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

Regulations 2021
Curriculum and
Syllabi (I & II Semesters)

B.Tech.
(Information Technology)

REGULATIONS 2021

CURRICULUM AND SYLLABI (I & II Semesters)

B.TECH. INFORMATION TECHNOLOGY

VISION AND MISSION OF THE INSTITUTION

VISION

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

MISSION

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

DEPARTMENT OF INFORMATION TECHNOLOGY

VISION AND MISSION

VISION

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

MISSION

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

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

B.TECH. (INFORMATION TECHNOLOGY)

PROGRAMME EDUCATIONAL OBJECTIVES:

PEO1: To provide students with core competence in mathematics, science and engineering concepts essential to formulate, analyze and solve hardware / software engineering problems.

PEO2: To impart students with good breadth of knowledge in the core areas of information technology and related engineering so as to comprehend engineering trade-offs, analyze, design and synthesize data and technical concepts to create novel products and solutions for the real time problems.

PEO3: To train students in the use of tools and techniques for software development in different application domains and to grow as an entrepreneur.

PEO4: To prepare students to apply their knowledge and multifaceted skills to get immediate employment and excel in IT professional careers or awareness of the lifelong learning needed to continue their education in IT or related post graduate programmes to perform excellence, leadership and demonstrate good citizenship.

PEO5: To inculcate in students to maintain high professionalism and ethical standards, effective oral and written communication skills, to work as part of teams on multidisciplinary projects and diverse professional environments, and relate engineering issues to the society, global economy and to emerging technologies.

PROGRAMME OUTCOMES:

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

PO1: apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: use research –based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

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

PO6: apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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: impart broad spectrum of knowledge and skill in the analysis, design, implementation and testing of software systems.

PSO2: provide problem solving capability through IT tools and techniques with adequate hands on experience to meet industry / research / societal needs.

REGULATIONS - 2021
B.TECH. DEGREE PROGRAMMES
(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 / seminar / internship / project and any other subject that is normally studied in a semester like English, Mathematics, Environmental Science, Engineering Graphics, Electronic Devices etc.,

iv) **"Institution"** means B.S. Abdur Rahman Crescent Institute of Science and Technology.

v) **"Academic Council"** means the Academic Council, which is the apex body on all academic matters of this Institute.

vi) **"Dean (Academic Affairs)"** means the Dean (Academic Affairs) of the Institution who is responsible for the implementation of relevant rules and regulations for all the academic activities.

vii) **"Dean (Student Affairs**)" means the Dean (Students Affairs) of the Institution who is responsible for activities related to student welfare and discipline in the campus.

viii) **"Controller of Examinations"** means the Controller of Examinations of the Institution who is responsible for the conduct of examinations and declaration of results.

ix) **"Dean of the School"** means the Dean of the School of the department concerned.

x) **"Head of the Department"** means the Head of the Department concerned.

2.0 ADMISSION

2.1a) Candidates for admission to the first semester of the eight semester B. Tech. degree programme shall be required to have passed the Higher Secondary Examination of the 10+2 curriculum

(Academic stream) prescribed by the appropriate authority or any other examination of any University or authority accepted by the Institution as equivalent thereto.

2.1b) The student shall have studied at least any three of the following courses: Physics, Mathematics, Chemistry, Computer Science, Electronics, Information Technology, Biology, Informatics Practices, Biotechnology, Technical Vocational Subjects, Agriculture, Engineering Graphics, Business Studies, Entrepreneurship at 10+2 level. In case if the student has not studied any or all the courses viz., mathematics, physics and chemistry, he / she shall undergo bridge course(s) in the concerned course(s) at 10+2 level knowledge.

2.2 Notwithstanding the qualifying examination, the candidate might have passed at 10+2, the candidate shall also write an entrance examination prescribed by the Institution for admission. The entrance examination shall test the proficiency of the candidate in the courses considered eligible for admission on the standards prescribed for 10+2 academic stream.

2.3 Candidates for admission to the third semester of the eight semester B.Tech. programme under lateral entry category shall be required to have passed minimum Three years / Two years (Lateral Entry) Diploma examination in any branch of Engineering / Technology or passed B.Sc. Degree from a recognized University as defined by UGC and passed 10+2 examination with Mathematics as a subject or Passed three year Diploma of Vocation Stream (D.Voc) in the same or allied sector or any other examination of any other authority accepted by the Institution as equivalent thereto.

2.4 The Institution shall offer suitable bridge courses in Mathematics, Physics, Engineering drawing, etc., for the students of diverse backgrounds.

2.5 The eligibility criteria such as marks, number of attempts and physical fitness shall be as prescribed by the Institution in adherence to the guidelines of regulatory authorities from time to time.

3.0 BRANCHES OF STUDY

3.1 Regulations are applicable to the following B.Tech. Degree

programmes in various branches of Engineering and Technology, each distributed over eight semesters, with two semesters per academic year.

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

4.0 STRUCTURE OF THE PROGRAMME

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

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

4.1.1 Mandatory Induction Programme for First year Students

The first year students upon admission shall undergo a mandatory three week induction programme consisting of physical activity, creative arts, universal human values, literary, proficiency modules, lectures by eminent people, visits to local

areas, familiarization with departments / schools and centres, etc.,

4.1.2 Personality and Character Development

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

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

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

4.1.3 Online Courses for Credit Transfer

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

4.1.4 Value Added Courses

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

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

These value added courses shall be specified in the consolidated mark sheet as additional courses pursued by the student over and

above the curriculum during the period of study.

4.1.5 Industry Internship

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

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

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

4.1.6 Industrial Visit

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

4.2 Each course is normally assigned certain number of credits:

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

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

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

5.0 DURATION OF THE PROGRAMME

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

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

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

6.0 REGISTRATION AND ENROLLMENT

6.1 The students of first semester shall register and enroll for courses at the time of admission by paying the prescribed fees. For the subsequent semesters registration for the courses shall be done by the student one week before the last working day of the previous semester.

6.2 Change of a Course

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

6.3 Withdrawal from a Course

A student can withdraw from an enrolled course at any time before the first continuous assessment test for genuine reasons, with the approval of the Dean (Academic Affairs), on the recommendation of the Head of the Department of the student.

7.0 BREAK OF STUDY FROM PROGRAMME

7.1 A student may be allowed / enforced to take a break of study for two semesters from the programme with the approval of Dean (Academic Affairs) for the following reasons:

7.1.1 Medical or other valid grounds

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

7.1.3 Debarred due to any act of indiscipline

7.2 The total duration for completion of the programme shall not exceed the prescribed maximum number of semesters (vide clause 5.1).

7.3 A student who has availed a break of study in the current semester (odd/even) can rejoin only in the subsequent corresponding (odd/even) semester in the next academic year on approval from the Dean (Academic affairs).

7.4 During the break of study, the student shall not be allowed to

attend any regular classes or participate in any activities of the Institution. However, he / she shall be permitted to enroll for the 'I' grade courses and appear for the arrear examinations.

8.0 CLASS ADVISOR AND FACULTY ADVISOR

8.1 Class Advisor

A faculty member shall be nominated by the Head of the Department as class advisor for the class throughout the period of study except first year.

The class advisor shall be responsible for maintaining the academic, curricular and co-curricular records of students of the class throughout their period of study.

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

8.2 Faculty Advisor

To help the students in planning their courses of study and for general counseling, the Head of the Department of the students shall attach a maximum of 20 students to a faculty member of the department who shall function as faculty advisor for the students throughout their period of study. Such faculty advisor shall guide the students in taking up the elective courses for registration and enrolment in every semester and also offer advice to the students on academic and related personal matters.

9.0 COURSE COMMITTEE

9.1 Each common theory course offered to more than one group of students shall have a "Course Committee" comprising all the course faculty teaching the common course with one of them nominated as a course coordinator. The nomination of the course coordinator shall be made by the Head of the Department / Dean (Academic Affairs) depending on whether all the course faculty teaching the common course belong to a single department or from several departments. The course committee shall ensure preparation of a common question paper and scheme of evaluation for the tests and semester end examination.

10.0 CLASS COMMITTEE

A class committee is constituted branch wise and semester wise by the Head of the Department / Dean of the School shall

normally comprise of faculty members handling the classes, student representatives and a senior faculty member not handling the courses as chairman.

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

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

10.2 The composition of the class committee for each branch from 3rd to 8th semester is as follows:

i) One senior faculty member preferably not handling courses for the concerned semester appointed as chairman by the Head of the Department
ii) All the faculty members handling courses of the semester
iii) Six student representatives (male and female) of each class nominated by the Head of the Department in consultation with the relevant faculty advisors
iv) All faculty advisors and the class advisors
v) Head of the Department

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

10.4 During these two meetings, the student members shall meaningfully interact and express opinions and suggestions to improve the effectiveness of the teaching-learning process, curriculum and syllabi, etc.

10.5 The third meeting of the class committee, excluding the student members, shall meet after the semester end examinations to

analyse the performance of the students in all the components of assessments and decide their grades in each course. The grades for a common course shall be decided by the concerned course committee and shall be presented to the class committee(s) by the course faculty concerned.

11.0 CREDIT LIMIT FOR ENROLLMENT & MOVEMENT TO HIGHER SEMESTER

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

11.2 The minimum credits earned by the student to move to 7^{th} semester shall not be less than 60 credits (40 credits for lateral entry students).

12.0 ASSESSMENT PROCEDURE AND PERCENTAGE WEIGHTAGE OF MARKS

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

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%

12.2 Theory Course

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

12.3 Laboratory Course

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

12.4 Laboratory Integrated Theory Courses

For laboratory integrated theory courses, the theory and practical

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

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

12.6 Industry Internship

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

12.7 Project Work

In the case of project work, a committee of faculty members constituted by the Head of the Department / Dean of the School will carry out three periodic reviews. Based on the project report submitted by the students, an oral examination (viva voce) shall be conducted as semester end examination by an external examiner approved by the Controller of Examinations. The weightage for periodic reviews shall be 50%. Of the remaining 50%, 20% shall be for the project report and 30% for the viva voce examination.

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

12.9 For the first attempt of the arrear theory examination, the internal assessment marks scored for a course during first appearance

shall be used for grading along with the marks scored in the arrear examination. From the subsequent appearance onwards, full weightage shall be assigned to the marks scored in the semester end examination and the internal assessment marks secured during the course of study shall become invalid.

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

13.0 SUBSTITUTE EXAMINATIONS

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

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

14.0 ATTENDANCE REQUIREMENT AND SEMESTER / COURSE REPETITION

14.1 A student shall earn 100% attendance in the contact periods of every course, subject to a maximum relaxation of 25% to become eligible to appear for the semester end examination in that course, failing which the student shall be awarded “I” grade in that course.

14.2 The faculty member of each course shall cumulate the attendance details for the semester and furnish the names of the students who have not earned the required attendance in the concerned course to the class advisor. The class advisor shall consolidate

and furnish the list of students who have earned less than 75% attendance, in various courses, to the Dean (Academic Affairs) through the Head of the Department / Dean of the School. Thereupon, the Dean (Academic Affairs) shall officially notify the names of such students prevented from writing the semester end examination in each course.

14.3 If a student secures attendance between 65% and less than 75% in any course in a semester, due to medical reasons (hospitalization / accident / specific illness) or due to participation in the institution approved events, the student shall be given exemption from the prescribed attendance requirement and the student shall be permitted to appear for the semester end examination of that course. In all such cases, the students shall submit the required documents immediately after joining the classes to the class advisor, which shall be approved by the Head of the Department / Dean of the School. The Vice Chancellor, based on the recommendation of the Dean (Academic Affairs) may approve the condonation of attendance.

14.4 A student who has obtained an "I" grade in all the courses in a semester is not permitted to move to the next higher semester. Such students shall repeat all the courses of the semester in the subsequent academic year.

14.5 The student awarded "I" grade, shall enroll and repeat the course when it is offered next. In case of "I" grade in an elective course either the same elective course may be repeated or a new elective course may be taken with the approval of the Head of the Department / Dean of the School.

14.6 A student who is awarded "U" grade in a course shall have the option to either write the semester end arrear examination at the end of the subsequent semesters, or to redo the course when the course is offered by the department. Marks scored in the continuous assessment in the redo course shall be considered for grading along with the marks scored in the semester end (redo) examination. If any student obtains "U" grade in the redo course, the marks scored in the continuous assessment test (redo) for that course shall be considered as internal mark for further appearance of arrear examination.

14.7 If a student with "U" grade, who prefers to redo any particular course, fails to earn the minimum 75% attendance while doing that course, then he / she is not permitted to write the semester end examination and his / her earlier "U" grade and continuous assessment marks shall continue.

15.0 REDO COURSES

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

15.2 The number of contact hours and the assessment procedure for any redo course shall be the same as regular courses, except there is no provision for any substitute examination and withdrawal from a redo course.

16.0 PASSING AND DECLARATION OF RESULTS AND GRADE SHEET

16.1 All assessments of a course shall be made on absolute marks basis. The class committee without the student members shall meet to analyse the performance of students in all assessments of a course and award letter grades following the relative grading system. The letter grades and the corresponding grade points are as follows:

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

"W" - denotes withdrawal from the course

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

examination

"U" - denotes unsuccessful performance in the course.

16.2 A student who earns a minimum of five grade points ('E' grade) in a course is declared to have successfully completed the course. Such a course cannot be repeated by the student for improvement of grade.

16.3 Upon awarding grades, the results shall be endorsed by the chairman of the class committee and Head of the Department / Dean of the School. The Controller of Examinations shall further approve and declare the results.

16.4 Within one week from the date of declaration of result, a student can apply for revaluation of his / her semester end theory examination answer scripts of one or more courses, on payment of prescribed fee, through proper application to the Controller of Examinations. Subsequently, the Head of the Department / Dean of the School offered the course shall constitute a revaluation committee consisting of chairman of the class committee as convener, the faculty member of the course and a senior faculty member having expertise in that course as members. The committee shall meet within a week to revalue the answer scripts and submit its report to the Controller of Examinations for consideration and decision.

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

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

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

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

Where n = number of courses

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

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

"U", “I” and **"W"** grades are excluded for calculating CGPA.

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

Percentage equivalent of marks = CGPA X 10

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

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

16.6.1 Eligibility for First Class with Distinction

- A student should not have obtained ‘U’ or ‘I’ grade in any course during his/her study
- A student should have completed the UG programme within the minimum prescribed period of study (except clause 7.1.1)

16.6.2 Eligibility for First Class

- A student should have passed the examination in all the courses not more than two semesters beyond the minimum prescribed period of study (except clause 7.1.1)

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

16.6.4 The CGPA shall be rounded to two decimal places for the purpose of classification. The CGPA shall be considered up to three decimal places for the purpose of comparison of performance of students and ranking.

17.0 SUPPLEMENTARY EXAMINATION

Final year students and passed out students can apply for supplementary examination for a maximum of three courses thus providing an opportunity to complete their degree programme. Likewise, students with less credits in VI semester can also apply for supplementary examination for a maximum of three courses to enable them to earn minimum credits to move to higher semester. The students can apply for supplementary examination within three weeks of the declaration of results in the even semester.

18.0 DISCIPLINE

18.1 Every student is expected to observe discipline and decorum both inside and outside the campus and not to indulge in any activity which tends to affect the reputation of the Institution.

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

19.0 ELIGIBILITY FOR THE AWARD OF DEGREE

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

i) Successfully earned the required number of total credits as specified in the curriculum of the programme of study within a maximum period of 14 semesters (12 semesters for lateral entry) from the date of admission, including break of study.

ii) Successfully completed the requirements of the enrolled professional development activity.

iii) No dues to the Institution, Library, Hostel, etc.

iv) No disciplinary action pending against him/her.

19.2 The award of the degree must have been approved by the

Institution.

20.0 MINOR DEGREE PROGRAMMES OFFERED FOR STUDENTS

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

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

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

Sl. No.	Minor Degree	Eligible Major Degree Programmes (from other Departments)
1.	Artificial Intelligence and Machine Learning	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering
2.	Block Chain	
3.	Cyber Security	
4.	Data Science	
5.	Internet of Things (IoT)	
6.	Virtual and Augmented Reality	Mechanical Engineering Aeronautical Engineering Polymer Engineering Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering
7.	Sensor Technology	Mechanical Engineering Aeronautical Engineering Polymer Engineering

		Automobile Engineering Civil Engineering Biotechnology Electrical and Electronics Engineering
8.	Robotics	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Civil Engineering Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering
9.	3D Printing	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Biotechnology Electrical and Electronics Engineering Electronics and Instrumentation Engineering Electronics and Communication Engineering
10.	Electric Vehicles	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology Civil Engineering Biotechnology Electronics and Communication Engineering
11.	Industrial Automation	Artificial Intelligence and Data Science Computer Science and Engineering (Cyber Security) Computer Science and Engineering (IoT) Computer Science and Engineering Information and Technology

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

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

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

21.0 POWER TO MODIFY

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

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

B.TECH. INFORMATION TECHNOLOGY

CURRICULUM FRAMEWORK, REGULATIONS 2021

(Choice Based Credit System)

SEMESTER I

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

SEMESTER II

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC	END 1281	English for Engineers	3	0	0	3
2.	BSC		Physics Elective	2	0	0	2
3.	BSC		Chemistry Elective	2	0	0	2
4.	BSC	MAD 1281	Advanced Calculus	3	1	0	4
5.	ESC	GED 1201	Engineering Mechanics	3	1	0	4
6	ESC	GED 1202	Basic Electrical and Electronics Engineering *	3	0	2	4
7.	PCC	ITD 1201	Programming in C++ *	2	0	2	3
8.	MC	GED 1206	Environmental Sciences	2	0	0	2
			Credits				**24**

SEMESTER III

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC		Humanities Elective I	3	0	0	3
2.	BSC		Mathematics Elective	3	1	0	4
3.	PCC	ITD 2101	Digital Principles and Applications *	2	0	2	3
4.	PCC	ITD 2102	Programming in Python *	2	0	2	3
5.	PCC	ITD 2103	Computer Architecture	3	0	0	3
6.	PCC	ITD 2104	Data Structures and Algorithms	3	0	0	3
7.	PCC	ITD 2105	Fundamentals of Web Designing *	2	0	2	3
8.	PCC	ITD 2106	Data Structures and Algorithms Laboratory **	0	0	2	1
9.	HS	GED 2101	Essential Skills and Aptitude for Engineers **	0	0	2	1
			Credits				**24**

SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	ITD 2201	Programming in Java *	2	0	2	3
2.	PCC	ITD 2202	Database Management System *	3	0	2	4
3.	PCC	ITD 2203	Computer Networks *	3	0	2	4
4.	PCC	ITD 2204	Software Engineering	3	0	0	3
5.	PCC	ITD 2205	Operating Systems *	3	0	2	4
6.	PEC		Professional Electives	3	0	0	3
7.	HSC	GED 2201	Workplace Skills and Aptitude for Engineers **	0	0	2	1
8.	MC	GED 2202	Indian Constitution and Human Rights	2	0	0	0
			Credits				**22**

SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	ITD 3101	Information Coding Techniques	3	0	0	3
2.	PCC	ITD 3102	Object Oriented Analysis and Design	3	0	0	3
3.	PCC	ITD 3103	Mean Stack Web Development *	2	0	2	3
4.	PCC	ITD 3104	AI and Machine Learning *	3	0	2	4
5.	PCC	ECD 3181	Signals and Systems	2	0	0	2
6.	PCC	ITD 3105	CASE Tools Laboratory **	0	0	2	1
7.	PEC		Professional Elective Courses				6
8.	HSC	GED 3101	Communication Skills for Career Success **	0	0	2	1
9.	PROJ	ITD 3106	Internship I ##	0	0	0	1
			Credits				**24**

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC	MSD 3281	Entrepreneurship	3	0	0	3
2.	HSC		Humanities Elective II	2	0	0	2
3.	OEC		Open Elective I	3	0	0	3
4.	PCC	ITD 3201	Software Testing	3	0	0	3
5.	PCC	ITD 3202	Cloud Computing Technologies	3	0	0	3
6.	PCC	ITD 3203	Software Development Laboratory **	0	0	2	1
7.	PEC		Professional Elective Courses				6
8.	HSC	GED 3201	Reasoning and Aptitude for Engineers **	0	0	2	1
			Credits				**22**

SEMESTER VII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	OEC		Open Elective II				3
2.	OEC		Open Elective III				3
3.	PCC	ITD 4101	Internet of Things *	2	0	2	3
4.	PEC		Professional Elective Courses				12
5.	PROJ	ITD 4102	Internship II ###				1
9.	HSC	GED 3202	Employability Skills $	0	0	2	1
			Credits				**22**

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PROJ	ITD 4201	Project work				9
			Credits				**9**

Overall Total Credits – 167

* Laboratory Integrated Theory course

** Laboratory Course

Three Week Orientation Programme – Mandatory Non-Credit Course

15 days of Industrial training during the summer vacation of second year. The credit will be awarded in the 5th Semester.

15 days of Industrial training during the summer vacation of third year. The credit will be awarded in the 7th Semester.

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

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LIST OF PROFESSIONAL ELECTIVE COURSES

SPECIALIZATION I
INFORMATION TECHNOLOGY APPLICATIONS

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	Sem
1.	PEC	ITDX 01	User Interface Design	3	0	0	3	IV
2.	PEC	ITDX 02	Android Application Development *	2	0	2	3	IV
3.	PEC	ITDX 03	Principles of Programming Languages	3	0	0	3	IV
4.	PEC	ITDX 04	Graphics and Multimedia *	2	0	2	3	IV
5.	PEC	ITDX 05	Human Computer Interaction	3	0	0	3	IV
6.	PEC	ITDX 06	Swift Programming *	2	0	2	3	V
7.	PEC	ITDX 07	Introduction to NoSQL Databases *	2	0	2	3	V
8.	PEC	ITDX 08	Computational Intelligence	3	0	0	3	V
9.	PEC	ITDX 09	Natural Language Processing	3	0	0	3	V
10.	PEC	ITDX 10	C# and .NET Framework *	2	0	2	3	V
11.	PEC	ITDX 11	Introduction to DevOps	3	0	0	3	VI
12.	PEC	ITDX 12	E-Commerce and Digital Marketing	3	0	0	3	VI
13.	PEC	ITDX 13	Principles of Compiler Design	3	0	0	3	VI
14.	PEC	ITDX 14	Virtual Reality *	2	0	2	3	VII
15.	PEC	ITDX 15	Software Quality Management	3	0	0	3	VII
16.	PEC	ITDX 16	Enterprise Resource Planning	3	0	0	3	VII
17.	PEC	ITDX 17	Agile Methodologies	3	0	0	3	VII
18.	PEC	ITDX 18	Game Theory	3	0	0	3	VII
19.	PEC	ITDX 19	Functional Programming	3	0	0	3	VII

SPECIALIZATION II
IOT & DATA COMMUNICATION NETWORK

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	Sem
1.	PEC	ITDX 26	Principles of Communication	3	0	0	3	IV
2.	PEC	ITDX 27	TCP/IP Protocol Suite	3	0	0	3	V
3.	PEC	ITDX 28	Wireless Network	3	0	0	3	VI
4.	PEC	ITDX 29	Introduction to Industry 4.0 and Industrial IoT	3	0	0	3	VI
5.	PEC	ITDX 30	Adhoc and Sensor Networks	3	0	0	3	VII
6.	PEC	ITDX 31	Python for IoT *	2	0	2	3	VII
7.	PEC	ITDX 32	GPU Architecture and Programming	3	0	0	3	VII
8.	PEC	ITDX 33	Software Defined Networks	3	0	0	3	VII
9.	PEC	ECDX 84	Embedded System	3	0	0	3	VI
10.	PEC	ECDX 85	5G Technology	3	0	0	3	VII

SPECIALIZATION III
DATA SCIENCE & AI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	Sem
1.	PEC	ITDX 41	Business and Data Analytics	3	0	0	3	V
2.	PEC	ITDX 42	Programming in R *	2	0	2	3	VI
3.	PEC	ITDX 43	Artificial Intelligence	3	0	0	3	VI
4.	PEC	ITDX 44	Data Mining Techniques and Tools *	2	0	2	3	VI
5.	PEC	ITDX 45	Big Data Analytics	3	0	0	3	VI
6.	PEC	ITDX 46	Soft Computing	3	0	0	3	VI
7.	PEC	ITDX 47	Analytics of Things	3	0	0	3	VII

8.	PEC	ITDX 48	Artificial Intelligence for Data Science *	2	0	2	3	VII
9.	PEC	ITDX 49	Scalable Data Science	3	0	0	3	VII
10.	PEC	ITDX 50	Deep Learning *	2	0	2	3	VII
11.	PEC	ITDX 51	Computer Vision and Image Processing	3	0	0	3	VII
12.	PEC	ITDX 52	Predictive Analytics	3	0	0	3	VII
13.	PEC	ITDX 53	Mathematical Foundation for Data Sciences	3	0	0	3	V
14.	PEC	ITDX 54	Data Science Using Python *	2	0	2	3	V

SPECIALIZATION IV
CLOUD COMPUTING

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	Sem
1.	PEC	ITDX 61	Nextgen Technologies	3	0	0	3	IV
2.	PEC	ITDX 62	Distributed Computing	3	0	0	3	V
3.	PEC	ITDX 63	Virtualization Techniques *	2	0	2	3	V
4.	PEC	ITDX 64	Fog Computing *	2	0	2	3	VI
5.	PEC	ITDX 65	Cloud Services and Platforms *	2	0	2	3	VI

SPECIALIZATION V
CYBER SECURITY

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C	Sem
1.	PEC	ITDX 71	Cryptography and Network Security	3	0	0	3	V
2.	PEC	ITDX 72	Security Analyst Fundamentals	3	0	0	3	VI
3.	PEC	ITDX 73	Ethical Hacking *	2	0	2	3	VI
4.	PEC	ITDX 74	Blockchain Technology	3	0	0	3	VII

5.	PEC	ITDX 75	Security in Computing	3	0	0	3	VII
6.	PEC	ITDX 76	Cyber Forensics	3	0	0	3	VII

PHYSICS ELECTIVES – II Semester

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

CHEMISTRY ELECTIVES – II Semester

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

MATHEMATICS ELECTIVES – III Semester

Sl. No.	Course Code	Course Title	L	T	P	C
1	MADX 01	Transforms and Partial Differential Equations	3	1	0	4
2	MADX 02	Discrete Mathematics	3	1	0	4
3	MADX 03	Probablity and Statistics	3	1	0	4
4	MADX 04	Random Processes	3	1	0	4
5	MADX 05	Numerical Methods	3	1	0	4

HUMANITIES ELECTIVES – III Semester

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

HUMANITIES ELECTIVES – VI Semester

Sl. No.	Course Code	Course Title	L	T	P	C
1	SSDX 11	Economics of Sustainable Development	2	0	0	2
2	SSDX 12	Sociology of Industrial Relations.	2	0	0	2
3	SSDX 13	Professional Ethics and Human Values	2	0	0	2
4	SSDX 14	Gender, Technology and Development	2	0	0	2

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

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

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

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

Sl. No.	Course Code	Course Title	L	T	P	C	Offering Department
1	GEDX 101	Advanced Entrepreneurship	3	0	0	3	CSB
2	GEDX 102	Artificial Intelligence and Machine Learning Applications	3	0	0	3	CSE
3	GEDX 103	Automotive Technology	3	0	0	3	Automobile
4	GEDX 104	Behavioural Psychology	3	0	0	3	SSSH
5	GEDX 105	Building Repair Solutions	3	0	0	3	Civil
6	GEDX 106	Cloud Services and Management	3	0	0	3	CA
7	GEDX 107	Cost Management for Engineers	3	0	0	3	Commerce
8	GEDX 108	Cyber Law and Ethics	3	0	0	3	CSL
9	GEDX 109	Data Analytics and Visualization	3	0	0	3	CA
10	GEDX 110	Deep Learning Essentials	3	0	0	3	CSE
11	GEDX 111	Drone Technologies *	2	0	2	3	Aero
12	GEDX 112	Electric Vehicle	3	0	0	3	EEE
13	GEDX 113	Emerging Technologies in Mobile Networks	3	0	0	3	ECE
14	GEDX 114	Fundamentals of Data Science and Machine Learning	3	0	0	3	IT
15	GEDX 115	Genetic Engineering	3	0	0	3	SLS
16	GEDX 116	Green Design and	3	0	0	3	Civil

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

SEMESTER I

PHD 1182	**ENGINEERING PHYSICS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**2**	**4**

COURSE OBJECTIVES:

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

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

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

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

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

MODULE I ELECTROMAGNETIC WAVES 9

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

MODULE II QUANTUM MECHANICS 9

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

MODULE III OSCILLATIONS, OPTICS AND LASERS 9

Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves - Energy transfer of a wave - Anti-reflection coating - Air Wedge – Michelson's Interferometer – Determination of wavelength of light and

thickness of thin transparent sheet-Characteristics of Laser – Spontaneous and Stimulated Emissions – Einstein's Coefficients - Population inversion – Pumping Mechanism – Laser Action – Types of Laser: Nd:YAG laser He-Ne laser and semiconductor laser - Applications : Laser Materials Processing - Holography.

MODULE IV INTRODUCTION TO SOLIDS 9

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

MODULE V PHYSICS OF SEMICONDUCTORS 9

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

PRACTICALS

List of Experiments

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

L – 45; P – 30 ; Total Hours – 75

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

CO1: Express the knowledge of electromagnetic waves.

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

CO3: Grasp ideas related to oscillations, interference phenomenon, apply it to understandoptical based devices and classify the different laser systems used forvarious applications.

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

CO5: Understand the principles of physics behind semiconductors, Hall effectand apply the same to identify type of any semiconductor sample, evaluateno. of charge carriers.

Board of Studies (BoS) :	**Academic Council:**
BOS of Physics was held on 21.6.21	17th AC held on 15.07.2021

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

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

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

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

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

COURSE OBJECTIVES:

To make the students conversant with

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

COB2: synthesis, properties and applications of nanomaterials

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

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

COB5: types of corrosion and its prevention.

MODULE I POLYMERS FOR ELECTRICAL AND ELECTRONIC APPLICATIONS 10

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

MODULE II NANOMATERIALS 10

Introduction – classification based on dimension with examples – properties of nanomaterials (surface to volume ratio and size quantisation effect) - synthesis of nanomaterials (Top-down and Bottom-up)– role of capping & reducing agents - CVD (CNT), laser ablation (Ag, Ag_2O), electrodeposition (semiconductor materials), precipitation (Ag, Au), thermolysis: solvothermal (CuO, CeO_2) and hydrothermal (TiO_2, ZnO, carbon dots), microwave method (metal oxide), biogenic method – nanocomposite.

MODULE III BATTERIES 8

Electrochemical and electrolytic cell – batteries: types (primary, secondary and flow cell) – primary batteries: dry cell, alkaline battery – secondary batteries: nickel cadmium cell – lead acid storage cell - lithium battery: primary and secondary type - PN junction solar cell, thin film solar cell.

MODULE IV PHOTOCHEMISTRY 9

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

MODULE V CORROSION AND ITS PREVENTION 8

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

PRACTICALS

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

L – 45; P – 30; Total Hours – 75

TEXT BOOKS:

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

REFERENCES:

1. Gowarikar V.R., Viswanathan N.V and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras, 1986.

2. Michael L. Berins, Plastics Engineering Hand Book, 5th Edition, Chapman and Hall, New York, 1991.
3. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, Thomas Graham House, Cambridge, 2005.
4. Principles of molecular photochemistry: An introduction, Nicholas J. Turro, V.Ramamurthy and Juan C. Scaiano, University Science Books, Sausalito, CA, 2009.

COURSE OUTCOMES:

The students will be able to

CO1: summarise the preparation, properties and applications of plastics used in electrical and electronic applications

CO2: synthesize different types of nanomaterials based on its size and applications.

CO3: illustrate construction and working of various types of batteries with the aid of a diagram.

CO4: state laws of photochemistry and elaborate the various types of photophysical processes and concepts of photochemistry.

CO5: explain the different types of corrosion and elaborate the methods of various coating techniques.

Board of Studies (BoS) : 11th BoS of Chemistry held on 17.06.2021

Academic Council: 15th AC held on 15.07.2021

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

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

SDG 9 : Industry, Innovation & Infrastructure

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

MAD 1181	**ALGEBRA AND DIFFERENTIAL CALCULUS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

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

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

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

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

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

MODULE I MATRICES 9+3

Characteristic Equation- Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton Theorem (without proof) – Orthogonal matrices – orthogonal transformations of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation

MODULE II THEORY OF EQUATIONS 9+3

Introduction - Surds and irrational roots – simple problems – Equations whose roots are in A.P,G.P and in H.P – Relations between the roots and coefficients – symmetric functions – Formation of equations – Decreasing and Increasing the roots – transformation of equation – Reciprocal equations

MODULE III DIFFERENTIAL CALCULUS 9+3

Limits of functions - one sided limits – Continuity - Curvature – Cartesian and polar coordinates – center and radius of curvature – Circle of curvature – Involutes and evolutes – Envelopes

MODULE IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 9+3

Laws of limits –Functions of two variables – partial derivatives – total differential – Implicit Functions – Jacobian - Taylor's series expansion – Optima of two variables – Lagrange's multiplier method

MODULE V ORDINARY DIFFERENTIAL EQUATIONS 9+3

Linear equations of second order with constant and variable coefficients – Simultaneous first order linear equations with constant coefficients –

homogeneous equations of Euler's type – method of undetermined coefficients- method of variation of parameters

L – 45 ; T-15; Total Hours – 60

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

At the end of the course students will be able to

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

CO2: solve equations using the relations between roots and coefficients

CO3: apply differential calculus in various engineering problems

CO4: use differential calculus on several variable functions

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

Board of Studies (BoS) :
12th BOS of Mathematics & AS held on 23.06.2021

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

GED 1101	ENGINEERING GRAPHICS	L	T	P	C
SDG: 9		2	0	2	3

COURSE OBJECTIVES:

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

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

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

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

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

MODULE I BASICS, ENGINEERING CURVES AND ORTHOGRAPHIC PROJECTION OF POINTS AND STRAIGHT LINES **L: 7 P: 7**

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

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

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

MODULE II PROJECTION OF PLANES AND SOLIDS **L: 7 P: 7**

Projection of plane lamina in first quadrant and its traces

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

MODULE III SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES **L:5 P:5**

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

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

MODULE IV THREE DIMENSIONAL PROJECTIONS L:4 P: 4

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

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

MODULE V ORTHOGRAPHIC PROJECTION USING CADD L:7 P:7

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

L – 30; P – 30; Total Hours – 60

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

After completion of the course, students should be able to

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

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

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

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

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

Board of Studies (BoS):
18th BoS of MECH held on 21.06.2021

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

GED 1102	ENGINEERING DESIGN	L	T	P	C
SDG:9		2	0	0	2

COURSE OBJECTIVES:

COB1: To learn the basic concepts of design in engineering

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

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

COB4: To introduce the role of innovation in engineering

MODULE I INTRODUCTION TO DESIGN 08

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

MODULE II DESIGN THINKING PROCESS 08

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

MODULE III PROTOTYPE DESIGN 07

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

MODULE IV INNOVATION 07

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

L – 30; Total Hours – 30

TEXT BOOKS:

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

REFERENCES:

1. Nigel Cross, “Design Thinking”, Berg Publishers, 2011.
2. Tom Kelley, “The Art of Innovation”, Profile Books Ltd, London, 2016.

3. Tim Brown, “Change by Design”, HarperCollins e-books, 2009.
4. Cliff Matthews, “Case Studies in Engineering Design”, John Wiley & Sons Pvt. Ltd, New York, 1998.

COURSE OUTCOMES:

After completion of the course, students should be able to

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

CO2: analyse the problems and perform design thinking process

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

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

Board of Studies (BoS): 18th BoS of MECH held on 21.06.2021

Academic Council: 17th AC held on 15.07.2021

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

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

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

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

GED 1103	MANUFACTURING PRACTICES LABORATORY	L	T	P	C
SDG: 9		0	0	2	1

COURSE OBJECTIVES:

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

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

COB3: To impart knowledge onsand mould preparation for simple components

COB4: To explorevarious tools, instruments and methods used in electrical wiring

COB5: To impart knowledge onDesign, assembly and testing of electronic circuits

PRACTICALS

List of Experiments:

CIVIL ENGINEERING PRACTICE:

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

MECHANICAL ENGINEERING PRACTICE

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

ELECTRICAL ENGINEERING PRACTICE:

1. Comparison of incandescent, fluorescent, CFL and LED lamps.
2. Domestic, staircase and go down wiring.
3. Measurement of earth resistance.
4. Study of protection devices (small relay, fuse, MCB, HRC, MCCB,

ECCB).

5. Familiarization of household electrical gadgets (Iron Box, Wet Grinder).
6. Study of inverter fed UPS/Emergency lamp

ELECTRONICS ENGINEERING PRACTICE:

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

P – 30; Total Hours – 30

TEXT BOOK:

1. S.Gowri and T.Jeyapoovan, “Engineering Practices Lab Manual – Civil, Mechanical, Electrical, Electronics included”, Vikas Publishing, 5th Edition, 2019.

REFERENCES:

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

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: demonstrate Plumbing requirements of domestic buildings.

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

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

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

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

Board of Studies (BoS):	**Academic Council:**
18th BoS of MECH held on 21.06.2021	17th AC held on 15.07.2021

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

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

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

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

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

COURSE OBJECTIVES:

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

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

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

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

COB5: To understand pointer and file operation concepts.

MODULE I INTRODUCTION TO C PROGRAMMING 05

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

MODULE II DECISION MAKING AND ARRAY 05

Decision Making and Branching: Simple if Statements, The if..else statements, Nesting of if..else statements, else…if Ladder, switch Statements, goto Statements, Looping: while, do…while, for Statements, Array: One-Dimensional, Two-Dimensional and Multi-Dimensional operations.

MODULE III USER-DEFINED FUNCTIONS AND FILE OPERATIONS 05

Definition of Functions - Function Types – Nesting of Functions – Recursion – Structures and Unions – Pointers - File handing operations.

PRACTICALS

LIST OF PROGRAMS IN C:

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

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

L – 15; P – 30; Total Hours – 45

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

Students who complete this course will be able to

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

CO2: bring out the importance of structural and procedural programming

CO3: write C coding using conditional and iteration statements

CO4: develop programs using Functions, Pointers and Files

CO5: implement program to build a real time application.

Board of Studies (BoS) :
18th BoS of CSE held on 26.07.2021

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

SEMESTER II

END 1181	**ENGLISH FOR ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

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

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

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

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

COB5: To sharpen their academic writing skills

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

MODULE I HUMAN RESOURCES 10

L: Listening to short texts – short formal & informal conversations.

S: Introducing one self – exchanging personal info.

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

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

Voc. development: Prefixes, Suffixes

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

MODULE II TRANSPORT 10

L: Listening to long scientific talks

S: Sharing personal information – greeting, leave taking.

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

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

Voc. development: Guessing meanings of words in context, vocabulary used in formal letters, e-mails & reports.

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

MODULE III ENERGY 9

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

S: Asking about routine actions & expressing opinions.

R: Locating Specific Information

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

Voc. development: Sequence words, misspelt words.

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

MODULE IV OUR LIVING ENVIRONMENT 8

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

S: Speaking about one's friend.

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

W: Argumentative writing.

Voc. Development: Synonyms, antonyms, phrasal verbs.

Lang. development: If clauses, Subject - Verb Agreement

MODULE V TECHNOLOGY 8

L: Listening to talks (General & Scientific).

S: Short group conversations.

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

W: Short essays, Dialogue writing.

Voc. Development: Idioms & Phrases.

Lang. development: Modal verbs.

L - 45; Total Hours - 45

TEXT BOOKS:

1. Board of Editors. Using English A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES:

1) Perry, Carol Rosenblum(2011). The Fine Art of Technical Writing, Create Space Independent Publishing Platform, New Delhi.
2) Dutt, P.K. Rajeevan G. andPrakash, C.L.N. (2007). A course in Communication Skills, Cambridge Univesity Press, India.
3) Sen, Leena(2004). Communication Skills, Prentice Hall, New Delhi.
4) Matt Firth, Chris Sowton et.al (2012). Academic English An Integrated Skills Course for EAP, Cambridge University Press, Cambridge.
5) Bailey,Stephen2011. Academic Writing: A practical guide for students, New York, Rutledge.
6) Redston, Chris&Gillies (2005). Cunningham Face2Face (Pre-intermediate Student's Book&Workbook) Cambridge University Press, New Delhi.
7) Dutt P. Kiranmai and RajeevanGeeta (2013). Basic Communication Skills, Foundation Books.

COURSE OUTCOMES:

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

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

CO3: Comprehend conversations and short talks delivered in English

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

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

Board of Studies (BoS) :
13thBoS of Department of English held on 17.6.2021

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

MAD 1281	**ADVANCED CALCULUS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

COB1: To acquaint **i**n the students in solving problems using multiple integrals

COB2: To acquire knowledge in vector calculus which is significantly used in engineering problems

COB3: To learn about the analytic functions and their mapping properties

COB4: To know complex integration using Cauchy's theorems.

COB5: To introduce techniques and engineering applications of Laplace Transforms

MODULE I MULTIPLE INTEGRATION 9+3

Multiple integrals– Cartesian and Polar coordinates – Change of order of integration – Beta and Gamma functions – Properties and applications- Multiple integrals to compute area and volume

MODULE II VECTOR CALCULUS 9+3

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields–Line, surface and volume integrals – Green's Theorem, Gauss Divergence Theorem and Stokes Theorem (statement only) – verification and evaluation of integrals

MODULE III COMPLEX DIFFERENTIATION 9+3

Analytic function - Necessary and Sufficient condition for analyticity – Cauchy-Riemann equations in polar coordinates - properties of analytic function – determination of analytic function – conformal mapping (w = z+a, az and 1/z) and bilinear transformation

MODULE IV COMPLEX INTEGRATION 9+3

Cauchy's integral theorem – Cauchy's integral formula – Taylor's series and Laurent's series expansion – singularities - classification – residues - Cauchy's residue theorem – contour integration – Unit circle and semi circular contours (excluding poles on the real axis)

MODULE V LAPLACE TRANSFORMS 9+3

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

L - 45 ; T-15; Total Hours – 60

TEXT BOOKS:

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

REFERENCES:

1. Jain, R.K. & Iyengar, S. R. K., “Advanced Engineering Mathematics”, Narosa Publishers, 5th edition, 2016.
2. Peter V. O'Neil, “Advanced Engineering Mathematics”, 7th edition, Cengage Learning, 2011.
3. Venkataraman, M.K., “Engineering Mathematics”, Volume I, 2nd edition, National Publishing Co., Chennai, 2003.
4. James Stewart ,“ Calculus” 7th edition, Brooks/Cole Cengagelearning, UK

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: compute the area and volume using multiple integrals

CO2: calculate vector identities and apply Gauss, Stokes and Greens theorems to simplify calculations of integrals

CO3: verify analyticity, conformity and bilinearity of complex functions

CO4: evaluate integrals using the Cauchy’s integral and formula and residue theorem

CO5: solve ordinary differential equations using Laplace transforms

Board of Studies (BoS) :	**Academic Council:**
12th BOS of Mathematics & AS held on 23.06.2021	17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	M														
CO 2	M														
CO 3	H														
CO 4	M														
CO 5	M														

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

Learning of various mathematical techniques like Integration and Vector Calculus will lead to knowledge of applications in Computer Science

GED 1201	ENGINEERING MECHANICS	L	T	P	C
SDG: 9		3	1	0	4

COURSE OBJECTIVES:

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

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

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

COB4: To impart knowledge on friction and its applications

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

MODULE I VECTOR APPROACH AND EQUILIBRIUM OF PARTICLE **L: 11 T: 3**

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

MODULE II EQUILIBRIUM OF RIGID BODY **L: 7 T: 3**

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

MODULE III PROPERTIES OF SURFACES **L:10 T:3**

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

triangle, circle- composite sections, Hollow section using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia

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

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

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

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

L – 45; T – 15; Total Hours – 60

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R, "Vector Mechanics for Engineers", McGraw Hill Education, 10th Edition, 2017.
2. R.K. Bansal., "A Text Book of Engineering Mechanics", Laxmi Publications, 6th Edition, 2015.

REFERENCES:

1. Russell C Hibbeler, "Engineering Mechanics: Statics & Dynamics", 14th Edition, Pearson, 2015.
2. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education India, 2005.
3. R.S. Khurmi., "A Text Book of Engineering Mechanics", S. Chand Publishing, 22nd Edition, 2018.

COURSE OUTCOMES:

After completion of the course, students should be able to

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

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

CO3: setermine the properties of surfaces

CO4: analyse and evaluate the frictional forces between the bodies

CO5: apply the laws of motion in solving dynamics problems

Board of Studies (BoS):
18th BOS held on 21.06.2021

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

GED 1202	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	2	4

SDG: 3, 5, 8, 12

COURSE OBJECTIVES:

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

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

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

COB4: To impart knowledge onbasic semiconductor devices and their applications.

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

MODULE I DC CIRCUITS AND MEASUREMENTS 12

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

MODULE II AC CIRCUITS AND MEASUREMENTS 17

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

MODULE III ELECTRICAL MACHINES 18

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

MODULE IV SEMICONDUCTOR DEVICES AND APPLICATIONS 14

Introduction to semiconductors - Characteristics of PN Junction Diode –

Zener Diode and its characteristics – SCR and its characteristics — Bipolar Junction Transistorand its characteristics – JFET & MOSFET – their characteristics.

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

MODULE V INTRODUCTION TO DIGITAL CIRCUITS 14

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

PRACTICALS

List of Experiments

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

L – 45 ; P – 30 ; Total Hours – 75

REFERENCES:

1. Edward Hughes, “Electrical and Electronics Technology”, Pearson India, 12th Edition, 2016.
2. D P Kothari and I J Nagrath, “Basic Electrical Engineering”, McGraw Hill Education, First Edition, 2017.
3. Cotton H, “Electrical Technology”, CBS Publishers, 7th Edition, 2007.
4. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2015.
5. Jacob Millman & Christos C. Halkias, Satyaprataba Jit “Electronic Devices and Circuits” McGraw Hill Education, 4th Edition, 2021.
6. Floyd, “Electronic Devices: Conventional Current Version” Pearson Education India, 7th Edition, 2008.
7. S. Salivahanan, N. Sureshkumar and A. Vallavaraj, “Electronic Devices and Circuits”, McGraw Hill Education (India) Pvt. Ltd., 2018.
8. Thomas L. Floyd, "Digital Fundamentals", 10th Edition Pearson Education Inc., New Delhi, 2008.

COURSE OUTCOMES:

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

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

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

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

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

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

Board of Studies (BoS) :
15th meeting of BoS of EEE held on 25.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	-	H	L	M	-	M	-	L	L	M	L	H	M	NA
CO2	H	-	H	L	M	-	M	-	L	L	M	L	H	M	NA
CO3	H	-	H	L	-	-	M	-	L	L	M	L	-	M	NA
CO4	H	-	H	L	-	-	M	-	L	L	M	L	L	M	NA
CO5	H	-	H	L	-	-	M	-	L	L	M	L	-	M	NA

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

SDG 3 :Good health and well being.

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

SDG 5: Gender equality

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

SDG 8: Descent work and economic

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

SDG 12: Responsible consumption and production.

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

ITD 1201	PROGRAMMING IN C++	L	T	P	C
SDG: 8		2	0	2	3

COURSE OBJECTIVES:

COB1: To introduce the basic concepts of object-oriented programming and C++

COB2: To impart the concepts of Constructor and Overloading in C++

COB3: To familiarize the concepts of Inheritance and Polymorphism in C++

COB4: To acquaint with the concepts of Template and Exceptions.

MODULE I OVERVIEW OF C++ 8+8

Introduction - Object oriented programming concepts; C++ fundamentals – Structure of C++ program, data types, variables, operators, control structures; ADT, Classes and objects, Inheritance, Polymorphism; Arrays, Pointers.

MODULE II CONSTRUCTOR AND OVERLOADING 8+8

Constructors - default constructor, parameterized constructor, copy constructor, destructors; Introduction to Function and Operator overloading; Function overloading; Operator overloading; Unformatted I/O, Formatted I/O.

MODULE III INHERITANCE AND POLYMORPHISM 7+8

Inheritance - Base class, Member accessibility, Single Inheritance, Multiple Inheritance, Virtual base class, Runtime polymorphism, Polymorphism - Virtual functions, pure virtual functions, dynamic binding.

MODULE IV TEMPLATES AND EXCEPTION 7+6

Class templates and Function templates; Exception handling - basics, try-catch-throw paradigm, exception specification, re-throwing an exception, uncaught exception.

PRACTICAL 30

LIST OF EXPERIMENTS

Students should develop and practice simple C++ programs using the following concepts.

1. Control statements
2. Classes and objects
3. Arrays
4. Pointers
5. Constructors

6. Function and operator overloading
7. Single and multiple inheritance
8. Exception handling

L – 30; P – 30; Total Hours – 60

TEXT BOOKS:

1. E. Balaguruswamy, “Object Oriented Programming with C++”, Tata McGraw Hill, 8th Edition, 2020.

REFERENCES:

1. Herbert Schildt, 'The Complete Reference C++', Tata McGraw Hill, 5th Edition, 2012
2. Deitel and Deitel, 'C++ How to Program', Pearson Education, 9th Edition, 2014
3. Bruce Eckel, 'Thinking in C++', Pearson Education, Second Edition, 2001.
4. James P. Cohoon, Jack W. Davidson, 'C++ Program Design - An Introduction to Programming & Object Oriented Design’, Tata McGraw Hill, 2nd Edition, 2000.

COURSE OUTCOMES:

CO1: Explain and apply the basic concepts of object oriented programming in C++ programs.

CO2: Describe, analyze, design and create programs (in C++) using Constructor and Overloading concepts.

CO3: Elucidate and create modular programs (in C++) with code reusability using Inheritance and polymorphism concepts.

CO4: Illustrate, apply, analyze, design and create programs (in C++) using Templates and Exceptions.

Board of Studies (BoS) :
14th BoS of IT held on 23.06.2021

Academic Council:
17th AC held on 15.07.2021

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

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

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

Statement: The proper learning of the OOP leads to inclusive and sustainable economic growth, full and productive employment for the students.

GED 1206	ENVIRONMENTAL	L	T	P	C
SDG: All	SCIENCES	2	0	0	2

COURSE OBJECTIVES:

To make the student conversant with the

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

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

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

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

MODULE I NATURAL RESOURCES 8

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

MODULE II ECOSYSTEMS AND BIODIVERSITY 8

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

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

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

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

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

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

Case studies related to current situation.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Erach Bharucha, “Textbook for Environmental Studies for Undergraduate Courses of all Branches of Higher Education for University Grants Commission”, Orient Blackswan Pvt. Ltd., Hyderabad, India, 2013.
2. Benny Joseph, “Environmental Studies”, Tata McGraw-Hill Education, India, 2009.
3. Ravikrishnan A, “Environmental Science and Engineering”, Sri Krishna Publications, Tamil Nadu, India, 2018.
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 Jersy, 1996.
3. Miller T.G. Jr., “Environmental Science”, Wadsworth Publishing Co. Boston, USA, 2016.
4. “Waste to Resources: A Waste Management Handbook”, The Energy and Resources Institute, 2014.
5. https://www.teriin.org/article/e-waste-management-india-challenges-and-opportunities.
6. https://green.harvard.edu/tools-resources/how/6-ways-minimize-your-e-waste.
7. https://www.aiims.edu/en/departments-and-centers/central-facilities/265-biomedical/7346-bio-medical-waste-management.html.
8. https://tspcb.cgg.gov.in/Shared%20Documents/Guidelines%20for%20Management%20of%20Healthcare%20Waste%20Waste%20Management%20Rules,%202016%20by%20Health%20Care%20Facilities.pdf.

COURSE OUTCOMES:

The student will be able to

CO1: analyse the current scenario of various natural resources and their depletion and suggest remedies to curb the exploitation.

CO2: identify food chains and web and its function in the environment, assess the impacts on the biodiversity and propose solutions to conserve it.

CO3: analyse the types and impacts of pollutants in the environment and propose suitable methods to alleviate the pollutants and the natural disasters.

CO4: assess on the impact of human population and the health related issues and immunisation practices and sustainable developments for a healthy life.

Board of Studies (BoS) :	**Academic Council:**
11th BoS of Chem held on 17.06.2021	17th AC held on 15.07.2021

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

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

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

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

PHYSICS ELECTIVE

PHDX 01	**NON DESTRUCTIVE TESTING OF**	**L**	**T**	**P**	**C**
SDG: 4	**MATERIALS**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To understand the importance, principle, concept and inspection methods of various surface NDT methods and develop the skills of interpretation of results effectively.

COB2: To study the working and instrumentation of thermography and eddy current testing methods and apply to interpret the results and investigate the possible defects.

COB3: To get full exposure about principle, instrumentation and standards of various radiographic NDT methods and improve the skill to identify the defects suitably.

COB4: To get deep insight into the principle, types of waves, instrumentation, standards, calibration methods of ultrasonic NDT methods.

COB5: To understand the importance, principle, concept and inspection methods of various surface NDT methods and develop the skills of interpretation of results effectively.

MODULE I SURFACE NDT METHODS 7

Liquid Penetrant Inspection – Principles, Types of dye and methods of application,developers, advantages and limitations of various methods, Interpretation of results. Magnetic Particle Inspection- Magnetic particle testing, Basic theory of magnetism, Magnetization methods, Interpretation of field indicators, Particle application, Inspection,Residual magnetism Principles and methods of demagnetization.

MODULE II THERMOGRAPHY AND EDDY CURRENT TESTING 7

Thermography- Principles, Contact and non contact inspection methods, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Applications, advantages, Limitations, Interpretation/Evaluation.

MODULE III RADIOGRAPHY 8

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square law, characteristics of films -graininess, density, speed, contrast, characteristic curves. Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Digital Radiography.

MODULE IV ULTRASONIC TESTING 8

Ultrasonic Testing: Basic principles of sound propagation, types of sound waves, Principle of UT, methods of UT, their advantages and limitations, Piezoelectric Material, Various types of transducers/probe, Calibration methods, use of standard blocks, technique for normal beam inspection.

L – 30; Total Hours – 30

TEXT BOOKS:

1. ASM Metals Handbook,Non-Destructive Evaluation and Quality Control, American Society of Metals, Metals Park, Ohio, USA, 200, 2018.
2. Baldev Raj, T.Jayakumar, M.Thavasimuthu Practical Non-Destructive Testing, Narosa Publishing House, 2014.

REFERENCES:

1. Ravi Prakash, Non-Destructive Testing Techniques, 1st revised edition, New Age International Publishers, 2010.
2. Paul E Mix, Introduction to Non-destructive testing: a training guide, Wiley, 2nd Edition New Jersey, 2005.
3. Charles, J. Hellier, Handbook of Nondestructive evaluation, McGraw Hill, New York 2001.
4. B.P.C. Rao, Practical Eddy Current Testing, Alpha Science International Limited (2006).

COURSE OUTCOMES:

CO1: Demonstrate the importance, principle, concept and inspection methods of various surface NDT methods and apply the same to interpret the results effectively.

CO2: Comprehend the ideas behind working of thermography and eddy current testing methods and apply them to interpret the results of testing and analyse the defects and problem.

CO3: Grasp the fundamental principles, and standards of various radiographic NDT methods and utilise them to identify the defects and defect location suitably.

CO4: Assimilate the ideas concerning the principle, types of waves, instrumentation, standards, calibration methods of ultrasonic NDT methods and identify the areas for their application.

Board of Studies (BoS) :
BOS of Physics was held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

PHDX 02	MATERIALS SCIENCE FOR ENGINEERING (For Polymer)	L	T	P	C
SDG: 4		2	0	0	2

COURSE OBJECTIVES:

COB1: To impart knowledge on the fundamentals of materials science and engineering.

COB2: To provide a basis for understanding properties and applications of dielectric materials.

COB3: To expose the students to different classes of materials, their properties, structures and imperfections

COB4: To aid the teaching learning process through relevant illustrations, animations, web content and practical examples

MODULE I CLASSIFICATION OF MATERIALS 6

Concept of amorphous, single crystals and polycrystalline materials, crystallinity and its effect on physical properties, metal, ceramic, polymers, classification of polymers, structure and properties, additives for polymer products, effect of environment on materials, composites

MODULE II PROPERTIES OF MATERIALS 10

Mechanical Properties: Stress-strain response of metallic, ceramic and polymer materials, yield strength, tensile strength and modulus of elasticity, toughness, plastic deformation, fatigue, creep and fracture- Electronic Properties:Free electron theory, Fermi energy, density of states, band theory of solids, semiconductors, Hall effect, dielectric behaviour, piezo, ferro, pyroelectric materials - Magnetic Properties: Origin of magnetism in metallic and ceramic materials, para-magnetism, diamagnetism, ferro and ferrimagnetism- Thermal Properties: Specific heat, thermal conductivity and thermal expansion, thermoelectricity- Optical Properties: Refractive index, absorption and transmission of electromagnetic radiation in solids, electro-optic and magneto-optic materials.

MODULE III CRYSTALLOGRAPHIC STRUCTURES AND IMPERFECTIONS 7

Crystal symmetry, point groups, space groups, indices of planes, close packing in solids, bonding in materials, coordination and radius ratio concepts, point defects, dislocations, grain boundaries, surface energy and equilibrium shapes of crystals.

MODULE IV THERMODYNAMICS AND KINETICS 7

Phase rule, phase diagrams, solid solutions, invariant reactions, lever rule, basic heat treatment of metals, solidification and phase transformations, Fick's laws of diffusion, mechanisms of diffusion, temperature dependence of diffusivity.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Nanotechnology: An introduction to nanostructuring techniques by Michael Köhler and Wolfgang Fritzsche, Wiley-VCH; 2Rev Ed edition, 2007.

REFERENCES:

1. William D. Callister, Jr., David G. Rethwisch, Materials Science and Engineering, Edition 9, Wiley, 2014.
2. Michael F. Ashby, David R.H. Jones , Engineering Materials 1 An Introduction to Properties, Applications and Design · Volume 1, Elsevier Science, 2012
3. Michael F. Ashby, David R.H. Jones , Engineering Materials 2: An Introduction to Microstructures, Processing and Design · Volume 2, Elsevier Science, 2013
4. Reza Abbaschian, Robert E. Reed-Hill, Physical Metallurgy Principles - SI Version, Cengage Learning, NY, 2009
5. "Encyclopedia of Polymer Science and Technology" 3rd Edition, Vol.1-12, Wiley Interscience , 2003

COURSE OUTCOMES

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

CO1: select suitable material for specific application.

CO2: analyse crystallographic structure of metals and their imperfections.

CO3: develop metal alloys with varying properties by selecting suitable heat treatment

CO4: correlate the various properties of material with their structure.

Board of Studies (BoS) :
BOS of Physics was held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

PHDX 03	BIOMATERIALS	L	T	P	C
SDG: 4		2	0	0	2

COURSE OBJECTIVES:

COB1:To gain basic knowledge in classification of biomaterials and their properties.

COB2:To provide a basis for understanding properties of metallic implant materials.

COB3:To enable the students to correlate theoretical principles with practical applications.

COB4:To help students understand biocompatibility & toxicological screening of biomaterials

MODULE I INTRODUCTION TO BIOMATERIALS 8

Introduction: Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Surface properties of materials, physical properties of materials, mechanical properties-Materials for biophotonic applications.

MODULE II IMPLANT MATERIALS 10

Metallic implants: Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion-ceramic implants : bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics-Polymer implants: Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin.

MODULE III BIOCOMPATIBILITY AND TOXICOLOGICAL SCREENING OF BIOMATERIALS 6

Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (in situ-implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests.

MODULE IV PRACTICAL ASPECTS OF BIOMATERIALS 6

Preparation of biomaterials - Microscopic study & analysis of different biomaterials- alginate – material preparation and characterization - Testing of various biomaterials- case studies on industrial and clinical applications of

biomaterials.

L – 30; Total Hours –30

TEXT BOOKS:

1. Myer Kutz, Standard Handbook of Biomedical Engineering and Design, McGraw Hill, 2003
2. Monika Saini, Yashpal Singh, Pooja Arora, Vipin Arora, and KratiJain. Implant biomaterials: A comprehensive review, World Journal of Clinical Cases, 2015.

REFERENCES:

1. John Enderle, Joseph D. Bronzino, Susan M.Blanchard, Introduction to Biomedical Engineering, Elsevier, 2005.
2. Park J.B., Biomaterials Science and Engineering, Plenum Press, 2007.
3. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,Woodhead Medical Textiles and Biomaterials for Healthcare, Publishing Limited 2006.
4. D F Williams, Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive Treatment Volume, VCH Publishers 1992.

COURSE OUTCOMES:

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

CO1: differentiate common use of biomaterials as metals, ceramics, polymers and apply them to classify its chemical structure, properties and morphology.

CO2: comprehend ideas involving general properties of implant materials and apply the same to identify the benefits of implant materials.

CO3: attain knowledge about the biocompatibility & toxicological screening of biomaterials and realize its usage in real life.

CO4: reflect upon the practical ideas of using biomaterials

Board of Studies (BoS) :
BOS of Physics was held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

PHDX 04	OPTICAL FIBRE COMMUNICATION	L	T	P	C
SDG: 4		2	0	0	2

COURSE OBJECTIVES:

COB1:To facilitate the knowledge about optical fibres and its transmission characteristics.

COB2:To make the students to learn about LED and laser diodes.

COB3:To make the students understand the various types of optical Receiversand sensors.

COB4: To enrich the knowledge on optical amplifiers and networks.

MODULE I INTRODUCTION TO OPTICAL FIBRES 7

Optical fibre – Principle and propagation of light in optical fibre – Numerical aperture and acceptance angle – Types of optical fibres – Attenuation – Absorption, Scattering losses, Bending losses and Dispersion in Optical fibres – Fiber Connectors and Couplers.

MODULE II FIBER OPTICAL SOURCES 7

Light Emitting Diodes (LED) – power and efficiency - double hetero LED – LED structure - LED characteristics – Semiconductor Lasers diode, Homojunction and Heterojunction laser diodes - Optical processes in semiconductor lasers - applications.

MODULE III FIBER OPTICAL RECEIVERS AND SENSORS 8

Photo detectors - photodiodes - phototransistors - noise characteristics - PIN diode Avalanche Photodiode (APD) characteristics - APD design of detector arrays – Charged Couple Device - Solar cells - Materials and design considerations, Thin film solar cells, amorphous silicon solar cells - Fiber optic sensors: Intrinsic and Extrinsic sensors, amplitude, phase, wavelength and polarization modulation.

MODULE IV OPTICAL AMPLIFIERS AND NETWORKS 8

Optical amplifiers, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers - Optical Networks: Basic networks, SONET/SDH, WDM Networks, Nonlinear effects on network performance, Performance of WDM + EDFA systems, Solitons, Optical CDMA, Ultrahigh capacity networks.

L – 30; Total Hours –30

TEXT BOOKS:

1. Gerd Keiser, Optical Fiber Communication, 3rd Edition, McGraw-Hill International, Singapore, 2013.

REFERENCES:

1 Govind P. Agrawal, Fiber-Optic Communication Systems (Wiley Series in Microwave and Optical Engineering) , Wiley 4th Edition, 2010.
2 J. Senior, Optical Communication, Principles and Practice, Prentice Hall of India, 3rd Edition, 2010.
3 D. C. Agrawal, Fiber Optic Communication, S.Chand& Co Ltd., 2005.
4 Rajiv Ramaswami, KumarSivarajan, Galen Sasaki, Optical Networks: A Practical Perspective, 3rd Edition, Morgan Kaufmann, 2009.
5 B. Culshaw, Optical Fiber Sensing and Signal Processing, Peter Peregrinus Ltd, 2014.

COURSE OUTCOMES:

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

CO1: realize basics of optical fiber and differentiate various modes and configurations.

CO2: understand and assimilate the working principle of LED and Diode Laser.

CO3: select suitable photodetectors/sensorsfor different types of applications.

CO4: analyze the mechanism of optical amplifiers and analyze optical networks.

Board of Studies (BoS) : BOS of Physics was held on 21.6.21

Academic Council: 17th AC held on 15.07.2021

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

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

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

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

PHDX 05	**SEMICONDUCTOR PHYSICS FOR**	**L**	**T**	**P**	**C**
SDG: 4	**INFORMATION TECHNOLOGY**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1:To understand the physics of semiconductor devices

COB2:To gain knowledge on various methods involved in nanofabrication of semiconductor devices

COB2:To study the working principle of optoelectronic devices and various display devices

COB4:To get insight to different types of data storage technologies

MODULE I INTRODUCTION TO SEMICONDUCTOR DEVICES 6

Semiconductors: N and P type, PN junction diode under forward and reverse bias — Zener diode, Schottky diode – Tunnel diode –bipolar junction transistor (BJT) - metal–oxide–semiconductor field-effect transistor (MOSFET), CMOS-concepts and fabrication.

MODULE II FABRICATION OF SEMICONDUCTOR DEVICES 6

Deposition of Semiconductor thin films – molecular beam epitaxy (MBE), chemical vapour deposition (CVD), pulsed laser deposition (PLD),magnetron sputtering,Types of lithography:Photo/ultraviolet /Electron-beam/Focused ion beam, Dip pen nanolithography, Etching process :Dry and Wet etching

MODULE III OPTOELECTRONIC DEVICES 10

Light Emitting Diodes (LED) - double hetero LED structure - LED characteristics - White LED – Applications, Semiconductor Lasers, Homojunction and Heterojunction laser diodes - Optical detection – PIN and avalanche photodiodes, Applications: Optical mouse, traffic lights, Luminescence, Cathode Luminescence, Electro Luminescence, Transparent Conductors, Liquid crystal displays – Dynamic scattering and Twisted nematic display, Display Glasses, Organic LEDs display, Charge-coupled devices (CCD), Inorganic Semiconductor TFT Technology, Organic TFT Technology; Flexible Displays, Touch Screen Technology.

MODULE IV MEMORY STORAGE DEVICES 8

Introduction to memory storage, Resistive Random Access Memory (ReRAM), Phase Change Memory (PCM); Magnetoresistive Random Access Memory (MRAM)- Gaint Magnetoresistance (GMR), Tunnel Magnetoresistance (TMR), Ferroelectric Random Access Memory (FeRAM); Comparison and future

directions, Hardware circuits, working analysis.

L – 30; Total Hours – 30

TEXT BOOKS:

1) W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate(Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 3rd Edition, 2018
2) Chris Mack, Fundamental Principles of Optical Lithography: The Science of Microfabrication, Wiley, 2008
3) D. S. Dhaliwal et al., Prevail :Electron projection technology approach for next-generation lithography, IBM Journal Res. & Dev. 45, 615, 2001.

REFERENCES:

1. V.K. Mehta, Rohit Mehta, Principles of Electronics (Multicolour Edition) S. Chand Publishers, 10th Rev. Edn. 2006 Edition
2. Albert Malvino, David J. Bates Electronic Principles (SIE), McGraw Hill, 7th Edition, 2017
3. U. Mishra, J. Singh, Semiconductor Device Physics and Design, Springer, 2014
4. S.M. Sze, Kwok K. Ng, Physics of Semiconductor Devices, Wiley Publishers, 3ed 2008.
5. Bhattacharya Pallab, Semiconductor Optoelectronic Devices, Second Edition, By Pearson 2017
6. Joseph A. Castellano, Handbook of Display Technology, Springer, 1992
7. Yoshio Nishi, Advances in Non-volatile Memory and Storage Technology, Elsevier 2014

COURSE OUTCOMES:

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

CO1: understand the physics of semiconductor devices and identify its significance towards information technology (IT).

CO1: gain insight into various fabrication techniques towards the realization of nano-dimensional semiconductor devices.

CO2: attain knowledge on working principles of optoelectronic devices and display technologies and can recognize their importance in commercial applications.

CO4: learn the principle of data storage and its application towards futuristic memory technology.

Board of Studies (BoS) :
BOS of Physics was held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

PHDX 06	SENSORS AND ACTUATORS	L	T	P	C
SDG: 4		2	0	0	2

COURSE OBJECTIVES:

COB1: To understand the basic concept of sensors towards detection of pressure, position, velocity and temperature.

COB2: To avail knowledge on sensor which are sensitive to light, magnetic field, and acoustic waves

COB3: To study the different types of fabrication techniques towards realization of various sensors.

COB4: To get introduced towards MEMS technology and various actuators.

MODULE I INTRODUCTION TO SENSORS: PRESSURE, POSITION, VELOCITY AND TEMPERATURE 8

Introduction to sensors – working principles– classification – static and dynamic characteristics, Error Analysis, Pressure sensors – strain gauge, piezoelectric force sensor, vacuum sensors, Position sensor -Proximity sensor, Capacitive, Inductive and displacement sensor, velocity and acceleration sensors, Temperature sensor-thermocouples- thermistors-Thermo-EMF Sensors, metal Junction and metal Semiconductor junction types.

MODULE II SENSORS : LIGHT, MAGNETIC FIELD AND ACOUSTIC 8

Photocondutors- Optical Detectors - Photodiodes, Phototranistors, Optical encoder-Charge Coupled Device (CCD), Fabry Perot sensor, Hall effect, magneto resistive, magneto strictive sensors, Acoustic sensors-microphones-resistive, capacitive, piezoelectric, fiber optic, solid state - electrect microphone.

MODULE III SENSORS FABRICATION TECHNIQUES 7

Fabrication techniques – molecular beam epitaxy (MBE), chemical vapour deposition (CVD), pulsed laser deposition (PLD),magnetron sputtering,Types of lithography:Photo/ultraviolet /Electron-beam/Focused ion beam, Dip pen nanolithography, Etching process :Dry and Wet etching

MODULE IV MICROSYSTEMS AND ACTUATORS 7

Microelectro-mechanical systems (MEMS) - RF- MEMS, Micro fabrication and Applications, Classification of transducers: electrostatic, piezoelectric,

thermal, Microsystem design and fabrication.working principles of Actuators. Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications Solid-state switches, relays Solenoids, D.C. Motors, A.C. Motors, Stepper motors. Shape memory alloy actuators.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Jacob Fraden, Hand Book of Modern Sensors: physics, Designs and Applications, 3rd edition, Springer, New York, 2015.
2. Jon. S. Wilson, Sensor Technology Hand Book, 1st edition, Elsevier, Netherland, 2011.
3. John G Webster, Measurement, Instrumentation and sensor Handbook, 2nd edition, CRC Press, Florida, 2014.

REFERENCES:

1. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate (Eds.), Handbook of NanoScience, Engg. and Technology, CRC Press, 3rd Edition, 2018
2. Chris Mack, Fundamental Principles of Optical Lithography: The Science of Microfabrication, Wiley, 2008
3. D. S. Dhaliwal et al., PREVAIL :Electron projection technology approach for next-generation lithography, IBM Journal Res. & Dev. 45, 615, 2001.
4. Tai-Ran Hsu, MEMS & Microsystem, Design and Manufacture, 1st ed., McGraw Hill India, New Delhi, 2017.
5. MassoodTabibArar, Microactuators – Electrical, Magnetic Thermal, Optical, Mechanical, Chemical and Smart structures, 1st ed., Kluwer Academic publishers, New York, 2014.

COURSE OUTCOMES:

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

CO1: get exposed to various types of sensors and apply the ideas to distinguish between pressure, position, velocity and temperature based sensors

CO2: familiarize towards light, magnetic field, and acoustic based sensors and recognize their importance in commercial applications.

CO3: gain insight into various fabrication techniques towards the realization of sensors

CO4: apply the ideas to conceptualize MEMS technology and different actuators in engineering field

Board of Studies (BoS) :
BOS of Physics was held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

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

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

SDG 4 : Ensuring inclusive and equitable quality education for all persons and promote lifelong learning opportunities.
Statement : The modules and topics mentioned in this course are designed to ensure all inclusive and thorough education with equity to all persons and promote learning opportunities at all times.

PHDX 07	FUNDAMENTALS OF NANOTECHNOLOGY AND ITS APPLICATIONS	L	T	P	C
SDG: 4		2	0	0	2

COURSE OBJECTIVES:

COB1: To introduce the basic concepts of Nanoscience through quantum mechanical theories and solid state physics.

COB2: To provide knowledge about the various synthesis methods applicable to different nano materials

COB3: To enrich the knowledge of students in various characterisation techniques.

COB4: To provide knowledge on applications of poymer based nano materials in various fields.

MODULE I BASICS OF NANO SCIENCE 7

Introduction to Nanoscience & Nanotechnology : Review of classical mechanics – overview Quantum Mechanics. Background to nanoscience and nanotechnology - scientific revolutions - nanosized effects – surface to volume ratio – atomic structure – molecular and atomic size - quantum effects - formation of nano sized particles – energy at the nanoscale.

MODULE II SYNTHESIS OF NANOMATERIALS 8

Nanomaterial Fabrication: Bottom-up vs. top-down - Preparations of Nanomaterials by mechanical and physical methods : – High energy ball milling – melt quenching and annealing – vapour deposition – Pulsed laser deposition – Magnetron sputtering - Microwave plasma evaporation. Chemical Methods of Preparation : Sol-gel method –Electrodeposition – Electrospinning. Arc method for carbon nanotubes – nanofibres and rods – synthesis of Graphene- Handling of nano particles - Health hazards – Precautions.

MODULE III CHARACTERIZATION OF NANOMATERIALS 8

Characterisation of Nanomaterials: XRD – particle size determination - SEM - FESEM - TEM – AFM – Nanoindentor – UV-VIS spectroscopy – FTIR, FT-Raman, Photoluminescence, NMR, ESR - Dielectric characterization – Magnetic characterization

.

MODULE IV APPLICATION OF NANO MATERIALS 7

Applications of Carbon based nanomaterials (CNT, CNF, Graphene) - Biosensor (principle, component, types, applications) - agriculture (nano-

fertilizers, herbicides, nano-seed science, nano-pesticides) and food Systems (encapsulation of functional foods, nano-packaging) – Nano - electronics, Nano-optics.

L – 30; Total Hours –30

TEXT BOOKS:

1. Nanotechnology: An introduction to nanostructuring techniques by Michael Köhler and Wolfgang Fritzsche, Wiley-VCH; 2Rev Ed edition, 2007.

REFERENCES:

1 Nanotechnology: basic science and emerging technologies by Mick Wilson, Kamali Kannangara, Geoff Smith, and Michelle Simmons, Chapman & Hall/CRC; I edition, 2002.

2 Handbook of NanoScience, Engineering and Technology by Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., CRC Press, 2012.

3 Nanocomposite Science and Technology by P. M. Ajayan, L. S. Schadler, P. V. Braun, WILEY-VCH Verlag GmbH, 2003.

4 Nanotechnology Applications in Agriculture – C.R. Chinnamuthu, B.Chandrasekaran and C. Ramasamy – 2008.

COURSE OUTCOMES:

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

CO1: understand basic principles of nanomaterials and apply them to differentiate the significance of nanomaterials compared to bulk materials.

CO2: familiarize the various synthesis methods of nanomaterials and compare them with the preparation of materials in bulk form.

CO3: get useful ideas about characterization techniques and differentiate different techniques.

CO4: understand the various applications of nanomaterilas and realize the role of nanomaterials in various fields

Board of Studies (BoS) :
BOS of Physics was held on 21.6.21

Academic Council:
17th AC held on 15.07.2021

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

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

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

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CHEMISTRY ELECTIVE

		L	T	P	C
CHDX01	**CHEMISTRY OF CONSTRUCTION MATERIALS**				
SDG: 9		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

To impart knowledge on

COB1: The chemistry of cement and concrete

COB2: The properties of steel and mechanism of corrosion

COB3: The quality of water and its impact on concrete

COB4: The analytical techniques for concrete research

MODULE I CHEMISTRY OF CEMENT AND CONCRETE 8

Cement - chemical composition - Bogue's compounds - hydration of cement - hydrated products - influence of hydrated products on properties of cement - types of cement - microstructure of aggregate phase and hydrated cement paste - Interfacial transition zone in concrete : significance and microstructure

MODULE II CHEMISTRY OF STEEL AND CORROSION 8

Steel for construction - chemical composition - types of steels - influence of chemical composition on properties. Corrosion of steel - mechanism of corrosion of steel in water and concrete medium - types of corrosion of steel associated to civil engineering. Corrosion prevention and control : coatings & inhibitors - working mechanism. Cathodic protection to steel : Concept - working mechanism - sacrificial anodes

MODULE III WATER CHEMISTRY FOR CONCRETE 7

Water quality parameters – pH, solids, hardness, alkalinity, chloride and sulphates in water and their determination- Water quality for building construction – Effect of water impurities on concrete strength and durability- Carbonate and Sulphate attack-Chloride attack –Alkali-Silica reactions in concrete-Case studies

MODULE IV ANALYTICAL TECHNIQUES FOR CONCRETE RESEARCH 7

Analytical techniques for cement concrete research - FITR spectroscopy - SEM - XRD - Cyclic voltammetry (CV) - Thermo-gravimetric analysis (TGA) and Differential thermal analysis (DTA) - Advanced chloride and water analysis techniques.

L – 30; Total Hours –30

TEXT BOOKS:

1. Wieslaw Kurdowski, Cement and Concrete Chemistry, Springer Netherlands, 2014.

REFERENCES:

1. P.C Jain and Monica Jain, Engineering Chemistry Dhanpatrai Publishing Company (P) Ltd.,New Delhi , 2013.
2. S SUmare and S S Dara, A text Book of Engineering Chemistry, S. Chand and Company Ltd, New Delhi, 2014.
3. M.G. Fontana and N.G. Green, Corrosion Engineering, McGraw Hill Book Company,NewYork, 1984.
4. B. Sivasnakar, Engineering Chemistry, Tata McGrow - Hill Publication Limited, New Delhi,second reprint 2008.
5. P. Kumar Mehta and Paulo J.M. Moteiro, "Concrete : Microstructure, Properties and Materials", McGraw Hill Education (India) Pvt. Ltd., 4th Edition, New Delhi, 2014
6. APHA Standard Methods for the Examination of Water & Wastewater, American Public Health Association, USA, 2005.

COURSE OUTCOMES:

CO1: Explain the properties of cement and concrete

CO2: Describe the properties of steel, mechanism of corrosion and its prevention

CO3: Enumerate the impact of water quality on the concrete

CO4: Elaborate the principle, instrumentation and applications of various analytical techniques for concrete research

Board of Studies (BoS) :
11thBoS of Chemistry held on 17.06.2021

Academic Council:
17th AC held on 15.07.2021

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

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

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

CHDX 02	**CHEMISTRY OF MATERIALS AND ELECTROCHEMICAL DEVICES**	**L**	**T**	**P**	**C**
SDG: 9		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

The students will be conversant with

COB1: concepts of corrosion, types and various methods to control corrosion.

COB2: the chemicals, chemical reactions, construction and working of different batteries and fuels cells.

COB3: the types, properties and manufacture of refractories and abrasives.

COB4: types, functions of lubricants and mechanism of lubrication.

MODULE I CORROSION AND ITS CONTROL 8

Types of corrosion - chemical corrosion – electrochemical corrosion – galvanic corrosion – differential aeration corrosion - factors influencing rate of corrosion.

Corrosion control – selection of materials - cathodic protection: sacrificial anode - corrosion inhibitors – paints: constituents & functions – treatment of metal surface for inorganic coatings - metallic coatings: hot dipping: galvanizing and tinning – electroplating — electroless plating.

MODULE II ELECTROCHEMICAL DEVICES 8

Electrochemical cell, electrolytic cell - introduction to batteries – classification – primary: dry alkaline – secondary: lead–acid, nickel–cadmium and lithium batteries, Fuel cells – classification based on temperature and electrolyte - hydrogen–oxygen fuel cell, applications – solar cells: construction and working – dye sensitised solar cells.

MODULE III REFRACTORIES AND ABRASIVES 7

Refractories: Introduction - refractory - classification – based on chemical nature - characteristic and selection of good refractory - properties of refractories: refractoriness - refractoriness under load - thermal spalling - porosity and dimensional stability – general manufacture of refractory – components, properties and uses of: silica, magnesite, zirconia refractories - super refractories - application of refractories.

Abrasives: classification - Moh’s scale – properties - natural abrasives: diamond, corundum, emery, garnet, quartz - synthetic abrasives: preparation, properties and uses: carborundum, alundum, boron carbide (norbide), tungsten carbide, zirconium silicate – grinding wheel – abrasive paper and cloth - Rockwell scale test - knoop hardness test.

MODULE IV LUBRICANTS 7

Introduction – functions of lubricant- mechanism of lubrication - classification of lubricant – selection of lubricants - lubricating oils - properties of lubricant: viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue - semisolid: grease (sodium, calcium, lithium, aluminium) - solid lubricant: graphite, graphene, molybdenum disulphide – lubricating emulsions - cutting fluids – synthetic and semi-synthetic lubricants.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Jain P.C and Monika Jain, Engineering Chemistry, Dhanpat Rai Publishing Co., New Delhi. 2016.

REFERENCES:

1. E. McCafferty, "*Introduction to Corrosion Science*" Springer, May 2010.
2. Tulika Sharma "*Electrochemical devices*" LAP Lambert Academic Publishing, 2011.
3. Jeffry S Gaffney, Nancy A Marley *General chemistry for engineers*, Elsevier, 2018.
4. Don M Pirro, Martin Webster, Ekkehard Daschner "*Lubrication Fundamentals*", Taylor & Francis Gp,LLC, 2016.
5. Theo Mang, Wilfred Dresel "*Lubricants and Lubrication*" Wiley-VCH, 2017

COURSE OUTCOMES:

The students will be able to

CO1: apply specific methods to control corrosion of different materials.

CO2: illustrate the construction and working of different types of cells, batteries and fuel cells.

CO3: compare the properties and devise a method of manufacture of refractories and abrasives.

CO4: analyze and choose the right type of lubrication based on the type of machines.

Board of Studies (BoS) : 11thBoS of Chemistry held on 17.06.2021

Academic Council: 17th AC held on 15.07.2021

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

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

SDG 9: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

CHDX 03	CHEMISTRY AND	L	T	P	C
SDG: 9	INSTRUMENTATION FOR ELECTRICAL AND ELECTRONIC APPLICATIONS	2	0	0	2

COURSE OBJECTIVES:

COB1: Synthesis, properties and applications of electrical and electronic devices.

COB2: Classification and types of fuel cells.

COB3: Types of sensors and their applications.

COB4: Principle, instrumentation and applications of analytical techniques.

MODULE I ELECTRICAL AND ELECTRONIC DEVICES 7

Solar Cell- Si solar cell, quantum dot solar cell, LCD : components, liquid crystals and their composition, electrodes – OLEDS: components, synthesis and modification of small molecules, polymers, phosphors - FRP-synthesis, properties and electrical applications - Solders : composition and uses – Capacitors : synthesis and modification of capacitor materials, fabrication.

MODULE II FUEL CELLS 7

Difference between batteries and fuel cells - classification of fuel cell (based on temperature and electrolyte) – principle, characteristic features, advantages, disadvantages and applications of polymer electrolyte membrane or proton exchange membrane fuel cell (PEMFC), direct methanol fuel cell (DMFC), alkaline fuel cell (AFC), phosphoric acid fuel cell (PAFC), molten carbonate fuel cell (MCFC), and solid oxide fuel cells (SOFC) microbial fuel cell, - hydrogen storage materials, challenges in using hydrogen as a fuel.

MODULE III SENSORS 7

Definition, receptor, transducer, classification of chemical sensors based on operating principle of transducer, Ion-selective electrodes, Conductometric gas sensors (chemoresistors), Electrochemical sensors, Potentiometric MOSFET gas sensor, Touch sensors (oximeter, glucometer), Chemocapacitors, Biochips and microarray.

MODULE IV ANALYTICAL TECHNIQUES 9

Voltammetry: cyclic voltammetry, electrogravimetry - principle, instrumentation and applications of: UV-Vis spectrophotometry, Atomic emission spectroscopy-Photoluminescence spectrophotometry, atomic absorption spectrophotometry –- FT-IR spectroscopy, Raman spectroscopy, TGA-DTA analyzer, TEM.

L –30; Total Hours – 30

TEXT BOOKS:

1. P.C. Jain & Monica Jain, Engineering Chemistry, Dhanpatrai Publishing Company (P) Ltd., New Delhi (2016).

REFERENCES:

1. K.M. Gupta & Nishu Gupta, Advanced electrical and electronic materials: process and applications, Wiley-Scrivener (2015).
2. S. Vairam, P. Kalyani and Suba Ramesh, Engineering Chemistry, Wiley India Ltd., New Delhi (2011).
3. B. Viswanathan & M. Aulice Scibioh, Fuel Cells: Principles and Applications, University Press (2008).

COURSE OUTCOMES:

CO1: Illustrate the construction and applications of electrical and electronic devices.

CO2: Classify the fuel cells and elaborate the different types of fuel cells.

CO3: Explain the different types of sensors and their applications.

CO4: State the principle and illustrate the instrumentation of various analytical techniques.

Board of Studies (BoS) : 11th BoS of Chemistry held on 17.06.2021

Academic Council: 17th AC held on 15.07.2021

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

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

CHDX 04	FUNCTIONAL MATERIALS AND APPLICATIONS	L	T	P	C
SDG: 11 & 12		2	0	0	2

COURSE OBJECTIVES: To make the students conversant with

COB1: specific materials for hardware components fabrication, data storage and their related properties

COB2: selection of advanced materials for various current applications

COB3: materials for the fabrication of sensors

COB4: essential characterization techniques and software tools with chemistry background

MODULE I MATERIALS FOR HARDWARE AND DATA STORAGE 7

Specific materials for electrical and electronic gadgets-computers, instruments (Semiconductors-N, S doped Silicon, CdX QDs, metal nano and other applications). Networking of networks and connecting devices - materials used in robotic construction (metal alloys, kevlor, biodegradable smart materials). Data storage and magnetic hard disk and devices-pendrive (flash memory-ferro magnetic and super paramagnetic materials, optical dics). Nanomaterials to enhance the lifetime and storage of CD, DVD and BD (Nano incorporated Polycarbonate, Al and lacquer) - Nanomaterials and small molecules for data storage.

MODULE II ADVANCED MATERIALS AND APPLICATIONS 8

Materials for 3D printing (Nylon, ABS, PLA, Ti, Au and Ag). Solar panels function monitoring-IOT enabled (crystalline Si, organometallics) – Displays and LCD, LEDs and its types-OLEDs (Group III-V materials). RGB analysis -sensing and TV/system screen (QDs and anthocyanins). Semiconductor chemistry for VLSI processing technology (metalloid staircase, Si, Ge, GaAs)-materials for inkjet printable circuit board (nanocarbon based) - Right material for signal speed and right thermal coefficient of expansion - Remote sensing (photodectectors and radiometers). Solder:-Lead based solder - issues and alternative for lead free solder (Conductive inks).

MODULE III MATERIALS FOR FABRICATION OF SENSORS 8

Wireless Sensors – Introduction to sensors (chemo/bio/gas sensors)-Wearable/touch sensors-Components - selection of materials - Device

fabrication and function monitoring - wireless, Smartphone based and IOT enabled-Properties of materials, anti-corrosive, water proof, insulation and lamination. Robotics in surgery, gene coding and molecular modelling. Biochips and DNA microarray chips (fluorescent dyes, glass/nylon).

MODULE IV ANALYTICAL TECHNIQUES AND SOFTWARE SOLUTIONS 7

Characterization tools – UV-Visible (DRS), FT-IR, SEM, TEM, AFM, TG-DTA and XRD (Principle and applications only). Introduction to softwares-ChemOffice, Image J, Origin - Molecular modelling, comparison of old drug structures with new, drug designing-drug for COVID-19 and drug delivery. Molecular docking (drug interaction in a human body).

L – 30; Total Hours – 30

TEXT BOOKS:

1. P. Roy, S.K. Srivastava, Nanomaterials for Electrochemical Energy Storage Devices (Book), John Wiley & Sons, 2019.
2. K. Brun, T. Allison, R. Dennis, Thermal, Mechanical, and Hybrid Chemical Energy Storage Systems (Book), Elsevier, 2000.

REFERENCES:

1. B.J. Cafferty, A.S. Ten, M.J. Fink, S. Morey, D.J. Preston, M. Mrksich, G.M. Whitesides, Storage of Information Using Small Organic Molecules, ACS Central Science, 2019, 5, 911−916.
2. Nabeel Ahmad P. Gopinath and Rajiv Dutta, 3D Printing Technology in Nanomedicine (Book), Elsevier, 2019.
3. Aaftaab Sethi, Khusbhoo Joshi, K. Sasikala and Mallika Alvala, Molecular Docking in Modern Drug Discovery: Principles and Recent Applications, IntechOpen, (2019), DOII: 10.5772/intechopen.85991.
4. W-L. Xing, J. Cheng, Frontiers in Biochip Technology, Springer, 2006.
5. Sulabha K. Kulkarni, Nanotechnology: Principles and Practices, 3rd Edition, Springer, 2015.

COURSE OUTCOMES:

CO1: Identification of suitable materials in electronic gadgets and data storage systems.

CO2: Application of specific functionalized materials for advanced applications

CO3: Choose appropriate materials for fabricating the different types of sensors

CO4: Hands on experience of software and exposure to material properties

Board of Studies (BoS) :
15th BoS of Department of Chemistry held on 15.06.2021

Academic Council:
17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	L	-	H	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	-	-	-	-	-	H	-	-	-	-	-	-	-	-
CO 3	-	-	-	L	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	-	H	-	-	-	-	-	-	-	-	-	-	-	-

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

SDG 11 & 12 :

Statement : Identification of suitable materials towards the manufacturing of electronic gadgets and data storage systems without much affecting the natural resources and application of the fabricated devices to the sustainable cites and communities.

CHDX 05	CHEMISTRY OF FUELS,	L	T	P	C
SDG: 9	COMBUSTION AND LUBRICANTS	2	0	0	2

COURSE OBJECTIVES:

The students will be conversant with

COB1: types, composition and process of manufacture of solid, liquid and gaseous fuels.

COB2: determination of calorific value and calculation of GCV and NCV.

COB3: types, concepts of corrosion and different methods for control of corrosion.

COB4: types, functions of lubricants and mechanism of lubrication.

MODULE I FUELS 8

Introduction – classification of fuels – calorific value – characteristics of a good fuel – comparison of solid, liquid and gaseous fuel – solid fuels – coal – ranking of coal – proximate analysis of coal – pulverised coal – metallurgical coke – manufacture of coke (Otto Hoffman) – Liquid fuel – petroleum – refining of petroleum – cracking – fixed bed catalytic cracking - synthetic petrol – Fischer-Tropsch process – biodiesel - Gaseous fuel – CNG – LPG – Biogas – producer gas – water gas

MODULE II COMBUSTION 8

Introduction – calorific value - Calorific value: Gross and net calorific value - Bomb Calorimeter - Gas calorimeter - Definition of combustion – theoretical calculation of calorific values (Dulong's formula) - Gross and net calorific values (problems) - air-fuel ratio - minimum requirement of air for complete combustion of fuels (problems) — Analysis of flue gas - Orsat's gas analysis method

MODULE III CHEMISTRY OF CORROSION 7

Types of corrosion - chemical corrosion – electrochemical corrosion – galvanic corrosion – differential aeration corrosion - factors influencing rate of corrosion.

Corrosion control – selection of materials - cathodic protection: sacrificial anode - corrosion inhibitors – paints: constituents & functions – treatment of metal surface for inorganic coatings - metallic coatings: hot dipping: galvanizing and tinning – electroplating — electroless plating.

MODULE IV LUBRICANTS 7

Introduction – functions of lubricant- mechanism of lubrication - classification of lubricant – selection of lubricants - lubricating oils- properties of lubricant: viscosity index - flash point and fire point - cloud point and pour point – oiliness - aniline point - carbon residue - semisolid: grease (sodium, calcium, lithium, aluminium) - solid lubricant: graphite, graphene, molybdenum disulphide – lubricating emulsions - cutting fluids – synthetic and semi-synthetic lubricants.

L – 30; Total Hours – 30

TEXT BOOKS:

1. Jain P.C and Monika Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Co., New Delhi. 2016.

REFERENCES:

1. Stephen R Turns, “An Introduction to Combustion: Concepts and Applications”, McGraw Hill Education, July 2017,
2. Samir Sarkar, “Fuels and Combustion”, University Press, 2009
3. Dipak K Sarkar “Thermal power plant: Design and operations – Chapter-3”, Elsevier, 2015.
4. E. McCafferty, “Introduction to Corrosion Science” Springer, May 2010.
5. Don M Pirro, Martin Webster, Ekkehard Daschner “Lubrication Fundamentals”, Taylor & Francis Gp,LLC, 2016.
6. Theo Mang, Wilfred Dresel “Lubricants and Lubrication” Wiley-VCH, 20172nd Edition, India, 2012. (ISBN 13: 9788131704370)

COURSE OUTCOMES:

The students will be able to

CO1: compare and interpret the different purpose of application, composition, and calorific value of different fuels.

CO2: calculate the minimum amount of air required, GCV and NCV for the combustion of the fuels.

CO3: apply specific methods to control corrosion of different materials.

CO4: analyze and choose the right type of lubrication based on the type of machines.

Board of Studies (BoS) :
11thBoS of Chemistry held on 17.06.2021

Academic Council:
!7th AC held on 15.07.2021

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

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

SDG 9: Industry, Innovation & Infrastructure

The holistic understanding of the materials used as fuels and lubricants and devices towards sustainable solutions for the advances in mechanical systems.

CHDX 06	INSTRUMENTAL METHODS OF POLYMER ANALYSIS	L	T	P	C
SDG 4		2	0	0	2

OBJECTIVES:

To impart knowledge on

COB1: To impart knowledge on spectroscopic analysis of polymers.

COB2: To equip with the knowledge of optical methods and X-ray diffraction methods for understanding the morphology and orientation of molecules

COB3: To develop an understanding on separation of various mixtures by different chromatographic techniques.

COB4: To understand the chemical elemental structure of polymers by NMR and mass spectroscopic technique.

MODULE I ULTRAVIOLET, VISIBLE AND IR SPECTROSCOPY 9

Principle- Instrumentation-Double beam spectrophotometers – single beam spectrophotometers -sources of radiation – Detectors – I operational procedure – qualitative and quantitative analysis – applications in polymer analysis.

Fourier Transform Infrared Spectroscopy -principle- instrumentation – optical materials – sources- detectors – typical spectrophotometers –– calibration and standardization – sample preparation - analysis – interpretation of FTIR spectra-principle of identification and characterization of polymers using IR

MODULE II NMR SPECTROSCOPY 7

Fundamental concepts – chemical shift – spin –spin- coupling. Instrumentation - data acquisition and spectral interpretation. Solid state NMR (magic angle), Applications of NMR and FT NMR in the characterization of polymers

MODULE III CHROMATOGRAPHY AND THERMAL ANALYSIS 7

Thermal analysis: DSC, TG/DTA, TMA, DMA, DETA with examples. gel permeation chromatography (GPC) – High pressure liquid chromatography (HPLC) – Thin layer chromatography (TLC - Gas chromatography (GC) – sample preparation. Chromatographic process and instrumentation – compositional separation and detectors – various types – Analyses. The uses and applications of various chromatographic techniques – pyrolysis gas chromatography.

MODULE IV X-RAY DIFFRACTION & NEWTON SCATTERING 7

Principle & basic concept of absorption of X-rays- monochromatic X-ray sources – X-ray detectors - Instrumentation – Experimental technique -Analysis by X-ray absorption. Absorption apparatus – X-ray diffraction – Diffraction apparatus. Application to polymer analysis.

L – 30; Total Hours – 30

TEXT BOOKS

1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch “Principles of Instrumental Analysis” 7th edition, Publisher Cengage Learning ,2016
2. Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan, “Introduction to Spectroscopy” 5th edition, Publisher Cengage Learning ,2015
3. Yang, Rui “Analytical methods for polymer characterization” CRC Press, 2018.
4. Joseph D. Menczel, R. Bruce Prime “Thermal analysis of polymers: fundamentals and applications” John Wiley, 2019.

REFERENCES:

1. Galen W. Euring, “Instrumental methods of chemical analysis”, McGraw Hill International editions, New York, 1985.
2. B.J. Hunt & MI Jones Blackie, “Polymer Characterisation”, Academic professional, London, 1997.
3. Hubert Lobo, Jose V.B.Bonilla, “Handbook of Plastic analysis” , Marcel Dekker inc, New York, 2003.
4. RA pethrick & JV Daukins, “Modern techniques for polymer characterization” , John Wiley & sons Chichester, UK, 1999.
5. D. Campbell and R. White, “Polymer characterization”, Chapman & Hall, London 1989.
6. Arza Seidel, “Characterization and Analysis of Polymers”, John wiley and sons, New jersey, 2008.
7. Nicholas P. Cheremisinoff, “Polymer Characterization: Laboratory Techniques and Analysis”, Noyes publications, New jersey, 1996.
8. John M Chalmers, Robert J Meier, “Molecular characterization and analysis of polymers” Elsevier, 2008

COURSE OUTCOMES

CO1: Gaining knowledge on principles of various instruments
CO2: Understand about various characterization techniques
CO3: Interpretation the polymer by different techniques

Board of Studies (BoS) :
11thBoS of Chemistry held on 17.06.2021

Academic Council:
!7th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	L	-	-	-	-	-	-	-	-	M	-	-
CO 2	-	-	-	M	-	-	-	-	-	-	-	-	M	-	-
CO 3	-	-	-	-	-	-	M	-	-	-	-	-	L	-	-
CO 4	-	-	-	M	-	-	-	-	-	-	-	-	L	-	-

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

SDG 4 : Aims at ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all

This course will provide deep knowledge on analysis of polymers using different instrumental methods.

CHDX 07	MEDICINAL CHEMISTRY	L	T	P	C
SDG: 9		2	0	0	2

COURSE OBJECTIVES:

To impart knowledge on

COB1: The basic factors governing drug design.

COB2: The software tools for molecular docking.

COB3: The synthetic pathway of antinfective, antineoplastic, cardiovascular and steroidal drugs.

COB4: The mode of action and side effects of synthetic drugs.

MODULE I INTRODUCTION TO DRUG DESIGN 7

Development of new drugs: Procedure followed in drug design – Literature survey - Search for Active Pharmaceutical Ingredient(s) - Molecular modification – Types of pharmaceutical form / mode of administration, Chemical Characterization of Medicinal Drugs - Molecular docking.

MODULE II ANTIINFECTIVE DRUGS 8

Synthesis, mode of action and side effect of Dapsone and Clofazimine (antileprotic) – Isoniazid, Rifampicin, Pyrazinamide and Ethambutol (antitubercular) – Fluconazole and griseofulvin (antifungal) – Chloroquine and Primaquine (antimalarial) - Semisytheticpencillin, Streptomycin, Ciprofloxacin (Antibiotics) - Nevirapine and Zidovudine (Antiviral)

MODULE III ANTINEOPLASTIC AND CARDIOVASCULAR DRUGS 8

Synthesis, mode of action and side effect of Mechlorethamine, Cyclophosphamide, Melphalan, Fluorouracil, 6-Mercaptopurine (Antineoplastic) – Sorbitrate, methylprednisolone, Methyldopa, quinidine (Cardiovascular).

MODULE IV STEROIDS AND RELATED DRUGS 7

Synthesis, uses and mode of action - (A) Androgens -testosterone (B) Estrogens and progestational agents – progesterone, (C) Adrenocorticoids – prednisolone, dexamethasone, Remdesivir (D) Glucocorticoids – Cortisol (E)Anabolicsteroids - nandrolone, oxandrolone (F) Neurosteroids – allopregnanolone.

L – 30; Total Hours – 30

TEXT BOOKS:

1. An Introduction to Drug Design, S. N. Pandeya and J. R.Dimmock, New Age International, 1997.

2. Burgers's Medicinal Chemistry and Drug Discovery, Fifth Edition; M. E. Wolff, John Wiley and Sons, 1996.
3. The organic chemistry of drug design and drug action, R. B. Silverman and M. W. Holladay, Academic Press, 3rd Edition, 2014.
4. Introduction to medicinal chemistry**:** How Drugs Act and Why, A. Gringuage, Wiley-VCH, 1996.
5. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry; Eleventh Edition; Lippincott Williams & Wilkins, 2004.

REFERENCES:

1. Strategies for Organic Drug Synthesis and Design, D. Lednicer, John Wiley, 2nd Edition 2008.

COURSE OUTCOMES:

CO1: Carry out searches to retrieve information relevant to the development of a new drug.

CO2: Describe and justify the role and importance of the various disciplines involved in the different phases of drug discovery and development.

CO3: Explain how synthetic methods are used to make early decisions in the drug discovery and development.

CO4: Elaborate the mode of action and side effect of the drugs.

Board of Studies (BoS) : 11thBoS of Chemistry held on 17.06.2021

Academic Council: 17th AC held on 15.07.2021

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

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

SDG 9 :Industry, Innovation & Infrastructure

Understanding of drugs preparation and usage in sustainable method reduces unwanted side effects and help to environments.