERENTIAL 7+3
EQUATIONS**

Solution of Ordinary Differential Equation Related to Electric Circuits – Bending of Beams- Motion of a Particle in a resisting medium – Simple harmonic motion.

L – 45; T – 15; Total Hours –60

TEXT BOOKS:

1. Ramana, B.V, "Higher Engineering Mathematics" Tata McGraw Hill Publishing Co. New Delhi, 2006.
2. Grewal B.S., "Higher Engineering Mathematics" (43rd edition), Khanna Publishers, New Delhi, 2012.
3. John W. Cell "Engineering Problems Illustrating Mathematics" Mc Graw Hill Publishing Co., New York 1943.

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics" (5th edition) Tata Mc Graw Hill Publishing Co. New Delhi, 2012
2. Kreyszig, E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.
4. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
5. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.
6. Venkataraman, M.K., "Engineering Mathematics", Volume I, 2nd edition, National Publishing Co., Chennai, 2003.
7. James Stewart ".Calculus" (7th edition),Brooks/Cole cengagelearning,UK

OUTCOMES:

After completing the course, student will be able to

- Understand the matrix techniques and compute eigen values and eigenvectors of a given matrix.
- Do the problems based on three dimensional analytic geometry.
- Apply differential calculus in engineering problems.
- Differentiate more than one variable and their applications.
- Solve the differential equations with constant coefficient and variable coefficient.
- Form and solve differential equations.

ENC 1181**ENGLISH**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To train students to use appropriate vocabulary in academic and technical contexts.
- To facilitate students to speak effectively while exchanging ideas and making presentations.
- To develop students' listening skill for comprehending and analyzing information.
- To develop their reading skill through sub skills like skimming, scanning and critical reading of a text.
- To sharpen their academic writing skills.
- To expose them to the correct usage of language and help them to apply that knowledge appropriately.

MODULE I**8**

L: Listening for general information

S : Self Introduction, Introducing one another.

R: Predicting the content

W: Paragraph Writing

Language Focus: Affixes, Simple Present tense , Connective & Prepositions.

MODULE II**8**

L: Listening for specific information (from dialogues)

S:Exchanging opinion.

R: Skimming technical Passages

W: Argumentative Writing (using the concept of Flipped Learning), Letter to the Editor.

Language Focus: Idioms, use of Modals, Simple Past tense & use of "Wh" and question tags.

MODULE III**7**

L: Learning the ways of describing images and presenting specific information (focusing on note making)

S: Making Presentations using visuals.

R : Scanning short texts for gist of information

W: Letter of Invitation, Expository Writing

Language Focus: Homophones, Homographs, Simple Future & Collocations.

MODULE IV

7

L: Understanding prepared presentation techniques through videos

S: Short Presentations.

R: Reading for coherence and cohesion

W: Letter seeking permission for Industrial Visit

Language Focus: S-V agreement, Euphemism

MODULE V

8

L : Understanding Non- Verbal Communications while listening to narration of incidents.

S: Narrating an experience

R: Inferential Reading

W: Process Description – Transcoding a Flow chart.

Language Focus: Interchange of Active & passive voice, Impersonal Passive voice.

MODULE VI

7

L: Learning Story telling techniques (stories & visuals) through audio files

S: Discussion in groups

R: Reading for critical appreciation

W: Developing an idea, Slogan writing, Interpreting a Bar Chart.

Language Focus: If clause and phrasal verbs.

TOTAL HOURS :45

REFERENCES:

1. Carol Rosenblunperry(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 Univesity Press, India.
3. Kala, Abdul & Arun Tiwari (2004). Wings of Fire: An Autobiography (Simplified and A bridged by Mukul Chowdhri). Hyderabad Univeristy Press.
4. Sen, Leena. (2004) Communication Skills. Prentice Hall, New Delhi.
5. Matt Firth, Chris Sowton et.al. (2012). Academic English: An Integrated Skills Course for EAP. Cambridge University Press, Cambridge.

OUTCOMES:

After completion of the course, students will have the ability to

- Demonstrate their range of vocabulary in academic and technical contexts
- Exchange ideas and make presentations
- Comprehend and respond appropriately to listening tasks.
- Read a text efficiently and process information.
- Create and draft different kinds of academic documents
- Communicate effectively using grammatically correct expressions.

ISC 1181**ARABIC**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To read and write in Arabic language.
- To learn vocabulary of different fields
- To develop situational communication skills.

MODULE I PREPARATORY ARABIC**7**

Introducing Arabic Alphabets.

Listening and Reading.

Audio & Video aided listening, Tajweed listening,

Writing Arabic Alphabets (connected & unconnected).

Introducing words.

Reading simple sentences.

Learning names of the things in and around the class room.

Exercises.

MODULE II FUNCTIONAL ARABIC**7**

Listening Arabic texts, stories and action verbs

Communicating Simple sentences.

Jumla' Ismiyya and Jumla' Fi'liyya

Situational Conversation:

Greetings, Introduction.

Classroom, College, Picnic.

Dining and Kitchen.

Reading skills.

Exercises

MODULE III FUNCTIONAL ARABIC**8**

Implication of effective listening.

Audio aids.

Writing Simple sentences.

Communicating ordinal and cardinal numbers.

Situational communication:

Playground, library.

Forms of plural – Sample sentences.

Introduction to tenses.

LNC 1181	MANDARIN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To improve the proficiency of students in Mandarin language.
- To develop their knowledge of vocabulary.
- To train them in using appropriate grammatical forms during communications.
- To empower them for successful communication in social and academic contexts.
- To make them appreciate the language usage in real life situations.

MODULE I **8**

· General Introduction to Chinese · Pinyin and Tones · Introduction to the Writing System: basic strokes and stroke order · Numbers 1-100, song · Days of the Week · Months of the Year

MODULE II **8**

Chinese names and related culture · Chinese family structures and values · Greetings -Introducing Yourself · Family members · Occupations

MODULE III **7**

Languages and Nationalities · Daily Routine · Chinese breakfast · Negative Sentences and Interrogative Sentences · Asking for Personal Information · The Verb *shi* and Basic Sentence Structures

MODULE IV **7**

Answering an Affirmative-negative Question · Food and drinks · Transportation · Likes and dislikes · Adverbs *bu*, *jiu* and *dou* · Verb-absent Sentences

MODULE V **8**

Jisui and duoda Questions · S+V+O Construction · Routines and Daily Activities · Haishi Questions · Modal Verbs · Hobbies and Habits

MODULE VI **7**

Making Suggestions with *haoma* · Colors · Clothing · Body parts · Talking

about Likes and Dislikes · Measurement Words in Chinese

TOTAL HOURS :45

TEXT BOOKS:

1. Ma, Yanmin, and Li, Xinying. *Easy Steps to Chinese, Vol. 1 Textbook*. Beijing: Beijing Language and Culture University Press, 2006. Print.
2. Ma, Yanmin, and Li, Xinying. *Easy Steps to Chinese, Vol. 1 Workbook*. Beijing: Beijing Language and Culture University Press, 2006. Print.

OUTCOMES:

On completion of the course, students will be able to

- Exhibit proficiency in Chinese Language.
- Use vocabulary in appropriate contexts.
- Use appropriate grammatical forms effectively.
- Use the language in social and academic contexts.
- Appreciate the use of language forms.

LNC 1182**GERMAN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To improve the proficiency of students in German language.
- To create awareness of using vocabulary among students.
- To expose them to correct grammatical forms of the language.
- To empower them for successful communication in social and academic contexts.

MODULE I**8**

Introduction to German alphabets, phonetics and pronunciation- Introducing themselves and others using simple sentences and answer to some basic personal questions-: Introduction to different types of articles and verbs, Nouns

MODULE II**8**

Understanding and responding to everyday queries like instruction, questions, - number & gender, pronouns, present and past tense.

MODULE III**7**

Short telephone messages, requests etc., if spoken slowly and clearly-- Detailed overview of articles, adjectives with/without articles, Prepositions

MODULE IV**7**

Ask and giving directions using simple prepositions- Ability to fill basic information on forms while registering for courses / classes.

MODULE V**8**

Ability to extract and understand relevant information in a public announcement, broadcast, newspaper, radio etc-- dative & accusative

MODULE VI**7**

Ability to describe about people, work, immediate environment, education and other topics related to personal needs in a concise manner-- Understanding of matters that are familiar and are encountered regularly like instances at school, work, at public places, places of leisure etc.

TOTAL HOURS :45

TEXT BOOKS:

1. Course book : Tangram aktuell 1 – Lektion 1–4 (Kursbuch + Arbeitsbuch mit Audio-CD zum Arbeitsbuch), Rosa-Maria Dallapiazza, Eduard von Jan, Til Schön herr, Hueber Publisher, ISBN 978-3-19-001801-7
2. Practice book: Tangram aktuell 1 – Lektion 1–4 (Kursbuch + Arbeitsbuch mit Audio-CD zum Arbeitsbuch), Rosa-Maria Dallapiazza, Eduard von Jan, Til Schön herr, Hueber Publisher, ISBN 978-3-19-001801-7.

REFERENCES:

1. NETZWERK A1 TEXTBOOK, Deutsch als Fremdsprache, Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, Langenscheidt and Klett, ISBN : 9788183076968
2. STUDIO D A1 (SET OF 3 BOOKS + CD), Hermann Funk. Cornelsen, ISBN: 9788183073509
3. Willkommen! Beginner's course. Paul Coggle, Heiner Schenke. 2nd edition. (chapter 1 - 6) ISBN: 9781444165159 –
4. Willkommen! Beginner's course. Paul Coggle, Heiner Schenke. ISBN: 978-1-444-16518-0
5. An Introduction to the German Language and Culture for Communication, Updated Edition Lovik, Thomas A., J. Douglas Guy & Monika Chavez. Vorsprung -. New York, Houghton Mifflin Company, 1997/2002. ISBN 0-618-14249-5.

OUTCOMES:

On completion of the course, students will be able to

- Show their proficiency in German Language.
- Use appropriate vocabulary in real life contexts.
- Use appropriate grammatical forms while communicating with people.
- Effectively use the language in social and academic contexts.

LNC 1183**JAPANESE****L T P C**
3 0 0 3**OBJECTIVES:**

- To train students to use appropriate vocabulary in academic and technical contexts.
- To facilitate students to speak effectively while exchanging ideas and making presentations.
- To develop their reading skill through sub skills like skimming, scanning and critical reading of a text.
- To sharpen their academic writing skills.
- To expose them to the correct usage of language and help them to apply that knowledge appropriately.

MODULE I**7**

Introduction of the Japanese writing system, i.e. *Hiragana*, *Katakana* and *Kanji*, word-building, writing foreign names and loan words in Katakana.

MODULE II**8**

Oral practice of pronunciation and intonation of Japanese sounds, Japanese greetings, self introduction, identifying things, time of the day, calendar; counting using Japanese numerical classifiers; describing things;

MODULE III**7**

Making comparisons; talking of daily activities, kinship terms used for address and reference, seasons, giving and receiving, shopping; making requests, talking of one's likes and dislikes.

MODULE IV**8**

Extensive practice of basic patterns at the lower intermediate level through drills and exercises.

MODULE V**7**

Comprehension of passages in simple Japanese and writing of composition in Japanese applying lower intermediate grammatical patterns.

MODULE VI**8**

Diverse texts based on Japanese culture, customs, history, food habits, and science etc, for the development of communicative competence of students; skimming, scanning of texts with emphasis on advanced sentence patterns, grammatical structures and idiomatic phrases, reading and writing of approximately

TOTAL HOURS :45**REFERENCES:**

1. Nihongo I, Kokusaigakuyukai, and other supplementary material
2. Exercise book 1 of Nihongo 1, and other supplementary material
3. Nippon, the Land and its People & Encyclopedia of Contemporary Japanese
4. Japani: Japanese Conversation for Improving Spoken Proficiency, By P.A. George, Inoue Yoriko and Itsuko Nandi, Books Plus.
5. Chukyu Nihongo, Tokyo GaikokugoDaigaku; Nihongo II, Kokusaigakuyukai, and other supplementary material.

OUTCOMES:

After completion of the course, students will have the ability to

- Demonstrate their range of vocabulary in academic and technical contexts
- Exchange ideas and make presentations
- Comprehend and respond appropriately to listening tasks.
- Read a text efficiently and process information.
- Create and draft different kinds of academic documents
- Communicate effectively using grammatically correct expressions.

PHC 1182**PHYSICS I**

L	T	P	C
3	0	2	4

OBJECTIVES

To make students conversant with the

- basic concepts of crystal physics and its structures
- production and applications of ultrasonic waves
- study of thermal conductivities of good and bad conductors
- phenomenon of wave optics and its applications
- principle of fibre optic communication and its applications to sensors
- wave mechanics principle and its applications in electron microscopy
- green energy physics and its environmental impacts to society

MODULE I**CRYSTAL PHYSICS****8**

Crystalline and amorphous solids – Unit Cell – Seven Crystal Systems – Bravais Lattice – Miller Indices – Interplanar Spacing – Characteristics of Unit Cell - Calculation of Number of atoms per unit cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP and Diamond structures – Defects in crystals-Point defects – Edge and screw dislocations and their significance - Surface Defects.

MODULE II**ULTRASONICS AND THERMAL PHYSICS****8**

Introduction to Ultrasonics - Properties - Production methods - Magnetostriction Oscillator method- Piezoelectric Oscillator method – Detection of Ultrasonics – Thermal method – Piezoelectric method – Kundt's tube method – Applications of Ultrasonics – Acoustic Grating – SONAR – Depth of sea – Velocity of blood flow, Ultrasonic Flaw detector (qualitative).

Transmission of heat – Conduction, Convection and Radiation – Thermal Conductivity of good Conductor – Forbe's method- Thermal Conductivity of bad Conductor – Lee's Disc method.

MODULE III**APPLIED OPTICS****8**

Interference – Air Wedge – Michelson's Interferometer – Determination of wavelength of light and thickness of thin transparent sheet.

Introduction to Laser – Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism –

8. Determination of Acceptance angle and Numerical Aperture using fiber optic cable.
9. Determination of thermal conductivity of a good conductor by Forbe's method.
10. Determination of thermal conductivity of a bad conductor by Lee's disc method.
11. Determination of solar cell characteristics.

P: 30 periods

TOTAL: 75 PERIODS

REFERENCES:

1. Gaur R.K. and Gupta S.L., "Engineering Physics", 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.
2. Palanisamy P.K., Physics for Engineers, Vol1 & Vol2, 2nd Edition, Scitech Publications, 2003.
3. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co., 2010.
4. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics", W.H. Freeman, 2007.
5. Markert J.T., Ohanian. H. and Ohanian, M. "Physics for Engineers and Scientists". W.W. Norton & Co. 2007.
6. Godfrey Boyle, "Renewable Energy: Power for sustainable future", 2nd edition, Oxford University Press, UK, 2009.

OUTCOMES:

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

- understand the different types of crystal structures
- apply the concept of ultrasonic principle in engineering and medical field
- calculate thermal conductivities of good and bad conductors
- differentiate the various laser systems and its applications in engineering and medical field
- apply the principle of fibre optics for communication and sensor applications
- formulate wave mechanics principle for applications in electron microscopy
- Correlate the different renewable energy sources for societal needs.
- To complement the knowledge acquired in the theory class.
- To correlate the experimental results for application.

GEC 1101	ENGINEERING GRAPHICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To introduce the students of all engineering programs, the basic concepts of engineering drawing, which is the basic communication medium for all engineers
- To provide practical exposure on important aspects like drawing analytic curves, orthographic projections, section of solids, development of surfaces, isometric projection, perspective projection and free hand drawing.
- To introduce computerized drafting.

MODULE I BASICS AND ENGINEERING CURVES 10

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

Conic sections: ellipse, parabola, hyperbola.

Special curves: cycloid, epicycloid, hypocycloid and involutes.

MODULE II ORTHOGRAPHIC PROJECTION 8

Orthographic projection – first angle, second angle, third angle and fourth angle projections –setup - assumptions, principle. Free hand sketching of orthographic views of simple machine parts as per first angle projection. Orthographic projection of points in all quadrants. Some commands and demonstration of drafting packages.

MODULE III PROJECTION OF STRAIGHT LINES AND PLANES 10

Projection of straight lines in first quadrant – true length and true inclinations – Rotating line and trapezoidal methods –traces of straight line.

Projection of plane lamina in first quadrant and its traces

MODULE IV PROJECTION OF SOLIDS 10

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

MODULE V SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12

Section of solids: prism, pyramid, cone, cylinder, and sphere – sectional view –

true shape of section Solids in simple position and cutting plane inclined to one reference plane only.

Development of surface of truncated solids: prism, pyramid, cone cylinder – frustum of cone, pyramid and simple sheet metal parts.

MODULE VI PICTORIAL PROJECTIONS 10

Isometric projection: Isometric scale – isometric axes- iso sheet - Isometric projection and view of prism, pyramid, cylinder, cone, frustums, truncated solids and simple products

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

L – 30; P – 30; TOTAL HOURS – 60

TEXT BOOKS:

1. N.D. Bhatt, 'Engineering Drawing' Charotar Publishing house, 53rd Edition, (2014)

REFERENCES:

1. K.V. Natarajan, 'A text book of Engineering Graphics', Dhanalakshmi publishers, Chennai. (2009)
2. Venugopal. K, and V. Prabhu Raja, Engineering Graphics, New Age International (P) Ltd., Publication, Chennai. (2011)

OUTCOMES:

- Students should be able to read the specifications and standards of technical drawing and able to draw conic sections and special curves.
- Students should be able to understand the insight of orthographic projection and to draw the various views of orthographic projection of a point and various components.
- Students should be able to draw the orthographic views of straight lines and plane figures.
- Students should be able to draw the orthographic views of simple solids.
- Students should be able to draw the sections of solids and development of solid surfaces.
- Students should be able to draw the isometric and perspective projection of simple solids and components.

GEC 1102	ENGINEERING DESIGN	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To understand the role of design in Engineering
- To understand the basic design concepts
- To understand the role of innovation in design

MODULE I DESIGN AS A CENTRAL ACTIVITY IN ENGINEERING 08

Product design – products and processes – product design methodology Design of systems; Software design

MODULE II NEED ANALYSIS AND CONCEPT DEVELOPMENT 07

Voice of customers – product specification - need analysis Bench marking Product architecture – concept generation and evaluation;

MODULE III CASE STUDIES IN ENGINEERING DESIGN 08

Product design – process design; system design; software design -Ergonomics – usability

MODULE IV INNOVATION AND DESIGN 07

Role of innovation in Engineering – incremental changes and systemic changes; scientific approach to driving innovation – case studies.

TOTAL HOURS – 30**REFERENCES:**

1. Clive L. Dym and David C. Brown, "Engineering Design: Representation and Reasoning", 2nd Edition, Cambridge University Press, New Delhi, 2011.
2. Daniel G. Dorner, G. E. Gorman and Philip J. Calvert, "Information Needs Analysis: Principles and practice in information organizations", Published by Faced Publishing, London. 2015.
3. Cliff Matthews, "Case Studies in Engineering Design", John Wiley & Sons Pvt. Ltd, New York, 1998.
4. Bengt-Arne Vedin, "The Design-Inspired Innovation Workbook", World Scientific, 2011.
5. Navi Radjou, Jaideep Prabhu and Simone Ahuja, "Jugaad Innovation", Published by Random House India, 2012.

OUTCOMES:

The students will be able to

- Apply the basic knowledge of design in engineering products / process / service.
- Analyse the problems and give innovative solutions.
- Correlate the basic knowledge of design in the real world problems.
- Apply innovative approaches to engineering design.

GEC 1103	BASIC ENGINEERING PRACTICES	L	T	P	C
		0	0	2	1

LABORATORY**OBJECTIVES:**

- To provide a practical exposure to basic engineering practices like carpentry, fitting, plumbing, welding and making of simple electrical and electronic circuits
- To have an understanding on the use of various tools, instruments and methods
- To enable the students to appreciate the practical difficulties and safety issues

CIVIL ENGINEERING PRACTICE

1. Study of plumbing in general household and industrial systems
2. Making a small window frame with Lap and Mortise & Tenon Joints
3. Introduction to power tools

MECHANICAL ENGINEERING PRACTICE

1. Fabrication of a small Table frame with Butt, Lap and Fillet Joints
Machining of a simple component like a table weight using lathe
2. Mold preparation for simple component

ELECTRICAL ENGINEERING PRACTICE

1. Comparison of incandescent, Fluorescent, CFL and LED lamps.
2. Study of Protection Circuits (small relay, fuse, MCB, HRC, MCCB, ECCB).
3. Familiarization of households Electrical Gadgets (Iron Box, Wet Grinder).
4. Understanding of Domestic and Industrial wiring.
5. Earthing and its significance.
6. Troubleshooting in Electrical Circuits.
7. Study of inverter fed UPS/Emergency lamp

ELECTRONICS ENGINEERING PRACTICE

1. Identifications symbolic representation of active and passive electronic components
2. Soldering and tracing of electronic circuits and checking its continuity
3. Assembling of A.C. to D.C, D.C to A.C. Circuits in bread Board and Mini project.

TOTAL HOURS – 30

OUTCOMES:

Upon the completion of the course, students should be able to

- Appreciate the practical skills needed even in making of simple objects, assemblies and circuits
- Attend minor defects especially in items used in day to day life
- Aware of the safety aspects involved in using tools and instruments

CSC 1151**PROGRAMMING IN C AND C++****L T P C****3 0 2 4****OBJECTIVES :**

- To learn advance structured and procedural programming.
- To improve the concepts of decision making in branching and Looping skills.
- To provide code organization and functional hierarchical decomposition with using complex data types.
- To implement the basic concepts of object oriented programming using C++ concepts.
- To learn how to design C++ classes for code reuse.
- To explain the concepts of inheritance and polymorphism.

MODULE I OVERVIEW , OPERATORS AND EXPRESSIONS 07

History of C – Importance of C – Structure of C - C Tokens – Keywords and Identifiers – Constants – Variables – Data Types – Declaration of Variables – Declaration of Storage class – Assigning Values to Variables - Operators- Arithmetic, Relational, Logical, Assignment, Increment, Conditional, Bitwise, Special, Expressions - Arithmetic, Evaluation, Type Conversion

MODULE II DECISION MAKING AND ARRAY 08

Decision Making and Branching: Simple if Statements, The if.. else statements, Nesting of if...else statements, The else...if Ladder, Switch Statements, goto Statements, Looping: While, Do...While, For Statements, Array: One-Dimensional, Two-Dimensional, Multi-Dimensional Array.

MODULE III USER-DEFINED FUNCTIONS AND POINTERS 08

Definition of Functions - Return Values and Their types – Function Calls – Function Declaration – Category of Functions – Nesting of Functions – Recursion – Understanding Pointers – Accessing the Address of a Variable – Declaring Pointer Variable – Chain of Pointers – Pointer Expressions.

MODULE IV OVERVIEW OF C++ 08

OOP Paradigm – Basic Concepts – Benefits of OOP – Applications of OOP - Simple C++ Program – Structure of C++ Programs – Tokens – Keywords – Identifiers and Constants – Basic Data types – Operators in C++ - Control

Structures.

MODULE V CLASSES AND OBJECTS 07

Specifying a Class – Defining Member Functions - C++ Program with Class – Nesting of Member Functions – Static Data Members – Static Member Functions - Arrays of Objects – Friendly Functions – Constructors and Destructors

MODULE VI OPERATOR OVERLOADING AND INHERTANCE 07

Operator Overloading : Unary Operators, Binary Operators –Rules for Overloading Operators – Inheritance: Defining Derived Classes – Single inheritance – Multilevel Inheritance – Multiple Inheritance – Hierarchical Inheritance – Hybrid Inheritance – Virtual Base Classes.

L-45 ;P-30;TOTAL HOURS-75

REFERENCES :

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.
3. TanmeyKasby, “An Object Oriented Programming with C++”, First Edition, ISBN:9788193270646, 2019.
4. E.Balagurusamy , “Object Oriented Programming with C++”, McGraw Hill Education, Seventh edition, ISBN-10: 1-25-902993-X, ISBN-13: 978-1-25-902993-6, 2017.

OUTCOMES:

Students who complete this course will be able to

- Impart knowledge on all types of operators and expressions.
- Bring out the essentials of Decision Making.
- Ability to design and develop the concept of pointers and functions.
- Apply an object-oriented approach to develop applications in various complications.
- Implement constructors and member functions using object oriented programming.
- Analyze how inheritances promote code reuse in object oriented programming.

CHC 1184	CHEMISTRY FOR DATA STORAGE AND TRANSMISSION	L T P C 2 0 2 3
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OBJECTIVES :

To make the students conversant with

- Types of electrodes, determination of pH, emf measurement,
- Classifications of electrical and electronic materials and applications of materials for robotics
- The basic analytical techniques like colorimetry, UV-Visible, IR spectroscopy.
- The synthesis, properties and applications of nanomaterials.

MODULE I ELECTROCHEMISTRY AND SENSORS 8

Types of electrodes (principle and working): gas (SHE), metal/metal ion electrode, metal-metal insoluble salt (calomel electrode), ion-selective (glass electrode) – pH determination using glass electrode standard cell (Weston-cadmium) – EMF measurement (problems). Chemical sensors: characteristics – classes of chemical sensors – biochemical sensors – multisensory arrays – electronic gadgets

MODULE II ELECTRICAL AND ELECTRONIC MATERIALS 7

Importance of electrical and electronic materials, scope and classification of electrical and electronic materials; types, properties and applications of conductive and semiconducting materials, dielectric materials types, properties and applications; magnetic materials types and applications; specific materials for electrical, electronic, computers, instruments, robotic and other applications (eg networking of networks and connecting devices, pendrive (flash memory) materials, materials used in robotic construction); recent advances and emerging trends in electrical and electronic materials (few examples).

MODULE III ANALYTICAL TECHNIQUES 8

Spectroscopy: (relation between interaction of electromagnetic radiation with matter and type of spectroscopy), electromagnetic spectrum – types of transitions – types of spectra (atomic and molecular) – Beer-Lamberts law (problems) – principles, instrumentation (block diagram only) and applications of colorimetry (includes estimation of concentration of a solution) – UV-Vis spectrophotometer – IR and Radio wavespectroscopy

MODULE IV NANOMATERIALS AND DATA STORAGE MATERIALS

7

Introduction – distinction between molecules, bulk materials and nanoparticles – classification based on dimension with examples – synthesis:– top-down approach: chemical vapour deposition, laser ablation, electrodeposition – bottom-up approach: precipitation, colloidal method, thermolysis (hydrothermal and solvothermal) – Carbon nanotube, Quantum dots, Surface Plasmon resonance, Superparamagnetic particles, Characterization and applications of nanomaterials. data storage and magnetic hard disk and devices. Nano materials to enhance the life time and storage of CD,DVD, BD, metallic nanoparticle-graphene and graphene oxide nanoparticles

PRACTICAL

1. Determination of EMF of the cell.
2. Determination of pH using glass electrode
3. Measurement of dielectric constant of materials
4. Emerging trends in electrical and electronic materials
5. Verification of Beer-Lamberts law and estimation of metal ion concentration of the given sample.
6. Applications of radiowaves
7. Synthesis of nanomaterials by sol-gel method.
8. Synthesis of quantum dots by colloidal method.

REFERENCES:

1. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", WileyIndia Ltd., New Delhi,2011.
2. G.A. Ozin and A.C. Arsenault, "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, Thomas Graham House, Cambridge,2005.
3. P.C Jain & Monica Jain, Engineering Chemistry Dhanpatrai PublishingCompany (P) Ltd., New Delhi (2013).
4. S SUMare& S S Dara, A text Book of Engineering Chemistry, S. Chand & Company Ltd, New Delhi,2014.
5. KM Gupta and Nishu Gupta, "Advanced electrical and electronic materials: process and applications, Wiley-Scrivener,2015.

OUTCOMES:

Upon completion of this course students will be able to-

1. Identify the fundamentals of electronics required in designing the devices.
2. Design and demonstrate the materials for robotics.
3. Demonstrate the role of spectroscopy in designing radiation based devices.
4. Integrate the properties of nanomaterials for their applications in data collection and its storage.

SEMESTER II

MAC 1283	PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The aims of this course are to

- Familiarize in solving partial differential equation of first, second and higher orders.
- Introduce basics and engineering applications of Fourier series, Laplace Transform, Fourier Transform and Z- Transform.

MODULE I PARTIAL DIFFERENTIAL EQUATIONS 8 + 2

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations – Lagrange's linear equation – Linear partial differential equations of second and higher order with constant coefficients.

MODULE II FOURIER SERIES 8+2

Fourier Series and Dirichlet's conditions - General Fourier series - Half range Fourier series - Parseval's identity - Harmonic Analysis.

MODULE III FOURIER TRANSFORMS 7+3

Fourier integral theorem (without proof) - Fourier transform pair - Fourier Inverse Transform – Properties - Convolution theorem - Parseval's identity.

MODULE IV APPLICATIONS OF FOURIER SERIES AND FOURIER TRANSFORMS 7+3

Applications of Fourier series and Fourier Transform to solution of PDEs having constant coefficients with special reference to Heat & Wave equations, Discrete & point Spectrum and Single pulse.

MODULE V LAPLACE TRANSFORM 8+2

Introduction to Laplace transform - Existence of Laplace Transform - Properties of Laplace Transforms - Initial & Final Value Theorems - Inverse Laplace Transform - Convolution Theorem – Circuits to signal square wave: Integral equations with

unrepeated complex factors – Damped forced vibrations: repeated complex factors – Resonance - Solution of differential equations

MODULE VI Z – TRANSFORM

7+3

Introduction and Definition of Z-transform - Properties of Z- Transform - Convolution Theorem of Z-Transform - Inverse Z–transform - Convolution Theorem of Inverse Z-Transform - Formation of difference equations - Solving Difference Equations using Z-Transform.

L – 45; T – 15; TOTAL HOURS –60

TEXT BOOKS:

1. Kreyszig .E., “Advanced Engineering Mathematics“, 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Grewal B.S., “Higher Engineering Mathematics”, 42nd edition, Khanna Publishers, New Delhi, 2012.
3. Ramana, B.V, “Higher Engineering Mathematics” Tata Mc Graw Hill Publishing Co. New Delhi, 2006.

REFERENCES:

1. Veerarajan.T., “Engineering Mathematics“, 5th edition, Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Peter V. O'Neil, “Advanced Engineering Mathematics”, 7th edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, “Advanced Engineering Mathematics”, 4th edition, Jones and Bartlett publishers, Sudbury, 2011.
4. Alan Jeffrey, “Advanced Engineering Mathematics”, Academic Press, USA, 2002.

OUTCOMES:

After completing the course, student will be able to

- Solve the partial differential equations.
- Derive a Fourier series of a given periodic function by evaluating Fourier coefficients.
- Apply integral expressions for the forward and inverse Fourier transform to a range of non-periodic waveforms.
- Solve wave equation and heat flow equation.
- Solve ordinary differential equations using Laplace transform.
- Solve difference equation using Z-transform.

GEC 1211	BASIC ENGINEERING MECHANICS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To impart knowledge about the basic laws of statics and dynamics and their applications in problem solving
- To acquaint both with scalar and vector approaches for representing forces and moments acting on particles and rigid bodies and their equilibrium
- To give an exposure on inertial properties of surfaces and solids
- To provide an understanding on the concept of work energy principle, friction, kinematics of motion and their relationship

MODULE I VECTOR APPROACH TO MECHANICS 07

Introduction - Units and Dimensions- Vectors – Vectorial representation of forces and moments –Vector Algebra and its Physical relevance in Mechanics - Laws of Mechanics – Parallelogram and triangular Law of forces -Lame’s theorem, Coplanar Forces – Resolution and Composition of forces- Equilibrium of a particle.

MODULE II EQUILIBRIUM OF PARTICLE 06

Forces in space - Equilibrium of a particle in space - Equivalent systems of forces – Principle of transmissibility – Single equivalent force

MODULE III EQUILIBRIUM OF RIGID BODY 06

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

MODULE IV PROPERTIES OF SURFACES 08

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 by using standard formula – second and product moments of plane area – Physical relevance - Rectangle, triangle, circle from integration - T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia- Mass moment of Area

GEC 1212**ENVIRONMENTAL STUDIES****L T P C****2 0 0 2****OBJECTIVES**

To make the student conversant with the

- various natural resources, availability, utilisation and its current scenario
- different ecosystems, energy transfer, values, threats and conservation of biodiversity
- levels of different pollutants and its impact and the causes and effects of natural disasters
- impacts of human population, impact assessment, human rights and environmental acts and sustainable development

MODULE I NATURAL RESOURCES**8**

Land resources: land degradation, soil erosion and desertification - Forest resources: use and over-exploitation, deforestation - Water resources: use and over-utilisation of surface and ground water, conflicts over water (inter-state and international), dams (benefits and problems), water conservation (rainwater harvesting and watershed management) - Mineral resources: use and exploitation, environmental effects of extracting and using mineral resources, mining - Food resources: world food problems, changes in land use by agriculture and overgrazing, modern agriculture and its effects, fertilizer and pesticide problems, water logging and salinity - Energy resources: increasing energy needs, renewable and non-renewable, use of alternate energy sources.

MODULE II ECOSYSTEM AND BIODIVERSITY**8**

Ecosystem- energy flow in the ecosystem - food chains, food webs and ecological pyramids - characteristics, structure and function of (a) Terrestrial ecosystems (forest, grassland, desert) and (b) Aquatic fresh water ecosystems (pond, lake, river) (c) Aquatic salt water ecosystems (ocean, estuary) - ecological succession.

Biodiversity - genetic, species and ecosystem diversity – hot-spots of biodiversity – biogeographic classification of India -endangered, endemic, extinct and invasive species of India - red data book - values of biodiversity: consumptive, productive, social, ethical, aesthetic and option values - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - conservation of biodiversity: in-situ and ex-situ conservation of biodiversity

MODULE III ENVIRONMENTAL POLLUTION AND NATURAL DISASTER 8

Definition, 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 hazards - ill-effects of fireworks and upkeep of clean environment - solid waste management: types (urban, industrial, biomedical and electronic wastes), collection, processing and disposal (incineration, composting and land-fill) - natural disaster and management: flood, cyclone, drought, landslide, avalanche, volcanic eruptions, earthquake and tsunami.

MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES 6

Population and population growth, population variation among nations, population explosion, family welfare programme.

Human health: air-borne, water borne diseases, infectious diseases, risks due to chemicals in food and environment.

Sustainable development - environmental legislation and laws: water act, air act, wildlife protection act, forest conservation act, environment protection act - environmental impact assessment, steps in EIA - human rights - women and child welfare.

Case studies related to current situation**L – 30; TOTAL HOURS – 30****TEXT BOOKS**

1. ErachBharucha, 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, Sri Krishna Publications, Tamil Nadu, India, 2015.
4. Raman Sivakumar, Introduction to Environmental Science and Engineering, McGraw Hill 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, New Age International Pvt Ltd., New Delhi, India, 2009.

REFERENCES

1. Masters G.M., Introduction to Environmental Engineering and Science, Prentice Hall, New Delhi, 1997.
2. Henry J.G. and Heike G.W., Environmental Science and Engineering, Prentice Hall International Inc., New Jersey, 1996.
3. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. Boston, USA, 2016.

OUTCOMES

The student will be able to

- predict the scenario of various natural resources and suggest remedies to curb the exploitation of these resources.
- identify food chain and web and its role in various ecosystems, assess the impacts on biodiversity and provide solutions to conserve it.
- analyse the impacts of pollutants in the environment and propose suitable method to alleviate the pollutants and the natural disasters.
- assess on the impact of human population and the health related issues and the ethics to be followed for sustainable life.

CSC 1251	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

OBJECTIVES :

This course aims

- To impart concepts of the Artificial Intelligence.
- To learn the methods of solving problems using Artificial Intelligence.
- To introduce the fundamental concepts of Expert Systems.
- To study about problem solving techniques using various AI based algorithms.
- To understand various knowledge representation techniques.
- To provide knowledge of AI systems and its variants.

MODULE I INTRODUCTION 08

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.

MODULE II KNOWLEDGE REPRESENTATION 08

Knowledge representation issues – Predicate logic – logic programming – Sematic nets - Frames and inheritance - constraint propagation –Representing Knowledge using rules – Rules based deduction system.

MODULE III REASONING UNDER UNCERTAINTY 08

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.

MODULE IV PLANNING AND LEARNING 07

Planning - Introduction, Planning in situational calculus - Representation for planning – Partial order planning algorithm- Learning from examples- Discovery as learning – Learning by analogy – Explanation based learning –Introduction to Neural nets – Genetic Algorithms.

MODULE V EXPERT SYSTEMS**07**

Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition - Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells.

MODULE VI APPLICATIONS**07**

Principles of Natural Language Processing Rule Based Systems Architecture - AI application to robotics - Current trends in Intelligent Systems.

L-45 ; TOTAL HOURS-45**REFERENCES :**

1. Daugherty, Paul R., and H. James Wilson. Human+ machine: reimagining work in the age of AI. Harvard Business Press, 2018.
2. Prateek, J.: Artificial Intelligence with Python, pp. 14–16. Packt Publishing, Birmingham (2017).
3. Husain, Amir. The sentient machine: The coming age of artificial intelligence. Simon and Schuster, 2017.
4. Kaplan, Jerry. Artificial intelligence: What everyone needs to know. Oxford University Press, 2016.

OUTCOMES:

Upon the completion of this course, the students will be able to meet the following outcomes:

- An ability to analyze a problem, identify and define the computing requirements appropriate to its solution.
- An ability to design, implement and evaluate a system / computer based system process, component or program to meet desired needs
- An ability to identify, formulate and solve engineering problems using the concepts of Artificial Intelligence.
- Design and conduct experiments as well as analyze and interpret data using Machine Learning Algorithms
- An ability to use current techniques and skills necessary for computing and engineering practice
- Get familiarized with the tools mandatory for handling problem solving techniques

CSC 1252	PROGRAMMING IN PYTHON LANGUAGE	L	T	P	C
		3	0	0	3

OBJECTIVES :

- Describe the core syntax and semantics of Python programming language.
- Discover the need for working with the strings and functions.
- Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
- Indicate the use of modules, packages and built-in functions to navigate the file system.
- Infer the Object-oriented Programming concepts in Python.
- To develop the ability to write database applications in Python.

MODULE I BASICS OF PYTHON 08

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 08

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- Functions

MODULE III STRINGS AND FUNCTIONS 07

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 07

Classes and objects- Attributes- Inheritance- Overloading- Overriding- Data hiding

MODULE V MODULES AND PACKAGES 08

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 VI WORKING WITH DATA IN PYTHON**07**

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**REFERENCES :**

1. Larry Lutz, "Python for Beginners: Step-By-Step Guide to Learning Python Programming", CreateSpace Independent Publishing Platform, First edition, ISBN- 1717410588, 9781717410580, 2018
2. Nicholas Ayden, "Python Programming", Independently Published, First Edition, ISBN- 1707051933, 9781707051939, 2019.
3. Michał Jaworski, Tarek Ziadé, "Expert Python Programming", Packt Publishing Ltd., Third Edition, ISBN-9781789808896, 2019.

OUTCOMES:

Students who complete this course will be able to

- Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.
- Express proficiency in the handling of strings and functions.
- Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets.
- Identify the commonly used operations involving file systems and packages.
- Develop cost-effective robust applications using the latest Python trends and technologies.
- Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python.

CSC 1253**DIGITAL LOGIC DESIGN****L T P C****3 0 2 4****OBJECTIVES :**

- Expose Boolean algebra, Boolean functions and realization of functions with basic gates.
- To design combinational and sequential circuits.
- To implement the K-map method for logical operation.
- To use the concepts of state and state transition for analysis and design of sequential circuits.
- Use the functionality of flip-flops for analysis and design of sequential circuits
- To learn register-transfer logic for Digital Systems.

MODULE I BINARY SYSTEMS AND LOGIC GATES 07

Digital Computers and Digital Systems - Binary Numbers – Number base conversion – Complements - Binary Codes – Binary Logic - Boolean Algebra and Theorems - Boolean functions - Canonical and Standard forms - Digital Logic Gates.

MODULE II GATE-LEVEL MINIMIZATION 08

The K-Map method-Two variable-Three variable-Four Variable -Product of sums simplification - Don't care conditions- NAND and NOR implementation - Other two level implementation – Tabulation Method.

MODULE III COMBINATIONAL LOGIC 08

Combinational circuits - Design procedures - Adder, Subtractor - Decimal adder – Binary Multiplier - Magnitude Comparators - Encoder - Decoder - Multiplexer – Demultiplexer.

MODULE IV SYNCHRONOUS SEQUENTIAL LOGIC 08

Sequential Circuits - Latches and Flip Flops - Analysis of clocked sequential circuits- State Table - State Reduction Diagram and State Assignment – Design Procedure.

MODULE V REGISTERS, COUNTERS, MEMORIES 06

Registers - Shift Registers - Ripple Counters - Synchronous Counters - Other Counters - HDL for Registers and Counters - Memory - Read-Only Memory –

Programmable Logic Array - Programmable Array Logic - Sequential Programmable Devices.

MODULE VI PROCESSOR AND CONTROL LOGIC DESIGN 08

Processor Organization – Arithmetic Logic Unit – Design of Arithmetic Circuit – Design of Logic Circuit – Design of Arithmetic Logic Unit – Design of shifter – Design of Accumulator – Control Organization – Hard-wired Control – Microprogram Control – Control of Processor Unit.

L – 45; P – 30; TOTAL HOURS-75

REFERENCES :

1. Sonali Singh, "Digital Logic Design: Learn the Logic Circuits and Logic Design", Illustrated Edition, BPB Publication, ISBN:978-81-8333-5805, 2018.
2. M. Morris Mano "Digital Logic and Computer Design", Pearson Education, 2nd Edition, ISBN : 978-93-325-4252-5, 2016.
3. M. Morris Mano and Michael D.Ciletti, "Digital Design with an introduction to the Verilog HDL", Pearson Education, Fifth Edition, ISBN-13: 978-0-13-277420-8, 2012.
4. Charles H.Roth, Jr., Kinney, "Fundamentals of Logic Design", Brooks Publications, Seventh Edition, ISBN-13 :978 -1-133-62848-4, 2013.
5. Donald D.Givone, "Digital Principles and Design", Tata McGraw-Hill, Third Edition, ISBN 0072525037, 2003.

OUTCOMES :

Students who complete this course will be able to

- Define different number systems, binary addition and subtraction, 2's complement representation and its operations
- Demonstrate the use of Karnaugh map and perform an algorithmic reduction of logic functions.
- Define the following combinational circuits: buses, encoders/decoders, (de)multiplexers, exclusive-ORs, comparators, arithmetic-logic units; and to build simple applications
- Evaluate the concepts of state and state transition for analysis and design of sequential circuits.
- Design and develop simple projects Using flip flops after state machine analysis.
- Expose the basics of processor and control logic design in digital systems.

CSC 1254	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES :

- Interpret the use of procedural statements like assignments, conditional statements, loops and function calls.
- Learn the syntax and semantics and create the functions in Python.
- Infer the supported data structures like lists, dictionaries and tuples in Python.
- Illustrate the application of matrices and regular expressions in building the Python programs.
- Discover the use of external modules in creating excel files and navigating the file systems.
- 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 Datastructures
3. String Manipulation and Functions
4. Classes and Objects
5. Overloading
6. Overriding
7. Inheritance
8. Information hiding
9. Modules and Packages
10. File handling
11. Loading Data with Pandas-Numpy

P- 30**TOTAL HOURS – 30****OUTCOMES :**

Students who complete this course will be able to

- 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.
- Examine Python syntax and semantics and be fluent in the use of Python flow control and functions.

- Examine the core data structures like lists, dictionaries, tuples and sets in Python to store, process and sort the data.
- Interpret the concepts of Object-oriented programming as used in Python using encapsulation, polymorphism and inheritance, polymorphism and inheritance.
- Discover the capabilities of Python regular expression for data verification and utilize matrices for building performance efficient Python programs.
- Identify the external modules for creating and writing data to excel files and inspect the file operations to navigate the file systems.

SEMESTER III

MAC 2181	STATISTICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

- To represent data by graphical methods
- To understand the fundamentals of Statistics
- To introduce Correlation and carry out Regression analysis
- To perform hypothesis testing for large sample
- To perform hypothesis testing for small sample
- To perform Analysis of Variance

MODULE I	DATA DESCRIPTION	8+2
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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	8+2
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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	8+2
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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 FOR LARGE SAMPLE	8+2
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Concept of population and sample, Random sample, Methods of taking a simple random sample-Large sample tests (test for an assumed mean and equality of two population means with known S.D.).

ENC 2181	ORAL COMMUNICATION	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To expose students to a range of professional contexts through podcasts for learning appropriate expressions.
- To train them in making poster presentations.
- To enable them to make effective business presentations.
- To help them learn persuasive and negotiation skills.
- To train them to debate on issues of current relevance
- To train them to participate in group discussions on current affairs

MODULE I **4**

Orientation to the Importance of Oral Communication -- Verbal and non-verbal communication -Paralinguistic features.

One-minute presentations (using Audacity/Voicethread) – Just a minute (JAM) on random topics

MODULE II **4**

Negotiating and persuading through effective arguments – to arrive at a conclusion (pair-work)

Understanding Negotiation, persuasion and marketing skills through Podcasts

Listening to short conversations and monologues for understanding real life conversations

MODULE III **4**

Making Poster presentations on current issues

Understanding nuances of making effective presentations (TED Videos)

MODULE IV **6**

Deliberation on social and scientific issues – Debates (focus on rebuttal skills and deconstructing arguments)

Viewing videos on debates (NDTV Discussions)

MODULE V **6**

Discussing social issues or current affairs in groups

Viewing group discussions and listening for specific information

MODULE VI**6**

Making full length presentation (through Voicethread) with the focus on one's career plans and prospects (discipline specific)

Listening to interviews for understanding speakers' perception (on industry related issues)

P – 30; TOTAL HOURS –30**REFERENCES:**

1. Hancock, Mark (2012). *English Pronunciation in Use*. Cambridge University Press, UK.
2. Anderson, Kenneth & et.al (2007). *Study Speaking: A Course in Spoken English for Academic Purposes* (Second Edition). Cambridge University Press, UK.
3. Hurlock, B.Elizabeth (2011). *Personality Development*. Tata McGraw Hill, New York.
4. Dhanavel,S.P (2015). *English and Soft Skills*. Orient Blackswan, Chennai.
5. Whitby, Norman (2014). *Business Benchmark: Pre-Intermediate to Intermediate*. Cambridge University Press, UK.

OUTCOMES:

On completion of the course, students will be able to

- Listen to business conversations and do related tasks.
- Deliver effective poster presentations.
- Make effective business presentations.
- Use persuasive and negotiating skills for justifying arguments.
- Participate effectively in debates.
- Speak English intelligibly, fluently and accurately in group discussions.

CSC 2151	FOUNDATIONS OF DATA STRUCTURES	L	T	P	C
		3	1	0	4

OBJECTIVES :

- To introduce the fundamental concept of data structures and to emphasize the importance of data structures in developing and implementing efficient algorithms.
- To explore different methods used to manipulate these data structures and examine the efficiency.
- To learn the advantages and applications of different data structures and select appropriate data structures based on requirements.
- To study the various searching & sorting techniques.
- To impart the knowledge of computer algorithms, as well as analysis of sophisticated algorithms.
- To learn the appropriate dynamic programming techniques to solve real world problems.

MODULE I	INTRODUCTION	0
		8

Linear Data Structures - Linked Lists - Singly Linked List, Doubly Linked List, Circular Linked List – Implementation - Applications. Stacks - Implementation using Arrays and Linked Lists - Applications in Recursion. Queues - Implementation and Applications.

MODULE II	NON LINEAR STRUCTURES	0
		8

Binary Trees – Properties - Basic tree traversals - Binary tree - Priority queues - Binary search tree -AVL trees - Graphs -Data Structures for Graphs, Types of Graphs - Directed Graphs, Weighted Graphs - Basic definitions and properties of Graphs, Graph Traversal - Breadth First Search and their applications.

MODULE III	SORTING AND SEARCHING	0
		8

Hash tables - Collision - Chaining - Linear Probing - Quadratic Probing - Double Hashing - Basic sorting and searching algorithms.

MODULE IV	BRUTE FORCE AND DIVIDE-AND-CONQUER	0
		7

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.

MODULE V DYNAMIC PROGRAMMING**0
7**

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.

MODULE VI GREEDY TECHNIQUE**0
7**

Greedy Technique – Container loading problem – Prim’s algorithm and Kruskal’s Algorithm – 0/1 Knapsack problem, Optimal Merge pattern – Huffman Trees.

L – 45; T – 15 ; TOTAL HOURS – 60**REFERENCES :**

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest, and C.Stein ,”Introduction to Algorithms”,Pearson Education, Third edition, ISBN: 9780262033848, 2009.
2. Langsam, Augenstein and Tanenbaum ,”Data structures using C and C++”,Second edition, PHI, ISBN:9788131518236, 2010.
3. R.F.Gilberg and B.A.Forouzan,”Data structures: A Pseudocode Approach with C”, 2nd edition, Cengage Learning, ISBN: 9788131503140,2005.

OUTCOMES :

Students who complete this course will be able to

- Write programs that use arrays, records, linked structures, stacks, queues, trees, and graphs
- Compare alternative implementations of data structures with respect to performance
- Analyze the impact of various implementation and design choices on the data structure performance
- Demonstrate the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms.
- Evaluate the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize dynamic-programming algorithms, and analyze them.
- Compare different greedy techniques. Pick an appropriate technique for a design situation.

CSC 2152	FUNDAMENTALS OF OPERATING SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To learn the objectives, functions and architecture of operating systems.
- To impart the knowledge of process management concepts.
- To study the functions of process concurrency and synchronization.
- To represent the role of operating system in memory management.
- To conceive the functions of operating system in file management.
- To compare the design features of various operating system.

MODULE I	INTRODUCTION	0
		5
	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	0
		8
	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 interprocess communication; deadlocks	
MODULE III	MEMORY MANAGEMENT	0
		8
	Physical and virtual address space; memory allocation strategies –fixed and variable partitions, paging, segmentation, virtual memory	
MODULE IV	FILE AND I/O MANAGEMENT	0
		8
	Directory structure, file operations, file allocation methods, device management	
MODULE V	PROTECTION AND SECURITY	0
		8
	Policy mechanism, Authentication, Internal access Authorization	
MODULE VI	CASE STUDY	0
		8
	Windows Operating systems, Linux operating systems, Operating system for hand held devices.	
	L – 45;	TOTAL HOURS – 45

REFERENCES :

1. Abraham Silberschatz, Peter B galvin , Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley & Sons Inc, ISBN:978-1-118- 06333-0, 2013.
2. Deitel H M, "Operating Systems", 3rd Edition, Pearson education India, New Delhi, ISBN : 978-0-536-21215-3, 2007.
3. Dhamdhare D M, "Operating Systems", 1st reprint, Tata McGraw Hill, New Delhi, ISBN 978-0-07-295769-3, 2006.

OUTCOMES :

Students who complete this course will be able to

- Analyze the functioning of operating systems.
- Compare the performance of various process scheduling algorithms.
- Evaluate the implementation of processes and problems related to process synchronization
- Interpretthe management of resources like memory , I/O devices can be managed
- Assess the features of various file management techniques
- Compile the features of various operating systems

CSC 2153**PRINCIPLES OF SOFTWARE ENGINEERING**

L	T	P	C
3	0	0	3

OBJECTIVES :

- To learn the process involved in developing software.
- To guide the significance of requirements gathering.
- To represent the requirements collected using the various design models
- To explore the various testing methodologies.
- To know reengineering and reverse engineering concepts.
- To learn object oriented model and represent domain constraints on the objects and on their relationships.

MODULE I SOFTWARE PROCESS AND PROCESS MODELS 09

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 Methodologies – Scrum – Introduction.

MODULE II REQUIREMENTS ENGINEERING 07

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

MODULE III DESIGN 08

Design Concepts - Design Model - Architectural Design – Component Level Design - User Interface Design - Pattern-Based Design.

MODULE IV SOFTWARE TESTING 07

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 MAINTENANCE AND REENGINEERING 07

Software Maintenance – Supportability – Reengineering – Software Reengineering – Reverse Engineering – Restructuring – Forward Engineering – Risk Management

MODULE VI OBJECT ORIENTED SOFTWARE ENGINEERING 07

Object Oriented Modelling – Object Oriented Software Life Cycle Models – Object Oriented Analysis – Object Oriented Design.

L – 45; TOTAL HOURS – 45**REFERENCES :**

1. Roger S. Pressman, "Software Engineering – A Practitioners Approach", Mc Graw Hill, Eighth Edition, ISBN -13: 9789339212087, 2017.
2. Ian Sommerville, "Software Engineering", Addison-Wesley, 9th Edition, ISBN-13: 978-0137035151, 2016.
3. Jibitesh Mishra, Ashok Mohanty, "Software Engineering", Pearson Education, ISBN 978-81-317-5869-4, 2016.

4. Yogesh Singh, Ruchika Malkotra, "Object Oriented Software Engineering", PHI Learning Private Ltd. First Edition, ISBN – 978-81-203 – 4535 – 5, 2012.

OUTCOMES :

Students who complete this course will be able to

- Choose the appropriate process model for the software project to be developed.
- Collect requirements based on the application.
- Design frameworks for the application to be developed.
- Apply the appropriate testing strategies to the developed products.
- Modify and improve the deployed product based on user requirements.
- Develop structured set of simple user defined classes using object oriented principles.

CSC 2154	DATABASE MANAGEMENT AND SQL	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To learn the fundamentals in database management systems and their design aspects.
- To impart the knowledge of relational database design and the query processing strategies.
- To know about the transaction management and design related to physical database.
- To adapt database in developing an application as well as exploring big data analytics and blockchain databases.
- To provide the knowledge on parallel and distributed databases.
- To explore advanced topics related to database systems.

MODULE I INTRODUCTION OF DATABASE SYSTEMS AND DESIGN 08

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 AND STRATEGIES IN QUERY PROCESSING 07

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

MODULE III TRANSACTION MANAGEMENT AND PHYSICAL DATABASE DESIGN 09

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

MODULE IV APPLICATION DEVELOPMENT AND BIG DATA ANALYTICS 07

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

MODULE V PARALLEL AND DISTRIBUTED DATABASES 07

Database System Architectures – Parallel and Distributed Storage – Parallel and Distributed Query Processing – Parallel and Distributed Transaction Processing.

MODULE VI ADVANCED DATABASES 07

Formal Relational Query Languages – Advanced Relational Databases Design – Object-based Databases – XML - Information Retrieval – PostgreSQL – NoSQL - mongoDB

L – 45; TOTAL HOURS – 45

REFERENCES :

1. Avi Silberschatz, Henry F. Korth, S. Sudarshan, "Database System Concepts", McGraw-Hill, ISBN 9780078022159, Seventh Edition, 2019.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson, Seventh Edition, ISBN-13: 978-0-13-397077-7, 2016.
3. C.J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Mc Graw Hill, ISBN-13: 978-0321197849, 2006.

4. 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
5. Brad Dayley, "NoSQL with MongoDB in 24 Hours", Sams, ISBN 9780672337130, 2014

OUTCOMES :

Students who complete this course will be able to

- Demonstrate the basic concepts and the design aspects in database management systems.
- Write SQL queries in designing the relational database design and apply the strategies related to query processing.
- Analyze the transaction process and physical storage management.
- Deploy database in an application and acquire knowledge on big data analytics and blockchain databases.
- Comprehend on parallel and distributed databases.
- Solve real world problems by identifying and applying appropriate database systems.

CSC 2155	FOUNDATIONS OF DATA STRUCTURES LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To demonstrate functions of linear structures
- To illustrate functions of non-linear structures
- To demonstrate recursion
- Understand which algorithm or data structure to use in different scenarios
- Choose the appropriate data structure.
- Choose algorithm design method for a specified application.

Design problems and implement solutions for the following concepts:

1. Arrays
2. Stacks
3. Queues
4. Recursion
5. Binary Trees
6. Binary Search Trees
7. Sorting – Searching
8. Priority queue implementation
9. AVL Balanced Trees
10. Graphs
11. Travelling Salesman Problem (Brute-force Technique)
12. Floyd's algorithm (Dynamic Programming)
13. Huffman Trees (Greedy Technique)

P - 30**TOTAL HOURS – 30****OUTCOMES :**

Students who complete this course will be able to

- Write programs that use arrays, linked structures, stacks, queues
- Select the data structures that efficiently model the information in a problem.
- Assess efficiency trade-offs among different data structure implementations or combinations.
- Implement and know the application of algorithms for sorting.
- Design programs using tree structures, AVL tree.
- Apply different algorithmic technique to solve classic problems

CSC 2156**DATABASE MANAGEMENT AND SQL LABORATORY**

L	T	P	C
0	0	2	1

OBJECTIVES :

- To study the concepts of database system.
- To explore the schema definition on database creation.
- To implement the complex SQL queries.
- To demonstrate cursors, triggers, procedure and functions in PL/SQL.
- To design and implement integrity constraints in databases.
- To deploy the database in a real time application.

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

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

P-30**TOTAL HOURS – 30****OUTCOMES :**

Students who complete this course will be able to

- Identify the schema for the database.
- Design complex SQL queries for retrieving the results.
- Apply constraints to the database.
- Design and implement the features of database.
- Implement database concepts in real time applications.
- Analyse the problem and identify the appropriate solution for it.

SEMESTER IV**MAC 2281****PROBABILITY**

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

- To understand the fundamental knowledge on probability
- To understand one dimensional random variable, Expectation and Inequalities
- To discuss discrete distributions and their uses
- To discuss continuous distributions and their uses
- To evaluate Generating functions
- To learn joint density function and use of generating functions

MODULE I BASIC PROBABILITY CONCEPTS 9+3

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.

MODULE II RANDOM VARIABLES 9+3

Random Variables and Expectation of a random variable – Moment inequalities (Tchebyshev, Markov, Jensen)-Continuous random variables -Functions of a random variable

MODULE III Discrete Distributions 9+3

Discrete distributions- Uniform, Bernoulli, Binomial, Geometric, Negative binomial, Hypergeometric and Poisson distribution.

MODULE IV CONTINUOUS DISTRIBUTIONS

Continuous distributions- Uniform, Gamma, exponential, chi-square, Beta, Normal distribution, Lognormal distribution, t-distribution, F-distribution. Deriving the Poisson process, Random number simulation

MODULE V GENERATING FUNCTIONS 9+3

Probability generating functions- Moment generating functions- moments- Cumulant generating functions- Linear functions

MODULE VI JOINT DISTRIBUTIONS 9+3

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”, 7th Edition. Prentice Hall

International, New Jersey 1999

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

REFERENCES:

- 1 S.C Gupta, V.K Kapoor, "Fundamentals of mathematical statistics ", Sultan chand and sons , New Delhi, 2019
- 2 S.C Gupta, V.K Kapoor, "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" Springer text series, 2nd Edition, 2013
- 4 Chin Long Chiang " Statistical Methods of Analysis " World Scientific Books, 2003

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

- Evaluate Probability and apply Baye's theorem
- Evaluate upper and lower bounds using moment inequalities
- Calculate probabilities and expected values for discrete distributions
- Calculate probabilities and expected values for continuous distributions
- Derive probability generating function, moment generating function, cumulant generating function and cumulants, and use them to evaluate moments.
- Analyse jointly distributed random variables and conditional distributions, and use generating functions

ENC 2281	WRITTEN COMMUNICATION	L	T	P	C
		0	0	2	1

OBJECTIVES:

- To help students identify content specific vocabulary and learn its usage.
- To expose them to reading for specific purposes, especially in professional contexts.
- To expose them to the process of different kinds of formal writing.
- To help them learn corporate correspondence for different purposes.
- To train them in preparing effective applications with résumé
- To make them write different types of reports.

MODULE I **4**

Introduction - process of writing – Fundamentals of academic and professional writing – Understanding short, real world notices, messages, etc.

MODULE II **4**

Reading industry related texts (ex. Manufacturing, textile, hospitality sector etc.) for specific information.

Writing Instructions and recommendations

MODULE III **6**

Understanding format and conventions of writing email, memo, fax, agenda and minutes of the meeting.

Writing email, memo, fax, agenda and minutes of the meeting for various purposes (industry specific)

MODULE IV **6**

Viewing letter of application and Résumé, letter calling for an interview, letter of inquiry and Promotional letter

Writing Functional résumé and letter of application using Edmodo,

MODULE V **6**

Viewing a Video and reading a case study (industry specific) – collaborative writing using Edmodo – reading and information transfer

Writing reports- Survey, feasibility and progress – exposure to discipline specific reports

MODULE VI**4**

Writing Statement of purpose (Higher Education)-- Justifying and writing about one's preparedness for job (Statement of Purpose highlighting strengths and weaknesses) – Peer evaluation skills through Edmodo.

P – 30; Total Hours –30**REFERENCES:**

1. Riordan, D (2013). *Technical Report Writing Today*. Cengage Learning, 10th edition. USA.
2. Oliu, W. E., Brusaw, C.T., & Alred, G.J.(2012). *Writing that Works: Communicating Effectively on the Job* . Bedford/St. Martin's. Eleventh Edition.
3. Garner, B.A. (2013). *HBR Guide to Better Business Writing (HBR Guide Series)*. Harvard Business Review Press. USA.
4. Sharma, R.C. & Krishna M. (2002). *Business Correspondence and Report Writing*. Tata MacGraw – Hill Publishing Company Limited, New Delhi.
5. Macknish, C. (2010). *Academic and Professional Writing for Teachers*. McGraw-Hill Education. USA.
6. Whitby, Norman (2014). *Business Benchmark: Pre-Intermediate to Intermediate*. Cambridge University Press, UK.

OUTCOMES:

On completion of the course, the students will have the ability to

- Identify content specific vocabulary and also use them in appropriate contexts.
- Demonstrate reading skills with reference to business related texts.
- Draft professional documents by using the three stages of writing.
- Create different types of documents for various corporate correspondences.
- Write effective letter of applications, résumé and statement of purpose.
- Write business related reports efficiently.

OUTCOMES :

Students who complete this course will be able to

- Understand the basis and structure of the network layer and protocols.
- Identify the different types of network devices and their functions within a network.
- Detect the reason for the data loss and delay in the network.
- Specify the shared communications protocols and interface methods used by hosts in a communications network
- Choose the appropriate transport protocol for any network application.
- Apply security algorithms in various environments for network security.

CSC 2252**ALGORITHMIC DESIGN TECHNIQUES**

L	T	P	C
3	1	0	4

OBJECTIVES :

- To analyze the complexity of data structures and associated methods.
- To understand the correctness and analyze complexity of algorithms .
- To understand various algorithmic design techniques and solve classical problems.
- To assess the Brute-Force and Divide and conquer techniques.
- To understand and apply Dynamic programming and greedy techniques.
- To apply algorithms to solve real world problems.

MODULE I INTRODUCTION 08

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 08

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 08

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 07

The Simplex Method – The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs, Stable marriage Problem.

MODULE V LIMITATIONS OF ALGORITHMIC POWER 07

Lower – Bound Arguments – P, NP NP- Complete and NP Hard Problems. Backtracking – n-Queen problem – Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound – LIFO Search and FIFO search – Assignment problem – Knapsack Problem – Travelling Salesman Problem –Approximation Algorithms for NP-Hard Problems – Travelling Salesman problem – Knapsack

MODULE VI ALGORITHMIC FRAMEWORKS**07**

External-Memory Algorithms -Parallel Algorithms - Online Algorithms - Case studies

L – 45; T-15 ; TOTAL HOURS – 60**REFERENCES :**

1. Rajesh K.Shukla, Analysis and Design of Algorithms, Wiley India Private Limited, ISBN : 978–81-265-5477-5, 2015.
2. Michael T Goodrich and Roberto Tamassia, Algorithm Design Foundations - Analysis and Internet Examples, John Wiley & Sons,Third Edition, ISBN: 9788126509867,2007.
3. 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.

OUTCOMES :

Students who complete this course will be able to

- Analyze the time complexity and space complexity measures of algorithms.
- Asses the various algorithmic design techniques and solve classical problems.
- Compare and contrast the dynamic programming and greedy techniques.
- Apply iterative models in problem solving.
- Predict the limitations of Algorithm design and minimize their impact during application.
- Solve real world problems by identifying and applying appropriate algorithm analysis techniques.

CSC 2253	KNOWLEDGE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To recognize the differences between data, information and knowledge.
- To study the various techniques for knowledge based systems.
- To represent object oriented knowledge.
- To learn expert systems and use of languages for Artificial Intelligence.
- To gain knowledge about knowledge based system design.
- To know the applications of knowledge engineering.

MODULE I INTRODUCTION 07

Data, Information and Knowledge - Knowledge Engineer Skills - Knowledge-Based Systems Introduction – Knowledge Reuse – Knowledge Engineering Techniques.

MODULE II KNOWLEDGE ACQUISITION 08

Knowledge and Intelligence – Applications of Knowledge Reuse – Issues Regarding Liability of Knowledge – Ethical Model of Knowledge – Stages, challenges, Approaches of Knowledge Acquisition – Techniques.

MODULE III KNOWLEDGE REPRESENTATION 07

Roles of Knowledge Representation – Classification of Knowledge – Relationship Between Attributes – Object Oriented Knowledge Representation – Advanced Knowledge Representation Techniques – Frames – Conceptual Dependencies.

MODULE IV KNOWLEDGE MANIPULATION 09

Knowledge Organization – Indexed Organization – Knowledge Management Platform – Reasoning – Knowledge Codification – Testing of Knowledge Based Systems – Role of Knowledge Management Systems.

MODULE V KNOWLEDGE BASED SYSTEM DESIGN 07

Semantic Web - Role Played by Social Networking Site – Representation of Design Knowledge - Knowledge Acquisition and Documentation Structuring - UML Notations in KADS.

MODULE VI APPLICATIONS 07

Case Study - Knowledge Engineering and Artificial Intelligence – Applications – Knowledge System Building Tool Study.

L – 45; TOTAL HOURS – 45

REFERENCES :

1. Ela Kumar, “Knowledge Engineering”, I.K International Publishing, First Edition,

ISBN 978-93-85-909-27-6, 2018.

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

OUTCOMES :

Students who complete this course will be able to

- Analyze the knowledge engineering
- Recognize the different stages of knowledge based systems.
- Evaluate the knowledge based system.
- Design knowledge acquisition system for an expert system.
- Construct semantic web.
- Analyze case study for real time applications of knowledge engineering and artificial intelligence.

CSC 2254	DATA WAREHOUSING AND DATA MINING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the data patterns and preprocessing in mining large databases
- To be familiar with the Data warehouse and Data Mining architecture and its Implementation.
- To understand the various Data classification Methods.
- To perform data clustering and outlier detection of data.
- To explore the various data stream mining methodologies.
- To understand how to implement of a web mining algorithm.

MODULE I INTRODUCTION 08

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 07

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 07

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 07

The Stream Data Model- Sampling Data in a Stream- Filtering Streams- Counting Distinct Elements - Moments of Streams- Decaying Windows

MODULE VI Web Mining 07

Information Retrieval Models- Text and Web Page Pre-Processing - Web Spamming- Social Network Analysis- HITS Algorithm- A Basic Crawler Algorithm- Document Sentiment Classification .

L – 45; TOTAL HOURS – 45

REFERENCES:

4. Parteek Bhatia, "Data Mining and Data Warehousing Principles and Practical Techniques", 1st Edition, Cambridge University Press, 2019, ISBN: 9781108727747
5. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets, Cambridge University Press 2019, ISBN: 9781316638491.
6. Alex Berson and Stephen J. Smith, Data Warehousing, Data Mining and OLAP, Tata McGraw – Hill Edition, 35th Reprint 2016. ISBN 13: 9780070587410.
7. Bing Liu, "Web Data Exploring Hyperlinks, Contents, and Usage Data", 2nd Edition, Springer, 2011, ISBN 978-3-642-19459-7
8. Jiawei Han & Micheline Kamber, "Data Mining – Concepts and Techniques", 3rd Edition, ISBN 978-0-12-381479- Morgan Kaufmann Publishers, Elsevier, 2012.
9. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", 1st Edition, ISBN: 1-892095-02-5, Pearson education, 2006

OUTCOMES:

Students who complete this course will be able to

- Distinguish between database and data warehouse
- Collect data based on the type of the application and its need.
- Design an application based on the appropriate classification model.
- Apply clustering and outlier detection in mining and warehouse techniques through the use of different tools
- Apply stream Data Mining principles and techniques for real time applications.
- Construct effective web crawling and spamming methods for improving web mining.

CSC 2255	ALGORITHMIC DESIGN TECHNIQUES LABORATORY	L	T	P	C
		0	0	2	1

OBJECTIVES :

- To conceive the importance of time and space complexity
- To explore real time problems and find the way to implement the solution.
- To study the divide and conquer algorithms and analyze the computational complexity
- To learn the various sorting techniques.
- To impart the knowledge of searching technique and analysis the time complexity.
- 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:
 - Insert a node
 - Delete a node
 - 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****OUTCOMES :**

Students who complete this course will be able to

- Design and evaluate the various sorting algorithms.
- Analyze the best-case, average-case and worst-case running times of algorithms using asymptotic analysis.
- Compare and evaluate the standard design techniques of algorithms and know the conditions in which particular technique is to be applied.
- Design efficient algorithms for problems encountered in common engineering design situations.
- Implement the approximation algorithms and randomized algorithms to address the limitations on the time complexity.
- Evaluate the limitations on the time complexity of algorithms.

CSC 2256**DATA MINING TOOLS LABORATORY**

L	T	P	C
0	0	2	1

OBJECTIVES:

- To familiar with the algorithms of data mining.
- To be acquainted with the tools and techniques used for Knowledge Discovery in databases.
- To implement web mining and text mining
- To Understand the data sets and data preprocessing.
- To implement searching and sorting techniques.
- 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

P-30**TOTAL HOURS – 30****OUTCOMES:**

Students who complete this course will be able to

- Apply data mining techniques and methods to large data sets.
- Use data mining tools to solve the complex problems.
- Demonstrate the classification, clustering and etc. in large data sets
- Develop and implement the data mining algorithm for the application.
- Compare and contrast the various classifiers.
- Implement DataStream mining and explore the various operations.

SEMESTER V

MSC 3181	CEO AND LEADERSHIP TRAINING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course aims at

- Bringing about positive transformation in students' attitude.
- Building unique leadership competencies that would ensure successful transition of students across all career stages.
- Sensitizing students to identify their strengths & weakness and training them to deal with it.
- Assisting students in enhancing their expressive ability and inducing a high level of self-confidence to manage both business and emotions
- Training students to become more adaptable and flexible to changing business environment

MODULE I INTRODUCTION TO LEADERSHIP 12

Leadership concept - meaning, definitions, importance of leadership, leadership traits. Leadership functions- general functions, listening, observing, managing and decision making. Components of leadership - leaders, followers and situation. Leadership theories – Trait theory, Skills theory, Style theory, Situational theory, Transformational theory, Transactional theory, Path Goal Theory and LMX. Assessing emotional intelligence and exploring the capabilities and inherent traits through psychometric tests - Multi factor leadership questionnaire and personal reflections

MODULE II LEADERSHIP STYLE AND COMMUNICATION 8

Leadership styles-visionary, Coaching, Affiliative, Democratic, Pacesetter, Commanding, Transformational, Transactional. Autocratic, Participative, Laissez-Faire Leader versus Managers. Leadership communication - Rationale, tactic, assertive, formal, informal, communication in crisis- leadership and negotiations, Leadership Presentations-convincing and impressive style

MODULE III LEADERSHIP ROLES 8

Facets of leadership- Leader as an individual – personality and leadership, values, attitudes and ethics of a leader. Leader as a relationship builder- empowering people to meet higher order needs, initiating organization wide motivational

programs, involvement with all stakeholders- focusing on organization growth. Leader as an inspirer- motivation and leadership, recognizing and appreciating contributions, empowering others to lead Leader as an innovator –leader’s role in shaping culture and values in an organization. Leader as a Liaison- Leader as team player.

MODULE IV LEADERSHIP CHALLENGES AND STRATEGIES 9

Challenges in leadership: Perception of organization culture and values, interpreting the power dynamics in the organization, establishing work life balance. Bad leadership – Reasons and impact. -Case Study of Marissa Mayer-Yahoo.Inc Organizational transformation through efficient leaders-Case study of Apple Inc. Blue Ocean Leadership-Steps to Blue ocean Leadership-Four Pillars of Blue Ocean leadership-Blue Ocean leadership grid.

MODULE V LEADERSHIP AND CEO TRAINING 8

Leader as a CEO: Traits of a successful CEO, Key responsibilities of a CEO, the path to be a CEO ,Training on Board Room Discussions, Meeting the CEO –Live sessions with industry CEO’s. Requirements of Leadership: - Cognitive skills, Interpersonal skills, Business skills, Strategic skills. Role of Emotional Intelligence in taking up key-positions in the organization.

MODULE VI TEACHING PEDAGOGY

Nurturing – Based on the identified strengths and weaknesses, training will be given to enhance the strengths and overcome the weakness.

Assessment - Continuous evaluation will be effected through group discussions, oratory assignments and situational enactments. Pre-and post-training assessment through peer reviews and faculty feedback.

Sustained development – Training will be imparted for self-development and monitoring of leadership skills to ensure sustained applicability of the skills learnt.

Total Hours –45

REFERENCES:

1. Andrew J DuBrin. “Leadership: Research Findings, Practice, and Skills”, 8th Edition, South-Western College Pub, 2015.
2. Yukl G , “Leadership in Organisations”, 8th Edition, Pearson Education, 2013.
3. Richard L Daft , “Leadership”, 5th Edition, South Western Cengage Learning

2012.

4. Stephen P. Robbins and Timothy A. Judge. "Organizational Behaviour", 15th Edition, New Delhi: Pearson, 2013.
5. Fred Luthans, "Organizational Behavior, An Evidence Based Approach", 12th Edition, New Delhi: McGraw Hill Education, 2013.
6. Emotional Intelligence, Why it can matter no more than IQ by Daniel Goleman (include a book) Publisher: Bloomsbury Publishing India Private Limited; Latest edition (2017)
7. Primal Leadership: Unleashing the Power of Emotional Intelligence by Prof Daniel Goleman , Richard Boyatzis and McKee ,Harvard Business Review Press.

Recommended Readings:

1. Jim Collins, (2001). "Good To Great: Why Some Companies Make the Leap...And Others Don't", Random House Publishers India Pvt.Ltd, New Delhi.
2. George, B. with Sims, P. True North: Discover Your Authentic Leadership, The Times Group Books; First edition (1 October 2015)
3. Kim, W. C., & Mauborgne, R. A. (2014). Blue ocean strategy, expanded edition: How to create uncontested market space and make the competition irrelevant. Harvard business review Press.
4. Leadership Wisdom by [Robin Sharma](#) Jaico Publishing House;

OUTCOMES:

The students will be able to

- Explore through self-introspection one's own leadership style, their strength and weakness
- Gain self confidence to lead a team in the organization
- Realize the role of leadership in making or breaking of an organization
- Acquire the practice of self introspection and development of leadership competencies thorough continuous efforts
- Manage their own emotions as well as other resulting in successful relationship building with all stakeholders

MSC 3182	SOCIAL ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fit between individual and their entrepreneurial ambitions.
- To identify the customers and find a problem worth solving.
- To create a business model for solving the problems of customer, forming solution and present the Business Model Canvas
- To develop a solution for customers' problem and analyze the problem solution fit & product market fit.
- To build and demonstrate a Minimum Viable Product (MVP) for startup.
- To analyze and understand the impact of social entrepreneurship on society and cases.

MODULE I SELF & OPPORTUNITY DISCOVERY 9

Finding the flow, Effectuation, Entrepreneurial Style, Business Opportunities, Problem Identification, Design Thinking, Potential solutions, Presentation of the problem- Case Study.

MODULE II CUSTOMER , SOLUTION AND BUSINESS MODEL 9

Customers and Markets, Identification of Customer Segment, Niche Segment, Customers Jobs, Pain and Gain, Early Adopters, Value Proposition Canvas, Basics of Business Model and Lean Canvas, Risk and Assumptions.

MODULE III VALIDATION AND MONEY 9

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 TEAM BUILDING AND MARKETING 7

Shared Leadership, Hiring, Fitment , Team Role and Responsibilities , Collaboration Tools and Techniques, Positioning and Branding, Channels

MODULE V SALES & SUPPORT 6

Sales Planning, Selling Skills, Project Management, Project Tracking, Basic of Business Regulation, Startup.

CSC 3151**ESSENTIALS OF DATA SCIENCE**

L	T	P	C
2	0	0	2

OBJECTIVES:

- To learn critical concepts and skills in computer programming and statistical inference in the process of conducting analysis of real-world datasets
- To explore the fundamental concepts and techniques in data science.
- To conceive the application of statistics in data science.
- To make predictions using statistical methods
- To interpret and communicate data and results using a vast array of real-world examples from different domains
- To think critically about data and draw 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 - Deflategate - 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**REFERENCES:**

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

Foundations of Data Science, 2019.

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

OUTCOMES:

Students who complete this course will be able to

- Apply statistical techniques for data analysis
- Use testing hypothesis to assess data models
- Demonstrate data visualization
- Appreciate the role of Sampling and Distributions in data analysis
- Discuss how data can be used responsibly to benefit society.
- Turn data into knowledge and that knowledge into action.

CSC 3152**ARTIFICIAL NEURAL NETWORKS**

L	T	P	C
3	0	0	3

OBJECTIVES :

- To conceive the fundamentals of artificial neural networks.
- To be familiar with components of artificial neural networks.
- To learn basic principles about the learning procedure.
- To acquire the knowledge on supervised learning network paradigms.
- To adapt genetic algorithm for seeking global optimum in self-learning situation.

MODULE I INTRODUCTION 08

Basics of Artificial Neural Networks- History of neural networks- Biological neural networks- Biological neural networks- The vertebrate nervous system, The neuron, Receptor cells, Information processing within nervous system.

MODULE II COMPONENTS OF ARTIFICIAL NEURAL NETWORKS 07

The concept of time in neural networks, Propagation function, Threshold value, Activation function, Output function, Learning strategies- Network topologies- The bias neuron , Orders of Activation.

MODULE III FUNDAMENTALS ON LEARNING AND TRAINING SAMPLES 09

Paradigms of Learning- Training patterns and teaching input- Using training samples - Learning curve and error measurement - Gradient optimization procedures - Hebbian rule.

MODULE IV SUPERVISED LEARNING NETWORK PARADIGMS 07

The perceptron, back propagation and its variants, The single layer perceptron , Linear separability, The multilayer perceptron , Back propagation of error, Resilient back propagation , Further variations and extensions to back propagation , Initial configuration of a multilayer perceptron.

MODULE V RADIAL BASIS FUNCTIONS 07

Information processing of an RBF network, Training of RBF networks, Growing RBF networks, Compare multilayer perceptrons and RBF- Jordan networks- Elman networks

MODULE VI GENETIC ALGORITHMS AND ITS APPLICATIONS 07

Inheritance Operators, Crossover types, inversion and Deletion, Mutation Operator, Bit-wise Operators, Convergence of GA, Applications of GA.

L – 45; TOTAL HOURS – 45

REFERENCES :

1. Josh Patterson and Adam Gibson, "Deep learning", O'Reilly Media, First Edition, ISBN 978-1-491-91425-0, 2017.
2. David Kriesel, "A Brief Introduction to Neural Networks", http://www.dkriesel.com/en/science/neural_networks , 2005.
3. S.Rajasekaran and G.A.Vijayalakshmi Pai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning, ISBN 978-81-203-2186-1, 2003.

OUTCOMES :

Students who complete this course will be able to

- Explore the complexity of simple elements of neural information processing
- Familiar with formal definitions for the neural network components
- Analyze with problems by means of training and, after sufficient training, to be able to solve unknown problems.
- Work with unsupervised learning network paradigm.
- Identify how information processing in RBF and MLP.
- Deploy real time applications based on using generic algorithms.

CSC 3153**CLOUD COMPUTING SERVICES**

L	T	P	C
2	0	0	2

OBJECTIVES :

- To provide students with the fundamentals and essentials of Cloud Computing.
- To know important cloud computing driven commercial systems and applications.
- To learn the key security and compliance challenges of cloud computing.
- To know the concepts, characteristics, delivery models and benefits of cloud computing.
- To study the importance of virtualization for cloud environment.
- To learn the different cloud service models.

MODULE I CLOUD COMPUTING 10

Characteristics – Cloud Deploying Models – Challenges – Applications – Virtualization – Virtual Machine Installation - Load Balancing – Service Level Agreements.

MODULE II CLOUD SERVICE MODELS 10

Service Models – IaaS - Amazon Web Services – PaaS – Windows Azure – SaaS – Google Apps - Benefits, Characteristics and adoption – Cloud Services Examples – Cloud Based Services and Applications – Cloud Services and Platforms.

MODULE III CLOUD APPLICATION DESIGN 10

Design Considerations - Reference Architectures – Design Methodologies – Data Storage – Data Analytics – Deployment and Management – Python for Cloud – Simulation Tool Study.

L – 30; TOTAL HOURS – 30**REFERENCES :**

1. Arshdeep Bahga, Vijay Madiseti, "Cloud Computing – A Hands – on Approach", First Edition, University Press, ISBN 978 817371923 3, 2014.
2. Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, "Distributed and Cloud Computing – From Parallel Processing to Internet of Things", First Edition, Elsevier, ISBN 978 – 0 12 – 385880 – 1, 2012.
3. Rajkumar Buyya , James Broberg , Andrzej Goscinski , "Cloud Computing Principles and Paradigms", First Edition, , John Wley, ISBN 978-0-470-88799-8, 2011.

OUTCOMES :

Students who complete this course will be able to

- Articulate the main concepts, key technologies, strengths, and limitations of cloud computing.
- Analyze the core issues of cloud computing such as security, privacy, and interoperability.
- Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud and hybrid cloud.
- Create a virtualization environment for running applications.
- Explore the different cloud simulation software.
- Analyze various cloud programming models and apply them to solve problems.

CSC 3154**DATA VISUALIZATION**

L	T	P	C
3	0	0	3

OBJECTIVES :

- To learn the importance of visual analysis.
- To impart the components involved in visualization design.
- To represent the technological advancements of data visualization.
- To focus on plots using Matplotlib and Folium.
- To develop skills to both design and evaluate various dashboard.
- To explore the various issues and best practices in information dashboard design

MODULE I INTRODUCTION TO VISUAL ANALYSIS 07

Information visualization – effective data analysis – visual perception – building blocks of visualization – analytical interaction and navigation – focus and context – analytical patterns

MODULE II TIME-SERIES AND DEVIATION ANALYSIS 07

Time-series analysis – time-series patterns – Part-to-whole and ranking patterns – deviation analysis

MODULE III DISTRIBUTION AND MULTIVARIATE ANALYSIS 09

Distribution analysis – distribution patterns – correlation analysis – correlation patterns and techniques – multivariate analysis – multivariate displays – multivariate analysis techniques

MODULE IV VISUALIZATION TOOLS AND TECHNIQUES 08

Data visualization tools – Python – Matplotlib - Basic Plotting - Line Plots - Area Plots – Histograms – Bar Charts – Pie-Charts – Box Plots – Scatter Plots – Bubble Plots – Regression Plots – Folium Maps with Markers

MODULE V DASHBOARD DESIGN 07

Information dashboard – Categorizing dashboards – Dashboard design issues – visually encoding data – Gestalt principles – designing dashboards for usability

MODULE VI CASE STUDIES 07

Chief Information Officers (CIO) dashboard - Marketing analysis dashboard - Social Media Dashboards - Healthcare Dashboards

L – 45; TOTAL HOURS – 45**REFERENCES :**

10. Ward, Grinstein Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", Natick: A K Peters, Ltd, 2nd Edition, 2015. ISBN: 978-1568814735
11. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 1st Edition, 2009. ISBN : 978-0970601988
12. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking

business intelligence beyond reporting", Wiley, 2nd Edition 2016. ISBN: 978-0470890615

OUTCOMES :

Students who complete this course will be able to

- Perceive the importance of data visualization.
- Design effective data visualizations in order to provide new insights.
- Identify appropriate visualization techniques based on the particular requirement.
- Experiment with different tools and create multiple versions of digital visualizations.
- Apply appropriate design principles in the creation of dashboard
- Construct the real time dashboards for various domains.

CSC 3155**PATTERN RECOGNITION**

L	T	P	C
3	0	0	3

OBJECTIVES :

- To learn the fundamentals concepts of pattern recognition
- To impart the knowledge on unsupervised learning and classification
- To explore the various statistical pattern recognition techniques
- To adapt the importance of back propagation
- To represent the various syntactical pattern recognition techniques
- To explore the recent advancement in pattern recognition

MODULE I INTRODUCTION TO PATTERN RECOGNITION 08

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 LINEAR DISCRIMINANT FUNCTIONS AND UNSUPERVISED LEARNING 07

Introduction—Discrete and binary Classification problems—Techniques to directly Obtain linear Classifiers -Formulation of Unsupervised Learning Problems—Clustering for unsupervised learning and classification.

MODULE III STATISTICAL PATTERN RECOGNITION 08

Introduction to statistical Pattern Recognition—supervised Learning using Parametric and Non Parametric Approaches.

MODULE IV NEURAL PATTERN RECOGNITION 07

Introduction to Neural networks—Feedforward Networks and training by Back Propagation—Content Addressable Memory Approaches and Unsupervised Learning in Neural PR.

MODULE V SYNTACTIC PATTERN RECOGNITION 07

Overview of Syntactic Pattern Recognition—Syntactic recognition via parsing and other grammars—Graphical Approaches to syntactic pattern recognition—Learning via grammatical inference.

MODULE VI APPLICATION AND CASE STUDY 07

Medical Applications – Healthcare Applications - Financial Applications – case study

L – 45; TOTAL HOURS – 45**REFERENCES :**

1. Robert Schalkoff, "Pattern Recognition: statistical, structural and neural approaches", JohnWiley & sons , ISBN 978-0-471-52974-3 , 2007.
2. Duda R.O., P.E.Hart & D.G Stork, "Pattern Classification", 2nd Edition, J.Wiley , ISBN 0-471-05669-3,2001.
3. Bishop C.M., "Neural Networks for Pattern Recognition", Oxford University Press, ISBN:

0-19853862, 1995.

OUTCOMES :

Students who complete this course will be able to

- Analyse the various concepts in pattern recognition.
- Apply different dimensionality reduction technique in real time system.
- Classify the data and identify the patterns.
- Recognize the significance feed forward networks and back propagation.
- Represent pattern structures, complex interrelationships between attributes.
- Design and implement advanced pattern recognition techniques in practical problems.

CSC 3156**MACHINE LEARNING TECHNIQUES**

L	T	P	C
3	0	0	3

OBJECTIVES :

- To impart the knowledge about the concepts of machine learning.
- To introduce the fundamental concepts of distributed nature of operating system, data and processes.
- To represent the distance based models for k-means algorithm.
- To know about the tree model, rule based models.
- To study the performance evaluation metrics.
- To learn the first order rules in machine learning.

MODULE I INTRODUCTION TO MACHINE LEARNING MODELS 08

Machine learning - Task : problems solved with machine learning, Looking for structure, performance evaluation - Models: Geometric models, Probabilistic models, Logical models, Grouping and grading –Features.

MODULE II LINEAR MODELS 08

Multivariate linear regression – regularized regression – perceptron –support vector machines- soft margin SVM-Going beyond linearity with kernel methods- Using Scikit-learn for SVM -Plotting the Hyperplane and the Margins -Making Predictions -Kernel Trick - Adding a Third Dimension -Plotting the 3D Hyperplane.

MODULE III DISTANCE-BASED MODELS 07

Distance and measure - Neighbours and exemplars - Nearest neighbor classification - Distance based clustering: K-means algorithm, clustering around medoids –silhouettes – hierarchical clustering – Using K-Means -learn Evaluating Cluster Size Using the Silhouette Coefficient-Calculating the Silhouette Coefficient-Finding the Optimal K.

MODULE IV TREE AND RULE MODELS 07

Decision trees – learning decision trees – ranking and probability estimation trees – regression trees – clustering trees – learning ordered rule lists – learning unordered rule lists – Using Decision trees -learn- Analyzing decision trees- Feature importance in trees.

MODULE V MODEL EVALUATION AND IMPROVEMENT 06

Cross-Validation in scikit-learn -Benefits of 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 VI ADVANCED LEARNING 09

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution -Analytical Learning –Explanation Base Learning – Reinforcement Learning – Case study-Design, Analysis and Evaluation of Machine Learning Experiments,Other Issues: Handling imbalanced data sets

L – 45; TOTAL HOURS – 45**REFERENCES :**

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth edition, ISBN-9780262358064, 0262358069, 2020
2. 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.
3. Wei-Meng Lee, "Python Machine Learning", John Wiley & Sons, First edition, ISBN:9781119545675, 1119545676, 2019

OUTCOMES :

Students who complete this course will be able to

- Interpret the basic machine learning models.
- Apply the specific learning algorithm for a linear regression.
- Analyze the appropriate distance based models for the various types of problem.
- Evaluate the learning ordered and unordered rule list.
- Apply principles and algorithms to evaluate models generated from data.
- Design advanced machine learning techniques for real time application

CSC 3157**MACHINE LEARNING LABORATORY**

L	T	P	C
0	0	2	1

OBJECTIVES :

- To study the basic concepts and techniques of Machine Learning.
- To develop skills of using recent machine learning software for solving practical problems.
- To impart the knowledge of various clustering techniques.
- To develop the appropriate decision tree models
- Make use of data sets in implementing the machine learning algorithms.
- To learn the procedures for 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. Distance based clustering and hierarchical clustering Technique
5. Cross-Validation in scikit-learn
6. decision trees - ranking and probability estimation trees – regression trees – clustering trees
7. Advanced learning Algorithm-Sequential Covering Algorithm-Explanation Base Learning -FOCL Algorithm
8. Reinforcement Learning

P-30**TOTAL HOURS – 30****OUTCOMES :**

Students who complete this course will be able to

- Analyze the procedures for the machine learning algorithms.
- Design the various machine learning algorithms.
- Apply appropriate data sets to the evaluation metrics
- Identify and apply rule-based models to solve real world problems.
- Optimize the various models and report on the expected accuracy that can be achieved
- Demonstrate the proficiency in applying machine learning models to real time applications

CSC 3158**DATA VISUALIZATION LABORATORY**

L	T	P	C
0	0	2	1

OBJECTIVES :

- To make familiar with the data visualization concepts.
- To conduct exploratory data analysis using visualization.
- To craft visual presentations of data for effective communication.
- To design and evaluate visuals based on principles of perception.
- To identify opportunities for application of data visualization in various domains.
- To assess existing visualizations based on visualization theory and principles.

SOFTWARE REQUIRED : PYTHON, ANACONDA PACKAGES

Design problems and implement solutions for the following concepts:

11. Chart types: categorical, hierarchical, relational, temporal & spatial
12. 2-D: dot plots, connected dot plots
13. Univariate scatter plots
14. Bar charts, Clustered bar charts, Box-and-whisker plots
15. Stacked bar chart, back-to-back bar chart
16. Proportional shape charts, bubble charts, polar charts
17. Pie chart, waffle chart
18. Pictograms
19. 3-D Charts: Multi-dimensional data visualization
20. Graph data visualization

P-30**TOTAL HOURS – 30****OUTCOMES :**

Students who complete this course will be able to

- Analyse the various types of chart in visualization
- Apply the data models and techniques for visual encoding and interaction.
- Implement the suitable visualization techniques according to the data.
- Utilize the current state of art data visualization practices.
- Identify opportunities for application of data visualization in various domains.
- Build and evaluate visualization systems.

SEMESTER VI

MSC 3181	CEO AND LEADERSHIP TRAINING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course aims at

- Bringing about positive transformation in students' attitude.
- Building unique leadership competencies that would ensure successful transition of students across all career stages.
- Sensitizing students to identify their strengths & weakness and training them to deal with it.
- Assisting students in enhancing their expressive ability and inducing a high level of self-confidence to manage both business and emotions
- Training students to become more adaptable and flexible to changing business environment

MODULE I INTRODUCTION TO LEADERSHIP 12

Leadership concept - meaning, definitions, importance of leadership, leadership traits. Leadership functions- general functions, listening, observing, managing and decision making. Components of leadership - leaders, followers and situation. Leadership theories – Trait theory, Skills theory, Style theory, Situational theory, Transformational theory, Transactional theory, Path Goal Theory and LMX. Assessing emotional intelligence and exploring the capabilities and inherent traits through psychometric tests - Multi factor leadership questionnaire and personal reflections

MODULE II LEADERSHIP STYLE AND COMMUNICATION 8

Leadership styles-visionary, Coaching, Affiliative, Democratic, Pacesetter, Commanding, Transformational, Transactional. Autocratic, Participative, Laissez-Faire Leader versus Managers. Leadership communication - Rationale, tactic, assertive, formal, informal, communication in crisis- leadership and negotiations, Leadership Presentations-convincing and impressive style

MODULE III LEADERSHIP ROLES 8

Facets of leadership- Leader as an individual – personality and leadership, values, attitudes and ethics of a leader. Leader as a relationship builder- empowering people to meet higher order needs, initiating organization wide motivational

programs, involvement with all stakeholders- focusing on organization growth. Leader as an inspirer- motivation and leadership, recognizing and appreciating contributions, empowering others to lead Leader as an innovator –leader’s role in shaping culture and values in an organization. Leader as a Liaison- Leader as team player.

MODULE IV LEADERSHIP CHALLENGES AND STRATEGIES 9

Challenges in leadership: Perception of organization culture and values, interpreting the power dynamics in the organization, establishing work life balance. Bad leadership – Reasons and impact. -Case Study of Marissa Mayer-Yahoo.Inc Organizational transformation through efficient leaders-Case study of Apple Inc. Blue Ocean Leadership-Steps to Blue ocean Leadership-Four Pillars of Blue Ocean leadership-Blue Ocean leadership grid.

MODULE V LEADERSHIP AND CEO TRAINING 8

Leader as a CEO: Traits of a successful CEO, Key responsibilities of a CEO, the path to be a CEO ,Training on Board Room Discussions, Meeting the CEO –Live sessions with industry CEO’s. Requirements of Leadership: - Cognitive skills, Interpersonal skills, Business skills, Strategic skills. Role of Emotional Intelligence in taking up key-positions in the organization.

MODULE VI TEACHING PEDAGOGY

Nurturing – Based on the identified strengths and weaknesses, training will be given to enhance the strengths and overcome the weakness.

Assessment - Continuous evaluation will be effected through group discussions, oratory assignments and situational enactments. Pre-and post-training assessment through peer reviews and faculty feedback.

Sustained development – Training will be imparted for self-development and monitoring of leadership skills to ensure sustained applicability of the skills learnt.

Total Hours –45

REFERENCES:

8. Andrew J DuBrin. “Leadership: Research Findings, Practice, and Skills”, 8th Edition, South-Western College Pub, 2015.
9. Yukl G , “Leadership in Organisations”, 8th Edition, Pearson Education, 2013.
10. Richard L Daft , “Leadership”, 5th Edition, South Western Cengage Learning

2012.

11. Stephen P. Robbins and Timothy A. Judge. "Organizational Behaviour", 15th Edition, New Delhi: Pearson, 2013.
12. Fred Luthans, "Organizational Behavior, An Evidence Based Approach", 12th Edition, New Delhi: McGraw Hill Education, 2013.
13. Emotional Intelligence, Why it can matter no more than IQ by Daniel Goleman (include a book) Publisher: Bloomsbury Publishing India Private Limited; Latest edition (2017)
14. Primal Leadership: Unleashing the Power of Emotional Intelligence by Prof Daniel Goleman , Richard Boyatzis and McKee ,Harvard Business Review Press.

Recommended Readings:

5. Jim Collins, (2001). "Good To Great: Why Some Companies Make the Leap...And Others Don't", Random House Publishers India Pvt.Ltd, New Delhi.
6. George, B. with Sims, P. True North: Discover Your Authentic Leadership, The Times Group Books; First edition (1 October 2015)
7. Kim, W. C., & Mauborgne, R. A. (2014). Blue ocean strategy, expanded edition: How to create uncontested market space and make the competition irrelevant. Harvard business review Press.
8. Leadership Wisdom by [Robin Sharma](#) Jaico Publishing House;

OUTCOMES:

The students will be able to

- Explore through self-introspection one's own leadership style, their strength and weakness
- Gain self confidence to lead a team in the organization
- Realize the role of leadership in making or breaking of an organization
- Acquire the practice of self introspection and development of leadership competencies thorough continuous efforts
- Manage their own emotions as well as other resulting in successful relationship building with all stakeholders

MSC 3182	SOCIAL ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fit between individual and their entrepreneurial ambitions.
- To identify the customers and find a problem worth solving.
- To create a business model for solving the problems of customer, forming solution and present the Business Model Canvas
- To develop a solution for customers' problem and analyze the problem solution fit & product market fit.
- To build and demonstrate a Minimum Viable Product (MVP) for startup.
- To analyze and understand the impact of social entrepreneurship on society and cases.

MODULE I SELF & OPPORTUNITY DISCOVERY 9

Finding the flow, Effectuation, Entrepreneurial Style, Business Opportunities, Problem Identification, Design Thinking, Potential solutions, Presentation of the problem- Case Study.

MODULE II CUSTOMER , SOLUTION AND BUSINESS MODEL 9

Customers and Markets, Identification of Customer Segment, Niche Segment, Customers Jobs, Pain and Gain, Early Adopters, Value Proposition Canvas, Basics of Business Model and Lean Canvas, Risk and Assumptions.

MODULE III VALIDATION AND MONEY 9

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 TEAM BUILDING AND MARKETING 7

Shared Leadership, Hiring, Fitment , Team Role and Responsibilities , Collaboration Tools and Techniques, Positioning and Branding, Channels

MODULE V SALES & SUPPORT 6

Sales Planning, Selling Skills, Project Management, Project Tracking, Basic of Business Regulation, Startup.

MAC 3281	STATISTICAL METHODS FOR DATA ANALYSIS	L	T	P	C
		2	0	0	2

OBJECTIVES:

The aim of the course is to

- introduce statistical quality control tools.

MODULE I	TESTS OF HYPOTHESES AND STATISTICAL INFERENCE	8
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Small sample tests – Student's ' t ' test for single mean , difference of means, paired t test – F test for difference of variances – Chi square test on theory of goodness of fit and analyses of independence of attributes.

MODULE II	DESIGN OF EXPERIMENTS	7
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Analysis of variance – one way classification – two way classification – Completely Randomised Block Designs – Randomised Block Design – Latin square designs - Statistical analysis -Interpretations - case studies.

MODULE III	STATISTICAL QUALITY CONTROL-I	8
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Quality improvement and statistics –Statistical quality control- statistical process control – control charts – design of control charts –analysis of patterns on control charts - X bar chart, R chart and S chart.

MODULE IV	STATISTICAL QUALITY CONTROL-II	7
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Process and product control – attribute charts – P, np and C charts – control charts performance.

TOTAL HOURS –30

TEXT BOOKS:

1. Douglas C.Montgomery, George C. Runger "Applied Statistics and probability for Engineers" V Edition – John Wiley & Sons Inc.
2. Miller, I., Miller, M., Freund, J. E. "Mathematical statistics" 7th Edition. Prentice Hall International, 1999.

REFERENCES:

1. Dekking, F.M., Kraaikamp, C., Lopuhaä, H.P., Meester, L.E. "A Modern Introduction to Probability and Statistics" Springer, 2nd Edition.

2. Chin Long Chiang "Statistical Methods of Analysis" World Scientific Books, 2003.
3. S.C.Gupta and V.K. Kapoor, "Mathematical Statistics", Sultan Chand publications.
4. Veerarajan "Fundamentals of Mathematical Statistics" I Edition, Yes Dee Publishing Pvt. Ltd., 2017.

OUTCOMES:

On completion of the course, students will be able to

1. develop and test hypothesis for different statistical tests
2. design an experiment and case study the experiment with different data.
3. analyze the industrial data using quality control design tools statistically.
4. analyze the industrial data using process and product control tools statistically.

Applications”, CRC Press, 2018, ISBN: 9780429820915.

OUTCOMES :

Students who complete this course will be able to

- Understand the different types of data and the big data lifecycle.
- Identify the characteristics of datasets and apply appropriate preprocessing methods.
- Solve problems associated with big data characteristics.
- Apply scaling up machine learning techniques and associated computing techniques and technologies
- Choose the appropriate data analysis technique for extracting the pattern.
- Integrate machine learning libraries and mathematical and statistical tools with modern technologies like Hadoop and mapreduce.

CSC 3252**IoT AND APPLICATIONS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concepts of Internet of Things.
- To realize the full potential of the IoT paradigm, it is necessary to address several challenges and Develop suitable conceptual and technological solutions for tackling them.
- To understand overview of IoT and its related concepts and evolution through time
- To perform stream processing toolkits to handle a large volume of data in motion and how they can be utilized in IoT environments
- To explore the effective management of resources in sensor networks and in parallel systems performing data analytics.
- To identify platforms and solutions supporting development and deployment of IoT applications.

MODULE I OVERVIEW 08

Introduction-Definition-IoT Architectures-Resource Management-IoT data management and Analytics-Communication Protocols-Applications- Security and Privacy.

MODULE II IOT DATA LINK LAYER & NETWORK LAYER PROTOCOLS 07

PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), WirelessHART, ZWave,Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP

MODULE III TRANSPORT & SESSION LAYER PROTOCOLS 09

Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer HTTP, CoAP, XMPP, AMQP, MQTT

MODULE IV SERVICE LAYER PROTOCOLS & SECURITY 07

Service Layer -oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 , 6LoWPAN, RPL, Application Layer

MODULE V IoT Framework 07

Open Iot Architecture For Iot/Cloud Convergence- Scheduling Process And Iot Service Life Cycle - Scheduling And Resource Management-Device/Cloud Collaboration Framework-Fog Computing

MODULE VI IOT APPLICATIONS. 07

IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management,eHealth.

L – 45; TOTAL HOURS – 45

REFERENCES:

1. Rajkumar Buyya and Amir Vahid Dastjerdi "IoT Principles and Paradigms", Cloud Computing and Distributed Systems (CLOUDS) Laboratory Department of Computing and Information Systems The University of Melbourne, Australia Manjrasoft Pty Ltd, Australia., USA Copyright © 2016 Elsevier Inc. All rights reserved. ISBN: 978-0-12-805395- 9.
2. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014, ISBN :978-0-12-407684-6.
3. Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI. ISBN:9781783553549, 2015.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011. ISBN 978-3-642-19156-5.
5. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3-642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
6. Daniel Minoli, —Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, ISBN: 978-1-118-47347-4, Willy Publications.

OUTCOMES:

Students who complete this course will be able to

- Develop scalable architecture, moving from closed systems to open systems, dealing with privacy and ethical issues involved in data sensing
- Design IoT applications in different domain and be able to analyze their performance
- Identify the security issues and propose suitable solutions.
- Design an IoT device to work with a Cloud Computing infrastructure.
- identify the Components that forms part of IoT Architecture
- Define the infrastructure for supporting IoT deployments.

CSC 3253	EXPLORATORY DATA ANALYSIS	L	T	P	C
		3	1	0	4

OBJECTIVES :

- To learn the fundamental data preparation and data understanding.
- To impart the importance of data analysis.
- To represent the essential exploratory techniques for understanding multivariate data by summarizing.
- To gain proficiency on data visualization and outlier detection.
- To acquire knowledge on feature selection and dimensionality reduction
- To know the applications of exploratory data analysis.

MODULE I INTRODUCTION TO EXPLORATORY DATA ANALYSIS 09

Data Analytics lifecycle, Exploratory Data Analysis (EDA) – Definition, Motivation, Steps in data exploration, The basic data types Data Type Portability. Introduction to Missing data, Traditional methods for dealing with missing data, Maximum Likelihood Estimation – Basics, Missing data handling, Improving the accuracy of analysis

MODULE II DATA SUMMARIZATION 07

Bayesian Estimation, Multiple Imputation-Imputation Phase, Analysis and Pooling Phase, Practical Issues in Multiple Imputation, Models for Missing Notation Random Data. Statistical data elaboration.

MODULE III VISUALIZATION AND OUTLIER ANALYSIS 08

1-D Statistical data analysis, 2-D Statistical data Analysis, ND Statistical data analysis. Introduction, Extreme Value Analysis, Clustering based, Distance Based and Density Based outlier analysis, Outlier Detection in Categorical Data

MODULE IV FEATURE SUBSET SELECTION 07

Feature selection algorithms: filter methods, wrapper methods and embedded methods, Forward selection backward elimination, Relief, greedy selection, genetic algorithms for features election.

MODULE V DIMENSIONALITY REDUCTION 07

Introduction, Principal Component Analysis(PCA), Kernel PCA, Canonical Correlation Analysis, Factor Analysis, Multi dimensional scaling, Correspondence Analysis

MODULE VI APPLICATION 07

Apply EDA on social media - Data Analysis Technical requirements – Disclosing the quality dataset, AnalysisModel development and evaluation.

L – 45; T-15; TOTAL HOURS –60

REFERENCES :

1. Charu C. Aggarwal ,“Data Mining The Text book”, Springer, ISBN 978-3-315-14141-1 2015.
2. Inge Koch, “Analysis of Multivariate and High dimensional data”, Cambridge University

Press, ISBN 978-0-52-88793, Second edition, 2014.

3. Craig K. Enders, "Applied Missing Data Analysis", The Guilford Press, ISBN 978-1-60623-639-0, 1st edition, 2010.
4. Suresh Kumar Mukhiya and Usman Ahamed, "Hands-On Exploratory Data Analysis with Python ", Packt Publishing Ltd, U.K. ISBN 978-1-178953-725-3, 2020.

OUTCOMES :

Students who complete this course will be able to

- Handle missing data in the real world data sets by choosing appropriate methods.
- Design the various techniques for summarize the data using basic statistics.
- Develop visualize the data using basic graphs and plots.
- Apply the different strategies to identify the outliers.
- Analyze appropriate feature selection and dimensionality reduction technique.
- Deploy applications in advance data models.

CSC 3254	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To learn the various levels of analysis involved in NLP
- To study the importance of statistical approaches.
- To impart the knowledge in morphology, syntax, semantics and pragmatics of the language.
- To recognize the significance of pragmatics for natural language processing.
- To represent the classical and non classical knowledge in retrieval system.
- To explore how to design automated natural language generation and machine translation.

MODULE I INTRODUCTION 08

Origins and challenges of NLP-Language and Grammar, Applications NLP-Information Retrieval. Text Normalization, Various Grammar-based Language Models-Statistical Language Model.

MODULE II WORD LEVEL AND SYNTACTIC ANALYSIS 07

Introduction- Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging

MODULE III SYNTACTIC & SEMANTIC ANALYSIS 09

Introduction to Context-free Grammar-Constituency Parsing-Probabilistic Parsing. - Meaning Representation-Lexical Semantics Ambiguity-Word Sense Disambiguation

MODULE IV NATURAL LANGUAGE GENERATION AND MACHINE TRANSLATION 07

Introduction-Architecture of NLG Systems Generation Tasks and Representations-Application of NLG. Problems in Machine Translation Characteristics of Indian Languages- Machine Translation Approaches.

MODULE V INFORMATION RETRIEVAL AND LEXICAL RESOURCES 07

Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – Evaluation. Word Net-Frame Net-Stemmers-POS Tagger Research Corpora.

MODULE VI APPLICATION 07

Phonetics: Speech Sounds and Phonetic Transcription, Automatic Speech Recognition and Text-to-Speech

L – 45; TOTAL HOURS – 45

REFERENCES :

1. Daniel Jurafsky and Prentice Hall James H Martin, "Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, ISBN9789332518414, 2018.
2. James Allen, "Natural Language Understanding", Wesley Longman Publ, 2nd edition, ISBN:978-0-8053-0334-6, 1995.
3. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information

Retrieval”, Oxford University Press, ISBN 978-0-19-569232-7, 2008.

OUTCOMES :

Students who complete this course will be able to

- Interpret the basic concepts approaches to syntax and semantics in NLP.
- Design the approaches to discourse the NLG system.
- Analyze the machine learning translation for language processing.
- Ensure the methods for statistical approaches to machine translation.
- Recognize the design features of information retrieval systems
- Evaluate the various applications involved in speech recognition.

CSC 3255**DATA AND NETWORK SECURITY**

L	T	P	C
3	0	0	3

OBJECTIVES :

- To explain the key security requirements of information systems.
- To explore the importance of encryption.
- To represent the requirements of advanced cryptographic techniques.
- To provide adequate knowledge on data security.
- To learn the risk factors and application gateways.
- To secure the real time system by applying security standards.

MODULE I NETWORK SECURITY 07

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 08

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 07

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 RISK MANAGEMENT AND ACCESS CONTROL 07

Risk Identification – Risk Assessment – Risk Control Strategies – Access Control: Identification, Authentication, Authorization, Accountability – Firewall processing models

MODULE VI CASE STUDIES 07

Secure Inter Branch Transactions – Cross Site Vulnerability – Virtual Elections – IBM SCS

L – 45; TOTAL HOURS – 45**REFERENCES :**

7. Stallings, W. (2017). Cryptography and network security, 7th edition . Pearson Education India. ISBN: 978– 9332585225
8. Whitman, M. E., & Mattord, H. J. (2011), Principles of information security, 4th edition, Cengage Learning. ISBN: 978-1111138219
9. Kahate, A. (2019). Cryptography and network security, 4th edition. Tata McGraw– Hill Education. ISBN: 978– 9353163303

OUTCOMES :

Students who complete this course will be able to

- Acquire knowledge on network security.
- Apply encryption algorithms to achieve confidentiality.
- Propose an appropriate cryptographic system framework.
- Discuss the need for data security.
- Examine the concepts of risk management and access control.
- Analyze the real world problem to attain practical skills.

CSC 3256**DATA ANALYTICS LABORATORY**

L	T	P	C
0	0	2	1

OBJECTIVES :

- To provide an overview of an exciting growing field of big data analytics.
- To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map Reduce.
- To explore the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
- To enable students to have skills that will help them to solve complex real-world problems.
- To impart the knowledge on various methods of selecting suitable model for different data analytic techniques.
- To know the recent research trends related to Hadoop File System, MapReduce and Google File System etc.

SOFTWARE REQUIRED : Hadoop, R studio

Design the problems and implement the solutions for following concepts

1. Preprocessing – Clustering Techniques
2. Classification- Data preparation Techniques.
3. Regression Technique
4. Classification Techniques
5. Clustering Techniques
6. Visualize Data Using Any Plotting Framework
7. Implement the applications –Social network analysis

P-30**TOTAL HOURS – 30****OUTCOMES :**

Students who complete this course will be able to

- Perform data gathering of large data from a range of data sources.
- Analyze existing big data - datasets and implementations, taking practicality, and usefulness metrics into consideration.
- Demonstrate the role of statistics in the analysis of large datasets
- Select and apply suitable statistical measures and analyze techniques for data of various structure and content and present summary statistics
- Demonstrate advanced knowledge of statistical data analytics as applied to large data sets.
- Deploy advanced statistical analytical skills to test assumptions, to generate and present new information and insights from large datasets

CSC 3257**MOBILE APP LABORATORY**

L	T	P	C
0	0	2	1

OBJECTIVES :

- To study Android platform and its architecture.
- To learn activity creation and Android UI designing
- To be familiarized with Intent, Broadcast receivers and Internet services.
- To work with SQLite Database and content providers.
- To integrate multimedia, camera and Location based services in Android Application.
- 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: AudioVideo- 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.

P-30**TOTAL HOURS – 30****OUTCOMES :**

Students who complete this course will be able to

- Develop various Android applications related to layouts & rich uses interactive interfaces.
- Demonstrate the android features and create and create, develop using android.
- Implement the Phone Gap features and advance android development.
- Develop Android applications related to mobile related server-less database like SQLITE.
- Design the multimedia, camera and Location based services in Android App.
- Implement various security issues in Android platform.

SEMESTER VII

CSC 4151	SOFTWARE PROJECT MANAGEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To introduce the various software development activities.
- To provide knowledge on the importance of project management processes and version control.
- To learn the goals and risks associated in managing software.
- To highlight the different software development strategies.
- To explore the emerging techniques involved in project management.
- To understand how to improve performance of a software product.

MODULE I SOFTWARE PROCESS 07

Project Management – Requirements Definition – Business Modeling – Design and Implementation – Verification and Validation – Deployment – Maintenance.

MODULE II MANAGING GOALS, TIME, COST 08

Assessing Risks – Project Goals – Deciding Work – Estimating – Scheduling Plan – Project Monitoring and Control – Project Closing.

MODULE III CHANGES, RISKS AND QUALITY 09

Managing Changes – Risk Management – Quality Management – Organization Structure – Communication.

MODULE IV SOFTWARE DEVELOPMENT 07

Software Pricing – Strategies – Traditional to Agile – Agile Methods – Open Source Practices.

MODULE V EMERGING TECHNIQUES 07

Search Based Software Project Management – Social Media Collaboration in Software Projects – Inner Source Project Management.

MODULE VI MANAGEMENT STANDARDS 07

NASA Practices – Capability Maturity Model – Open Source Tools for Managing Projects.

L – 45; TOTAL HOURS – 45

REFERENCES :

10. Adolfo Villfiorita, "Introduction to Software Project Management", CRC press, ISBN - 9780429087905, 2016.
11. Gunther Ruhe, Claes Wohlin, "Software Project Management in Real World", Springer, ISBN-9783642550348, 2014.
12. Roger S. Pressman, "Software Engineering – A Practitioners Approach", Mc Graw Hill, Eighth Edition, ISBN -13: 9789339212087, 2017.

OUTCOMES :

Students who complete this course will be able to

- Choose the planning techniques appropriate to type of project.
- Evaluate alternative courses of action to attain project objectives.
- Plan risk management activities throughout project
- Assess project performance management strategies to baseline
- Plan and estimate project scope, resources, and schedule.
- Use qualitative and statistical tools to measure conformance to quality specifications.

CSC 4152**PREDICTIVE ANALYTICS**

L	T	P	C
2	0	0	2

OBJECTIVES :

- To learn the basic concepts of data analytics.
- To comprehend the idea of data cleansing.
- To study the importance of classification and regression techniques.
- To provide knowledge in clustering techniques
- To explore the various analytical models.
- To improve the performance of models.

MODULE I DATA CLEANSING 10

Data Mining Process – KDD Process Model – Challenges – Sampling – Data processing – Segmentation – Outlier detection

MODULE II PREDICTIVE MODELS 10

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 10

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.

L – 30; TOTAL HOURS – 30**REFERENCES :**

- Han, J., Kamber, M., & Pei, J. (2011), Data mining concepts and techniques 3rd edition. The Morgan Kaufmann Series in Data Management Systems, 5(4), 83– 124. ISBN: 978-9380931913
- Trevor Hastie, Robert Tibshirani, Jerome Friedman (2009), The Elements of Statistical Learning– Data Mining, Inference, and Prediction, 2nd Edition, Springer Verlag. ISBN: 978-0387848570
- Ian H. Witten, Eibe Frank (2011) “Data Mining: Practical Machine Learning Tools and Techniques”, Morgan Kaufmann Series in Data Management Systems, Morgan Kaufmann, 3rd Edition. ISBN: 978-0123748560

OUTCOMES :

Students who complete this course will be able to

- Acquire the knowledge on the fundamental concepts of data analytics.
- Apply data processing based on the requirement.
- Prepare and analyze data through various analytical models.
- Recognize and apply appropriate regression techniques.
- Compare and analyze the performance of the meta-level model
- Enhance the performance of the models and improve the outcomes.

CSC 4153	DEEP LEARNING ALGORITHM AND ARCHITECTURES	L	T	P	C
		3	1	0	4

OBJECTIVES :

- To conceive the theoretical foundations, algorithms and methodologies of Neural Network
- To explore the various applications using specific deep learning models.
- To provide the practical knowledge in handling and analyzing real world applications.
- To learn the topics such as convolution neural networks, recurrent neural networks, training deep networks and high-level interfaces.
- To represent the language and fundamental concepts of artificial neural networks.
- To study the complexity of deep learning algorithms and their limitations.

MODULE I INTRODUCTION TO DEEP LEARNING 08

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.

MODULE II DEEP LEARNING ARCHITECTURES 08

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.

MODULE III DEEP LEARNING NETWORKS 07

Introduction – Historical context of Deep Learning – Classes of Deep Learning Network – Deep Networks for Unsupervised learning – Deep Networks for Supervised learning – Hybrid Deep Networks.

MODULE IV CNN ARCHITECTURE 07

Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet, AlexNet – Applications.

MODULE V SEQUENCE MODELLING 08

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short Term Memory Networks.

MODULE VI PRACTICAL METHODOLOGY AND APPLICATION 07

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 ;T-15; TOTAL HOURS – 60

REFERENCES :

- 1 Michelucci, Umberto, "Advanced Applied Deep Learning: Convolutional Neural Networks and Object Detection", Apress, First Edition, ISBN: 9781484249765, 1484249763, 2019.
- 2 Gibson, A., Patterson, J. "Deep Learning: A Practitioner's Approach. Taiwan: O'Reilly Media", First Edition, ISBN:9781491914236, 1491914238, 2017.
- 3 YuxiLiu, Saransh Mehta, "Hands on Deep learning Architectures with Python", Packt Publishing Ltd, First Edition, ISBN:9781788998086, 2019.
Bert Moons, Daniel Bankman, Marian Verhelst, "Embedded Deep Learning", Springer, First Edition, ISBN:9783319992228, 2019.

OUTCOMES :

Students who complete this course will be able to

- Recognize the characteristics of deep learning models that are useful to solve real-world problems.
- Implement the different methodologies to create the applications using deep nets.
- Analyze the concept of Deep Learning networks.
- Design and deploy the CNN architectures.
- Design the test procedures to assess the efficacy of the developed model.
- Apply the appropriate deep learning algorithms for analyzing the data for variety of problems.

Physics Elective Courses

(To be offered in II Semester)

PHCX 01	FUNDAMENTALS OF ENGINEERING MATERIALS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To familiarize students with basic ideas of nanomaterials and its electrical, electronic, mechanical and magnetic properties.
- To help students acquire the properties and applications of magnetic materials and dielectric materials.
- To familiarize students with basic ideas about the properties of dielectric and its applications
- To enable the students to correlate theoretical principles with practical applications.

MODULE I CONDUCTING AND SEMICONDUCTING MATERIALS **7**

Conductors: properties, Fermi distribution function, Fermi energy in metals- density of states- conducting polymers-properties-applications, semiconductors: intrinsic and extrinsic semiconductors-carrier concentrations, conductivity and energy band gap, semiconducting polymers- properties- applications.

MODULE II DIELECTRIC MATERIALS **8**

Polarization- dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – Internal field -Clausius Mosotti relation - dielectric loss – dielectric breakdown – applications of dielectric materials (capacitors and transformers) – Pyroelectricity, Piezoelectricity, ferroelectricity and applications in FERAM - multiferroic materials and its applications.

MODULE III MAGNETIC MATERIALS **7**

Origin of magnetism-magnetic moment, susceptibility, permeability – Bohr magneton –Dia, Para and Ferro magnetism –Spontaneous magnetization- Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its application -Giant Magneto-resistance effect(GMR) - Magnetic resonance imaging(MRI).

MODULE IV NANOMATERIALS**8**

Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties – quantum confinement – classification of nanomaterials – quantum well, quantum wire, quantum dot - nanoporous materials - carbon nanotubes, grapheme - nanocomposites – applications.

PRACTICALS

1. Determination of energy band gap of a semiconductor.
2. Determination of resistivity of metals by four point probe method.
3. Determination of dielectric constant of dielectric material.
4. Determination of time constant of a capacitor using RC circuit.
5. Determination of paramagnetic susceptibility of given liquid.
6. Determination of hysteresis loss in a transformer using BH curve.
7. Analysis of size effect on the absorption spectrum of nanomaterials.

L : 30 periods, P: 30 periods**Total: 60 periods****REFERENCES:**

1. William D.Callister, Material Science and Engineering, Wiley Publications, 2006.
2. Raghavan, V., Materials Science and Engineering, 5th edition, Printice Hall of India Pvt Ltd. New Delhi, 2004.
3. Wahab.M.A, Solid State Physics: Structure and Properties of Materials,Narosa Publishing House Pvt. Ltd., New Delhi , 2nd Edition, 2010.
2. Pillai, S.O., Solid State Physics, New Age International, New Delhi, 2005.
3. Charles P.Poole and Frank J. Owens, "Introduction to nanotechnology", Wiley (India), 2009.
4. Pradeep. T., "Textbook of Nanoscience and Nanotechnology", McGraw Hill Education (India) Private Limited, New York, 2012.

OUTCOMES:

On completion of this course, the student will be able to

- Differentiate between the properties of the nanomaterials compared to bulk materials.
- Comprehend the significance of properties of magnetic materials and derive these properties from synthesized materials.
- Apply the concepts of conducting and semiconducting materials for solid state devices.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 02**HEAT AND THERMODYNAMICS**

L	T	P	C
2	0	2	3

OBJECTIVES:

- To familiarize students with basic concepts of heat.
- To help students acquire the fundamentals of heat conduction and radiation.
- To enable students acquaint with the basics of thermodynamic concepts.
- To make students understand the fundamentals of heat based experiments.

MODULE I CONCEPTS OF HEAT**10**

Definition of temperature, thermal and thermodynamic equilibrium- relationship between temperature and kinetic energy- definition of solid, liquid, gas- Introduction to phase transitions, critical and triple points- definition of heat capacity, mechanical equivalent of heat -Joule's calorimeter- latent heat- Microscopic model of ideal gas- equation of state, internal energy, equipartition theorem- equation of state for non-ideal gases.

MODULE II CONDUCTION AND RADIATION**10**

Thermal conductivity – rectilinear flow of heat – thermal conductivity of a good conductor – Forbe's method – thermal conductivity of a bad conductor – Lee's disc method – conduction of heat through compound media-radiation – Planck's law blackbody radiation – Wien's law – Stefan's law – Newton's law of cooling from Stefan's law – Solar constant – Pyrometry.

MODULE III FUNDAMENTALS OF THERMODYNAMICS**10**

Thermodynamic equilibrium – zeroth law of thermodynamics – first law of thermodynamics – Reversible and irreversible processes – second law of thermodynamics -Heat engine – Carnot's engine – Carnot's theorem – Internal combustion engines – petrol and diesel engines(qualitative) – Entropy – entropy and available energy – temperature – entropy diagram for Carnot's cycle - Third Law of thermodynamics(qualitative).

L : 30 periods**PRACTICALS**

1. Determination of mechanical equivalent of heat by Joule's calorimeter.
2. Relation between temperature of a body and time by plotting a cooling curve- Newton's law of cooling.
3. Determination of specific heat capacity of liquid by cooling.
4. Determination of thermal conductivity of a bad conductor-Lee's disc method

5. Determination of thermal conductivity of a good conductor-Forbe's method

L : 30 periods, P: 30 periods

Total: 60 periods

REFERENCES :

1. Mathur. D.S, "Heat & Thermodynamics", S.Chand& Co., 2009.
2. Brijlal& Subramaniam, "Heat and Thermodynamics", S.Chand& Co, Delhi., 2010.
3. Gupta. A.B and Roy. H, "Thermal Physics", Books and Allied Ltd., 2002.
4. Sharma. J.K and Sarkar. K.K, "Thermodynamics and statistical Physics",Himalaya Publishing House, 1988.

OUTCOMES:

On completion of this course, the student will be able to

- Understand the concepts of heat and its properties.
- Comprehend the ideas governing the conduction and radiation processes.
- Understand and apply the ideas of laws of thermodynamics in thermodynamic systems.
- Perform heat based experiments and determine its various properties.

PHCX 03	INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY	L T P C 2 0 2 3
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OBJECTIVES:

- To acquire basic knowledge about the nanomaterials and applications.
- To learn about the imaging techniques of nanomaterials.
- To gain the basic concepts of fabrication techniques.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I NANOMATERIALS AND APPLICATIONS 10

Properties of nanomaterials – size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties – quantum confinement – classification of nanomaterials – quantum well, quantum wire, quantum dot- nanoporous materials- zeolite, mesoporous materials, carbon nanotubes, graphene- nanocomposites - applications (qualitative): Molecular electronics-nanoelectronics – nanophotonics - single electron transistor-drug delivery.

MODULE II SYNTHESIS AND IMAGING TECHNIQUES 12

Top-down and bottom up approaches – mechanical alloying and mechanical ball milling-sol-gel approach-hydrothermal method-precipitation method-spray pyrolysis-spin coating-self assembled monolayer (SAM)-Chemical vapour deposition method – Physical vapour deposition method: laser ablation method, sputtering method. Optical microscopy – Phase contrast and interference microscopy –confocal microscopy- high resolution Scanning electron microscope (HRSEM)- high resolution Transmission electron microscope (HRTEM)-Atomic force microscope- Scanning Tunnelling microscope (STM).

MODULE III NANOFABRICATION 8

Photolithgraphy - electron beam lithography - X-ray and Ion beam lithography- nanoimprint lithography - soft lithography - nanoelectromechanical systems (NEMS) - nanoindentation principles.

L : 30 periods**PRACTICALS**

1. Synthesis of nanomaterials by sol-gel method.
2. Synthesis of nanomaterials by hydrothermal method.

3. Synthesis of nanomaterials by solid state reaction method.
4. Synthesis of nanomaterials by chemical bath deposition method.
5. Synthesis of nanomaterials by co-precipitation method.
6. Synthesis of nano thin films by spray pyrolysis method.
7. Synthesis of nano thin films by pulsed laser deposition (PLD) method.
8. Analysis of size effect on the absorption spectrum of nanomaterials.
9. SEM characterization of nanomaterials.
10. AFM characterization of nano thin films.
11. Phase confirmation by XRD.

L : 30 periods, P: 30 periods

Total: 60 periods

REFERENCES:

1. Charles P. Poole and Frank J. Owens, "Introduction to nanotechnology", Wiley (India), 2009.
2. Cao. G., "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, 2004.
3. Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., "Handbook of NanoScience, Engineering and Technology", CRC Press, 2002.
4. Pradeep. T., "Textbook of Nanoscience and Nanotechnology", McGraw Hill Education (India) Private Limited, New York, 2012.
5. Chris Mack, "Fundamental Principles of Optical Lithography: The Science of Microfabrication", John Wiley & Sons, 2008.
6. Bandyopadhyay A.K., "Nano Materials", New Age International Publishers, New Delhi, 2008.

OUTCOMES:

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

- Understand the importance and basic concepts of the nanomaterials.
- Comprehend the imaging techniques for nanomaterials.
- Illustrate the various nanofabrication techniques.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 04	LASERS AND THEIR APPLICATIONS	L	T	P	C
		2	0	2	3

OBJECTIVES

- To recognize the fundamentals of laser and its characteristics.
- To comprehend and compare the different laser systems.
- To apply lasers in metrology and material processing.
- To understand the working of laser instrumentation.
- To correlate the experimental results for applications.

MODULE I LASER THEORY 8

Spontaneous and stimulated emission - Population inversion – Einstein's A & B coefficients - Threshold condition – super-radiance Laser – Three level and four level laser systems -conditions for CW and pulsed laser action. Q-Switching - experimental methods - cavity dumping - Mode locking - experimental methods - Spatial and Temporal coherence.

MODULE II DIFFERENT LASER SYSTEMS 8

Laser systems – General description - Laser structure - excitation mechanism - Different laser systems- He-Ne laser, Carbon-dioxide laser - Excimer laser – Free electron laser- Alexandrite laser - Ti-Sapphire laser – Semiconductor diode laser - Diode pumped solid state laser - Pulsed-CW dye laser- Fibre laser.

MODULE III METROLOGICAL AND MATERIAL PROCESSING APPLICATIONS 8

CW and Pulsed laser beam characteristics and its measurements - Beam focusing effects - spot size - Power and Energy density Measurements - Distance measurement - Interferometric techniques - LIDARS - different experimental arrangements - Pollution monitoring by remote sensing - Laser gyroscope - Laser welding, drilling, machining and cutting - Laser surface treatment - Laser vapour deposition – Biophotonic applications.

MODULE IV LASER INSTRUMENTATION 6

Laser for measurement of length, current and voltage – Laser Doppler Velocimetry - Holography and speckle in displacement and deformation measurements - Laser for communication with fiber optics as channel.

L : 30 periods

PRACTICALS

1. Tuning of Dye Laser using DFDL Arrangement
2. Determination of Brewster Angle using He-Ne laser
3. Study of transversely Pumped Dye Lasers
4. Study of longitudinally Pumped Dye Lasers
5. Determination of power and wavelength using Distributed Feedback Dye Laser (DFDL)
6. Determination of fibre optic losses using semiconductor laser.
7. Bandgap determination of a semiconductor diode.

L : 30 periods, P: 30 periods

Total: 60 periods

REFERENCES:

1. William T. Silfvast, "Laser Fundamentals", Cambridge University Press, 2009.
2. Ghatak. A. & Thyagarajan. K. "Optical Electronics", Cambridge University, 1994.
3. Laud.B.B., "Laser and Non-Linear Optics", Second Edition, New Age International (p) Limited Publishers, 2011.
4. Nambiar. K.R., "Lasers Principle, Types and Applications", New Age International (p) Ltd, 2004.
5. Wilson. J. & Hawkes. J.F.B., "Opto Electronics - An Introduction", Prentice Hall, 1992.
6. William M.Steen, "Laser Material Processing", Springer-Verlag, Berlin, Third Edn., 2005.

OUTCOMES:

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

- To complement the knowledge acquired in the theory class.
- To work with dye lasers for tunability of laser wavelength
- To measure the loss of information involved in fibre optic communication
- To correlate the results for application.

PHCX 05**MATERIALS SCIENCE**

L	T	P	C
2	0	2	3

OBJECTIVES

- To gain basic knowledge in conducting and semiconducting materials and their properties.
- To provide a basis for understanding properties and applications of dielectric materials.
- To impart knowledge on magnetic and optical materials and their properties & applications.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I CONDUCTING AND SEMICONDUCTING MATERIALS 8

Quantum free electron theory of metals and its importance - Energy distribution of electrons in metals - Fermi distribution function - Density of energy states and carrier concentration in metals - Fermi energy – Classification of solids into conductors, semiconductors and insulators on the basis of Band theory – Introduction to Elemental and Compound semiconductors - Carrier concentration derivation for Intrinsic semiconductors - Density of electrons in conduction band & Density of holes in valence band- intrinsic carrier concentration - Fermi energy & Variation of Fermi energy level with temperature - Mobility and electrical conductivity - Band gap determination.

MODULE II DIELECTRIC MATERIALS 7

Introduction to dielectric materials & basic definitions – Electronic, Ionic, Orientation & space charge polarizations - Total polarization – Frequency and temperature dependence of polarization - Internal field in a dielectric material - Deduction of Clausius - Mosotti's relation - dielectric loss & loss tangent – Different types of dielectric breakdown – Applications of dielectric materials : Capacitors and Transformers.

MODULE III MAGNETIC MATERIALS 7

Introduction to magnetic materials & origin of magnetic moment - Different types of magnetic materials and their properties - Ferromagnetism & Domain theory of ferromagnetism - Hysteresis, Soft and Hard magnetic materials - Antiferromagnetic materials - Ferrites and its applications – Applications of magnetic materials : Data storage.

MODULE IV OPTICAL MATERIALS**8**

Optical properties of semiconductors - Direct and Indirect bandgap semiconductors – Traps, recombination centre, color center and exciton – Luminescence : Fluorescence and Phosphorescence - Liquid crystal display : twisted nematic crystal display – Applications of Optical materials - Optical Sources : light emitting diode and laser diode - Photo detectors : PIN photodiode and Avalanche Photodiode - Pyroelectric devices - Electro optic effect : Kerr effect and Faraday effect.

PRACTICALS

1. Resistivity measurement of a semiconductor using four point probe method.
2. Determination of band gap of a semiconductor diode.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination dielectric constant of a given non-polar liquid.
5. Determination of magnetic susceptibility of a given paramagnetic liquid using Quincke's method.
6. Determination of energy loss of a given transformer core using hysteresis method.
7. To study the I-V characteristics of a photodiode.

L : 30 periods, P: 30 periods**Total: 60 periods****REFERENCES**

1. Palanisamy P.K., "Physics II", Material Science for ECE, Scitech Publications (India) Pvt Ltd., 2006.
2. Kasap. S.O., "Principles of Electronic materials and devices", McGraw Hill Publishers, 3rd Edition, 2007.
3. Arumugam. M, "Physics II", Material Science for ECE, Anuradha Publishers, 5th Edition, 2005.
4. Sze. S.M., "Semiconductor Devices – Physics and Technology", John Wiley, 2nd Edition. 2002.
5. Raghavan. V, "Materials Science and Engineering", Prentice Hall of India, 5th Edition, 2004.

OUTCOMES

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

- Gain knowledge about fundamentals of conducting and semiconducting materials
- Understand the concepts and applications of Dielectric, Magnetic materials
- Familiarize Optical materials and their applications in Engineering and Medical fields.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 06**NON-DESTRUCTIVE TESTING**

L	T	P	C
2	0	2	3

OBJECTIVES:

- To study the process and applications of ultrasonic inspection method.
- To understand the basic concepts of radiographic inspection method.
- To acquire the knowledge about the various surface Non-Destructive Testing (NDT) techniques.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I ULTRASONIC INSPECTION METHOD**10**

Ultrasonic Testing- Principle of operations- types of sound waves -types of Transducers-transmission and pulse-echo method- straight beam and angle beam, instrumentation- calibration methods-ultrasonic testing technique- data representation, A Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction-thickness determination-, advantages, disadvantages and applications.

MODULE II RADIOGRAPHIC INSPECTION METHOD**10**

Radiographic testing- Principle-Interaction of X-ray with matter-X-ray radiography-method of generation-industrial radiography inspection techniques- Equipment-Exposure charts-Types of films-Fluoroscopy- Xero-Radiography –Limitations-Gamma radiography-Equipment, radiation sources- method of generation- film processing- interpretations of radiography-safety in industrial radiography.

MODULE III SURFACE NDT TECHNIQUES**10**

Liquid Penetrant Testing – Principles, Characteristics and types of liquid penetrants-developers- advantages and disadvantages of various methods- Inspection Procedure and Interpretation of results. Applications of Liquid Penetrant testing. Magnetic Particle Testing- Principle-magnetizing technique-procedure –equipment- Interpretation and evaluation of test indications-.applications and limitations-demagnetization.

L : 30 periods**PRACTICALS**

1. Inspection of welds using solvent removable visible dye penetrant.
2. Inspection of welds using solvent removable fluorescent dye penetrant.
3. Inspection on non magnetic materials by eddy current method.

4. Inspection on magnetic materials by eddy current method.
5. Inspection of welds by Eddy current Testing.
6. Inspection of welds by Magnetic Particle Testing - Dry method.
7. Inspection of welds by Magnetic Particle Testing - Wet method.
8. Ultrasonic flaw detector- Inspection of defects.
9. Demonstration of Radiographic inspection.

L : 30 periods, P: 30 periods

Total: 60 periods

REFERENCES:

1. Baldev Raj., Jayakumar T.,Thavasimuthu., "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Ravi Prakash., "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.
3. ASM Metals Handbook of Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, Volume-17, 2000.
4. Paul E Mix., "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005.
5. Charles J., Hellier, "Handbook of Nondestructive evaluation", McGraw Hill, New York, 2001.

OUTCOMES:

Upon completion of this course, the students will be able to

- Illustrate the ultrasonic inspection methods of NDT.
- Understand the basic concept of radiographic inspection method.
- Test the surfaces by the various surface NDT techniques.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

PHCX 07	PROPERTIES OF MATTER AND ACOUSTICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand principles and properties of elasticity.
- To understand the basic concepts and application of viscosity.
- To analysis acoustic of building.
- To know about photoelasticity and its applications.

MODULE I ELASTICITY**8**

Stress and strain - Hooke's Law of elasticity - Elastic moduli - Stress-Strain Diagram - Poisson's Ratio - Relation between elastic constants - Work done in stretching and twisting a wire - Twisting couple on a cylinder- Expression for bending moment - Cantilever–Expression for depression - Uniform bending and Non-uniform bending of beams (theory & experiment) - I form Girders (qualitative treatment) and applications.

MODULE II VISCOSITY**8**

Viscosity- Newton's formula for viscous flow- Streamline and turbulent motion- Reynolds number - Poiseuille's formula- Determination of coefficient of viscosity- factors affecting viscosity - capillary flow method - Stoke's formula- viscosity of highly viscous liquids – Stoke's method - Lubricants and its applications –viscosity measurements- Viscometer- Variation of Viscosity with Temperature.

MODULE III ACOUSTICS OF BUILDING**7**

Basic requirement for the acoustically good halls - Reverberation and time of reverberation – Sabine's formula for reverberation time - Absorption coefficient and its measurement -Transmission of sound and transmission loss - Factors affecting the architectural acoustics and their remedy-sound absorbing materials-vibration and noise control systems for buildings.

MODULUE IV PHOTOELASTICITY**7**

Polarization- double refraction-Theory of Plane, Circularly and Elliptically polarized light- Quarter wave plate and half wave plate- photo elasticity- Theory of photo-elasticity- Stress optic relations- model materials-analysis techniques- Photo elastic bench.- Three dimensional photo elasticity-Digital photo elasticity- Photo elastic coatings.

L : 30 periods**PRACTICALS**

1. Determination of viscosity of liquid by Poiseuille's method.
2. Determination of viscosity of liquid by Stoke's method.
3. Analysis of stress by photo elastic method.
4. Verification of Hooke's law by spring method.
5. Determination of Young's modulus of the cantilever beam.
6. Determination of rigidity modulus by static torsion method.
7. Visit to acoustically good auditorium and identifying the sound absorbing materials in the auditorium.

L : 30 periods, P: 30 periods**Total: 60 periods****REFERENCES:**

1. Mathur D.S., "Elements of Properties of Matter", S.Chand & Co, Delhi, 2009.
2. Gaur R.K., Gupta S.L., "Engineering Physics", Dhanpat Rai Publishers, 2010.
3. Brijlal and Subramaniam., " Properties of Matter", Eurasia Publishing Co, New Delhi, 2002.
4. Smith C.J., " General Properties of Matter", Orient & Longman, 1960.
5. Kenneth G. Budinski and Michel K., Budinski, "Engineering Materials Properties and Selection", Pearson, Singapore, 2002.

OUTCOMES:

Upon completion of this course, the students will be able to

- Understand the basic concepts of the elasticity of materials.
- Comprehend the concepts of viscosity of liquid and measurement.
- Demonstrate the acoustical aspects of building and its importance in construction.
- Illustrate the fundamental concept of photo elasticity and its use for the stress analysis of the object.

PHCX 08	PROPERTIES OF MATTER AND NONDESTRUCTIVE TESTING	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To impart knowledge about the principles and properties of elasticity.
- To learn the laws governing the dynamic of rigid bodies.
- To acquire the knowledge of the various techniques of Non-Destructive Testing (NDT) of materials.
- To understand the principle and basic concept of low temperature applications.

MODULE I ELASTICITY**8**

Stress and strain - Hooke's Law of elasticity - Elastic moduli - Stress-Strain Diagram - Poisson's Ratio - Relation between elastic constants - Work done in stretching and twisting a wire - Twisting couple on a cylinder- Expression for bending moment- Cantilever-Expression for depression - Uniform Bending and Non-uniform bending of beams (theory & experiment) - I form Girders (qualitative treatment) and applications.

MODULE II DYNAMICS OF RIGID BODIES**8**

Rigid bodies - angular acceleration - Torque on a particle - angular momentum - law of conservation of angular momentum - moment of inertia and its significance - Theorem of parallel and perpendicular axis - moment of inertia of a thin uniform bar - moment of inertia of a rectangular lamina - moment of inertia of uniform circular disc - Moment of inertia of hollow and solid cylinders – flywheel (qualitative) - kinetic energy of rotating body – Routh rule.

MODULE III NDT TECHNIQUES**6**

Ultrasonic Testing- types of Transducers-transmission and pulse-echo method- Radiographic testing- Principle-Interaction of X-ray with matter-X-ray radiography- method of generation-industrial radiography inspection techniques- Liquid Penetrant Testing- Inspection Procedure and Interpretation of results.

MODULE IV LOW TEMPERATURE PHYSICS**8**

Definition of Refrigeration and Air-Conditioning - Types of Refrigeration Systems- Applications- Comfort Air Conditioning, Industrial Refrigeration, Food processing and food chain - Cryogenic treatment - Low temperature properties of engineering materials: Mechanical properties, Thermal properties, Electrical properties.

L : 30 periods**PRACTICALS**

1. Verification of Hooke's law by spring method.
2. Determination of Young's modulus of the beam by bending method.
3. Inspection of welds using solvent removable visible dye penetrant.
4. Inspection of welds using solvent removable fluorescence dye penetrant.
5. Inspection of welds by Magnetic Particle Testing.
6. Determination of moment of inertia of the disc by torsion pendulum method.
7. Determination of moment of inertia of the disc by static torsion method.
8. Demonstration of working of flywheel.

L : 30 periods, P: 30 periods**Total: 60 periods****REFERENCES:**

1. Mathur D.S., "Elements of Properties of Matter", S.Chand & Co, Delhi, 2009.
2. Brijlal & Subramaniam, "Properties of Matter", Eurasia Publishing Co, Delhi, 2002.
3. Gaur R.K., Gupta S.L., "Engineering Physics" Dhanpat Rai Publishers, 2010.
4. BaldevRaj., Jayakumar T., ThavasimuthuM., "Practical Non-Destructive testing", Narosa Publishing House, 2009.
5. Brijlal & Subrahmanyam., "Heat and Thermodynamics" S.Chand & Company Ltd, 2002.
6. Paul E Mix., "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition, New Jersey, 2005.
7. Charles J., Hellier., "Handbook of Nondestructive evaluation", McGraw Hill, New York, 2001.

OUTCOMES:

Upon completion of this course, the students will be able to

- understand the basic of concept of elasticity of materials.
- comprehend the basic concepts of motion of rigid bodies and its applications.
- Demonstrate the various NDT techniques and its importance.
- Illustrate the low temperature systems and its applications.

PHCX 09	SEMICONDUCTOR PHYSICS AND OPTOELECTRONICS	L T P C 2 0 2 3
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OBJECTIVES:

- To understand the Physics of Semiconductor devices.
- To make the students learn the fundamentals of Photoluminous - semiconductors, Optoelectronic devices, Optical modulators/detectors.
- To make them understand the technology behind latest Display devices like LCD, Plasma and LED Panels.
- To enable the students to correlate theoretical principles with practical applications.

MODULE I PHYSICS OF SEMICONDUCTORS**8**

Elemental and compound semiconductors – Drift and diffusion current - Intrinsic semiconductors – 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.

MODULE II OPTOELECTRONIC DEVICES**7**

Light Emitting Diodes (LED) – power and efficiency - double hetero LED - LED structure - LED characteristics - White LED – Applications. Liquid crystal displays – Dynamic scattering and Twisted nematic display, Semiconductor Lasers, Homo Junction and Hetero Junction laser diodes - Optical processes in semiconductor lasers.

MODULE III OPTICAL MODULATORS**7**

Modulation of light – birefringence – Modulation Techniques - Electro optic effect – Electro optic materials – Types of Electro optic Modulators : Kerr and Pockel modulators – Magneto optic effect - Magneto optic Modulators – Acousto Optic modulators.

MODULE IV OPTICAL DETECTORS**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.

L : 30 periods

PRACTICALS

1. Resistivity measurement of a semiconductor using four point probe method.
2. Determination of band gap of a semiconductor diode.
3. Determination of Hall coefficient of a given semiconductor material.
4. Determination of the wavelength of a given laser source using diffraction grating.
5. Determination of Planck's constant using LED.
6. To study the I-V characteristics of photodiode and phototransistor.
7. To study the characteristics of a solar cell.

L : 30 periods, P: 30 periods

Total: 60 periods

REFERENCES:

1. Arumugam. M, "Physics II", Anuradha Publishers, 5th Edition, 2005.
2. Sze. S.M., "Semiconductor Devices – Physics and Technology", 2nd edn. John Wiley, 2002.
3. Wilson & J.F.B. Hawkes, "Optoelectronics – An Introduction", Prentice Hall, India, 1996.
4. Bhattacharya, "Semiconductor optoelectronic devices", Second Edn, Pearson Education, 2002.
5. Safa O. Kasap, "Optoelectronics & Photonics: Principles & Practices", Second Edn, Pearson Education, 2013.
6. Palanisamy P.K., "Semiconductor physics and optoelectronics" Scitech Publications, 2003.

OUTCOMES:

On completion of this course, the student will be able to

- Understand the principles of Physics behind semiconductor devices.
- Choose the correct semiconductors for electronic devices and display.
- Differentiate the working principle of LED and Diode Laser.
- Apply the knowledge of modulation of light for different types of optical modulators.
- Select suitable photodetectors for different types of applications.
- Complement the knowledge acquired in the theory class and correlate the results for applications.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

- Dutt and Sundharam (2013), *Indian Economy*, S. Chand & Company Pvt. Ltd, New Delhi.
- Hussain, Moon Moon (2015), *Economics for Engineers*, Himalaya Publishing House, New Delhi.

REFERENCES:

- Cleaver Tony (2004), "*Economics: The Basics*", Routledge, London.
- Mell Andrew and Walker Oliver (2014), "*The Rough Guide to Economics*", Rough Guide Ltd.

OUTCOMES:

On successful completion of this course,

- Students will have had exposure to the basic concepts of demand, supply and various pricing strategies.
- Students will have understood the macroeconomic concepts of national income and inflation.
- Students will be able to apply the knowledge of money, banking and public finance in their real life situations.
- Students will have an overview of the economic reforms introduced in Indian economy.

SSCX 02	PRINCIPLES OF SOCIOLOGY.	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To acquaint the students with Concepts and perspectives of Sociology
- To explain the reflection of society in Individuals and vice versa
- To describe the hierarchical arrangement of individuals and groups in society
- To explicate the dimensions, forms and factors of Social change.
- To examine the context, impact and agencies of Globalization

MODULE I THE FOUNDATIONAL CANON 8

Sociology-Definition, scope and importance; Major theoretical perspectives-Functionalism, Conflict Theorising and Interactionism; Elements of social formation-Society, Community, Groups and Association; Associative Social Process- Co-operation, Accommodation and Assimilation; Dissociative Social Process- Competition and Conflict.

MODULE II INDIVIDUAL AND SOCIETY 7

Culture-definition, characteristics, functions, types, cultural lag and civilization, Socialization – definition, process, stages, agencies and anticipatory socialization; Social Control- definition, characteristics, importance, types & agencies.

MODULE III SOCIAL INEQUALITY AND STRATIFICATION 7

Concepts- inequality, hierarchy, differentiation, Social Exclusion, and Social Stratification. Forms of Social Stratification- Caste, Class and Estate. Gender and Social Stratification- sex and gender, patriarchy, factors perpetuating gender stratification; Globalization and gender inequality

MODULE IV SOCIAL CHANGE AND GLOBALIZATION 8

Social Change-definition, nature, direction; Forms- evolution, development, progress and transformation; Factors of social change- demography, economy, technology, polity and culture. Globalization- definition, characteristics, historical and social context and Impact, agencies of globalization- IGOs, INGOs, Nation-State, MNEs and Media

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

- Giddens A. 1989. "Sociology" Cambridge: Polity Press.
- Heald Haralambos, R.M(2014) . "Sociology Themes and Perspectives", Oxford, New Delhi-92
- Bhushan Vidya and D.R. Sachdeva (2012). "Fundamental of Sociology", Pearson, Delhi.

REFERENCES:

- Das Gupta, Samir and Paulomi Saha (2012), "An Introduction to Sociology", Pearson, Delhi
- Bottomore, T.B. 1972. *Sociology- A Guide to Literature and Problems*, New Delhi,

OUTCOMES:

On successful completion of this course,

- Students will have exposure to the fundamentals tenets of Sociology.
- Students will be trained to understand social reality with sociological perspective.
- Students will be oriented to constructively analyze human interactions, social relationship and social issues
- Students will gain exposure to the dynamics of human society with special reference to the contemporary trends of globalization.

SSCX 03	SOCIOLOGY OF INDIAN SOCIETY.	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To present a portrayal of the components of the Indian Social structure
- To describe the nature and contemporary structure of Indian social Institutions.
- To examine the causality and magnitude of social problem facing the contemporary India.
- To elucidate the processes forms and impact of change and development in Indian society

MODULE I INDIAN SOCIAL STRUCTURE 7

Unity and Diversity; Concepts of unity and diversity- racial, religious, ethnic and linguistic composition of India. Types of communities-rural, urban and tribal; Social backwardness- OBC, SC and ST; Indian minorities- religious, ethnic, linguistic and LGBT

MODULE II INDIAN SOCIAL INSTITUTIONS 7

Family- definition, types, characteristics, functions of family; Joint Family- definition features, utility, changes; Marriage- definition, characteristics, marriage as sacrament or contract. Caste- definition, principles, contemporary changes, dominant caste, caste -class interface.

MODULE III SOCIAL PROBLEMS IN INDIA 8

Social Problem-definition, 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 IV SOCIAL CHANGE AND DEVELOPMENT IN INDIA 8

Socio-cultural Change- Sanskritization, Westernization, Secularization, Modernization;
Processes of Social change- Industrialization, Urbanization, Globalization;
Development- definition, elements, role of government, industry and corporate

sector. Technology and change- invention and innovation, impact of technology on social institutions, technology and development.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

- Sharma,K.L.2008. *Indian Social Structure and Change*. Jaipur: Rawat Publications,.
- Shah, A.M. 1998. *The Family in India: Critical Essays*. New Delhi: Orient Longman,
- Ahuja Ram. 1999. *Social problems in India*, Rawat Publication: New Delhi.
- Ahuja Ram. 2014. *Society in India*,, Rawat Publication: New Delhi.

REFERENCES:

1. Jayapalan, N.(2001), “Indian Society and Social Institutions” Atlantic Publishers & Distri,
2. Atal, yogesh (2006), “Changing Indian Society” Rawat Publications, Jaipur

OUTCOMES:

On successful completion of this course,

1. Students will gain an in-depth understanding of the social structure and social institutions that constitute society in India.
2. Students will be sensitized to the various categories ,Inequalities and their challenges
3. Students will be exposed to the social problems encountered in contemporary India.
4. Students will gain knowledge about the various forms and trends of the social change.
5. Students will become aware about the challenges in the path of progress of Indian society and realize relevance of their role in bringing about development

Humanities Elective II
(To be offered in IV Semester)

SSCX 04	ECONOMICS OF SUSTAINABLE DEVELOPMENT	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To have an increased awareness on the concept and components of sustainable development.
- To develop the ability to demonstrate the need of sustainable development and international responses to environmental challenges.
- To have an insight into global environmental issues and sustainable globalization.
- To establish a clear understanding of the policy instruments of sustainable development.

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 7

Evolution of the Concept – Rio Summit and sustainable development - various definitions of sustainable development - Components of sustainable development: Social, environmental and economic components.

MODULE II NEED FOR SUSTAINABLE DEVELOPMENT 8

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, Montreal Protocol, Basel Convention.

MODULE III GLOBALIZATION AND ENVIRONMENT 8
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 7
DEVELOPMENT

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; T – 0; Total Hours –30

TEXT BOOKS:

1. Anderson, David A (2010), “*Environmental Economics and Natural Resource Management*”, Routledge, 3rd edition.
2. Karpagam M (1999), “*Environmental Economics: A Textbook*”, Sterling Publishers Pvt. Ltd, New Delhi.

REFERENCES:

1. Karpagam M and Jaikumar Geetha (2010), “*Green Management Theory and Applications*”, Ane Books Pvt. Ltd, New Delhi.
2. Sengupta Ramprasad (2004), “*Ecology and Economics: An Approach to Sustainable Development*”, Oxford University Press, New Delhi.

OUTCOMES:

On successful completion of this course,

- The students will have understood the concepts and components of sustainable development.
- The students will have a holistic overview on the challenges of sustainable development and International responses to environmental challenges.
- The students will have gained knowledge on the global environment issues and demonstrate responsible globalization through global governance.
- The students will have developed awareness of the ethical, economic, social and political dimensions that influence sustainable development.

SSCX 05	INDUSTRIAL SOCIOLOGY	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To introduce sociological approaches and perspectives to understand the social relationship in manufacturing industries and corporate sector.
- To explain the structure and functions of industrial organizations.
- To elucidate the dynamics of organizational behavior, leadership and communication.
- To inculcate professional ethics and values to equip students to work in organizational settings.

MODULE I INTRODUCTION 8

Industrial Sociology- 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; Industrial conflict- strike , lockout and trade unions.

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 8

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.

MODULE IV PROFESSIONAL ETHICS AND VALUES 7

Concepts- values- morals, and ethics, Integrity, work ethics , service learning - Civic Virtue - caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - commitment - empathy - Self-Confidence - Environmental Ethics, Cyber issues - computer ethics, cyber crimes, plagiarism Ethical living-concept of harmony in life.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. Narender Singh, Industrial Sociology, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
2. Gisbert Pascal, Fundamentals of Industrial Sociology, Tata Mc. Graw Hill Publishing Co., New Delhi, 1972
3. Schneider Engeno. V, Industrial Sociology 2nd Edition, Mc. Graw Hill Publishing Co., New Delhi, 1979.

REFERENCES:

- Robbins, Stephen, Organizational Behaviour , Prentice Hall of India PVT ltd new Delhi, 1985
- Devis Keith , Human Behaviour at work place, Mc. Graw Hill Publishing Co., New Delhi,1984

OUTCOMES:

On successful completion of this course,

1. Students will have acclimatized with sociological perspectives for dealing with social relationships in production and service organizations.
2. Students will be familiar with structure of authority, roles and responsibility in organizational settings.
3. Students will imbibe leadership, communication and behavioral acumen to govern organization
4. Students will be sensitized to standards of desirable behavior to engage in industrial and corporate sector.

SSCX 06**LAW FOR ENGINEERS**

L	T	P	C
2	0	0	2

OBJECTIVES:

1. To understand the Constitution and Governance of our country.
2. To apprise the students of human rights - local and international and redressal mechanism.
3. To have an insight into the industrial, corporate and labour laws of our country.
4. To establish a clear understanding about the importance of intellectual property related laws.

MODULE I INDIAN CONSTITUTION AND GOVERNANCE 8

Constitution – salient features, Preamble, Citizenship, Fundamental rights, Fundamental duties, Directive principles, Union executive, Legislature – Union – State and union territories – Election Commission – Election for parliament and state legislature, Judiciary- basic functioning of the Supreme Court and High Courts, Right to information Act 2005 – evolution – concept – practice.

MODULE II HUMAN RIGHTS 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.

MODULE III INDUSTRIAL, CORPORATE AND LABOUR LAWS 8

Corporate laws – meaning and scope, Companies Act 1956 – Indian Contract Act 1872 - Principles of Arbitration - Industrial Employment (Standing Orders) Act 1946 - Industrial Disputes Act 1947 - Workmen's Compensation Act 1923 - The Factories Act, 1948.

MODULE IV LAWS RELATED TO IPR 7

IPR – meaning and scope, International organization – WIPO – TRIPS, Major Indian IPR Acts – Copyright laws, Patent and Design Act, Trademarks Act, Trade Secret Act, Geographical Indicator.

L – 30; T – 0; Total Hours –30

TEXT BOOKS:

1. M.P. Jain (2005) *Indian Constitutional Law*, Wadhwa & Co.
2. H. D, Agarwal (2008), *International Law and Human Rights*, Central Law Publications,
3. Rao, Meena (2006), *Fundamental Concepts in Law of Contract*, 3rd edn., Professional offset.
4. Ramappa (2010), *Intellectual Property Rights Law in India*, Asia Law House.
5. Singh, Avtar (2007), *Company Law*, Eastern Book Co.
6. R.F, Rustamji (1967), *Introduction to the Law of Industrial Disputes*, Asia Publishing House.

REFERENCES:

1. Acts: Right to Information Act, Industrial Employees (standing order) Act, Factories Act, Workmen Compensate Act.

OUTCOMES:

On successful completion of this course,

1. Students will be able to apply the basic concepts of Indian Constitution, Governance and power in their real life situation.
2. Students will have gained knowledge in human rights, cultural, social and political rights.
3. Students will have synthesized knowledge about industrial, corporate and labour laws of our country.
4. Students will have an overview of IPRs and laws related to Intellectual Property Rights.

- Describe the origin, changes and management of environmental hazards.
- Develop the knowledge on natural disasters.
- Develop the knowledge on man-made disasters.
- Discuss the different segments of disaster management.
- Explain the concept of different disaster relief measures.
- Achieve sufficient knowledge on the National Policy on Disaster Management.

Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

MODULE VI **QUALITY SYSTEMS** **7**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System– Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits

Total Hours –45

TEXT BOOKS:

1. Dale H.Besterfield, et al., “Total Quality Management”, Pearson Education, Inc. 2003.

REFERENCES:

1. James R.Evans & William M.Lindsay, “The Management and Control of Quality”, 5th Edition, South-Western (Thomson Learning), 2002.
2. Feigenbaum.A.V., “Total Quality Management”, McGraw-Hill, 1991.
3. Oakland.J.S., “Total Quality Management”, Butterworth Heinemann Ltd.,Oxford, 1989.
4. Narayana V. and Sreenivasan. N.S., “Quality Management – Concepts and Tasks”, New Age International, 1996.
5. Zeiri, “Total Quality Management for Engineers”, Wood Head Publishers, 1991.

OUTCOMES:

The student should be able to

- Apply the various statistical tools and approaches for Quality control.
- Achieve continuous process improvement through TQM.

GECX 103**ENERGY STUDIES**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the growing demand, supply of energy on global and national levels and the need for renewable energy promotion.
- To understand the basic need for energy conservation and waste heat recovery.
- To learn the important aspects of energy audit and management.
- To get acquainted with the global environmental issues and carbon credits.

MODULE I GLOBAL AND NATIONAL ENERGY SCENARIO 7

Role of energy in economic development, various energy resources - overall energy demand and availability- Energy consumption in various sectors and its changing pattern - Exponential increase in energy consumption and projected future demands. Need for renewable energy.

MODULE II SOLAR ENERGY 8

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

MODULE III OTHER RENEWABLE ENERGY SOURCES 8

Power from wind – wind turbine working and types, solar thermal power plants – low medium and high power generation, power from wave , tidal, geothermal sources, OTEC system. MHD power plants – working, types, merits and demerits. Energy from biomass.

MODULE IV COGENERATION, WASTE HEAT RECOVERY AND COMBINED CYCLE PLANTS 8

Cogeneration principles- topping and bottoming cycles, role in process industries. Energy from wastes- waste heat recovery- heat recovery from industrial processes. Heat exchange systems – recuperative and regenerative heat exchangers – commercially available waste heat recovery devices. Combined cycle plants – concept, need and advantages, different combinations and practical scope.

MODULE V ENERGY CONSERVATION AND MANAGEMENT 7

Need for energy conservation – use of energy efficient equipment. Energy conservation opportunities - in educational institutions, residential, transport, municipal, industrial and commercial sectors – concept of green building. Energy audit in industries – need, principle and advantages. Case studies.

MODULE VI GLOBAL ENERGY ISSUES AND CARBON CREDITS 7

Energy crisis, fossil consumption and its impact on environmental climate change. Energy treaties – Montreal and Kyoto protocols - Transition from carbon rich and nuclear to carbon free technologies, carbon foot print – credits – clean development mechanism.

L – 45; Total Hours –45

TEXT BOOKS:

1. S.S. Rao and B.B. Parulekar, “Energy Technology”, 3rd Edition, Khanna Publishers, New Delhi, 2011.
2. O. Callaghn. P.W., “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.

REFERENCES:

1. G.D. Rai, “Non Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
2. Archie, W Culp. “Principles of Energy Conservation”, McGraw Hill, 1991.
3. D Patrick and S W Fardo, “Energy Management and Conservation”, PHI,1990
4. P. O’Callaghan: “Energy Management”, McGraw - Hill Book Company, 1993.
5. Kenney, W. F., “Energy Conservation in Process Industries”, Academic Press, 1983.

OUTCOMES:

The student should be able to

- Realize the global and national energy status and need to switch over to renewable energy technology.
- Energy audit and suggest methodologies for energy savings.
- Utilize the available resources in an optimal way.
- Concern about the global environmental issues & promote carbon credits.

GECX 104**ROBOTICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn about the robots, various components, of Robots, programming and their applications.

MODULE I**8**

Definition- Need - Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence- basic parts - functions – specifications. of robot, degrees of freedoms, end effectors – types, selection

MODULE II ROBOT DRIVES AND CONTROL**8**

Controlling the Robot motion – Position and velocity sensing devices – Design of drive systems – Hydraulic and Pneumatic drives – Linear and rotary actuators and control valves – Electro hydraulic servo valves, electric drives – Motors – Designing of end effectors – Vacuum, magnetic and air operated grippers.

MODULE III ROBOT SENSORS**8**

Transducers and Sensors – Tactile sensor – Proximity and range sensors – Sensing joint forces – Robotic vision system – Image Representation - Image Grabbing –Image processing and analysis – Edge Enhancement – Contrast Stretching – Band Rationing - Image segmentation – Pattern recognition – Training of vision system.

MODULE IV ROBOT PROGRAMMING & AI TECHNIQUES**7**

Types of Programming – Teach pendant programming – Basic concepts in AI techniques – Concept of knowledge representations – Expert system and its components.

MODULE V ROBOTIC WORK CELLS AND APPLICATIONS OF ROBOTS**7**

Robotic cell layouts – Inter locks – Humanoid robots – Micro robots – Application of robots in surgery, Manufacturing industries, space and underwater.

MODULE VI ROBOT KINEMATICS AND DYNAMICS 7

Forward and inverse Kinematic equations, Denavit – Hartenbers representations
Fundamental problems with D-H representation, differential motion and velocity
of frames - Dynamic equations for single, double and multiple DOF robots – static
force analysis of robots.

L – 45; Total Hours –45

REFERENCES:

1. Yoram Koren, "Robotics for Engineers", Mc Graw-Hill, 1987.
2. Kozyrey, Yu, "Industrial Robots", MIR Publishers Moscow, 1985.
3. Richard. D, Klafter, Thomas, A, Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Prentice-Hall of India Pvt. Ltd., 1984.
4. Deb, S.R. "Robotics Technology and Flexible Automation", Tata Mc Graw-Hill, 1994.
5. Mikell, P. Groover, Mitchell Weis, Roger, N. Nagel, Nicholas G. Odrey, "Industrial Robotics Technology, Programming and Applications", Mc Graw- Hill, Int. 1986.
6. Timothy Jordanides et al, "Expert Systems and Robotics", Springer – Verlag, New York, May 1991.

OUTCOMES:

Students would be able to

- Understand about the robots, its various components.
- Design Robots for industrial applications.
- Do programming for robots and apply them in real time applications.

GECX 105	TRANSPORT MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the transport fleet and their related activities for minimizing operational cost.
- To understand the need of maintenance and its importance.
- To understand the functions and applications of various types of transport system.

MODULE I INTRODUCTION 7

Personnel management; objectives and functions of personnel management, psychology, sociology and their relevance to organization, personality problems. Selection process: job description, employment tests, interviewing, introduction to training objectives, advantages, methods of training, training procedure, psychological tests.

MODULE II ORGANISATION AND MANAGEMENT 7

Forms of Ownership – principle of Transport Management – Staff administration – Recruitment and Training – welfare – health and safety. Basic principles of supervising. Organizing time and people. Driver and mechanic hiring - Driver checklist - Lists for driver and mechanic - Trip leasing - Vehicle operation and types of operations.

MODULE III TRANSPORT SYSTEMS 9

Introduction to various transport systems. Advantages of motor transport. Principal function of administrative, traffic, secretarial and engineering divisions. chain of responsibility, forms of ownership by state, municipality, public body and private undertakings.

MODULE IV SCHEDULING AND FARE STRUCTURE 8

Principal features of operating costs for transport vehicles with examples of estimating the costs. Fare structure and method of drawing up of a fare table. Various types of fare collecting methods. Basic factors of bus scheduling. Problems on bus scheduling.

GECX 106	CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the system modeling and to derive their transfer function.
- To provide adequate knowledge of time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed-loop frequency responses of Control systems.

MODULE I BASIC CONCEPTS AND SYSTEM REPRESENTATION 8

Control System - Basic elements in control systems – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – Block diagram reduction techniques – Signal flow graphs.

MODULE II TIME RESPONSE ANALYSIS AND DESIGN 8

Time response – Time domain specifications – Types of test input – First and Second order system - Type I and Type II System – Response - Error coefficients – Generalized error series – Steady state error – P, PI, PID modes of feedback control.

MODULE III FREQUENCY RESPONSE ANALYSIS AND DESIGN 7

Performance specifications - correlation to time domain specifications - bode plots and polar plots – gain and phase margin – constant M and N circles and Nichols chart – all pass and non-minimum phase systems.

MODULE IV STABILITY 8

Characteristics equation – Location of roots in s plane for stability – Routh Hurwitz criterion – Root locus construction – Effect of pole, zero addition – Gain margin and phase margin – Nyquist stability criterion.

MODULE V COMPENSATOR DESIGN 8

Performance criteria – Lag, lead and lag-lead networks – Compensator design using bode plots and root locus technique.

MODULE VI CONTROL SYSTEM COMPONENTS AND 6
APPLICATION OF CONTROL SYSTEMS

Synchros – AC servomotors - DC Servo motors - Stepper motors - AC Tacho generator - DC Tacho generator - Typical applications of control system in industry.

L – 45; Total Hours –45

REFERENCES:

1. K. Ogata, "Modern Control Engineering", 4th Edition, Pearson Education, New Delhi, 2003.
2. I.J. Nagrath & M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003.
3. C.J.Chesmond, "Basic Control System Technology", Viva student edition, 1998.
4. I.J.Nagarath and M.Gopal, "Control System Engineering", Wiley Eastern Ltd., Reprint, 1995.
5. R.C.Dorf and R.H.Bishop, "Modern Control Systems", Addison-Wesley (MATLAB Reference), 1995.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Proper understanding of basics of Control Systems.
- Ability and skill to carry-out time domain and frequency domain analysis.
- Capable of determining stability of the system using Routh Hurwitz criterion, Root locus and Nyquist criterion.
- Ability to design lag, lead and lag lead compensator networks.

GECX 107	INTRODUCTION TO VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Basic concepts of HDL.
- Verilog language and its syntax constructs.
- Programmable Logic Devices and FPGAs
- MOS devices theory
- CMOS based combinational and sequential circuits

PREREQUISITES:

Fundamentals of Electronics

Basics knowledge in Digital Electronics.

MODULE I REVIEW OF BASIC DIGITAL SYSTEMS 7

Boolean algebra, Building blocks of combinational logic design-Adders, multiplexer, encoder, decoder, comparator, Latches & flip-flops, counters, shift registers.

MODULE II LOGIC DESIGN USING VERILOG HDL 8

Overview of Digital Design with Verilog HDL, Levels of Design Description, Concurrency, Hierarchical Modeling Concepts, Modules and Ports, Component instantiation Data flow and RTL, structural, gate level, switch level modeling and Behavioral Modeling.

MODULE III LANGUAGE CONSTRUCTS OF VERILOG HDL 7

Identifiers- gate primitives, gate delays, operators, timing controls, procedural assignments, conditional statements Variable types, arrays and tables, Tasks and functions, Test bench.

MODULE IV BUILDING BLOCKS OF DIGITAL VLSI SYSTEMS 8

HDL Design -Data Path Operations-Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multiplication, Shifters, Memory Elements. Programmable logic elements and AND-OR arrays, FPGAs programming methods.

MODULE V TRANSISTOR THEORY 7

Introduction to MOS Transistors-NMOS & PMOS Characteristics, Current Equations, Complementary CMOS Inverter-DC Characteristics, Static Load MOS Inverters.

MODULE VI BASICS OF DIGITAL CMOS DESIGN 8

NMOS & PMOS Logic Gate, CMOS Logic Gate, Basic layout design of simple gate-stick diagram, CMOS Logic Structures-full adder, multiplexers.

Total Hours –45

TEXT BOOKS:

1. M.Morris Mano "Digital Design", 3rd Edition, Prentice Hall of India Pvt. Ltd New Delhi, 2003

REFERENCES:

1. Michael D. Ciletti "Advanced Digital Design with the Verilog HDL" (2nd Edition) Hardcover – January 31, 2010
2. J.Bhasker: Verilog HDL primer, BS publication, 2001.
3. J. P. Uyemura, "Introduction to VLSI Circuits and System", Wiley, 2002
4. Neil Weste and K. Eshragian, "Principles of CMOS VLSI Design: A System Perspective," 2nd edition, Pearson Education (Asia) Pvt.Ltd., 2000
5. Douglas A Pucknell & Kamran Eshragian, "Basic VLSI Design" PHI 3rd Edition (original edition – 1994)

OUTCOMES:

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

- Create basic Register Transfer Level (RTL) models for combinational circuits & Sequential circuits using Verilog HDL.
- Create basic behavioral models for combinational circuits & Sequential circuits using Verilog HDL.
- Describe the usage of Programmable Logic Devices and FPGAs.
- Describe MOS devices theory and inverter circuit DC characteristics
- Design the basic digital building blocks using MOS circuit.
- Apply VLSI design concepts based on the requirements to conduct experiments or projects

GECX 108	PLANT ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide in depth knowledge on Plant Engineering
- To introduce detail engineering and P&ID
- To learn about the support to Instrumentation from other disciplines
- To study about the Installation and commissioning

MODULE I INTRODUCTION OF PLANTS 7

General Project Cycle – Feed – Sales - Plant Description, Component / Areas of Plant, Plant Layout, Plant Interfaces, Plant Location

MODULE II ELEMENTS OF PLANT 8

Main Elements of a Plant, Process Flow Scheme (PFD – Process Flow Diagram) P&ID's, Plant Legend Finalization.

MODULE III DETAIL ENGINEERING 10

P& ID Development with PFD's, Major Discipline Involvement & Inter discipline Interaction, Major Instrumentation & Control Systems - Development Phase – Instrument List , I/O Count, Specification Sheets, Instrument Installation (Hook ups) , Control Philosophy – Detail Engineering.

MODULE IV SUPPORT FROM OTHER DISCIPLINE 8

Other Discipline Supports to Instrumentation – Plot Plan, Piping / Equipment Plan, Electrical Area Classification, Fire Hazardous Classification Telecommunication Systems - Control Network architecture.

MODULE V INSTALLATION AND COMMISSIONING 7

Plant Construction - Key Drawings for Construction Support Construction Activities, System Testing, Startup / Commissioning, Production.

MODULE VI CASE STUDIES 5

Case studies of Water Treatment Plant - Paper Industry – Power Plant etc

L – 45; Total Hours –45

REFERENCES:

1. Duncan C Richardson, Plant Equipment and Maintenance Engineering Handbook, McGraw-Hill Education: New York, Chicago, San Francisco, Athens, London, Madrid, Mexico City, Milan, New Delhi, Singapore, Sydney, Toronto, 2014 McGraw-Hill Education
2. Gabriel Salvendy, Handbook of Industrial Engineering – Technology and operations Management, John Wiley & Sons, 2001.
3. Robert C Rosaler , Standard Handbook of Plant Engineering, Mc Graw Hill third Edition, 2004
4. R. Keith Mobley, Plant Engineer's Handbook, Technology and Engineering, 2001.

OUTCOMES:

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

- Review and correct P&IDs
- Do installation and commissioning of new plants
- Apply plant engineering in design and maintenance of water treatment plant / power plant etc

GECX 109	NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

The students should be able to

- Discuss the basic concepts of computer security, model and attacks
- Examine the major types of threats and the associated attacks
- Identify the encryption techniques in real time applications
- Understand the special requirements for wireless security and how authentication is implemented in wireless systems
- Understand the functions of Network Security Device Firewall and its types
- Interpret the various network intrusion such as computer viruses, network worms etc

MODULE I INTRODUCTION 6

Computer Security Concepts - The OSI Security Architecture - Security Attacks - Security Services - Security Mechanisms - A Model for Network Security - Standards – classical encryption techniques.

MODULE II SYMMETRIC ENCRYPTION AND MESSAGE CONFIDENTIALITY 7

Symmetric Encryption Principles - Symmetric Block Encryption Algorithms - Random and Pseudorandom Numbers - Stream Ciphers and RC4 - Cipher Block Modes of Operation

MODULE III PUBLIC KEY CRYPTOGRAPHY AND MESSAGE AUTHENTICATION 8

Approaches to Message Authentication - Secure Hash Functions - Message Authentication Codes - Public-Key Cryptography Principles - Public-Key Cryptography Algorithms - Digital Signatures

MODULE IV KEY DISTRIBUTION ,USER AUTHENTICATION AND TRANSPORT-LEVEL SECURITY 8

Symmetric Key Distribution Using Symmetric Encryption - Kerberos - Key Distribution Using Asymmetric Encryption - X.509 Certificates - Public-Key

Infrastructure -Federated Identity Management - Web Security Considerations - Secure Socket Layer and Transport Layer Security - Transport Layer Security

MODULE V WIRELESS NETWORK SECURITY, ELECTRONIC MAIL SECURITY AND IP SECURITY 8

IEEE 802.11 Wireless LAN Overview -IEEE 802.11i Wireless LAN Security - Wireless Application Protocol Overview - Wireless Transport Layer Security - WAP End-to-End Security - Pretty Good Privacy - S/MIME – Domain Keys Identified Mail- IP Security Overview -IP Security Policy - Encapsulating Security Payload - Combining Security Associations - Internet Key Exchange - Cryptographic Suites

MODULE VI SYSTEM SECURITY 8

Intruders -Intrusion Detection -Password Management - Types of Malicious Software - Viruses Virus Countermeasures – Worms - Distributed Denial of Service Attacks- The Need for Firewalls - Firewall Characteristics - Types of Firewalls - Firewall Basing - Firewall Location and Configurations

L – 45; Total Hours –45

REFERENCES:

1. William Stallings, "Network security Essentials: Applications and standards", Prentice Hall, Fifth Edition , ISBN-13: 978-0134527338, 2013
2. William Stallings, "Cryptography and Network Security: Principles and Practice", Pearson, ISBN-13:978-0-273-79335-9,2013
3. Behrouz Forouzan, Debdeep Mukhopadhyay, Cryptography and network security (sie) 2nd edition, ISBN-13: 978-0070702080, 2016
4. Wikipedia, "Network Security and Management" , [https://en.wikipedia.org/wiki/Book:Network Security and Management](https://en.wikipedia.org/wiki/Book:Network_Security_and_Management), 2014.
5. Nitesh Dhanjani, Justin Clarke, "Network Security Tools", O'Reilly Media, ISBN-13: 9780596007942, 2005.

OUTCOMES:

Students who complete this course will be able to

- Recognize the computer security concepts, architecture attacks and model
- Distinguish the symmetric and asymmetric encryption techniques

- Apply the cryptographic algorithms in different applications
- Express the network security designs using available secure solutions such as PGP,SSL, IPsec, etc.
- Describe the firewalls principles and different types of firewalls applied in organization
- Identify abnormalities within the network caused by worms, viruses and Network related security treats.

GECX 110	KNOWLEDGE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course

- Focuses on positioning knowledge as a valuable commodity, embedded in products and in the tacit knowledge of highly mobile individual employees.
- Presents KM as a deliberate and systematic approach to cultivating and sharing an organization's knowledge base.
- Brings out the paradigm in terms of information technology and intellectual capital.

MODULE I KNOWLEDGE MANAGEMENT 6

KM Myths – KM Life Cycle – Understanding Knowledge – Knowledge, intelligence – Experience – Common Sense – Cognition and KM – Types of Knowledge – History of Knowledge Management - From Physical assets to Knowledge Assets – Expert knowledge – Human Thinking and Learning.

MODULE II KNOWLEDGE MANAGEMENT SYSTEMS AND MODELS 9

Challenges in Building KM Systems – Conventional Vs KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – KM cycle - Different variants of KM cycle - KM models - Implications and practical implementations.

MODULE III CAPTURING KNOWLEDGE AND SHARING 9

Tacit knowledge capture - Explicit knowledge codification – Knowledge taxonomies - Knowledge sharing - Communities - Obstacles to knowledge capture and sharing.

MODULE IV KNOWLEDGE MANAGEMENT TOOLS 9

KM System tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Knowledge capture and creation tools - Content creation tools - Data mining and knowledge discovery – Content management tools - Knowledge sharing and dissemination tools – Group ware

and Collaboration tools - Intelligent filtering tools.

MODULE V KNOWLEDGE APPLICATION 6

KM at individual level - Knowledge workers - Task analysis and modeling - Knowledge application at group and organizational levels – Knowledge repositories - Knowledge reuse -Case study: e-learning.

MODULE VI VALUE OF KNOWLEDGE MANAGEMENT 6

KM return on investment and metrics - Benchmarking method – Balanced scorecard method - House of quality method - Results based assessment method - Measuring success - Future challenges for KM.

L – 45; Total Hours –45

TEXT BOOKS:

1. Elias M. Awad, Hassan M. Ghaziri, "Knowledge Management", Prentice Hall, 2nd Edition, 2010.
2. Jay Liebowitz, "Handbooks on Knowledge Management", 2nd Edition, 2012.
3. Irma Becerra-Fernandez, Rajiv Sabherwal, "Knowledge Management: Systems and Processes", 2010.

OUTCOMES:

Students who complete this course will be able to

- Describe the fundamental concepts in the study of knowledge and its creation, acquisition, representation, dissemination, use and re-use, and management.
- Explains the core concepts, methods, techniques, and tools for computer support of knowledge management.
- Critically evaluate current trends in knowledge management and apply it for e-learning

GECX 111	CYBER SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Cyber Security Standards and Policies.
- To know the legal, ethical and professional issues in Cybersecurity.
- To understand Cyber Frauds and Abuse and its Security Measures.
- To know the technological aspects of Cyber Security.

MODULE I FUNDAMENTALS OF CYBER SECURITY 7

Security problem in computing – Cryptography Basics – History of Encryption – Modern Methods – Legitimate versus Fraudulent Encryption methods – Encryption used in Internet.

MODULE II CYBERCRIME AND CYBEROFFENSES 8

Cybercrime and Information Security – Cybercriminals – Classifications of Cybercrimes – Email Spoofing – Spamming – Cyber defamation – Internet Time Theft – Forgery – Web jacking – Hacking – Online Frauds – Software Piracy – Mail Bombs – Password Sniffing – Cyberoffenses – Categories – Planning the attacks – Cyberstalking – Cybercafe and Cybercrimes – Botnets.

MODULE III CYBERCRIME: MOBILE AND WIRELESS DEVICES 8

Proliferation of Mobile and Wireless Devices – Trends in Mobility – Credit card frauds in Mobile and Wireless Computing – Security Challenges – Authentication Service Security – Attacks on Mobile Phones.

MODULE IV TOOLS AND METHODS USED IN CYBERCRIME 8

Proxy Servers and Anonymizers – Phishing – Password Cracking – Keyloggers and Spywares – Virus and Worms – Trojan Horses and Backdoors – Steganography – DoS and DDoS Attacks.

MODULE V SECURITY POLICIES 7

Introduction - Defining User Policies – Passwords – Internet Use – Email Usage – Installing/ Uninstalling Software – Instant Messaging – Defining System Administrative Policies – Defining Access Control Developmental Policies Standards, Guidelines and Procedures – Basics of assessing a system

MODULE VI COMPUTER FORENSICS**7**

General Guidelines – Finding Evidence on the PC - Finding Evidence in System Logs – Windows Logs – Linux Logs – Getting Back Deleted Files – Operating System Utilities – The Windows Registry.

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

1. Nina Godbole, Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley, 2011.
2. Chuck Easttom, “Computer Security Fundamentals”, 2nd Edition, Pearson Education,2012.

REFERENCES:

1. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, 3rd Edition, Pearson Education,2003.
2. William Stallings, “Cryptography and Network Security – Principles and Practices”, 3rd Edition, Pearson Education,2003.
3. Atul Kahate, “Cryptography and Network Security”, Tata McGraw Hill,2000.

OUTCOMES:

Upon completion of this course, students will be able to

- Explain the general security issues.
- Discuss various cybercrimes and offenses.
- Outline the occurrence of Cybercrime in mobile and wireless environment.
- Use relevant tools and methods in cybercrime
- Apply security policies in cyber forensics.
- Outline the strategies adopted in computer forensics.

GECX 112	GENETIC ENGINEERING	L	T	P	C
		3	1	0	4

OBJECTIVES:

- The course aims to provide an advanced understanding of the core principles and topics of Cell and Organism reproduction and the Principles of heredity and their experimental basis, and to enable students to be able to apply these principles in assessment of pedigrees to identify genotypes and predict the mating outcomes.

MODULE I GENETICS AND ORGANISM 10

Genetics and human affairs, Genetics and Biology, Genes and Environment, Techniques of genetic analysis, The chromosome theory of heredity, Sex chromosomes, Sex linkage, The parallel behaviour of autosomal genes and chromosomes.

MODULE II MENDELISM AND LINKAGE 12

Mendel's laws of inheritance, Interaction of genes, Variations on dominance, Multiple alleles, Lethal alleles, Several genes affecting the same character, Penetrance and expressivity, Linkage- Basic eukaryotic chromosome mapping, The discovery of linkage, Recombination linkage symbolism, Linkage of genes on X chromosomes, Linkage maps, Examples of linkage maps.

MODULE III FINE STRUCTURE OF GENES 10

The concept of promoter, Coding sequence, Terminator, Induction of gene for expression. The concept of extranuclear genome in higher plants and animals, Overview of mitochondrial genome, Chloroplast genome.

MODULE IV RECOMBINATION IN BACTERIA AND VIRUSES 10

Conjugation recombination and mapping the E.coli chromosomes, Transformation, Transduction, Chromosome mapping. Population genetics: Darwin's revolution, Variation and its modulation, The effect of sexual reproduction on variation, The sources of variation, Selection quantitative genetics

GECX 113	FUNDAMENTALS OF PROJECT MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES:

The students would gain knowledge on

- Technicalities attached to Project Management and Significance of Quality Consideration
- Project management methodologies – tools and techniques, supplemented with examples from case studies
- The importance of Efficient HR team and role of Communication in executing Projects.
- Managing Risks in Project Management

MODULE I INTRODUCTION TO PROJECT MANAGEMENT 9

Introduction to Project and Project Management-Project Management as a Career-Project Management Skill Sets-Project Scope Management: Project Charter, Scope Creep, Scope Validation, Scope Change Control-Type of Organization: Organization Structure-Influence of Organization Structure on Project, Project Stakeholders and Organizational Productivity.

MODULE II PROJECT MANAGEMENT PROCESS, TOOLS AND TECHNIQUES 8

Project life cycle-Initiation, Planning, Execution, Monitoring and Closing Phase; - Link between project management process, process groups and knowledge areas; Project management tools and techniques- Project Stakeholders description and mapping - Stakeholder Management Process

MODULE III PROJECT QUALITY, COST AND SCHEDULE MANAGEMENT 10

Triple constraints of project-quality, cost and schedule-Quality Planning, Quality Assurance and Quality Control, Process Control, Cost of Quality, Seven Tools of Quality Control- Cost Management: Cost Estimating Methods, Estimating Completion Cost, Earned Value Management, Budgeting, Life-Cycle Cost analysis- Project Time Management: Duration Estimation Method, FS/FF/SS/SF Relations, Lead/Lag, Arrow Diagram Method and Precedence Diagram Method for Scheduling-Resource Allocation

MODULE IV PROJECT HR MANAGEMENT 5

Organizational Goals- (MBO/MBE/MBP)-Responsibility Assignment Matrix (RAM)-Types of Powers- Manage or Lead-Conflict management Techniques-Performance Evaluation Process-Motivation Theories and its Application for execution of Projects-Leadership Styles-Project Team Building-Project Staffing Constraints/Policies

MODULE V COMMUNICATION MANAGEMENT 5

Communication Management: Understanding Body languages of Project Personnel-Effective Communications- Interpersonal Skills for project Managers-PMIS-Communicating with the Customer-Communicating with Management-Formal vs. Informal Communications-Written, Verbal and Non-Verbal Communications.

MODULE VI PROJECT PROCUREMENT & RISK MANAGEMENT 8

Introduction to Project Procure Management: Soliciting RFQ/RFP-Contract Proposals-Contract Negotiation-Contract Closure-Risk Management: Defining risks-Risk management process-Risk identification-Qualitative and Quantitative Risk-Probability and Decision trees-Risk Response strategies / methods-Expected monetary value-Risk vs. life cycle phases

L – 45; Total Hours –45

REFERENCES:

1. Jack. R. Meredith, Samuel. J. Mantel & Scott. M. Shafer, Project Management in Practice, Fifth Edition, Bangalore: Wiley, 2015
2. Bob Hughes, Mike Cotterrel “Software Project Management”, Tata McGraw-Hill, 2009

OUTCOMES:

- Learners will be able to identify the Key Knowledge Areas and apply PM process in hypothetical project assignments given as continuous assessment.
- They would be able to suitably recognize tools and techniques required for various phases included in a project.
- They would also be able to manage scope, time, cost and other major components that would help them to execute the project efficiently.

MODULE VI INVENTORY CONTROL, REPLACEMENT MODELS 8
AND GAME THEORY

Types of inventory- Inventory cost - EOQ - Deterministic inventory problems – Introduction to probabilistic models & system level inventory control - Replacement models – Replacement of items that deteriorate with time – value of money changing with time – not changing with time – Individual and group replacement policy - Game theory – simple games.

L – 45; Total Hours –45

TEXT BOOKS:

1. Hamdy ATaha, “Operations Research an introduction”, 8th edition, Phil Pearson, 2007.
2. Winston.W.L., “Operations Research”, 4th edition, Thompson-Brooks/Cole, 2003.

REFERENCES:

1. Wayne.L. Winston, “Operations Research applications and algorithms”, 4th edition, Thomson learning, 2007.
2. Frederick. S. Hiller and Gerald.J.Lieberman, “Operations Research concepts and cases”, 8th edition (SIE), Tata McGraw – Hill Pub. Co. Ltd., New Delhi, 2006.
- A. Ravindran, D. T. Phillips and J. J. Solberg, "Operations Research:Principles and Practice", 2nd edition, John Wiley & Sons, New York, 1992.
3. Robertazzi. T.G., “Computer networks and systems-Queuing theory and performance evaluation”, 3rd edition, Springer, 2002.

OUTCOMES:

At the end of the course students will be able to

- solve linear programming problems
- solve transportation and assignment problems.
- solve network and sequencing problems.
- apply the operations research techniques to solve industrial problems.

GEEX 115	NANO TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of Nanoscience relevant to the field of engineering.
- To provide an exposure about the importance of various synthesis method.
- To enrich the knowledge of students in various characterisation techniques.

MODULE I	INTRODUCTION & CLASSIFICATION OF NANOMATERIALS	9
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Definition - Origin of nanotechnology - Difference between bulk and nanomaterials- Top-down and bottom-up processes - Size dependent properties (magnetic, electronic, transport and optical), Classification based on dimensional property - 0D, 1D, 2D and 3D nanostructures – Kubo gap.

MODULE II	TYPES OF NANOMATERIALS	9
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Metal oxides and metal nano particles - Ceramic nano particles - Semi conducting quantum dots - Core-shell quantum dots - Nanocomposites - Micellar nanoparticles.

MODULE III	PRODUCTION OF NANOPARTICLES	7
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Sol-gel, hydrothermal, solvothermal, Plasma Arcing, Electro deposition, RF sputtering, Pulsed laser deposition, Chemical vapour, deposition.

MODULE IV	CARBON BASED NANOMATERIALS	6
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Carbon nanotubes: Single wall nanotubes (SWNT), Multiwall nanotubes (MWNT) - structures-carbon nanofibre, Fullerenes-Application of carbon nanotubes and Fullerenes.

MODULE V	NANOPHOTONICS	7
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Light and nanotechnology, Interaction of light and nanotechnology, Nanoholes and photons, nanoparticles and nanostructures; Nanostructured polymers, Photonic Crystals, Solar cells.

MODULE VI	CHARACTERISATION TECHNIQUES	7
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Basic principles of scanning Electron Microscopy (SEM), Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Scanning probe

microscopy (SPM) and Transmission electron microscopy (TEM), Particle size analyzer, Luminescence techniques.

L – 45; Total Hours –45

TEXT BOOKS:

1. Hari Singh Nalwa, “Handbook of Nanostructured Materials and Nanotechnology”, Academic Press, 2000.
2. Guozhong Cao, “Nanostructures and Nano materials-Synthesis, Properties and Applications”, Imperial College Press (2011).
3. Zhong Lin Wang, “Handbook of Nanophase and Nanomaterials (Vol 1 and II)”, Springer, 2002.
4. Mick Wilson, Kamali Kannangara, Geoff smith, “Nanotechnology: Basic Science and Emerging Technologies”, Overseas press, 2005.

REFERENCES:

1. A. Nabok, “Organic and Inorganic Nanostructures”, Artech House, 2005.
2. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: “Nanotechnologies and Nanophysics”, Springer-Verlag Berlin Heidelberg, 2007.
3. Mick Wilson, Kamali Kannangara, Michells Simmons and Burkhard Raguse, “Nano Technology – Basic Science and Emerging Technologies”, 1st Edition, Overseas Press, New Delhi,2005.
4. M.S. Ramachandra Rao, Shubra SinghH, “Nanoscience and Nanotechnology: Fundamentals to Frontiers”, Wiley, 2013.

OUTCOMES:

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

- Apply the knowledge of different types of nanomaterials for various engineering applications.
- Acquire the knowledge of various methods of production of nanomaterials.
- Familiarize with various characterization techniques.

GECX 116	VEHICLE MAINTENANCE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know about the various methods of maintaining procedure, vehicle insurance and basic problems in a vehicle.
- The student able to impart knowledge in maintaining of engine components and subsystems.
- The student able to impart knowledge in maintaining of transmission, driveline, steering, suspension, braking and wheels.
- The student able to impart carefully maintaining their vehicle and can increase driving safety.

MODULE I MAINTENANCE, WORKSHOP PRACTICES, 7
SAFETY AND TOOLS

Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

MODULE II ENGINE AND ENGINE SUBSYSTEM 8
MAINTENANCE

General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls.

MODULE III TRANSMISSION AND DRIVELINE MAINTENANCE 8

Clutch- general checks, adjustment and service- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

MODULE IV STEERING AND SUSPENSION MAINTENANCE 7

Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, and power steering system.

MODULE V BRAKE AND WHEEL MAINTENANCE 7

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, parking brake. Bleeding of brakes. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation.

MODULE VI AUTO ELECTRICAL AND AIR CONDITIONING MAINTENANCE 8

Maintenance of batteries, starting system, charging system and body electrical - Fault diagnosis using Scan tools. Maintenance of air conditioning parts like compressor, condenser, expansion valve, evaporator - Replacement of hoses- Leak detection- AC Charging- Fault diagnosis Vehicle body repair like panel beating, tinkering, soldering, polishing, painting.

L – 45; Total Hours –45

TEXT BOOKS:

1. Ed May, "Automotive Mechanics Volume One" , Mc Graw Hill Publications, 2003
2. Ed May, "Automotive Mechanics Volume Two" , Mc Graw Hill Publications, 2003
3. Vehicle Service Manuals of reputed manufacturers
4. Vehicle maintenance and garage practice by Jigar A.Doshi Dhru U.Panchal, Jayesh P.Maniar. 2014
5. A Practical Approach to Motor Vehicle Engineering and Maintenance 3rd Edition by Allan Bonnicks.

REFERENCES:

1. Bosch Automotive Handbook, Sixth Edition, 2004.
2. Advanced Automotive Fault Diagnosis by Tom Denton 2011.
3. Nissan Patrol Automotive Repair Manual: 1998-2014 by Haynes Manuals Inc.
4. Automobile electrical manual a comprehensive guide by Haynes manual car repair.

OUTCOMES:

On completion of the course student should be able to

- Prepare maintenance schedules and procedures with appropriate tools.
- Demonstrate the procedure and methods to repair and calibrate the engine.
- Analyze the causes and remedies for fault in transmission and drive line systems.
- Analyze the causes and remedies of steering and suspension systems.
- Analyze the causes and remedies of brake system.
- Demonstrate the procedure for wheel alignment and wheel balanced.

TEXT BOOKS

1. Gonzalez and Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2016.
2. Anil. K. Jain, "Fundamentals of Digital Image Processing"; 4th Edition, PHI, 2007

REFERENCES

1. Pratt William, "Digital Image Processing", John Wiley & Sons, 2007.
2. Arthur Weeks Jr., "Fundamentals of Digital Image Processing", PHI, 2006.

OUTCOMES:

On completion of the course, students will be able to

- Explain the fundamental concepts of digital image processing.
- Discuss about color image processing
- Recognize & apply various image enhancement techniques.
- Apply various transforms for image processing.
- Apply various techniques for image segmentation and restoration.
- Identify and use appropriate image compression techniques

Group II courses
(To be offered in VII Semester)

GECX 201	GREEN DESIGN AND SUSTAINABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the concepts of sustainable development and fundamentals of socio economic systems.
- To understand the basics of green building and frame work for the attainment of sustainability.
- To enhance the student's interest in the design of green building and energy efficient measures in a buildings.

MODULE I CONCEPTS OF SUSTAINABLE DEVELOPMENT 7

Objectives of Sustainable Development - Need for sustainable development- Environment and development linkages - Globalisation and environment- Population, poverty and pollution- global, regional and local environment issues- Green house gases and climate change.

MODULE II SUSTAINABLE DEVELOPMENT OF SOCIO 8
ECONOMIC SYSTEMS

Demographic dynamics of sustainability- Policies for socio economic development- Sustainable Development through trade- Economic growth-Action Plan for implementing sustainable development- Sustainable Energy and Agriculture.

MODULE III FRAME WORK FOR ACHIEVING SUSTAINBAILITY 7

Sustainability indicators- Hurdles to sustainability- Business and Industry – Science and Technology for Sustainable Development- Performance indicators of sustainability and assessment mechanism- Constraints and barriers of Sustainable Development.

MODULE IV GREEN BUILDINGS 8

Introduction to Green Building- Energy- Water- Materials and Resources - Sustainable Sites and Land Use - Indoor Environmental Quality- Life Cycle Assessment- Energy, water and materials efficiency.

MODULE V ENERGY CONSERVATION AND EFFICIENCY 7

Energy savings- Energy Audit- Requirements- Benefits of Energy conservation- Energy conservation measures for buildings- Energy wastage- impact to the environment.

MODULE VI GREEN BUILDINGS DESIGN 8

Elements of Green Buildings Design- Foundation, Electrical, Plumbing, flooring, Decking, roofing, insulation, wall coverings, windows, siding, doors and finishing, LEED certification for Green Buildings, Green Buildings for sustainability.

Total Hours –45

TEXT BOOKS:

1. Kirby, J., Okeefe, P., and Timber lake, “Sustainable Development”, Earthscan Publication, London, 1995.

REFERENCES:

1. Charles Kibert, J., “Sustainable Construction: Green Building Design and Delivery”, 2nd Edition, John Wiley and sons, 2007.

OUTCOMES:

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

- explain the objective, need for the sustainability and also the link between the globalization and environment.
- Address the economic, environmental, and social concerns in the sustainable development.
- Acquire knowledge on the performance indicators, constraints and barrier for sustainability.
- Explain the relationship between sustainability and emergence of green building practices.
- Recommend relevant energy conservation measures in a building
- describe the elements in green building design and suggest ideas for attaining sustainability in building.

MODULE VI TECHNOLOGY POLICY**8**

Government Policies- Energy Policy-Appropriate technology Development
Centre-its function and responsibilities-Building policies-Case Studies.

Total Hours –45**TEXT BOOKS:**

1. Barrett Hazeltine and Christopher Bull, "Appropriate Technology: Tools Choices and Implications", Academic Press, Orlando, USA, 1998.
2. Ken Darrow and Mike Saxenian, "Appropriate Technology Source Book : A Guide to Practical Books for Village and Small Community Technology", Stanford, 1986.

REFERENCES:

1. Richard Heeks, "Technology and Developing Countries: Practical Applications Theoretical Issues", 1995.
2. John Pickford, "The Worth of Water : Technical Briefs on Health, Water and Sanitation", Intermediate Technology Publications, 1998.

OUTCOMES:

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

- describe about the tools, choices of appropriate technology along with concepts of energy fundamentals
- conceptualize the techniques to be adopted in building design for saving energy and water.
- acquire knowledge about the techniques for water, health and sanitation management
- explain the classification, collection dispose and recycling systems adopted in waste management.
- elucidate the concepts of green building and renewable energy sources.
- express the polices relevant to technology and recommend an appropriate technology for an sustainable development.

REFERENCES:

1. Law, A.M., & W.D. Kelton, "Simulation Modelling and Analysis", McGraw Hill, Singapore, 2000.
2. Harrel, C.R., et. al., "System Improvement Using Simulation", 3rd Edition, JMI Consulting Group and ProModel Corporation, 1995.
3. Harrel, C.R. & T. Kerim, "Simulation Made Easy, A Manager's Guide", IIE Press, 1995.
4. Geoffrey Gordon, "Systems Simulation", Prentice Hall, 2002.
5. David Kelton, Rondall P Sadowski, David T Sturrock, "Simulation with Arena", Mc Graw Hill, 2004.

OUTCOMES:

The student should be able to

- Model and simulate systems and environments through the use of computers.
- Conduct experiments with discrete dynamic, stochastic system models on a computer.

MODULE V EVALUATION, INVESTIGATION AND 6
RECOMMENDATION

Paired comparison and Evaluation Matrix techniques - Criteria for selection of VE solutions. Design – Materials – Quality – Marketing – Manufacturing - Preview session. The report - presentation.

MODULE VI IMPLEMENTATION PHASE AND CASE STUDIES 8

Design department - Materials department - Production Planning & Control - Quality Control – Manufacturing – Marketing - Need for co-ordinated teams - The Action Plan. Value Engineering case studies.

L – 45; Total Hours –45

TEXT BOOKS:

1. Mudge, Arthur E. "Value Engineering- A systematic approach", McGraw Hill, New York, 2000.
2. Kumar S, Singh R K and Jha J K (Ed), "Value Engineering", Narosa Publishing House, 2005.

REFERENCES:

1. Park RJ, "Value Engineering: A Plan for Invention", St.Lucie Press, New York, 1999.
2. Lawrence, D.M., "Techniques of Value Analysis and Engineering", McGraw Hill 1988.
3. George, E.D., "Engineering Design: a Material and Processing Approach", McGraw Hill, 1991.
4. Heller, D.E., "Value Management, Value Engineering and Cost Reduction", Addison Wesley, 1988.

OUTCOMES:

- The student will be able to realize the value of products, processes and implement value analysis to achieve productivity improvement.

GECX 205	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various safety measures to be taken in different industrial environments.

MODULE I SAFETY MANAGEMENT 7

Evolution of modern safety concept- Safety policy - Safety Organization - line and staff functions for safety- Safety Committee- budgeting for safety. safety education and training.

MODULE II SAFETY IN MANUFACTURING 7

Safety in metal working-Machine guarding -Safety in welding and gas cutting - Safety in cold forming and hot working of metals -Safety in finishing, inspection and testing -Regulation.

MODULE III SAFETY IN CONSTRUCTION 8

General safety consideration in Excavation, foundation and utilities – Cordoning – Demolition – Dismantling –Clearing debris – Types of foundations – Open footings.

Safety in Erection and closing operation - Safety in typical civil structures – Dams-bridges-water Tanks-Retaining walls-Critical factors for failure-Regular Inspection and monitoring.

MODULE IV ELECTRICAL SAFETY 8

Electrical Hazards – Energy leakage – Clearance and insulation – Excess energy – Current surges – Electrical causes of fire and explosion – National electrical Safety code.

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance.

MODULE V SAFETY IN MATERIAL HANDLING 8

General safety consideration in material handling devices - Ropes, Chains, Sling, Hoops, Clamps, Arresting gears – Prime movers.

Ergonomic consideration in material handling, design, installation, operation and maintenance of Conveying equipments, hoisting, traveling and slewing mechanisms.

Storage and Retrieval of common goods of shapes and sizes in a general store of a big industry.

MODULE VI SAFETY EDUCATION AND TRAINING 7

Importance of training-identification of training needs-training methods – programme, seminars, conferences, competitions – method of promoting safe practice - motivation – communication - role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

L – 45; Total Hours –45

REFERENCES:

1. Krishnan N.V, “Safety Management in Industry”, Jaico Publishing House, Bombay, 1997.
2. Blake R.B., “Industrial Safety”, Prentice Hall, Inc., New Jersey, 1973.
3. Fulman J.B., “Construction Safety, Security, and Loss Prevention”, John Wiley and Sons, 1979.
4. Fordham Cooper W., “Electrical Safety Engineering”, Butterworths, London, 1986.
5. Alexandrov M.P., “Material Handling Equipment”, Mir Publishers, Moscow, 1981.

OUTCOMES:

Students would be able to

- Acquire knowledge on various safety Hazards.
- Carry out safety measures for different industrial environments.

GECX 206	ADVANCED OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the various advanced optimization tools.
- To provide an understanding to deal with ill identified and fuzzy problems.

MODULE I INTRODUCTION 7

Review of conventional optimization techniques - limitations - limitation of exhaustive search - need for artificial intelligence - bio mimicking methods

MODULE II HEURISTICS METHODS 8

Introduction – Advanced methods of algorithm design: Greedy method, Backtracking method, Divide and Conquer method – Dynamic programming – Heuristics exploration algorithms – Greedy search - Local search – Hill climbing – Tabu search – Gradient search – Beam search – Simulated Annealing.

MODULE III GENETIC ALGORITHM 7

Introduction - Basics of GA – Population – Reproduction – Cross over – Mutation -genetic algorithms in search, optimization and machine learning-practical genetic algorithms.

MODULE IV ANT COLONY OPTIMIZATION 8

Introduction: Ant Colony Optimization – Meta-heuristic Optimization – History – The ACO Meta-heuristic – ACO Algorithms: Main ACO – Ant system – Ant colony system – Max-Min Ant system – Applications: Routing in telecommunication networks – Travelling salesmen – Graph Coloring – Advantages & Disadvantages

MODULE V FUZZY LOGIC AND ANN 8

Fuzzy logic, knowledge representation and inference mechanism – Fuzzy and expert control – standard Takagi-Sugeno mathematical characterizations – Design example – Biological foundations to intelligent systems: Artificial

neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks.

MODULE VI IMPLEMENTATIONS & APPLICATIONS 7

Reduction of size of an optimization problem – multilevel optimization – parallel processing – multi objective optimization – Job shop scheduling – Vehicle scheduling – Line balancing – Sensor integration.

L – 45; Total Hours –45

REFERENCES:

1. Singiresu S. Rao, “Engineering optimization – Theory and practices”, John Wiley and Sons, 1996.
2. Ravindran – Phillips –Solberg, “Operations Research – Principles and Practice, John Wiley and Sons, 1987.
3. Fredrick S.Hillier and G.J.Liberman, “Introduction to Operations Research”, McGraw Hill Inc. 1995.
4. Kalymanoy Deb, “Optimization for Engineering Design”, PHI, 2003
5. Christos H. Papadimitriou, Kenneth Steiglitz, Combinatorial Optimization, PHI 2006

OUTCOMES:

At the end of the course student will be able to

- Formulate a real life situation as an optimization the problem.
- Identify the appropriate solution methodology and provide a solution

GECX 207	MATLAB SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Teach students how to mathematically model engineering systems
- Teach students how to use computer tools to solve the resulting mathematical models. The computer tool used is MATLAB and the focus will be on developing and solving models of problems encountered in engineering fields

MODULE I INTRODUCTION MATLAB DATA PRESENTATION 7
 Vectors, Matrices -Vector/Matrix Operations & Manipulation- Functions vs scripts- Making clear and compelling plots-Solving systems of linear equations numerically and symbolically- Least squares regression -Curve fitting.

MODULE II MATLAB PLOT FUNCTION 7
 Introduction- Plot Function – Animation- 3D Plots-Customizing Plots – Plot Applications- Saving &Painting Plots.

MODULE III ROOT FINDING AND COMPUTER REPRESENTATION OF NUMBERS 7
 Linearization and solving non-linear systems of equations- The Newton-Rapson method- Integers and rational numbers in different bases- Floating point numbers- Round off and errors in basic arithmetic-Significant digits when reporting results

MODULE IV ORDINARY DIFFERENTIAL EQUATIONS 8
 Numerical integration and solving 1st order, ordinary differential equations (Euler’s method and Runge-Kutta)- Use of ODE function in MATLAB

MODULE V NON-LINEAR DIFFERENTIAL EQUATIONS 8
 Converting 2nd order and higher ODEs to systems of 1st order ODEs- Solving systems of ODEs via Euler’s method and Runge-Kutta)- Solving single and systems of non-linear differential equations by linearization-Use of the function ODE in MATLAB to solve differential equations

MODULE VI INTRODUCTION OF SIMULINK 8

Simulink & its relations to MATLAB – Modeling a Electrical Circuit- Modeling a fourth order differential equations- Modeling the solution of three equations with three unknowns- Representing a model as a subsystem-Simulink demos.

L – 45; Total Hours –45

REFERENCES:

1. Griffiths D V and Smith I M, Numerical Methods for Engineers, Blackwell, 1991.
2. Laurene Fausett, Applied Numerical Analysis Using MATLAB, Pearson 2008.
3. Moin P, Fundamentals of Engineering Numerical Analysis, Cambridge University Press, 2001.
4. Wilson HB, Turcotte LH, Advanced mathematics and mechanics applications using MATLAB. CRC Press, 1997
5. Ke Chen, Peter Giblin and Alan Irving , Mathematical Exploration with MATLAB, Cambridge University Press, 1999.

OUTCOMES:

At the end of this unit students will be able to:

- Use Matlab as a convenient tool for solving a broad range of practical problems in engineering from simple models to real examples.
- Write programs using first principles without automatic use of built-in ones.
- Write programs for solving linear and nonlinear systems, including those arising from boundary value problems and integral equations, and for root-finding and interpolation, including piecewise approximations.
- Be fluent in exploring Matlab's capabilities, such as using matrices as the fundamental data-storage unit, array manipulation, control flow, script and function m-files, function handles, graphical output.
- Make use of Matlab visual capabilities for all engineering applications.
- An ability to identify, formulate, and solve engineering problems. This will be accomplished by using MATLAB to simulate the solution to various problems in engineering fields

GECX 208	EMBEDDED SYSTEMS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a detailed overview of embedded system.
- To equip students with the software development skills necessary for practitioners in the embedded systems field.
- To understand entire software development lifecycle and examine the various issues involved in developing software for embedded systems.

MODULE I EMBEDDED SYSTEMS OVERVIEW 8

Introduction –Embedded Systems vs. General computing systems- Fundamental Components of embedded systems- Characteristics- Challenges-Examples- Embedded System design process.

MODULE II EMBEDDED COMPUTING PLATFORM 8

Overview of Processors and hardware units in an embedded system-CPU buses – Memory devices –Memory types- I/O devices – Designing with computing platforms- Consumer electronics architecture-Design example: Alarm clock.

MODULE III REAL TIME EMBEDDED SYSTEMS 8

Programming embedded systems in assembly and C – Real time systems – Hard and Soft real time systems- Need for RTOS in Embedded Systems- Multiple tasks and processes –Context switching-Scheduling policies- Interprocess communication and synchronization.

**MODULE IV EMBEDDED SOFTWARE DEVELOPMENT PROCESS 8
and TOOLS**

Development process of an embedded system-software modules and tools for implementation of an embedded system- Integrated development environment- Host and target machines-cross compiler-cross assembler-Choosing right platform.

MODULE V PROGRAM MODELING IN EMBEDDED SYSTEMS 8

Program Models – Data Flow Graph model-control DFG model-Synchronous DFG model- Finite state machines- UML modeling – UML Diagrams.

MODULE VI EMBEDDED SYSTEMS APPLICATION**5**

Application specific embedded system – case study: digital camera hardware and software architecture, embedded systems in automobile, embedded system for a smart card.

Total Hours –45**TEXT BOOKS:**

1. Marilyn Wolf , "Computers as components", Elsevier 2012.
2. Shibu. K.V, "Introduction to Embedded Systems", Tata McGraw Hill,2009.
3. Rajkamal, "Embedded Systems Architecture, Programming and Design",1st Reprint,Tata McGraw-Hill, 2003
4. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons,2002.

REFERENCES:

1. Sriram V Iyer and PankajGupta ,"Embedded Realtime Systems Programming "TataMcGraw-Hill,2008
2. Qing Li and Carolyn Yao," Real-Time Concepts for Embedded Systems",CMPBooks, 2003
3. David E.Simon, "An Embedded Software Primer", Pearson Education, 2003

OUTCOMES:

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

- Identify the suitable processor and peripherals in embedded applications
- Develop embedded programs in assembly and c
- Choose the right platform for designing an embedded system
- Explore different scheduling mechanism in rtos
- Design the program model for embedded applications.
- Analyze different domain specific applications in embedded systems.

GECX 209	USABILITY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objective of this course is

- To understand the emerging concept of usability, requirements gathering and analysis.
- To learn about human computer interaction with the help of interfaces that has high usability.

MODULE I INTRODUCTION 6

Cost Savings – Usability Now – Usability Slogans – Discount Usability Engineering – Usability – Definition – Example – Trade-offs – Categories – Interaction Design – Understanding & Conceptualizing Interaction – Cognitive Aspects.

MODULE II USER INTERFACES 8

Generation of User Interfaces – Batch Systems, Line Oriented Interfaces, Full Screen Interfaces, Graphical User Interfaces, Next Generation Interfaces, Long Term Trends – Usability Engineering Life Cycle – Interfaces – Data Gathering – Data Analysis Interpretation and Presentation.

MODULE III INTERACTION DESIGN 8

Process of Interaction Design - Establishing Requirements – Design, Prototyping and Construction - Evaluation and Framework.

MODULE IV USABILITY TESTING 8

Usability Heuristics – Simple and Natural Dialogue, Users' Language, Memory Load, Consistency, Feedback, Clearly Marked Exits, Shortcuts, Error Messages, Prevent Errors, Documentation, Heuristic Evaluation – Usability Testing - Test Goals and Test Plans, Getting Test Users, Choosing Experimenters, Ethical Aspects, Test Tasks, Stages of a Test, Performance Measurement, Thinking Aloud, Usability Laboratories.

MODULE V USABILITY ASSESSMENT METHODS 8

Observation, Questionnaires and Interviews, Focus Groups, Logging Actual Use, User Feedback, Usability Methods – Interface Standards - National,

International and Vendor Standards, Producing Usable In-House Standards.

MODULE VI USER INTERFACES 7

International Graphical Interfaces, International Usability Engineering, Guidelines for Internationalization, Resource Separation, Multilocale Interfaces – Future Developments – Case Study.

L – 45; Total Hours –45

TEXT BOOKS:

1. Yvonne Rogers, Helen Sharp, Jenny Preece, “Interaction Design: Beyond Human - Computer Interaction”, John Wiley & Sons, 3rd Edition, 2011 (Module I, II, III).
2. Jakob Nielsen, “Usability Engineering”, Morgan Kaufmann Academic Press, 1994. (Module I – VI).

REFERENCES:

1. Ben Shneiderman, Plaisant, Cohen, Jacobs, “Designing the User Interface: Strategies for Effective Human Interaction”, Pearson Education, 5th Edition, 2010.
2. Laura M. Leventhal, Julie A. Barnes, “Usability Engineering: Process, Products, and Examples”, Pearson/Prentice Hall, 2008

OUTCOMES:

Students who complete this course will be able to

- build effective, flexible and robust user interfaces.
- translate system requirements into appropriate human/computer interaction sequences.
- choose mode, media and device for the application requirements.

GECX 210	SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the various decision phases in a supply chain
- To be aware of the Supply Chain and its drivers
- To design Supply Chain Network
- To build a aggregate plan in supply chain
- To understand Sourcing Decisions in Supply Chain
- To comprehend the influence of Information technology in Supply Chain

MODULE I INTRODUCTION TO SUPPLY CHAIN 7

Understanding Supply Chain - Decision phases - Supply chain performance - Competitive and supply chain strategies - Achieving strategic fit - Expanding strategic scope

MODULE II SUPPLY CHAIN DRIVERS AND DESIGN 7

Drivers of supply chain performance – Designing distribution network - Network Design in the Supply Chain - Network design in Uncertain Environment

MODULE III AGGREGATE PLANNING AND MANAGING SUPPLY, DEMAND AND INVENTORY 8

Aggregate Planning in a Supply chain: role - Managing Supply - Managing Demand in Supply Chain – Cycle and Safety inventory in supply chain – Level of product availability.

MODULE IV MANAGING INVENTORY IN SUPPLY CHAIN 8

Managing Economies of Scale in a Supply Chain : Cycle Inventory- Managing uncertainty in a Supply Chain Safety Inventory- Determining optimal level of Product Availability

MODULE V SOURCING AND TRANSPORTATION 8

Sourcing decision in supply chain - Third and Fourth – Party Logistics providers - Supplier scoring and assessment - Transportation in a Supply Chain – Risk and Trade-offs in transportation design.

MODULE VI INFORMATION TECHNOLOGY IN A SUPPLY CHAIN 7

Information technology in a supply chain – CRM, ISCM, SRM in supply chain -
Over view of recent trends in Supply Chain: e-SRM, e-LRM, e-SCM.

L – 45; Total Hours –45

REFERENCES:

1. Sunil Chopra and Peter Meindl, “Supply Chain Management-Strategy Planning and Operation”, Pearson Education, 5th Indian Reprint, 2013.
2. Jananth Shah “Supply Chain Management – Text and Cases“ Pearson Education, 2008.
3. Altekar Rahul V, “Supply Chain Management-Concept and Cases”, Prentice Hall India, 2005.
4. Monczka et al., “Purchasing and Supply Chain Management”, Thomson Learning, 2nd Edition, 2nd Reprint, 2002.

OUTCOMES:

- After taking up the course the student will be able to brighten his prospects of taking up a career on supply chain management.
- The student decision making capability specific to supply chain issues in an industry is improved.
- The student can plan a well defined execution of supply chain strategy in companies.
- The student will be able to design a optimal distribution network as per the demands of the industry.
- The student can also determine the most favorable transportation plan for a company.
- The student will also be able to bring in company from paper environment to paperless environment.

GECX 211	SYSTEMS ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To describe the phases of the systems development life cycle
- To teach the automated tools for system development
- To develop and evaluate system requirements.
- To explain the organizational issues in system implementation
- To teach the usability testing and electronic data interchange
- To elucidate the importance of System analysis and design in electronic commerce.

MODULE I FUNDAMENTALS OF SYSTEM DEVELOPMENT 8

System Concept – Characteristics – Elements of System – Types of System – Modern Approach to System Analysis and Design – System Development Life Cycle – Approaches to Improving Development – Tools for System Development – Succeeding as a System Analyst – Skills – Managing the Project.

MODULE II AUTOMATED TOOLS FOR SYSTEMS 7
DEVELOPMENT

What is requirements determination? Fact finding techniques, Tools for documenting procedure and decision-CASE Tools-Need for CASE tools-Reverse engineering and reengineering- phases of the software life cycle-Ranking projects-Value Chain Analysis- Corporate Strategic Planning vs. Information Systems Planning.

MODULE III SYSTEM ANALYSIS 8

Determining System Requirements – Traditional Methods - Modern Methods – Radical Methods – Structuring System Requirements – Process Modeling – Data Flow Diagramming – Logic Modeling – Conceptual Data Modeling – E-R Modeling.

MODULE IV SYSTEM DESIGN 8

System Implementation – Software Application Testing – Installation – Documentation – Training and Support – Organizational Issues in Systems Implementation – Maintaining Information System – Conducting System

Maintenance.

MODULE V USABILITY AND MEASURING USER 7
SATISFACTION

Usability Testing-User satisfaction test- A tool for analyzing user satisfaction – Unified Modeling Language(UML)- Case study: System Design: Application in Human Resource-Financial Applications

MODULE VI SAD IN E-COMMERCE 7

Systems analysis and design in the era of electronic commerce: B2B, B2C and C2C e-commerce -advantages and disadvantages of e-commerce. E-commerce system architecture – physical networks, logical network, World Wide Web, web-services - HTML, XML - case studies-EI electronic data interchange: EDI standards - virtual private networks - XML and EDI

L – 45; Total Hours –45

REFERENCES:

1. Jeffrey A. Hoffer, Joey F. George, Joseph S. Valacich, “Modern Systems Analysis and Design”,Fifth Edition, Prentice Hall, March 2007.
2. Ned Kock, “Systems Analysis & Design Fundamentals” Sage South Asia, May 2008.
3. Joseph S. Valacich, Jeffrey A. Hoffer, Joey F. George, “Essentials Of System Analysis And Design” Prentice Hall , August 2005.
4. Rumbaugh et al, “Succeeding with Booch and Rumbaugh Methods”, Addison Wesley, second Edition, 1998.
5. Larman, C.,” Applying UML and Patterns. An introduction to Object-Oriented Analysis and Design”. Prentice-Hall PTR, 2002.

OUTCOMES:

- List the characteristics of the system and specify the approaches in the development of the system.
- Summarize the phases of the software life cycle
- Differentiate Corporate Strategic Planning and Information Systems Planning.
- Illustrate the system requirements through various modeling diagrams.
- Use tools and techniques for process and data modeling.
- Solve realistic systems analysis problems and perform user satisfaction test.

GECX 212**ADVANCED MATERIALS****L T P C****3 0 0 3****OBJECTIVES:**

To make the student conversant with

- Dielectric materials
- Magnetic materials
- Energy materials
- Nano materials
- Semi conductors
- Smart materials

MODULE I**8**

Dielectric Materials- Polarization and Mechanism-Internal or local field-Clausius-Mossotti relation- Dielectric loss- Temperature and Frequency effect- Measurement of Dielectric constant and loss using Scherring bridge- electric break down- ferro, piezo, pyroelectric materials and its application.

MODULE II**8**

Magnetic Materials- Terminology and classification of magnetic materials (Dia, Para, Ferro & Ferri) – Magnetic moments due to electrospin – Domain theory of Hysteresis – Heisenberg theory of Exchange Interaction (without derivation)- Structure and properties of Ferrites- Properties of Soft and Hard Magnetic Materials- Application: floppy disk, CD ROM, Magneto optical recording.

MODULE III**8**

Energy Materials (Nuclear) - Introduction to nuclear materials- Materials for nuclear fuel in fission and fusion reactors, Fissile and fertile materials- Control & Construction Materials for Nuclear reactors, Moderators, Heat Exchangers- Radiation proof materials- Brief discussion of safety and radioactive waste disposal.

MODULE IV**7**

Nano Materials- The nanosize range- classification of nanomaterials- processing of nanomaterials-properties of nanomaterials- mechanical, electrical, magnetic properties- other properties- carbon based nanomaterials- other nanomaterials and its application.

MODULE V**7**

Semiconductors- The energy gap in solids-Extrinsic Semiconductors- Intrinsic Semiconductors- Hall Effect in semiconductors- Application of Hall Effect- Basic ideas of compound semiconductors -Semiconductor materials- Fabrication of Integrated Circuits- Some semiconductor Devices

MODULE VI**7**

Smart materials- aerospace materials Ni and Co based super alloys, Special steels, Titanium alloys, Intermetallics, ceramics and their composites, New High strength material, Properties of Materials, Materials in Medical Applications, Stainless steel alloys, Cobalt based alloys, titanium based alloys, polymers

L – 45; Total Hours –45**REFERENCES:**

1. Materials science and Engineering: A first course by V. RAGHAVAN, 6th ed., Eastern Economy edition, Prentice Hall of India, 2015
2. Materials science and Engineering: An Introduction by William D. Callister Jr., 7th ed. John Wiley & Sons Inc. 2007
3. Material science by Dr.M.Arumugam, Anurasha agencies ,third revised edition ,2002

OUTCOMES:

Students will be able to know

- significance of dielectric materials
- types and applications of magnetic materials
- applications of nuclear materials for energy harvesting
- applications of nano materials
- significance of semi conductor devices
- applications of smart materials

GECX 213	NATIONAL SERVICE SCHEME	L	T	P	C
		2	0	0	2

OBJECTIVES:

Primary Objective: Personality development through community service.

To achieve the above objective, the following should be adhered:

- To provide an understanding about the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
- To develop certain basic skills for personality development through community development.
- Understand the community in which they work and their relation
- Identify the needs and problems of the community and involve them in problem-solving and
- Practice national integration and social harmony.

MODULE I INTRODUCTION TO NSS 8

Orientation and structure of NSS,-Aims and Objectives of National Service Scheme- The history of NSS- Symbol and meaning- NSS hierarchy from national to college level – Role and responsibilities of various NSS functionaries

MODULE II PERSONALITY AND COMMUNITY DEVELOPMENT SKILLS 8

Importance of youth Leadership, Traits of Good Leadership and Personality Development. Role of youth in creating awareness through NSS Programmes on Health & Hygiene; Environmental Conservation and Enrichment for Sustainable Development; Sanitation and Swachh Bharat.

MODULE III UNDERSTANDING YOUTH 7

Definition and Profiles of youth categories, Youth Issues, Challenges and Opportunities for Youth, Youth as agent of social change & Community Mobilization Role of Youth in Nation Building. National Youth Policy.

MODULE IV SOCIAL HARMONY AND NATIONAL INTEGRATION 7

National Integration, Various obstacles in the way of National Integration; such as caste, religion, language and provisional problems etc. Role of youth in Peace building and conflict resolution-Globalization and its Economic Social Political and

Cultural impacts.

L – 30; Total Hours –30

TEXT BOOKS:

- National Service Scheme – A Youth Volunteers Programme for Under Graduate students as per UGC guidelines J.D.S.Panwar et al. Astral International. New Delhi.
- National Service Scheme Revised Manual, 2006.Govt. of India. Ministry of Youth Affairs & Sports. New Delhi.
- Social Problems in India, *Ram Ahuja*.

REFERENCES:

1. National Youth Policy-2014. Ministry of Youth Affairs & Sports. .Govt. of India

OUTCOMES:

On successful completion of this course-

- Students will have exposure to the the aims, structure and programmes and activities of National Service scheme in terms of Nation Building
- Students will be trained to skills for personality development through community development.
- Students will gain knowledge about national integration and social harmony.
- Students will be exposed to the role of youths in Nation building Students will gain

MODULE V TEST PROCEDURES 6

Constant Volume Sampling I and 3 (CVSI &CVS3) Systems- Sampling Procedures — Chassis dynamometers - Seven mode and thirteen mode cycles for Emission Sampling.

MODULE VI EMISSION MEASUREMENTS 6

Emission analysers —NDIR, FID, Chemiluminescent, Smoke meters, Dilution Tunnel, SHED Test, Sound level meters.

L – 45; Total Hours –45

TEXT BOOKS:

1. V.Ganesan, 'Internal combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2005.
2. Crouse and Anglin, 'Automotive Emission Control', McGraw Hill company., Newyork 1993.

REFERENCES:

1. G.P.Springer ad D.J.Patterson, Engine Emissions, Pollutant formation, Plenum Press, New York. 1986.
2. D.J.Patterson and N.A.Henin, 'Emission from Combustion Engine and their control', Anna Arbor Science Publication,1985.
3. L.Lberanek, 'Noise Reduction', Mcgrawhill Company., Newyork1993.
4. C.Duerson, 'Noise Abatment', Butterworths Ltd., London1990.
5. A.Alexander, J.P.Barde, C.Iomure and F.J. Langdan, 'Road traffic noise',
6. Applied science publisher ltd., London,1987.

OUTCOMES:

On completion of the course student should be able to

- Identify the sources of emission from vehicles.
- Analyse the causes and effects of emissions.
- Analyse causes and effects of noise pollution
- Bring out solutions for control of emissions.
- Demonstrate the test procedures and emission norms.
- Select suitable instruments for measurement of emissions.

GECX 215	MOTOR VEHICLE ACT, INSURANCE AND	L	T	P	C
	POLICY	3	0	0	3

OBJECTIVES:

- To learn about basic act and regulation followed for road vehicle
- To learn about systematic steps involved to get licence and registration of motor vehicle
- To learn about various types of motor vehicle policies and insurances

MODULE I BASIC RULES FOR ROAD VEHICLE 8

Display and Use of Number Plates- Attachment of number plates- Number plates in horizontal position- Removal of number plates on transfer- Hours prescribed for lighted lamps- Mounting of lamps and reflectors- Multiple beam headlamps- Daytime running lamps- Auxiliary driving lamps- Parking lamps- Brakes- Stopping distances- Emergency or parking brakes- Horn- Muffler- Mirrors- Inspection of motor vehicles- Standards of safety and repair

MODULE II LICENSING OF DRIVERS OF MOTOR VEHICLES 8

Necessity of driving licence- Age limit in connection with driving of motor vehicle-Responsibility of owners of motor vehicles-Restriction on the holding of driving licence-Grant of learner's licence-Grant of driving licence-Addition to driving licence- Renewal of driving licence-Revocation of driving licence on grounds of disease or disability-Driving licence to drive motor vehicle belonging to the central government- power of court to disqualify- suspension of driving licence in certain cases- suspension or cancellation of driving licence on conviction- Endorsement.

MODULE III REGISTRATION OF MOTOR VEHICLE 7

Necessity for registration – Registration Where and how to be made- Special provision for registration of motor vehicle of diplomatic officers-Temporary registration- Production of vehicle at the time of registration- Refusal of registration- renewal of certificate of registration- effectiveness in India of registration- Change of residence or place of business-transfer of ownership- Suspension of registration – cancellation of registration suspended under section 53- certificate of fitness of transport vehicle-cancellation of registration.

MODULE IV INSURANCE OF MOTOR VEHICLE 8

Necessity for insurance against third party – Requirements of policies and limits of liability- - Duty of insurers to satisfy judgements and awards against person insured in respect of third party risks-Duty to give information as to insurance- Settlement between insurers and insured persons- transfer of certificate of insurance-production of certain certificates, licences and permit in certain cases-Special provisions as to compensation in case of hit and run motor accident – Types of motor polices

MODULE V CONTROL OF TRANSPORT VEHICLES 7

Power to State Government to control road transport- Transport authorities-General provision as to applications for permits- Application for stage carriage permit- Procedure of Regional Transport Authority in considering application for stage carriage permit- Scheme for renting of motor cabs- Application for private service vehicle permit- Procedure in applying for and granting permits- Duration and renewal of permits- Transfer of permit- Replacement of vehicles-Temporary permits

MODULE VI OFFENCES AND PUNISHMENT 7

Driving without holding an effective driving licence- Driving by an under-aged person (Minor driving vehicle)- Holding of a driving licence permitting it to be used by other person.- Driving a vehicle at an excessive speed- Driving or permitting to drive a vehicle carrying excess load- Driving dangerously / its Abetment Driving an uninsured vehicle

Rider and pillion rider failing to wear protective head gear (Helmet) -Violation of Mandatory Signs -.e-challan and spot challan

L – 45; Total Hours –45

TEXT BOOKS:

1. The motor vehicle act 1988, Universal law publishing co.cpvt ltd. Newdelhi 2011
2. A Commentary On The Motor Vehicles Act, 1988 by SUKHDEV AGGARWAL The Bright Law House, New Delhi

REFERENCES:

1. The Motor Vehicles Act, 1988 Along with Latest Case Law, Notifications & Table of Offences and Punishments Asia Law House; 15th edition (2014)
2. Assessment of Compensation in Accidents under Motor Vehicles Act by Karkara Delhi Law House (2013)

OUTCOMES:

On completion of the course students should be able to

- Explain the analysis of rules and regulations for road vehicles
- Analyze the procedure for getting driving license for vehicles at national and international level
- Analyze the procedure for registration of vehicles.
- Analyze the procedure for Insurance of vehicles and claims.
- Analyze the procedure for obtaining Government Permits and renewal
- Analyze the consequences of not following the rules and regulations

L – 45; T – 0; Total Hours – 45

TEXT BOOKS:

1. A.Bruce Carlson, Paul B. Crilly, “Communication Systems”, 5th Edition, McGraw Hill Int., 2011.
2. B.P. Lathi, Zhi Ding, Hari M. Gupta, “Modern Digital and Analog Communication Systems”, 4th Edition, Oxford University Press, 2017.

REFERENCES:

1. Herbert Taub, Donald L. Schilling, Goutam Saha, “Principles of Communication Systems” 4th Edition, McGraw Hill Int. 2013.
2. Simon Haykin, “An Introduction To Analog And Digital Communications”, 1st Edition, Wiley India, 2010.
3. Simon Haykin , “Communications Systems” 4th Edition, Wiley India, 2006.
4. Hwei P. Hsu, “Analog and Digital Communications” 3rd Edition,

OUTCOMES:

On completion of the course students will be able to

- Identify various communication systems and the corresponding modulation schemes.
- Predict the characteristics of various analog and digital modulation schemes.
- Interpret the effect of noise and bandwidth in a communication systems
- Apply the Nyquist criteria for a given baseband signals.
- Evaluate the performance of communication receivers.
- Demonstrate the applications of common communication systems.

GECX 217	LEAN MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objective of the Course to make the student know about

- The basics of lean production management,
- How Lean principles are applied to the Construction industry to improve the operation management and product development.
-

MODULE I **7**

Lean production – Introduction, background, and lean thinking. Importance of philosophy, strategy, culture, alignment, focus and systems view. Discussion of Toyota Production System.

MODULE II **8**

Manufacturing systems – an overview of manufacturing strategies. Job shops, batch flow, and flexible manufacturing systems Flow production and lean production systems

MODULE III **7**

Value stream mapping in process design and product development Waste reduction - lead time reduction

Process cycle time and value-added vs. non-value added activities Optimum lot sizing

MODULE IV **8**

Lean production processes, approaches and techniques.—Importance of focusing upon flow. Tools -. Workplace organization – 5S. - Stability. - Just-In-Time – One piece flow – Pull. - . Cellular systems. - . Quick change and set-up reduction methods. f. Total productive maintenance. -. Poka-Yoke – mistake proofing, quality improvement. Standards. - . Leveling. - . Visual management. Just-in-time techniques – SMED and Takt Times - Standard work processes and line balancing Poka-yoke and pull systems material handling reduction and facilities planning

MODULE V **8**

Managing change in the lean organization Human resource management and

the lean enterprise Employee involvement – Teams – Training – Supporting and encouraging involvement – Involving people in the change process -- communication -- Importance of culture. Startup of lean processes and examples of applications. Sustaining improvement and change, auditing, follow-up actions.

MODULE VI

7

The lean enterprise and supply chain management Costs and risks of lean initiatives - Measuring lean initiatives

Total Hours –45

TEXT BOOKS:

1. The Toyota Way Field book, Jeffrey Liker and David Meier, McGraw-Hill, 2006. Lean Production Simplified, Pascal Dennis, Productivity Press, 2007.
2. Womack, James P., and Daniel T. Jones. Lean Thinking. New York, NY: Simon and Schuster, 2003. ISBN: 0743249275.
3. Murman, Earll. Lean Enterprise Value. New York, NY: Palgrave Macmillan, 2002. ISBN: 0333976975.

REFERENCES:

1. Readings at <http://www.leanconstruction.org/readings.htm>
2. Hopp, W. J., and Spearman, M. L. (2011). Factory Physics, Third Edition, Waveland Press, Long Grove, IL. 720pp.

OUTCOMES:

The student will be able to

- Describe the manufacturing approaches employed and the background and philosophy of lean production.
- Illustrate the concept of waste reduction
- Apply evaluation techniques that can be used in preparation for and use in lean production activities.
- Select the tools that can be used implementing lean production in production operations.
- Discuss the importance of workplace organization, pull production, cellular arrangement and employee involvement, need for employee creativity
- Describe about the Methods for promoting success in implementing lean transformations

GECX 218	SPATIAL DATA MODELING AND ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the fundamental representation and analysis of geospatial phenomena and provides the various methods and algorithms used in GIS analysis.
- To focus in terrain modeling, geomorphometry, watershed analysis and introductory GIS-based modeling of landscape processes (water, sediment). The course includes analysis from lidar data, coastal change assessment and 3D visualization.

MODULE I INTRODUCTION TO GEOSPATIAL DATA 7

Mapping natural phenomena –Concept of continuous fields and discrete sampling – Units, projections, coordinate transformation – Georeferencing, geospatial formats, conversions, geospatial data abstraction library – Raster and vector representation, raster and vector conversions and resampling.

MODULE II DATA DISPLAY AND VISUALIZATION 7

Display of continuous and discrete data, use of color, shading, symbols, to extract the spatial pattern and relationships – 3D visualization: multiple surfaces and volumes, 3D vector objects – visualization for data analysis (lighting, scaling, transparency, cutting planes, animations) – view/create maps/post your data on-line (Google Earth/Maps, GPS visualizer)

MODULE III GEOSPATIAL ANALYSIS 7

Foundations for analysis of continuous and discrete phenomena – neighborhood operations and buffers – analysis and modeling with map algebra – cost surfaces and least cost path – spatial interpolation and approximation (gridding)

MODULE IV TERRAIN MODELING AND ANALYSIS 9

terrain and bathymetry mapping – mathematical and digital representations (point clouds, contour, raster, TIN) – DEM and DSM, working with multiple return lidar data – spatial interpolation of elevation data and topographic analysis, line of sight, view shed analysis – solar irradiation, photovoltaic energy potential, time series of elevation data, analysis of coastal change.

GECX 219	ADVANCED ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop an entrepreneurial mindset.
- To learn the tools and methods for achieving sustainable growth.
- To explore various funds for a business and to get know about importance of a good team.
- To select public image branding and examine all channel types.
- To identify technology needs and establish key metrics to measure progress the business.
- To know about legal issues, regulations of starting and operating a venture and capstone presentation on practice venture.

Course Pre-requisites - Completion of Social Entrepreneurship Course
Access to Learnwise Platform

MODULE I ENTREPRENEURSHIP BASICS & REFINING BUSINESS MODEL 8

Entrepreneurship Basics - Recap of Key Concepts, Introduction to First Venture, Recap of idea selection and Lean Canvas, Revisit product/service, Business model, Team formation. **Refining Business Model** –Pivoting, Types of Business Model, Refining Business Models, Evaluate business model, Identify additional customer segments, Analyze Business Model of Competitors, Importance of Product Management.

MODULE II BUSINESS PLANNING & REVENUE 8

Business Planning – Introduction to Business Plan, Make a Sales Plan, Hiring Sales Team, Make a People Plan for Venture, Financial Planning and Forecasting Template, Revisit Business Model, Create a Procurement Plan, Negotiation. **Revenue** –Exploring ways to Increase Revenue, Understanding Primary Revenue Source, Customer Lifecycle for Growing Customers, Exploring Secondary Sources of Revenue.

MODULE III FUNDING GROWTH & BUILDING A-TEAM 7

Funding Growth – Funding Options for an Entrepreneur, Explore the Right Funding Options, Exploring crowd funding platforms, Create Your Funding Plan,

Pitch Practice. **Building A-Team** – Intro to Building an A-Team, Defining roles and responsibilities, Pitching to Attract Talent, Setting Your Team Up for Success, Defining Role of a New Hire

MODULE IV BRANDING AND CHANNEL STRATEGY 7

Branding and Channel Strategy– Intro to Branding, Draw your Venture’s Golden Circle, Define Your Values, Positioning Statements, Selecting Brand Name, Social Media Handle, Logo and Mobile app names for Your Venture, Creating online public profiles, Bulls Eye Framework and other traditional channel types, Identify your Right Channel using Bulls Eye Framework.

MODULE V LEVERAGING TECHNOLOGIES AND AVAILABLE PLATFORMS & MEASURING PROGRESS 8

Leveraging Technologies and Available Platforms – Leaping Ahead with Technology, Digital Marketing for Your Startup, Plan a Social Media Campaign, Digital Collaboration, Store Your Documents Online, Other Platforms, Make Your Tech Plan and Platform Wish List. **Measuring Progress** – Metrics for Customer Retention and Satisfaction, Find your CAC, CLV, and ARPU, Key Financial Metrics, How to Communicate Your Metrics, Find New Revenue Streams based on Your Key Financial Metrics, Re-forecast your Financial Plan to Increase Margin.

MODULE VI LEGAL MATTERS & SEEKING SUPPORT & FINAL PROJECT 7

Legal Matters – Identify the Professional Help and Legal and Compliance Requirements for Your Venture, Conduct a Trademark Search for Your Company/Brand Name. **Seeking Support** – How Mentors Help to Create Successful Startups, Identify Mentors and Advisors, Scout for Board of Directors. **Final Project** – Capstone Project Presentation.

Total Periods- 45

TEXT BOOKS

1. Learn wise platform - Wadhvani Foundation, 2018.
2. All Lessons are delivered as Online videos accessible using Wadhvani Foundation’s Learnwise Platform - <https://lms.learnwise.wfglobal.org>

OUTCOMES:

On completion of the course, students will be able to

- Achieve sustainable growth by pivoting, refining business models, expand customer segments, and business planning for developing early customer traction into a repeatable business.
- Develop strategies to grow revenues and markets.
- Develop an A-Team, brand strategy and create digital presence.
- Develop brand and channel strategy for customer outreach
- Leverage social media to reach new customers cost effectively.
- Explore licensing and franchising for business expansion.

GECX 220	ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of Electric Vehicles.
- To familiarize the basic energy transfer processes that govern existing and proposed methods of power generation for Electric Vehicles.
- To familiarize with the traditional and non-traditional sources for Electric Vehicles in terms of energy content, accessibility, required processing steps and projected remaining reserves

MODULE I INTRODUCTION 8

A Brief History - Types of Electric Vehicle in Use Today : Battery electric vehicles - The IC engine/electric hybrid vehicle - Fuelled electric vehicles - Electric vehicles using supply lines - Solar powered vehicles - Electric vehicles which use flywheels or super capacitors - Ultra Capacitor – Ultra high Speed Flywheels.

MODULE II BATTERIES 7

Battery Parameters - Lead Acid Batteries - Nickel-based Batteries - Sodium-based Batteries - Lithium Batteries - Metal Air Batteries - Battery Charging - Choice of Battery - Use of Batteries in Hybrid Vehicles - Battery Modeling.

MODULE III FUEL CELLS 8

Hydrogen Fuel Cells - Fuel Cell Thermodynamics - Connecting Cells in Series - Water Management in the PEM Fuel Cell - Thermal Management of the PEM Fuel Cell - A Complete Fuel Cell System - Hydrogen Supply - Fuel Reforming - Hydrogen Storage.

MODULE IV ELECTRIC VEHICLE MODELLING AND DESIGN CONSIDERATIONS 7

Tractive Effort - Modeling Vehicle Acceleration - Modelling Electric Vehicle Range - Aerodynamic Considerations - Transmission Efficiency - Electric Vehicle Chassis and Body Design - General Issues in Design.

MODULE V DESIGN OF ANCILLARY SYSTEMS 7

Heating and Cooling Systems - Design of the Controls - Power Steering - Choice of Tyres - Wing Mirrors, Aerials and Luggage Racks - Electric Vehicle Recharging

and Refueling Systems.

MODULE VI ENVIRONMENTAL IMPACT AND ENERGY STORAGE 8

Vehicle Pollution - The Effects - A Quantitative Analysis - Vehicle Pollution in Context - Alternative and Sustainable Energy Used via the Grid Hybridization of Energy Storages - Energy Consumption in Braking - Brake System of EVs and HEVs - Antilock Brake System.

Total Hours – 45

REFERENCES:

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd, 2nd edition, 2015.
2. M. Ehsani, Y. Gao, Stefano Lango, K.M.Ebrahimi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 3rd Edition, 2018.
3. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, 2nd edition, CRC Press, 2016.
4. Tom Denton, "Electric and Hybrid Vehicles" Routledge Publishers, 1st edition, March 2016.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Identify and quantify the important energy transfer for Batteries and fuel cell schemes.
- Identify the opportunities and challenges of advances in Electric Vehicles.
- Choose a suitable drive scheme for developing an electric hybrid vehicle depending on Resources
- Design and develop basic schemes of electric vehicles and hybrid electric vehicles.
- Choose proper energy storage systems for vehicles
- Identify the current industry activities by car makers, electricity utilities, parts, suppliers (motors and batteries), including joint ventures, product announcements and pilot projects.

MODULE VI GENETIC MODELING AND APPLICATIONS**8**

Genetic operators, cross over types, mutation operator, coding steps of GA, convergence characteristics, applications of AI techniques in various domains using GATool in matlab

Total Hours –45**REFERENCES:**

1. Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, 1992.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 1997.
3. David Goldberg, "Genetic Algorithms and Machine learning", PHI
4. Wassermann, P. D. "Neural Computing" Van Reinhold, 1988.
5. Zimmermann, H. J., 'Fuzzy Set Theory and Its Applications', 2nd Edition, Kluwer Academic Publishers.
6. Martin T. Hogan, Howard B. Demuth. M., 'Neural network design' 4th edition
7. Zureda, J.M., 'Introduction to Artificial Neural Systems', Jaico publishing house Bombay, 1994.
8. Bose N.K, Liang P. 'Neural Network Fundamentals with graphs, Algorithms and applications', TMH Pub. Co. Ltd, 2001.
9. S.Rajasekaran, G.A.Vijayalaxmi Pai , Neural Networks, Fuzzy logic and Genetic algorithms Synthesis and Applications , PHI private learning Ltd., New Delhi, 2011.

OUTCOMES:

At the end of the course, the student is expected to possess knowledge and achieve skills on the following:

- Enumerate the theoretical basis of soft computing.
- Discuss the neural networks and supervised and unsupervised learning networks
- Design suitable neural networks, fuzzy systems, genetic representations with appropriate fitness functions for simple problems
- Apply the most appropriate soft computing algorithm for a given situation
- Know the key issues in using these techniques for search of difficult search-spaces
- Be aware of the different approaches and different applications in the field.