



B.S. Abdur Rahman

**Crescent**

Institute of Science & Technology

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

*Regulations 2017*  
*Curriculum and Syllabi*

(Amendments updated upto June 2020)

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**B.Tech. CSE**  
**(Internet of Things)**



**REGULATIONS 2017  
CURRICULUM AND SYLLABI  
(Amendments updated upto June 2020)**

**B.TECH. CSE (INTERNET OF THINGS)**



## **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 up skill students with strong foundational concepts and ethically develop innovative and research-oriented methodologies to solve the problems identified.
- To prepare students for critical analysis of existing literature in a specialization field and to educate them on advanced techniques and resources that enables them to build solutions or systems of varying complexity.
- To educate students about the effective use of Internet of Things (IoT) technology for solving real-life multi-disciplinary problems that cater to the need of society and are economically feasible.
- To furnish an environment of life-long learning, professional and ethical attitude & innovation needed for a successful progressive career of students.
- To produce graduates that have a strong technical foundation for successful professional careers and evolves as key players/ entrepreneurs in the field of information technology.

## 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:** Capable of implementing eco-friendly unified solutions for present and new applications related to IoT technology and applications.

**PSO2:** Focus on getting the right blend of aptitude and attitude to be the candidate of the first choice for jobs and higher learning or to become a successful entrepreneur and a respectable citizen.

**REGULATIONS - 2017**  
**B.TECH. DEGREE PROGRAMMES**  
**(With Amendments incorporated up to 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 Programme like 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 3<sup>rd</sup> to 8<sup>th</sup> semester is as follows:

- i) One senior faculty member preferably not handling courses for the concerned semester appointed as chairman by the Head of the Department
- ii) 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 3<sup>rd</sup> semester
- Not less than 40 credits, (20 for lateral entry) to move to the 5<sup>th</sup> semester
- Not less than 60 credits, (40 for lateral entry) to move to the 7<sup>th</sup> 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:

<b>Letter Grade</b>	<b>Grade Points</b>
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  $i^{\text{th}}$  course and  $G_{P_i}$  is the Grade Point in the  $i^{\text{th}}$  course

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

Where  $n$  = number of courses

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

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

"U", "I", "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
• Electronics and Instrumentation Engineering	• Computer Science and Engineering
• Information Technology	• Artificial Intelligence and Data Science
• Computer Science and Engineering (IoT)	• Computer Science and Engineering (Cyber Security)

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

<b>Sl. No.</b>	<b>Minor Degree (Optional)</b>	<b>Eligible Major Degree Programmes (from other Departments)</b>
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.
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**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.

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**B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE AND TECHNOLOGY****Vandalur, Chennai – 600048****B.TECH. CSE (INTERNET OF THINGS)****CURRICULUM & SYLLABUS, REGULATIONS 2017****SEMESTER I**

<b>Sl. No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	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 1181	Physics	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	1	0	4
8.	EC	CSC 1152	C and C++ Laboratory	0	0	2	1
							<b>22</b>

**SEMESTER II**

<b>Sl. No.</b>	<b>Course Group</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	BS	MAC1281	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 1241	Introduction to sensors	3	0	0	3

6.	EC	CSC 1252	Python Programming	3	0	0	3
7.	EC	CSC 1253	Digital System	3	0	2	4
8.	EC	CSC 1254	Python Programming Laboratory	0	0	2	1
							<b>24</b>

### SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BS	MAC 2182	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	CSC 2101	Data Structures	3	1	0	4
5.	EC	CSC 2102	Computer Networks	3	0	2	4
6.	EC	CSC 2103	Software Engineering	3	0	0	3
7.	EC	CSC 2141	Advanced Micro-controller based systems	3	0	0	3
8.	EC	CSC 2105	Data structures Laboratory	0	0	2	1
9.	EC	CSC 2142	Advanced micro- controller Laboratory	0	0	2	1

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### 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 2282	Written Communication	0	0	2	1
4.	EC	CSC 2241	Java Programming	3	0	0	3
5.	EC	CSC 2212	Analysis of Algorithms	3	1	0	4
6.	EC	CSC 2242	Adhoc and Wireless Sensor Networks	3	0	0	3
7.	EC	CSC 2214	Database Management Systems	2	0	0	2
8.	EC	CSC 2243	Java Programming Laboratory	0	0	2	1

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9.	EC	CSC 2215	DBMS Laboratory	0	0	2	1
10	EC	CSC 2244	Adhoc and Wireless Sensor Networks Laboratory	0	0	2	1
11.	PE	-	Programme Elective #1 (CSE)	3	0	0	3*
							<b>25</b>

### 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	ENC 3181	Communication & soft skill – I	0	0	2	1
4.	EC	CSC 3101	Operating Systems	3	0	0	3
5.	EC	CSC 3103	Artificial Intelligence and Machine Learning	3	0	0	3
6.	EC	CSC 3141	Embedded System Design and Programming	3	0	0	3
7.	EC	CSC 3142	Embedded System Design and Programming Laboratory	0	0	2	1
8.	EC	CSC 3104	Web development Laboratory	0	0	2	1
8.	PE	-	Programme Elective #2(CSE)	3	0	0	3
9..	PE	-	Programme Elective #3(IoT)	3	0	0	3

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### 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	-	Mathematics Elective II	2	0	0	2
3.	HS	ENC 3281	Communication and soft skill - II	0	0	2	1
4.	EC	CSC 3241	Cryptography and Network Security	3	0	0	3

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5.	EC	CSC 3242	IoT Architecture and its Protocols	3	0	0	3
6.	EC	CSC 3211	Big Data Analytics	3	0	0	3
7.	EC	CSC 3214	Big Data Analytics Tools Laboratory	0	0	2	1
8.	EC	CSC 3243	Cryptography and Network Security Laboratory	0	0	2	1
9.	PE	-	Programme Elective #4(CSE)	3	0	0	3
10.	PE	-	Programme Elective #5(IoT)	3	0	0	3
							<b>23</b>

### 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 4141	Privacy and security in IoT	3	0	0	3
3.	EC	CSC 4102	Compiler Design	3	0	0	3
4.	EC	CSC 4103	Cloud Computing	3	0	2	4
5.	EC	CSC 4104	Compiler Laboratory	0	0	2	1
6.	EC	CSC 4105	Internship				1
7.	PE	-	Programme Elective #6(CSE)	3	0	0	3
8.	PE	-	Programme Elective #7(IoT)	3	0	0	3
9.	PE	-	Programme Elective #8(IoT)	3	0	0	3
							<b>24</b>

### SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	EC	CSC 4211	Project Work	0	0	24	12
							<b>12</b>

**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 IV****Programme Elective #1 (CSE)**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	3*
							C
1.	PE	CSCX 201	Multimedia and Animation	3	0	0	3
2.	PE	CSCX 202	VFX	3	0	0	3
3.	PE	CSCX 203	Digital Transmission	3	0	0	3
4.	PE	CSCX 204	Information Technology in Organization	3	0	0	3
5.	PE	CSCX 205	Innovation and New product development	3	0	0	3
6.	PE	CSCX 206	Fundamentals of Computer Forensics	3	0	0	3
7.	PE	CSCX 207	Open Source Technologies	2	0	2	3
8.	PE	CSCX 208	User Interface Design	3	0	0	3
9.	PE	CSCX 209	Stress Management	1	0	0	1
10.	PE	CSCX 210	Information Ethics	1	0	0	1

**SEMESTER V****Programme Elective #2 (CSE)**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	3*
							C
1.	PE	CSCX 101	2D Character Animation	2	0	0	2
2.	PE	CSCX 102	Image processing	2	0	2	3
3.	PE	CSCX 103	Multimedia Application Development	2	0	0	2
4.	PE	CSCX 104	3D Animation	2	0	2	3

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5.	PE	CSCX 105	Advanced Computer Graphics	2	0	2	3
6.	PE	CSCX 106	Multimedia Design program	2	0	2	3
7.	PE	CSCX 111	Agile practices	1	0	0	1
8.	PE	CSCX 112	Software testing	2	0	0	2
9.	PE	CSCX 113	Software Requirements and Modeling	2	0	0	2
10.	PE	CSCX 114	Theory of Computation	3	0	0	3
11.	PE	CSCX 122	Foundation on Robotics	2	0	0	2
12.	PE	CSCX 123	Sound Editing and processing	2	0	2	3
13.	PE	CSCX 124	Computer Vision	3	0	0	3
14.	PE	CSCX 125	Mobile Multimedia Systems	2	0	0	2
15.	PE	CSCX 126	Scripting Languages	2	0	2	3
16.	PE	CSCX 127	Online video production	1	0	0	1
17.	PE	CSCX 128	Multimedia security	2	0	0	2
18.	PE	CSCX 129	Multimedia Communication and Networking	3	0	0	3
19.	PE	CSCX 130	Gaming Technology	3	0	0	3
20.	PE	CSCX 132	Queuing Theory	3	0	0	3
21.	PE	CSCX 136	Software metrics	2	0	0	2
23.	PE	CSCX 139	C# & .NET	2	0	0	2

### SEMESTER V

#### Programme Elective #3 (Internet of Things)

Sl. No.	Course Group	Course Code	Course Title	3*			
				L	T	P	C
1.	PE	CSCX 351	Multimedia and IoT Technology	3	0	0	3
2.	PE	CSCX 352	Advanced Sensor Technologies	3	0	0	3
3.	PE	CSCX 117	Virtualization Techniques	3	0	0	3

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4.	PE	CSCX 137	Multicore Architecture	2	1	0	3
5.	PE	CSCX 134	Design of Computer Network services	3	0	0	3
6.	PE	CSCX 107	Network Modeling	3	0	0	3
7.	PE	CSCX 108	Cellular and Wireless Networks	3	0	0	3
8.	PE	CSCX 109	Network Management	2	0	0	2
9.	PE	CSCX 110	Network Simulators	1	0	0	1
10.	PE	CSCX 133	Network Trouble shooting tools	1	0	0	1
11.	PE	CSCX 131	Routing Protocols	3	0	0	3
12.	PE	CSCX 138	Statistics and analytics using R programming	2	0	2	3

### SEMESTER VI

#### Programme Elective #4 (CSE)

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	CSCX 214	Information Retrieval	3	0	0	3
2.	PE	CSCX 215	Software Risk Management	1	0	0	1
3.	PE	CSCX 216	Social Media Security	3	0	0	3
4.	PE	CSCX 217	Web Security	2	0	0	2
5.	PE	CSCX 218	Software design and architecture	1	0	0	1
6.	PE	CSCX 219	Software Configuration Management	2	0	0	2
7.	PE	CSCX 220	Human Computer Interaction	3	0	0	3
8.	PE	CSCX 221	Green Computing	3	0	0	3
9.	PE	CSCX 222	XML and Microservices	3	0	0	3
10.	PE	CSCX 224	Advanced Machine Learning	3	0	0	3

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11.	PE	CSCX 228	Information Visualization	2	1	0	3
12.	PE	CSCX 229	Cyber Forensics	3	0	0	3
13.	PE	CSCX 232	Database Security	3	0	0	3
14.	PE	CSCX 233	Software Quality Assurance	3	0	0	3
15.	PE	CSCX 234	Customer Relationship Management	1	0	0	1
16.	PE	CSCX 235	Service Oriented Architecture	2	0	0	2
17.	PE	CSCX 236	Genetic Algorithm	3	0	0	3
18.	PE	CSCX 237	Enterprise Resource Planning	2	1	0	3
19.	PE	CSCX 238	API Design	2	0	0	2

#### Program Elective #5 - IoT

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	CSCX 451	Smart cities design	3	0	0	3
2.	PE	CSCX 452	IoT in health care	3	0	0	3
3.	PE	CSCX 453	Business Process Management Cognitive IoT	3	0	0	3
4.	PE	CSCX 454	Biometric Systems	3	0	0	3
5.	PE	CSCX 455	Software Defined Networks	3	0	0	3
6.	PE	CSCX 456	Smart Devices Security	3	0	0	3
7.	PE	CSCX 457	Open Source Programming for IoT	3	0	0	3
8.	PE	CSCX 458	Quantum Computing	3	0	0	3
9.	PE	CSCX 459	Wearable Computing	3	0	0	3
10.	PE	CSC X 460	Distributed Computing Systems	3	0	0	3

**SEMESTER VII****Programme Elective #6 (CSE)**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	3*
							C
1.	PE	CSCX 143	Deep Learning	2	0	2	3
2.	PE	CSCX 144	Intrusion Detection and Prevention	3	0	0	3
3.	PE	CSCX 145	Security Law and Compliance	2	0	0	2
4.	PE	CSCX 146	Software Design patterns	1	0	0	1
5.	PE	CSCX 147	Writing skills for engineering leaders	1	0	0	1
6.	PE	CSCX 148	Software Reliability	2	0	0	2
7.	PE	CSCX 149	AAIP – Animation with Portfolio Development	2	0	2	3
8.	PE	CSCX 150	Advanced SAS: Macros & SQL	2	0	0	2
9.	PE	CSCX 151	Advanced Programming in Data Science	3	0	0	3
10.	PE	CSCX 155	Security Issues in Cloud Computing	3	0	0	3
11.	PE	CSCX 156	Security Evaluation and Assessment Methodology	3	0	0	3
12.	PE	CSCX 157	Software process and product quality	1	0	0	1
13.	PE	CSCX 158	System Integration	2	0	0	2
14.	PE	CSCX 159	IBM Websphere	2	0	2	3
15.	PE	CSCX 160	AVIP – Broadcast	1	0	0	1
16.	PE	CSCX 161	Full Stack mobile application development I (Front end)	2	0	2	3
17.	PE	CSCX 162	Advanced Game Design	2	0	0	2
19.	PE	CSCX 166	Web Application Security	2	0	0	2
20.	PE	CSCX 167	Cyber Laws and Ethics	2	0	0	2
21.	PE	CSCX 168	Secure Interconnecting systems	3	0	0	3
22.	PE	CSCX 169	Software Maintenance	2	0	0	2
23.	PE	CSCX 170	Personal Software Process	1	0	0	1
24.	PE	CSCX 171	Web analytics and Social media mining	3	0	0	3
25.	PE	CSCX 172	Ruby	1	0	0	1

26.	PE	CSCX 173	Full Stack mobile application development II (Back end)	2	0	2	3
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**Elective #7 and #8 - IoT****(3+3)**

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PE	CSCX 353	SDN and NFV for IOT	3	0	0	3
2.	PE	CSCX 353	Smart Grid	3	0	0	3
3.	PE	CSCX 354	Industrial IoT	3	0	0	3
4.	PE	CSCX 355	Advanced Embedded System	3	0	0	3
5.	PE	CSC X 356	FOGG computing	3	0	0	3
6.	PE	CSCX 357	Energy Harvesting Technologies and Power Management for IoT Devices	3	0	0	3
7.	PE	CSCX 358	3D Printing and Design	3	0	0	3
8.	PE	CSCX 359	Security in Wireless Networks	3	0	0	3
9.	PE	CSCX 360	Smart Convergent Technologies	3	0	0	3
10.	PE	CSCX 361	Edge Computing	3	0	0	3
11.	PE	CSCX 362	Block Chain Technology	3	0	0	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

**Maths Elective Courses  
(To be offered in IV Semester)**

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MACX 01	Discrete Mathematics And Graph Theory	3	1	0	4
2.	MACX 02	Probability And Statistics	3	1	0	4
3.	MACX 03	Random Processes	3	1	0	4
4.	MACX 04	Applied Numerical Methods	3	1	0	4

**Maths Elective Courses**  
**(To be offered in VI Semester)**

Sl. No.	Course Code	Course Title	L	T	P	C
1.	MACX 05	Mathematical Programming	2	0	0	2
2.	MACX 06	Statistical Methods for Data Analysis	2	0	0	2
3.	MACX 07	Numerical Methods for Integral and Differential Equations	2	0	0	2
4.	MACX 08	Mathematical Modelling	2	0	0	2
5.	MACX 09	Graph Theory	2	0	0	2

**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)**

<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Offering Department</b>
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
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)**

<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Offering Department</b>
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.	GECX 207	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	System Analysis and Design	CA
12.	GECX 212	Advanced Materials	Physics & Chemistry
13.	GECX 213	National Service Scheme	School of Humanities
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

<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Offering Department</b>
19.	GECX 219	Advanced Entrepreneurship	MBA
20.	GECX 220	Electric Vehicles	EEE
21.	GECX 221	Artificial Intelligence and Evolutionary Computing using Malab	EEE



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” (43<sup>rd</sup> 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 cengage learning,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 &amp; 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 &amp; 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 Rosenblun perry(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.

**ISC1181****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 &amp; Video aided listening, Tajweed listening,

Writing Arabic Alphabets (connected &amp; 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.

Exercises.



**LNC1181****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.

**LNC1182****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 Schönherr, 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 Schönherr, 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.

**LNC1183****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. Exersice book 1of 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 Gaikokugo Daigaku; 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.





method.

10. Determination of thermal conductivity of a bad conductor by Lee's disc method.

11. Determination of solar cell characteristics.

**L – 45; P – 30; TOTAL HOURS – 75**

### **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.

<b>GEC 1101</b>	<b>ENGINEERING GRAPHICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**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



<b>GEC 1102</b>	<b>ENGINEERING DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**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", 2<sup>nd</sup> 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.

<b>GEC1103</b>	<b>BASIC ENGINEERING PRACTICES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>LABORATORY</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**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
2. Machining of a simple component like a table weight using lathe
3. 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

<b>CSC 1151</b>	<b>PROGRAMMING IN C AND C++</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**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 ;T-15;TOTAL HOURS-60**

**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. Tanmey Kasby, “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.

<b>CSC 1152</b>	<b>C AND C++ LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**OBJECTIVES :**

- To make familiar with the structure of C programs
- To design real time problems and find the way to implement the solution.
- To implement the Control statements, Arrays, Functions and Pointers.
- To prepare students to get full use of code reusability using object oriented programming.
- To implement the basic concepts of object oriented programming using C++ concepts.
- To focus on solving problems based on analyzing, designing and implementing programs in C and C++.

**SOFTWARE REQUIRED : C/C++**

Design problems and implement solutions for the following concepts:

**C Programs**

1. Structure of a basic program, Type conversions and Operators
2. Decision Making – Branching and looping
3. Arrays – Sorting and searching.
4. Functions.
5. Pointers.

**C++ Programs**

6. Simple C++ program with Control statements.
7. Classes with Object
8. Constructors and destructors.
9. Method overloading.
10. Operator Overloading
11. Inheritance
12. Virtual base Classes

**P-15 TOTAL HOURS – 15**

**OUTCOMES :**

Students who complete this course will be able to

- Acquire basic knowledge about structure of C programs.
- Debug the programs and find the solution using Decision Making.
- Create programs using arrays, functions and pointers.
- Develop programs using concepts of object oriented programming.

- Apply constructor and destructors in object oriented programming.
- Build Knowledge on reusability.

**SEMESTER II**

<b>MAC 1281</b>	<b>PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**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“, 10<sup>th</sup> edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2001.
2. Grewal B.S., “Higher Engineering Mathematics”, 42<sup>nd</sup> 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“, 5<sup>th</sup> edition, Tata Mc Graw Hill Publishing Co. New Delhi, 2012.
2. Peter V. O'Neil, “Advanced Engineering Mathematics”, 7<sup>th</sup> edition, Cengage Learning, 2011.
3. Dennis G. Zill, Warren S. Wright, “Advanced Engineering Mathematics”, 4<sup>th</sup> 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 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 periods****Total: 30 periods****TEXT BOOKS**

1. Erach Bharucha, Textbook for Environmental Studies For Undergraduate Courses of all Branches of Higher Education for University Grants Commission, Orient Blackswan Pvt Ltd, Hyderabad, India, 2013.
2. Benny Joseph, Environmental Studies, Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A, Environmental Science and Engineering, 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 1241****INTRODUCTION TO SENSORS****L T P C****3 0 0 3****OBJECTIVES****The aims of this course is to**

- To recognize the importance of sensors
- To gain knowledge in the physical principles behind each sensor
- To explore the working principles of pressure and flow sensors
- To be aware of various acoustic, humidity and moisture sensors
- To expose how Light and radiation detection is used in sensing
- To be familiar with the different Temperature , chemical and biological sensors

**MODULE 1- INTRODUCTION****7**

The human body as a sensor system, sensors in an automobile, classification of sensors, Example of a gas sensor, sensor as a passive or active element, sensor as a part of a measurement system, sensor properties, Historical development of sensors, sensor system

**MODULE 2 - PHYSICAL PRINCIPLES OF SENSING****8**

Electric Charges, Fields, and Potentials - Capacitance - Magnetism - Induction - Resistance - Piezoelectric Effect -Pyroelectric Effect - Hall Effect - Seebeck and Peltier Effects – SoundWaves - Temperature and Thermal Properties - Heat Transfer

**MODULE 3 - PRESSURE AND FLOW SENSORS****8**

**Pressure Sensors** :Concepts of Pressure - Units of Pressure - Mercury Pressure Sensor -Bellows, Membranes, and Thin Plates - Piezoresistive Sensors - Capacitive Sensors - VRP Sensors - Optoelectronic Sensors –Indirect pressure sensors -Vacuum Sensors

**Flow Sensors** - Basics of Flow Dynamics - Pressure Gradient Technique - Thermal Transport Sensors - Ultrasonic Sensors - Electromagnetic Sensors. - Microflow Sensors - Breeze Sensor - Coriolis Mass Flow Sensors - Drag Force Flow Sensors- Cantilever MEMS sensors – Dust and smoke detectors

**MODULE 4 - ACOUSTIC , HUMIDITY AND MOISTURE SENSORS****7**

**Acoustic Sensors:** Microphone characteristics -Resistive Microphones -

Condenser Microphones -Fiber-Optic Microphone - Piezoelectric Microphones - Electret Microphones –dynamic microphones

**Humidity and moisture sensors** :Concept of Humidity -Capacitive Sensors – Resistive sensors - Thermal Conductivity Sensor - Optical Hygrometer- Oscillating Hygrometer – Soil Moisture .

#### **MODULE 5 - LIGHT AND RADIATION DETECTORS**

**7**

**Light Detectors:** Introduction -Photodiodes - Phototransistor –Photoresistors - Cooled Detectors –Imaging sensors –UV detectors -Thermal RadiationDetectors .**Radiation Detectors** :Scintillating Detectors-Ionization Detectors - Ionization Chambers - Proportional Chambers . - Geiger–Müller Counters -Semiconductor Detectors – Cloud and Bubble chambers

#### **MODULE 6 –TEMPERATURE, CHEMICAL AND BIOLOGICAL SENSORS**

**8**

**Temperature Sensors**-Thermoresistive Sensors - Resistance Temperature Detectors - Silicon Resistive Sensors - Thermistors -NTC Thermistors -Self-Heating Effect in NTC Thermistors - PTC Thermistors - Thermoelectric Contact Sensors - Semiconductor P-N Junction Sensors - Optical Temperature Sensors - Acoustic Temperature Sensor - Piezoelectric Temperature Sensors .

**Chemical and Biological Sensors** – Chemical and Bio-chemicalsensors - Chemical Sensor Characteristics –Electrical and Electrochemical sensors – Photo ionization detectors – Spectrometers – Pellister Catalytic sensors –Optical transducers

**Total – 45 Hours**

#### **References:**

1. Jacob Fraden, “ Handbook of Modern Sensors – Physics, Designs and Applications” Springer fifth edition, 2016
2. John Vetelino and AravindReghu, “Introduction to Sensors” CRC Press, 1st Edition, 2010.
3. Jose Luis Santos and FaramarzFarahi, “ Handbook of Optical Sensors” CRC Press 1st Edition, 2018
4. Ion Sinclair,“ Sensors and tranducers” Newnws publisher, Third Edition, 2001.
5. Kalantar-zadeh and Kourosch , “ Sensors - An Introductory Course” Springer, 2013

**OUTCOMES**

**After completion of course, students would be able to:**

- Describe the importance of sensors
- Outline the physical principles behind each sensor
- Bring out the different types of pressure & flow sensors, their designs and working principles
- illustrate different acoustic , humidity & moisture sensors, their designs and working principles
- identify different light and radiation detectors for sensing
- impart knowledge on the various temperature , chemical and biological sensors and their sensing capability.



**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 ;T-0;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 SYSTEM****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.

<b>CSC 1254</b>	<b>PYTHON PROGRAMMING LABORATORY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**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-15****TOTAL HOURS – 15****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.

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

<b>PHCX 01</b>	<b>FUNDAMENTALS OF ENGINEERING MATERIALS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**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 basics 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, 5<sup>th</sup> 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 , 2<sup>nd</sup> 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

**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.

<b>PHCX 03</b>	<b>INTRODUCTION TO NANOSCIENCE AND TECHNOLOGY</b>	<b>L T P C</b>
		<b>2 0 2 3</b>

**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.

**P: 30 period**

**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.

<b>PHCX 04</b>	<b>LASERS AND THEIR APPLICATIONS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

## 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.

**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, 3<sup>rd</sup> Edition, 2007.
3. Arumugam. M, "Physics II", Material Science for ECE, Anuradha Publishers, 5<sup>th</sup> Edition, 2005.
4. Sze. S.M., "Semiconductor Devices – Physics and Technology", John Wiley, 2<sup>nd</sup> Edition. 2002.
5. Raghavan. V, "Materials Science and Engineering", Prentice Hall of India, 5<sup>th</sup> 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.

**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.

<b>PHCX 07</b>	<b>PROPERTIES OF MATTER AND ACOUSTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**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.

**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.

<b>PHCX 08</b>	<b>PROPERTIES OF MATTER AND NONDESTRUCTIVE TESTING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**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.

**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. Baldev Raj., Jayakumar T., Thavasimuthu M., "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.

<b>PHCX 09</b>	<b>SEMICONDUCTOR PHYSICS AND OPTOELECTRONICS</b>	<b>L T P C 2 0 2 3</b>
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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, Homojunction and Heterojunction 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.

**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.