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 - IV Semesters)
(Amendments updated upto February 2022)

B.Tech. (Automobile Engineering)

REGULATIONS 2021

CURRICULUM AND SYLLABI (I - IV SEMESTERS)

(Amendments updated upto February 2022)

B.TECH. AUTOMOBILE ENGINEERING

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 AUTOMOBILE ENGINEERING

VISION AND MISSION

VISION

- To be a leader for Education, Training, Consultancy and Research in Automobile Engineering for the progress of Automotive Industries and over-all Socio-Economic progress of the Country in a sustainable manner.

MISSION

- To provide quality education to the students and to mould them as professionals with sound knowledge in the field of Automobile Engineering.
- To equip students to solve challenging problems in Automobile Engineering and related areas taking in to account their impact on the society.
- To facilitate students to develop good communication, leadership and managerial skills through team approach in conducting experiments and projects
- To pursue academic and collaborative research with industry and related research institutions.

PROGRAMME EDUCATIONAL OBJECTIVES AND OUTCOMES

B.TECH. (AUTOMOBILE ENGINEERING)

PROGRAMME EDUCATIONAL OBJECTIVES

The Mission of the Automobile Engineering Program is achieved by student learning outcomes that prepare the graduate to be able to:

- inculcate involvement in learning by adapting a holistic approach through well designed curriculum, pedagogy and evaluation for a successful professional career.
- provide a strong foundation in physical sciences and analytics to enable comprehensive understanding of the basic principles of Automobile Engineering.
- develop knowledge and skill in applying engineering principles to conceive, design, analyze, manufacture, maintain and recycle Automobile Engineering systems and components.
- equip the students with essential fundamental knowledge from other relevant disciplines to infuse a multi-disciplinary approach.
- empower the students through projects, internships leading to development of creativity, self confidence and team spirit.
- create the ambience with scope for developing communication and life skills so as to meet the needs of the society in the globalized environment

PROGRAMME OUTCOMES

The following list of educational outcomes was chosen by the department to describe what the students are expected to know or be able to do at time for graduation from the program:

- Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
- Design/development of solutions: 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.
- Conduct investigations of complex problems: 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.
- Model tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- The engineer and society: 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.
- Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
- Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

- Individual and team work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
- Communication: 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.
- Project management and finance: 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.
- Life-long learning: 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

B. Tech Automobile Engineering graduates will be able to:

- design, model and analyze automobile components, sub systems and automotive electronic systems.
- develop as professionals in automotive system design, validation, operation, testing with emission measurement and control and maintenance of vehicles

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 7th 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 ith course and GP_i is the Grade Point in the ith course,

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

Where n = number of courses

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

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

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

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

Percentage equivalent of marks = CGPA X 10

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

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

First Class	6.50 and above and completing the programme within a maximum of 10 semesters for all students (except lateral entry students) and 8 semesters for lateral entry students
Second Class	Others

16.6.1 Eligibility for First Class with Distinction

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

16.6.2 Eligibility for First Class

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

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

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

17.0 SUPPLEMENTARY EXAMINATION

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

18.0 DISCIPLINE

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

18.2 Any act of indiscipline of a student, reported to the Dean (Student

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

19.0 ELIGIBILITY FOR THE AWARD OF DEGREE

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

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

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

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

iv) No disciplinary action pending against him/her.

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

20.0 MINOR DEGREE PROGRAMMES OFFERED FOR STUDENTS

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

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

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

Sl. No.	Minor Degree	Eligible Major Degree Programmes (from other Departments)
1.	Artificial Intelligence and	Mechanical Engineering

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

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

**B.TECH. AUTOMOBILE ENGINEERING
CURRICULUM FRAME WORK, REGULATIONS 2021**
(Choice Based Credit System)

SEMESTER I

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	BSC	PHD 1181	Applied Physics *	3	0	2	4
2.	BSC	CHD1181	Engineering Materials and Applications *	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 1181	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 1283	Partial Differential Equations and Transforms	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	AUD 1211	Fluid Mechanics	3	0	0	3
8.	PCC	AUD 1212	Fluid Mechanics Laboratory **	0	0	3	1
9.	MC	GED 1206	Environmental Sciences	2	0	0	2

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Credits   **25**
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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	AUD 2101	Engineering Thermodynamics	3	1	0	4
4.	PCC	AUD 2102	Strength of Materials	3	1	0	4
5.	PCC	AUD 2103	Manufacturing Processes * (PBL)	2	0	2	3
6.	PCC	AUD 2104	Automotive Engines *	3	0	2	4
7.	PCC	AUD 2105	Automotive Component Modelling Laboratory **	0	0	2	1
8.	HSC	GED 2101	Essential Skills and Aptitude for Engineers **	0	0	2	1

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Credits   **24**
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SEMESTER IV

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PCC	AUD 2211	Two and Three Wheelers Technology (PBL)	3	0	0	3
2.	PCC	AUD 2212	Automotive Materials and Metallurgy *	2	0	2	3
3.	PCC	AUD 2213	Automotive Transmission	3	1	0	4
4.	PCC	AUD 2214	Mechanics of Machinery *	3	0	2	4
5.	PCC	AUD 2215	Automotive Chassis	3	0	0	3
6.	PCC	AUD 2216	Automotive Chassis Laboratory **	0	0	2	1
7.	PEC		Professional Elective I	3	0	0	3
8.	HSC	GED 2201	Workplace Skills and Aptitude for Engineers **	0	0	2	1
9.	MC	GED 2202	Indian Constitution and Human Rights	2	0	0	0

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Credits   **22**
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SEMESTER V

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC	MSD 3281	Entrepreneurship	3	0	0	3
2.	PCC	AUD 3101	Design of Automotive Components (PBL)	3	0	0	3
3.	PCC	AUD 3102	Vehicle Dynamics	3	0	0	3
4.	PCC	AUD 3103	Vehicle Inspection and Maintenance *	2	0	2	3
5.	PCC	AUD 3104	Vehicle Body Engineering	3	0	0	3
6.	PEC		Professional Elective II	3	0	0	3
7.	PEC		Professional Elective III	3	0	0	3
8.	HSC	GED 3101	Communication Skills for Career Success **	0	0	2	1
9.	PROJ	AUD 3105	Internship I ##	0	0	0	1
			Credits				**23**

SEMESTER VI

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	HSC		Humanities Elective II	2	0	0	2
2.	OEC		Open Elective I	3	0	0	3
3.	PCC	AUD 3211	Automotive Emissions and Control *	2	0	2	3
4.	PCC	AUD 3212	Battery Technology for Electric Vehicles (PBL)	3	0	0	3
5.	PCC	AUD 3213	Automotive Electrical and Electronics	3	0	0	3
6.	PCC	AUD 3214	Automotive Electrical and Electronics Laboratory **	0	0	2	1
7.	PEC		Professional Elective IV	3	0	0	3
8.	PEC		Professional Elective V	3	0	0	3
9.	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	AUD 4101	Hybrid and Electric Vehicles * (PBL)	2	0	2	3
4.	PEC		Professional Elective VI	3	0	0	3
5.	PEC		Professional Elective VII	3	0	0	3
6.	PEC		Professional Elective VIII	3	0	0	3
7.	PEC		Professional Elective IX	3	0	0	3
8.	PROJ	AUD 4102	Internship II ###				1
9.	HSC	GED 4101	Employability Skills $	0	0	2	1
			Credits				**22**

SEMESTER VIII

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PROJ	AUD 4211	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

IV SEMESTER

COMBUSTION ENGINEERING

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1	PEC	AUDX 01	Alternative Fuels and Energy Systems *	2	0	2	3
2	PEC	AUDX 02	Simulation of I.C. Engine Processes	3	0	0	3
3	PEC	AUDX 03	Combustion Thermodynamics	3	0	0	3
4	PEC	AUDX 04	Power Plant Engineering	3	0	0	3
5	PEC	AUDX 05	Heat and Mass Transfer *	2	0	2	3
6	PEC	AUDX 06	Fuel Cell Technology	3	0	0	3

V SEMESTER

AUTOMOTIVE MATERIALS AND PRODUCTION PROCESSES

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PEC	AUDX 07	Advanced Material Testing and Failure Analysis	3	0	0	3
2.	PEC	AUDX 08	Computer Aided Design and Manufacturing *	2	0	2	3
3.	PEC	AUDX 09	Design of Jigs, Fixtures and Press Tools *	3	0	2	3
4.	PEC	AUDX 10	Composite Materials for Automobiles	3	0	0	3
5.	PEC	AUDX 11	Production Process of Automotive Components *	2	0	2	3
6.	PEC	AUDX 12	Surface Engineering	3	0	0	3

AUTOMOTIVE INSTRUMENTATIONS AND DIAGNOSTICS

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PEC	AUDX 13	Homologation and Testing	1	0	0	1
2.	PEC	AUDX 14	Geometric Dimensioning and Tolerance	1	0	0	1
3.	PEC	AUDX 15	Vehicle Engineering and Integration	1	0	0	1
4.	PEC	AUDX 16	Vehicle Diagnostics	2	0	0	2
5.	PEC	AUDX 17	Automotive Instrumentation and Embedded Systems	3	0	0	3
6.	PEC	AUDX 18	Measurements and Instrumentation *	2	0	2	3

VI SEMESTER

DYNAMICS OF AUTOMOBILE

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PEC	AUDX 19	Automotive Aerodynamics	3	0	0	3
2.	PEC	AUDX 20	Computational Fluid Dynamics *	2	0	2	3
3.	PEC	AUDX 21	Finite Element Analysis of Automotive Components	3	0	0	3
4.	PEC	AUDX 22	Vehicle Design Data Characteristics *	2	0	2	3

AUTOMOTIVE OFF ROAD VEHICLE

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PEC	AUDX 23	Design of Hydraulics and Pneumatics Systems for Automotives	3	0	0	3
2.	PEC	AUDX 24	Tractor and Agricultural Machineries	3	0	0	3
3.	PEC	AUDX 25	Motorsport Engineering	3	0	0	3
4.	PEC	AUDX 26	Automotive Suspension and Steering Systems	3	0	0	3

5.	PEC	AUDX 27	Off Road Vehicle	1	0	0	1

VII SEMESTER

ELECTRIC VEHICLE AND TECHNOLOGY

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PEC	AUDX 28	Electric Vehicle Charging Station	3	0	0	3
2.	PEC	AUDX 29	Electric Bike Design, Servicing and Maintenance	3	0	0	3
3.	PEC	AUDX 30	EV Technology and Business Management	3	0	0	3
4.	PEC	AUDX 31	Advanced Driver Assistance systems	3	0	0	3
5.	PEC	AUDX 32	Connected and Autonomous Vehicle Engineering	3	0	0	3
6.	PEC	AUDX 33	Vehicle Control System	3	0	0	3
7.	PEC	AUDX 34	Modern and Intelligent Vehicle Systems	3	0	0	3
8.	PEC	AUDX 35	Vehicle Networking and Internet of things	3	0	0	3

AUTOMOTIVE SAFETY AND COMFORT SYSTEM

Sl. No.	Course Group	Course Code	Course Title	L	T	P	C
1.	PEC	AUDX 36	Automotive Safety Systems	3	0	0	3
2.	PEC	AUDX 37	Automotive Accident Investigation and Reconstruction Techniques	3	0	0	3
3.	PEC	AUDX 38	Automotive Sensors and Applications	2	0	0	2
4.	PEC	AUDX 39	Traffic Engineering	3	0	0	3
5.	PEC	AUDX 40	Automotive HVAC systems	2	0	0	2
6.	PEC	AUDX 41	Vehicle Comfort System and Ergonomics	3	0	0	3

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	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	3	0	0	3	IT

15	GEDX 115	Science and Machine Learning					
		Genetic Engineering	3	0	0	3	SLS
16	GEDX 116	Green Design and Sustainability	3	0	0	3	Civil
17	GEDX 117	Image Processing and its Applictoins	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 1181   **APPLIED PHYSICS**   L   T   P   C

SDG: 4   3   0   2   4

COURSE OBJECTIVES:

COB1: To make the students in understanding the importance of mechanics and properties of matter.

COB2: To classify the different types of crystal structures and study their defects.

COB3: To correlate the quantum mechanics principles and its impact in its application.

COB4: To introduce the basics of oscillations, optics and lasers.

COB5: To analyze the acoustics of buildings and applications of ultrasonics.

MODULE I   MECHANICS AND PROPERTIES OF MATTER   9

Moment of inertia (M.I.) - Radius of gyration - Theorems of M .I - M.I of circular disc, solid cylinder , hollow cylinder , solid sphere and hollow sphere - Elasticity – Stress-strain diagram – Factors affecting elasticity – Poisson's ratio - Twisting couple on a wire – Shaft – Torsion pendulum – Bending moment - Depression on a cantilever – Young's modulus by cantilever – Uniform and non-uniform bending – I Shape Girders-Viscosity.

MODULE II   CRYSTAL PHYSICS   9

Miller Indices-Interplanar distance-closely packed crystal structures and Diamond structures –Reciprocal Lattice -Defects in crystals: voids – Line defects - Edge and screw dislocations - Surface Defects - Crystal Growth Techniques - Bridgman method – Czochralski method (qualitative)-Polymorphism and allotropy in crystals.

MODULE III   QUANTUM MECHANICS   9

Black body radiation – Planck's theory of radiation – Deduction of Wien's displacement law and Rayleigh – Jean's law from Planck's theory –– Dual nature of matter – de-Broglie wavelength - Physical significance of wave function – Schrodinger wave equation – Time independent and time dependent wave equation – Particle in one dimensional box – Quantum computing.

MODULE IV   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 –CO_2 laser and semiconductor laser - Applications : Laser Materials Processing - Holography.

MODULE V   ACOUSTICS & ULTRASONICS   9

Basic requirement for the acoustically good halls - Reverberation and time of reverberation – Sabine's formula for reverberation time - Absorption coefficient and its measurement - Factors affecting the architectural acoustics and their remedy-Sound absorbing materials - Introduction to Ultrasonics - Properties - Production methods – MagnetostrictionOscillator method-Piezoelectric Oscillator method – Detection of Ultrasonics –Thermal method – Piezoelectric method – Kundt's tube method – Applications of Ultrasonics – Acoustic Grating – SONAR – Depth of sea – Velocity of blood flow - Ultrasonic Flaw detector.

PRACTICALS

List of Experiments

1. Determination of rigidity modulus of the given wire using Torsional pendulum.
2. Determination of young's modulus of the beam by uniform / non-uniform bending method.
3. Determination of young's modulus of the beam by cantilever method.
4. Determination of coefficient of viscosity of low viscous liquid by Poiseuille's flow.
5. Determination of coefficient of viscosity of high viscous liquid by Stoke's method.
6. To determine the frequency of an electrically maintained tuning fork using a vibration generator. (Melde's experiment)
7. Determination of thickness of a thin wire / sheet using Air Wedge method.
8. Determination of wavelength of laser light using semiconductor laser

diffraction.

9. Determination of angle of divergence of a laser beam using semiconductor diode laser and He-Ne laser.

10. Determination of particle size of lycopodium powder using semiconductor laser.

11. Determination of velocity of sound in solids using Kundt's tube method.

12. Determination of velocity of ultrasonic waves in the liquid using ultrasonic interferometer.

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.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.

2. Brij Lal and N. Subramanyam, Properties of Matter, S.Chand& Co, 2003.

3. P K. Palanisamy, Engineering Physics Vol I and II Scitech Publications (India) Pvt Ltd, 2018.

4. Serway R.A. and Jewett, J.W., Physics for Scientists and Engineers with Modern Physics, Brooks/cole Publishing Co., 2010.

5. Tipler P.A. and Mosca, G.P., Physics for Scientists and Engineers with Modern Physics, W.H. Freeman, 2007.

6. Markert J.T., Ohanian. H. and Ohanian, M., Physics for Engineers and Scientists, W.W. Norton & Co., 2007.

COURSE OUTCOMES:

CO1: grasp the importance of mechanics andthe principles of elastic behaviour of materials & apply them toanalyze the various substances based on elasticity.

CO2: get acquainted with the topics concerning types, defects in crystalstructures, methods of preparation and apply the same to categorize differentcrystal systems in real time

CO3: comprehend the importance & principles of quantum mechanics

andutilize ideas to understand working of modern devices and its variants.

CO4: know the basics of oscillations, optics and lasers and their applications.

CO5: assimilate the ideas of acoustical requirements of buildings, understand principles of ultrasonics and add values to their usefulness in acoustical design of halls and their applications.

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 1181	ENGINEERING MATERIALS AND	L	T	P	C
SDG: 9	APPLICATIONS	3	0	2	4

COURSE OBJECTIVES:
To make the students conversant with

COB1: preparation, properties and applications of various polymers and composites

COB2: synthesis, properties and applications of nanomaterials

COB3: the basic concepts and different types of catalysts involved in catalytic processes.

COB4: basic principles and its applications of certain spectroscopic techniques towards characterization of chemical compounds and concepts of photochemical processes involved in photochemical reactions.

COB5: different types of sensors and its applications.

MODULE I   POLYMER AND COMPOSITES   9

Introduction – classification: source, heat, composition and structure- glass transition temperature – synthesis, properties and applications of polycarbonate, polyurethane, teflon, ABS, kevlar, bakelite, epoxy resin, acrylic polymers (PAN) - biopolymers : importance and applications of biodegradable polymers (PLA, PHBV).

Composites- Introduction - properties and applications: fibre-reinforced plastics (glass, carbon and aramid), ceramic matrix composites (CMC) –- bio-composites.

MODULE II   NANOCHEMISTRY   9

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), bio-nanomaterials - biogenic method (synthesis of Ag, Au by plants extracts, bacteria, fungi)

MODULE III   CATALYSIS   9

Types of catalysis – Criteria for catalysts - catalysis by transition metal ions and their complexes-   solid catalyst - metal oxides and zeolites - shape selective catalysts- mechanism of catalytic action- CO oxidation, NOx and SOx reduction – Enzyme catalysis-Mechanism of enzyme action- electrocatalysis -green catalyst.

MODULE IV   PHOTOCHEMISTRY AND SPECTROSCOPY   9

Laws of photochemistry – Quantum yield -– Jablonski diagram - photophysical processes - photosensitisation – Quenching– chemiluminescence – bioluminescence

Atomic and molecular spectrum – absorption and emission spectrum - Beer Lambert's law – problems and applications – principles and applications: colorimetry, UV -vis spectroscopy (Chromophore- auxochrome, red and blue shift), atomic absorption spectroscopy, IR spectroscopy (finger print region, functional group interpretation)

MODULE V   SENSORS   9

Sensors – types: bio and toxic chemicals sensors- principle, working and applications of Electrochemical sensors: MEMS and NEMS, - Biosensors- construction, working and classification, Advantages - Biochips - touch sensor (oxi and gluco meter) - Advanced sensors: Smoke and gas sensors, humidity sensors, temperature sensor and alcohol sensor.

PRACTICALS
List of Experiments

1. Preparation of polymers – phenol-HCHO, urea-HCHO, polylactic acid, epoxy resin
2. Determination of molecular weight and degree of polymerization using Oswald'sviscometer.
3. Synthesis of nano-ZnO and CuO by precipitation
4. Demonstration of Laser ablation techniques for nanomaterials.
5. Electrochemical synthesis of graphene oxide
6. One-pot synthesis using green catalyst.
7. Green synthesis: Photocatalytic reactions, solvent - free organic reaction - Aldol; green oxidation, green reduction.
8. Diels - Alder reaction in eucalyptus oil (green process).
9. Spectrophotometer iron estimation.(Beer Lambert's law) determination of Fe^{3+}

10. FT-IR spectral characterisation (functional group interpretation)

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.
2. G.A. Ozin and A.C. Arsenault, "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, Thomas Graham House, Cambridge,2012.
3. B. Viswanathan, S. Sivasanker and A.V. Ramaswamy (Editors), Catalysis: Principles and Applications, Narosa Publishing House, 2002.
4. Gadi Rothenberg, Catalysis: Concepts and Green Applications, WILEY-VCH
5. Nicholas J. Turro, V.Ramamurthy and Juan C. Scaiano, Principles of molecular photochemistry: An introduction, University Science Books, Sausalito, CA, 2009.
6. John Vetelino, AravindReghu , Introduction to Sensors By · 2017.

REFERENCES:

1. John S. Wilson, Sensor Technology Handbook, Elsevier 2005.

COURSE OUTCOMES:

The students will be able to

CO1: enumerate and compare the preparation, properties and applications of various types of polymers and composites.

CO2: synthesize different type of nanomaterials on a commercial scale based on its size and applications.

CO3: apply the concepts of spectroscopic techniques towards spectral interpretation for identification of compounds and explain various photochemical processes in photochemical reactions.

CO4: Impart types, characteristics and applications of different types of catalyst.

CO5: categorize the sensors and its applications to real time situation.

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

11thBoS of Chemistry held on 17.06.2021   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	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	M	-	-	-	-	-	-	-	-
CO4	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	M	-	-	-	-	-	-	-	-	-	-	-

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

SDG 9: To support scientific & technology development and innovation of materials and electronic devices.

Introduction of basics on various materials and electronic devices towards innovation on new technology.

MAD 1181

SDG: 4

ALGEBRA AND DIFFERENTIAL CALCULUS

L	T	P	C
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   9+3
**   VARIABLES**

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; P – 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) :

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
CO1	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	M	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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 Engineering problems

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):

18thBoS 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

SDG: 9

MANUFACTURING PRACTICES LABORATORY

L	T	P	C
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:**
18thBoS 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	L	T	P	C
SDG: 8	PROBLEM SOLVING	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   05
OPERATIONS

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,Stephen 2011. Academic Writing: A practical guide for students, New York, Rutledge.

6) Redston, Chris&Gillies (2005). Cunningham Face2Face (Pre-intermediate Student's Book&Workbook) Cambridge University Press, New Delhi.

7) Dutt P. Kiranmai and 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) :   **Academic Council:**

13[th]BoS of Department of English   17th AC held on 15.07.2021

held on 17.6.2021

	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 1283

SDG: 4

PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

COB1: To formulate and solve partial differential equation of first, second and higher orders

COB2: To introduce basics and engineering applications of Fourier series

COB3: To develop Fourier transform techniques

COB4: To introduce techniques and engineering applications of Laplace Transforms

COB5: To acquaint with Z -Transform techniques for discrete time systems

MODULE I   PARTIAL DIFFERENTIAL EQUATIONS   9+3

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

MODULE II   FOURIER SERIES   9+3

Fourier Series and Dirichlet's conditions - General Fourier series – Even and Odd functions - Half range Fourier series - Parseval's identity - Harmonic Analysis

MODULE III   FOURIER TRANSFORMS   9+3

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

MODULE IV   LAPLACE TRANSFORM   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

MODULE V   Z – TRANSFORM   9+3

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

L – 45; T – 15; Total Hours– 60

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: form and solve the partial differential equations

CO2: derive a Fourier series of a given periodic function by evaluating Fourier coefficients

CO3: apply integral expressions for the forward and inverse Fourier transform to a range of non-periodic waveforms

CO4: solve ordinary differential equations using Laplace transforms

CO5: Solve difference equations using Z-transform

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
CO1	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-

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 Partial differential equations and transform techniques will help to solve complicated engineering problems

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: determine the properties of surfaces
CO4: analyse and evaluate the frictional forces between the bodies

CO5: apply the laws of motion in solving dynamics problems

Board of Studies (BoS):
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.

**BASIC ELECTRICAL AND
ELECTRONICS ENGINEERING**

L	T	P	C
3	0	2	4

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 & 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 & 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   14
                APPLICATIONS**

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) :   **Academic Council:**

15th meeting of BoS of EEE held on   17th AC held on 15.07.2021
25.06.2021

	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	-	-	-
CO2	H	-	H	L	M	-	M	-	L	L	M	L	-	-	-
CO3	H	-	H	L	-	-	M	-	L	L	M	L	-	-	-
CO4	H	-	H	L	-	-	M	-	L	L	M	L	-	-	-
CO5	H	-	H	L	-	-	M	-	L	L	M	L	-	-	-

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.

AUD 1211   **FLUID MECHANICS**   **L   T   P   C**

SDG: 9   **3   0   0   3**

COURSE OBJECTIVES:

COB1: To have a working knowledge of the basic properties of fluids.

COB2: To understand the mass equation, energy equation and bernoulli's equation.

COB3: To understand the losses in flow through pipes.

COB4: To gain knowledge in dependent and independent variables for a model of flow and to understand boundary layer concept.

COB5: To understand the working of pumps and turbines

MODULE I   FLUID PROPERTIES AND HYDROSTATICS   9

Fluid properties: Mass density, specific weight, specific volume, specific gravity, viscosity, vapour pressure, compressibility, surface tension and capillarity. Fluid statics: fluid pressure at a point, variation of pressure within a static fluid, hydrostatic law - Pressure head, Pascal's law. Measurement of pressure - Piezometric tube, manometry.

MODULE II   FLUID DYNAMICS   9

Control volume – Fluid Kinematics - Types of flows; Steady flow, Unsteady flow, Uniform and Non Uniform flow, Rotational flow, Irrotational flow, 1-D, 2-D, 3-D flows– Streamline and Velocity potential lines- Euler and Bernoulli's equations and their applications – moment of momentum – Momentum and Energy correction factors – Impulse – Momentum equation-Navier-Stokes Equations-Applications.

MODULE III   OPEN CHANNEL FLOW   9

Flow through pipes – Open Channels and Measurement pipe flow: Darcy's law – Minor losses – Multi reservoir problems – pipe network design – Moody's diagram – Hagen Poiseuille equation – Turbulent flow. Specific Energy – Critical flow concept – specific force – Hydraulic jump – uniform flow and gradually varying flow

MODULE IV   DIMENSIONAL ANALYSIS & BOUNDARY LAYERS   9

Dimensional homogeneity – Raleigh and Buckingham theorems – Non-dimensional numbers – Model laws and distorted models - Unit quantities - Specific quantities - Boundary layer development on a flat plate and its characteristics - Boundary layer thickness, displacement thickness,

momentum thickness, energy thickness layer separation and its control.

MODULE V   TURBOMECHINERY   9

Pumps: classification, difference between positive and non-positive displacement pumps. Construction and working of reciprocating pump. Centrifugal pump-heads of a centrifugal pump, priming, velocity triangle, work done, efficiencies of centrifugal pump. Hydraulic turbine: Classification, difference between impulse and reaction turbine. Construction and working of Pelton turbine, Francis turbine and Kaplan turbine.

L – 45 ; Total Hours- 45

TEXT BOOKS:

1. Rajput.R.K, "A text book of Fluid Mechanics and Hydraulic Machines", S. Chand & Company Ltd., New Delhi, Revised edition-2019.
2. Dr.R.K. Bansal, Fluid Mechanics and Hydraulic Machines, , Laxmi Publication (P) Ltd., New Delhi, Tenth edition - 2000.

REFERENCES:

1. P.N.Modi and S.M.Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House, Naisarak, Delhi, 1999.
2. YunusCengel and John Cimbala, "Fluid Mechanics: Fundamentals and Applications" McGraw Hill Education, 4th edition.
3. Pijush Kundu, Ira Cohen and David Dowling, "Fluid Mechanics", Academic press – Elseiver, 6th Edition.
4. Vijay Gupta and S.K.Gupta, "Fluid Mechanics and Applications, New-Age International Ltd., 1999.

COURSE OUTCOMES:

CO1: Student should be able to determine the properties of fluids and should able to apply the hydrostatic laws.

CO2: Student should be able to solve fluid flow problems by applying mass, energy, and bernoulli's equation.

CO3: Student should be able to calculate the losses in fluid flow through pipes.

CO4: Student should be able to find the dependent and independent parameters for a model of fluid flow and to apply the boundary layer concept to fluid flow.

CO5: To demonstrate the construction and working of pumps and turbines.

Board of Studies (BoS) :

12thBoS of Automobile Engg. held on
28.06.2021

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
CO1	H	L	L	L									M	M
CO2	H	L	L	L									M	M
CO3	H	L	L	L									M	M
CO4	H	L	L	L									M	M
CO5	H	L	L	L									M	M

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

SDG No. 9: To enhance scientific research and development in fluids.

Statement: The deep understanding of mechanics of fluid helps in development of new ideas in the field of fluids.

AUD 1212 **FLUID MECHANICS LABORATORY** L T P C

SDG: 9 0 0 3 1

COURSE OBJECTIVES:

COB1: To learn about the various measurements of fluid parameter.

COB2: To verify the laws of fluid mechanics.

COB3: To study the performance of various pumps.

COB4: To study the performance of various turbines.

COB5: To learn about the flow pattern of laminar and turbulent flow.

PRACTICALS

List of Experiments:

1. Comparison of Coefficient of Discharge of given Orifice meter and venturi meter.
2. Calibration of Rota meter.
3. Determination of friction factor for the given set of pipes
4. Performance study of centrifugal pumps / Submersible pumps.
5. Determination of maximum efficiency for the given reciprocating pump.
6. Characteristic curves for Gear pump / Vane pump.
7. Determination of maximum power at constant speed / constant load for an impulse turbine.
8. Performance characteristic of Reaction turbine.
9. Impact of jet on flat and curved vanes.
10. Verification of Bernoulli's theorem.
11. Performance test on a jet pump.
12. Flow visualization:- Laminar and Turbulent flows.
13. Flow visualization and pressure measurement on aero-foil.

P – 45; Total Hours– 45

TEXT BOOKS:

1. Sarbjit Singh, "Experiments in Fluid Mechanics", PHI publishers, India, 2009.(ISBN: 978-8120337626)

REFERENCES:

1. Robabehjazaei, "Fluid Mechanics Experiments", Morgan and claypool Publishers, United States, 2020. (ISBN: 1681739283).
2. Habib Ahmari and Shah Md Imran Kabir, "Applied Fluid Mechanics Lab Manual", Mavs Open Press, Arlington, 2019.(ISBN: 978-1-64816-997-7).

3. 1. Bireswar Majumdar, "Fluid Mechanics with Laboratory Manual", PHI publishers, India, 2013.

COURSE OUTCOMES:

CO1: Students should able to demonstrate the procedure for measuring important parameters of the fluid flows.

CO2: Students should able to prove laws of fluids

CO3: Students should be able to run and calculate the performance of the pumps.

CO4: Students should be able to run and calculate the performance of the turbines.

CO5: Student should able to differentiate and analyze the laminar and turbulent flow.

Board of Studies (BoS) :

12th BoS of Automobile Engg. held on 28.06.2021

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
CO1	H	L	L	L									M	M
CO2	H	L	L	L									M	M
CO3	H	L	L	L									M	M
CO4	H	L	L	L									M	M
CO5	H	L	L	L									M	M

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

SDG No. 9: To enhance scientific research and development in fluids.

Statement: The experimental study provides better knowledge about the properties of fluid that helps in creating new ideas for applications

GED 1206	**ENVIRONMENTAL SCIENCES**	L	T	P	C
SDG: All		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   8
                 MANAGEMENT

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   6
                ISSUES

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

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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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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

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

SEMESTER III

AUD 2101   ENGINEERING THERMODYNAMICS   L   T   P   C

SDG: 12   3   1   0   4

COURSE OBJECTIVES:
   COB1: To learn the basic concept, zeroth and first law of thermodynamics.
   COB2: Impart the knowledge on the second law of thermodynamics and availability.
   COB3: To learn the properties of pure substance, phase change process, steam quality and work done and heat transfer by the steam.
   COB4: To learn ideal gas and vapour cycles.
   COB5: To impart the knowledge of thermodynamics relations of gas mixtures.

**MODULE I   INTRODUCTORY CONCEPTS, ENERGY AND THE   9+3
                FIRST LAW OF THERMODYNAMICS**

Review of fundamental concepts, Thermodynamic systems, Properties and processes, Zeroth law, Concept of temperature and Temperature Scales, Thermodynamic equilibrium, Quasi equilibrium process, Displacement work, PV diagram, Energy transfer by work and heat, First law thermodynamics, Energy balance for the closed and open systems, Application to closed and open systems, steady and unsteady flow processes.

MODULE II   THE SECOND LAW OF THERMODYNAMICS   9+3

Introduction to the second law of thermodynamics – Thermal reservoirs – Heat engines – Kelvin Planck statements – Refrigerators and heat pumps - Clausius statement - Perpetual motion machines – Reversible and irreversible processes – The Carnot cycle and principles – Entropy - T-s diagram - Tds Equations - Entropy change for a pure substance - Availability for open and closed system processes.

MODULE III   PROPERTIES OF PURE SUBSTANCES   9+3

Pure substance – Phase change of a pure substance – Phase change processes of pure substance (T-v, P-v, P-T and P-v-T diagram) – Property table – Enthalpy – Saturated liquid and vapor states – Saturate liquid and vapor

mixture – Super heated vapor – Compressed liquid – Ideal gas equation of state - Determination of dryness fraction. Calculation of work done and heat transfer in non-flow and flow processes using Steam Table and Mollier Chart.

MODULE IV   GAS POWER CYCLE   9+3

Basics of power cycles – Air standard assumption – Otto cycle – Diesel cycle – Brayton cycle - Rankine cycle – Regenerative Rankine cycle.

MODULE V   GAS MIXTURE AND THERMODYNAMIC   9+3
RELATIONS

Properties of Ideal gas, real gas - comparison. Equations of state for ideal and real gases. Vander Waal's relation - Reduced properties - Compressibility factor - Principle of Corresponding states - Generalized Compressibility Chart. Maxwell relations - Tds Equations - heat capacities relations - Energy equation, Joule-Thomson experiment - Clausius-Clapeyron equation.

L – 45 ; T - 15 ; Total Hours – 60

TEXT BOOKS:
1. Boles, Michael   A., and Cengel, Yunus   A., Thermodynamics: An Engineering Approach. India, McGraw-Hill Education, 2015.
2. Nag, P.   K., Engineering   Thermodynamics. India: Tata   McGraw Hill, 2005.

REFERENCES:
1. Bailey, Margaret   B., Shapiro, Howard   N., Boettner, Daisie D., Moran, Michael   J., Fundamentals   of   Engineering Thermodynamics. United Kingdom: Wiley, 2014.
2. Borgnakke, Claus., Sonntag, Richard E.. Borgnakke's Fundamentals of Thermodynamics. United States: Wiley, 2018.

COURSE OUTCOMES:
After Completion of this course the student will able to:
CO1: apply and calculate the energy balance of thermodynamic systems.

CO2: analyze the systems with second law of thermodynamics.

CO3: evaluate the steam quality of pure substance.

CO4: analyze the various gas power cycles used in internal combustion engine.

CO5: compute the thermodynamic properties.

Board of Studies (BoS) :

13thBoS of Auto held on15.12.2021

Academic Council:

18th AC held on 24.02.2022

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

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

SDG No.12: Ensure the sustainable energy consumption and production patterns.

Statement : To understand, evaluate and develop the efficiency of energy consumption system.

AUD 2102 **STRENGTH OF MATERIALS** L T P C

SDG: 9 3 1 0 4

COURSE OBJECTIVES:

COB1: To gain knowledge of simple stresses, strains and deformation in components.

COB2: To assess forces, stresses, and bending moment of beams.

COB3: To evaluate the deflection of beams.

COB4: To gain knowledge in the torsion of circular bars.

COB5: Impart knowledge on two dimensional stresses.

MODULE I **CONCEPT OF STRESSES AND STRAINS** **9+3**

Rigid and Deformable bodies, Elastic constants, Stresses: Tensile, Compressive and Shear, Deformation of simple and compound bars under axial load, Thermal stresses and strain.

MODULE II **ANALYSIS OF BEAMS** **9+3**

Types of beams: Supports and loads, Shear force and bending moment diagrams, Cantilever and simply supported, Stresses in beams, Theory of simple bending.

MODULE III **DEFLECTION OF BEAMS** **9+3**

Relationship between deflection, slope and radius of curvature, Evaluation of beam deflection and slope: Double integration method, Macaulay method, and Moment-area method.

MODULE IV **TORSION OF SHAFTS** **9+3**

Analysis of torsion of circular bars, Bars of solid and hollow circular section, Stepped shaft, Twist and torsion stiffness, Columns and Struts, Eulers theory & Rankine's theory.

MODULE V **TWO DIMENSIONAL STRESSES** **9+3**

Principal plane, Principal stress, Analytical method: Direct stress in two mutually perpendicular directions accompanied by a simple shear stress. Mohr's circle: direct stress in two mutually perpendicular directions with and without shear stress, Thin cylindrical and spherical shells, Volumetric strains.

L – 45; T – 15; Total Hours – 60

TEXT BOOKS:

1. Ferdinand Pierre Beer, Johnston,"Mechanics of Materials,McGraw-Hill, 2012.
2. Russell C. Hibbeler, "Mechanics of Materials", 10th Edition, Pearson, 2017.
3. R. K. Bansal, "A Textbook of Strength of Materials (in S.I. Units)", Laxmi Publications, 2010.

REFERENCES:

1. D.K. Singh, **"**Strength of Materials", 4th edition, Springer International Publishing, 2020.
2. Egor P. Popov, Toader A. Balan, "Engineering Mechanics of Solids", Pearson India Education Services, 2018.
3. Timoshenko S.P, Elements of Strength of Materials, Tata McGraw-Hill, New Delhi 1997.
4. Ray Hulse, Keith Sherwin & Jack Cain,"Solid Mechanics", Palgrave ANE Books, 2004.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: analyze the simple stresses, strains and deformation in components.

CO2: compute and analyze the shear forces & bending moments of beams.

CO3: evaluate the effect of beam deflection.

CO4: compute the variable parameters related to columns.

CO5: analyze the two dimensional stresses.

Board of Studies (BoS) :   **Academic Council:**
13th BoS of Auto held on15.12.2021   18th AC held on 24.02.2022

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

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

SDG 9: This subject will be a pre-requisite for understanding and designing of different automobile parts with appropriate technology.

The understanding of stress, strain, deformation, and mechanics of the materials will lead to effective designing of automotive components.

AUD 2103   **MANUFACTURING PROCESSES**   L   T   P   C

SDG: 9   **(PBL)**   2   0   2   3

COURSE OBJECTIVES:

COB1: To know about the casting processand its types

COB2: To know about the functions of lathe machine

COB3: To study about the various types of welding process

COB4: To enable students understand about the types of sheet metal forming process

COB5: To understand the different methods of plastic components manufacturing.

MODULE I   METAL CASTING PROCESS   6

Casting: Sand casting process, Pattern types, materials and allowances, Mold making and properties of moulding sand, Shell casting and die casting process, Defects in castings.

MODULE II   TURNING MACHINES   6

Centre Lathe Machine: Constructional features / Parts and Functions of lathe, working principle, specifications, various operations, different types of lathe.

MODULE III   METAL JOINING PROCESSES   6

Fundamentals, Types of welding - Gas welding, Arc Welding, MIG and TIG welding, Resistance welding, Friction welding, Applications, Welding defects.

MODULE IV   METAL FORMING PROCESS   6

Sheet metal forming Process: Sheet metal characteristics, Typical shearing, bending and drawing operations, dies and presses, Stretch forming, roll bending, spinning operations. High Energy Rate Forming processes: Explosive forming, Electromagnetic forming.

MODULE V   MANUFACTURE OF PLASTIC COMPONENTS   6

Types and characteristics of plastics – Molding of thermoplastics – working principle, Injection moulding, Compression and transfer moulding, Blow moulding, Rotational molding, Film blowing, Thermoforming, 3D printing, Typical industrial applications.

PRACTICALS

List of Lab Experiments:

1. Turning
   - Turning, Step turning and taper turning operations
   - Single start V thread and knurling operations
2. Sand casting
   - Dumble mould
   - Flange mould
3. Welding
   - Lap/Butt Joint
   - T Joint
4. Sheet metal
   - Tray shape
   - Funnel shape
5. Shaping of plastics
   - Plastic Bottle by blow moulding machine
   - Chair Bushes by injection moulding machine (Demo)
   -

L – 30 ; P – 30 ; Total Hours – 60

TEXT BOOKS:

1. Serope Kalpakjian, Steven R. Schmid, "Manufacturing Engineering and Technology", Publisher: Prentice Hall, 6th Edition, India, 2013.

REFERENCES:

1. P. N. Rao, "Manufacturing Technology (Volume 1) – Foundry, Forging and Welding", Tata McGraw Hill Education, 4th Edition, New Delhi, 2013.
2. Mikell P. Groover, "Fundamentals of Modern Manufacturing Materials, Processes and Systems", Publishers: Wiley India, 2012.

COURSE OUTCOMES:

Upon successful completion of the course the students will be able to

CO1: identify a suitable process for making a product using casting

CO2: identify a suitable operation for making a component using lathe machine

CO3: select an appropriate welding process & its parameters for joining of
metals

CO4: assess a suitable metal forming process for making an industrial
product

CO5: identify a suitable manufacturing process for fabricating plastic
Products

Board of Studies (BoS) :   **Academic Council:**
13ᵗʰBoS of AUTO held on 15.12.2021   18th AC held on 24.02.2022

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

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

SDG 9. Having an ability to manufacture a component or an automotive
product by appropriate technology applying all the relevant standards and
with realistic constraints, including public health, safety, society and
environment.

Statement : The holistic understanding of the course related concepts will
lead to identify and evaluatedifferent manufacturing process for an
automobile.

AUD 2104 **AUTOMOTIVE ENGINES** L T P C

SDG: 7 3 0 2 4

COURSE OBJECTIVES:

COB1: To understand the basic concepts and working of internal combustion engines.

COB2: To understand the fuel and ignition systems.

COB3: Study the combustion processes of SI and CI engines.

COB4: Study the concept of lubrication and cooling systems.

COB5: To understand the exhaust and supercharger systems.

MODULE I **ENGINE TERMINOLOGY, CYCLES AND** **9**
  OPERATION

Introduction, Engine Classifications, Terminology and abbreviation,Engine Components, Spark ignition engine operation, Compression ignition engine operation, Type of engines, Valve and port timing diagram, VVT and types , Scavenging methods.

MODULE II **FUEL SYSTEM AND IGNITION SYSTEM** **9**

CI engine Fuel system : Inline pump, Distributor pump, unit injection system, CRDI injection system, Types of nozzle, CRDI injector nozzle, Type of feed pump,Fuel filters.
SI engine Fuel system : carburetor, Throttle body injection, Port fuel injection, MPFI injection, GDI, Stratified charge engine.
SI Engine Ignition System : Magneto coil ignition system and Battery coil ignition system; Electronic ignition system, TCI and CDI system, Spark Advance mechanism.

MODULE III **COMBUSTION** **9**

Turbulence, Swirl ,Squish and Tumble, Combustion chamber; open combustion chamber and divided combustion chamber, Types of combustion chamber , Combustion in SI engine, Combustion in divided chamber engine, Factors affecting flame front, Knocking in SI engine, Factors of affecting knocking, Combustion in CI engine, Knocking in CI engine, Factor affecting Knocking in CI engine.

MODULE IV **COOLING SYSTEM AND LUBRICATION SYSTEM** **9**

Cooling System : Air cooled engine, liquid cooled engine, thermostat, water pump.
Lubrication system : Lubrication oils and properties, Mist ,Dry and wet lubrication, Oil pump, type of oil pump, Oil filter.

MODULE V   TURBOCHARGERS AND OPERATING   9
CHARACTERISTICS

Blow down, Methods of power boosting; Compressors,Turbines, Types of supercharging and turbocharging, Variable geometry turbocharger, Inter cooler, EGR. Engine parameters; Work, Mean effective pressure, Torque and Power, Type of Dynamometers, Air and fuel ratio, Engine efficiency, Volumetric efficiency, Friction power,

PRACTICALS
List of Experiments

1. Dismantling and assembling of 3 cylinder petrol engine.
2. Dismantling and assembling of 4 cylinder diesel engine.
3. Study of oil filter, fuel filter, fuel injection system, carburettor, MPFI
4. Study of ignition system components – coil, magneto and electronic ignition systems.
5. Study of engine cooling system components
6. Study of engine lubrication system components
7. Ovality and taper measurement of cylinder bore and comparison with standard specifications
8. Ovality and taper measurement of engine crank shaft and comparison with standard specification

L – 45 ; P – 30 ; TOTAL HOURS – 75

TEXT BOOKS:
1. Ganesan, V., Internal Combustion Engines. India, McGraw-Hill Education (India) Private, 2012.
2. Pulkrabek, Willard W., Engineering Fundamentals of the Internal Combustion Engine. United Kingdom, Pearson Higher Education & Professional Group, 2013.

REFERENCES:
1. Heywood, John. Internal Combustion Engine Fundamentals 2E. Greece, McGraw-Hill Education, 2018.
2. Stone, Richard. Introduction to Internal Combustion Engines. United States, SAE International, 2012.
3. Kirkpatrick, Allan T., and Ferguson, Colin R., Internal Combustion Engines: Applied Thermo sciences. United Kingdom, Wiley, 2015.
4. Wellington, Barry F., Diesel Engines and Fuel Systems. Australia, Angel Key Publications Pty Limited, 2019.

COURSE OUTCOMES:

After Completion of this course the student will able to:

CO1: Identify and explain the working of automotive engines.

CO2: Select a suitable fuel and ignition system for automobile engines.

CO3: Analyze the combustion parameters of engines.

CO4: Select the lubrication and cooling systems for engine.

CO5: Evaluate the performance of automotive engines.

Board of Studies (BoS) :

13th BoS of AUTO held on 15.12.2021

Academic Council:

18th AC held on 24.02.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	H	H	H	L	L	M					L	M	H	H
CO2	H	H	H	L	L	M					L	M	H	H
CO3	H	H	H	L	L	M					L	M	H	H
CO4	H	H	H	L	L	M					L	M	H	H
CO5	H	H	H	L	L	M					L	M	H	H

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

SDG No 7: Ensure access to affordable, reliable, sustainable and modern energy for all.

Statement :   The holistic understanding of automotive engines will leads to optimal usage of fossil fuels.

| AUD 2105 | **AUTOMOTIVE COMPONENT MODELLING** | L | T | P | C |
| SDG: 9 | **LABORATORY** | 0 | 0 | 2 | 1 |

COURSE OBJECTIVES:

COB1: To familiarise with modelling software for modelling of engine components

COB2: To model the chassis components with dimensions.

COB3: To learn the use of standard practices in modelling of components.

COB4: To visualize the complete assembly of the various system.

COB5: To model a complete car body with dimensions

PRACTICALS

List of Experiments:

14. 2D – Drawing
15. 3D - Modelling
16. Modelling of piston, piston pin and piston rings.
17. Modelling of the connecting rod assembly.
18. Modelling of the crankshaft assembly.
19. Modelling of propeller shaft with universal joint.
20. Modelling of leaf spring
21. Modelling of helical spring
22. Modelling of Alloy wheel rim
23. Modelling of an oil pump
24. Modelling of a Disc brake
25. Modelling of a car body with dimensions

Any one of the 3D MODELING software's like PTC CREO, CATIA, Simens NX

P – 45 ; Total Hours – 45

TEXT BOOKS:

1. Bhatt .N.D. and PANCHAL.V.M. "Machine Drawing", Charotar Publishing House, 388001, 53rd Edition, 2014.
2. K.R. Gopalakrishnan., "Machine Drawing", 27th Edition, 2017.
3. JaecheolKoh., "CATIA V5 Design Fundamentals", 2nd Edition, ONSIA, 2012, (ISBN: 1477689028).
4. Randy Shih, "Parametric Modeling with Siemens NX" ,2019 Edition, SDC Publications,(ISBN : 1630572802)

REFERENCES:

1. Sham Tickoo Purdue Univ, "NX 11.0 for Designers"Dennis Fitzpatrick",2016, Cadcim Technologies, ISBN: 1942689780

2. Brain Griffiths., "Engineering Drawing for Manufacture", Elsevier, 2002, (ISBN : 008050566X)

3. D.E. Hewitt., Engineering Drawing and Design for Mechanical

4. David L., Goetsch Williams Chaulk John A., Nelson, TechnicalDrawing (Drafting and Design) Savee Informatics.

COURSE OUTCOMES:

Students should be able to

CO1: use various tools for modelling engine components

CO2: create various models of chassis components

CO3: create a part or component model with standard practices

CO4: assemble various components into a complete one

CO5: modify any changes in car body model

Board of Studies (BoS) :	**Academic Council:**
13th BoS of AUTO held on 15.12.2021	18th AC held on 24.02.2022

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

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

SDG No.9: To perform scientific research in automobiles.

Statement: 9 The software knowledge obtained through practical sessions helps the students to improve the skills in modification of in existing automobile and also to design a new concept car.

GED 2101

SDG: 17

ESSENTIAL SKILLS AND APTITUDE FOR ENGINEERS

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

COB1: To enable them to make effective business presentations

COB2: To train them to participate in group discussions

COB3: To enhance the problem-solving skills

COB4: To train students in solving analytical problems

MODULE I   ORAL DISCOURSE   07

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

MODULE II   VERBAL COMMUNICATION   08

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

MODULE III   BASIC NUMERACY   08

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

MODULE IV   ANALYTICAL COMPETENCY   07

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

P – 30; TOTAL HOURS - 30

REFERENCES:

1. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK
2. Swan, Michael (2005). Practical English Usage, Oxford University Press
3. Bhattacharya. Indrajit (2008). An Approach to Communication Skills, DhanpatRai& Co., (Pvt.) Ltd. New Delhi.
4. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company

Pvt. Limited, 2009

5. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017

6. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning , S. Chand Limited, 2010

7. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016

8. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018

9. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

COURSE OUTCOMES:

CO1: Make effective business presentations
CO2: Speak English intelligibly, fluently and accurately in group discussions
CO3: To apply the various problem-solving techniques
CO4: Understand and solve aptitude problem

Board of Studies (BoS) :
13[th]BoS of the 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	PSO 1	PSO 2	PSO 3
CO1										H					
CO2									M	H					
CO3					L	L									
CO4		M		L											
CO5															

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

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

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

AUD 2211	TWO AND THREE WHEELERS	L	T	P	C
SDG: 9	TECHNOLOGY (PBL)	3	0	0	3

COURSE OBJECTIVES:

COB1: To gain the knowledge about the fundamentals, constructional and design aspects of two and three wheelers.

COB2: To develop the ability to know the operating characteristics of two and three wheelers steering and transmission systems.

COB3: To know the working principle of different types of suspension, brakes and wheels.

COB4: To impart knowledge about the frames and body structures.

COB5: To know about the working of electrical vehicle.

MODULE I   Fundamentals of Two And Three Wheeler   9

History of two & three wheeler vehicles. Classification & layouts of two wheelers (motorcycles, scooters, mopeds) and Three wheelers vehicles (by applications – goods/passengers, carriage capacity). Selection criteria and Design considerations for two wheeler & three wheeler engines. Systems requirements for Engine lubrication, cooling & starting (Kick starter mechanism, Moped cranking mechanism & Button Start mechanism).

MODULE II   Steering and Transmission System   9

Clutch – requirements; different types -need of primary reduction, selection of transmission – gear transmission, gear shift mechanism, belt transmission, types of automatic transmission (Continuous Variable Transmission – CVT),final drive and differential for three wheeler. Need and requirements of steering system and geometry, steering column construction; steering system for three wheelers, controls on handle bar of two wheelers.

MODULE III   Suspension and Brakes   9

Suspension requirements- design considerations- Front and rear suspension systems layouts – telescopic fork and its types, swing arms – shock absorber – single and twin, Springs and dampers, Design consideration of brake-types of brakes: disc; drum; braking mechanism: mechanical; hydraulic and servo; ABS in two wheelers, Front and rear brake link lay-outs.

MODULE IV   Frames and comfort   9

Main frame and its types, Diamond frame, Cradle frame, Back bone frame, Under bone frame. Types of frame- construction, loads acting on frame; design consideration; materials; three wheeler layout; aerodynamic; aesthetic and ergonomics considerations regulations. Handling characteristics; driver and pillion seating arrangement; ergonomics and comfort; road holding and vehicle stability; gyroscope effect; riding characteristics and performance measurements.

MODULE V   Electric Two and Three Wheelers   9

Recent developments in two and three Electric Vehicles, Driveline layout of electric two and three wheeler, electric motors, motor controller, battery management system, battery specifications, Charging system.

L – 45; Total Hours – 45

TEXT BOOKS:

1. Dhruv U Panchal, Two and Three Wheeler Technology, 20 August 2015.

REFERENCES:

1. Dole Manoj, Mechanic Two & Three Wheeler Training, March 2021.
2. Smith Manilal Solanki, Two and Three Wheeler Technology, January 2019.
3. Irvind, P.E., Motor cycle Engineering, Temple Press Book, London, 2000.

COURSE OUTCOME-

On completion of the course students should be able to

CO1: explain the constructional details of various types of two and three wheelers design.

CO2: analyze the requirement and performance of the two and three wheelers.

CO3: demonstrate the working of suspension, braking, wheels and tyres.

CO4: identify the design consideration of frames.

CO5: apply the drive-line controllers and battery management system for two and three wheelers.

Board of Studies (BoS) :
13thBoS of AUTO held on 15.12.2021

Academic Council:
18th AC held on 24.02.2022

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

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

SDG 9: This course will lead to effective understanding of two and three wheeler's steering, transmission, suspension, brakes powered by fossil fuel and electrical energy.

The understanding of this course will lead to the design of two and three wheeler vehicles.

AUD 2212

SDG: 9

AUTOMOTIVE MATERIALS AND METALLURGY	L	T	P	C
	2	0	2	3

COURSE OBJECTIVES:

COB1: To impart knowledge on the structure, properties, phase diagrams and applications of materials so as to identify and select suitable materials for various engineering applications.

COB2: To study about the structure, properties and applications of various materials like ferrous, non-ferrous and its alloys.

COB3: To give insight in to non-metallic materials such as polymers, ceramics and composites.

COB4: Impart the students to investigate, analyze and provide solutions using heat treatment process and strengthening mechanism.

COB5: To develop knowledge on the mechanical properties of materials through various testing procedures in engineering field.

MODULE I   CRYSTALLOGRAPHY, CONSITITUTION OF METAL AND METAL ALLOYS   6

Fundamentals, Crystal structure – Types, Crystal imperfections, Grain size, Constitution of alloys, Lever Rule, Solid solutions-substitutional and interstitial. Phase diagrams - Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron – Iron carbide equilibrium diagram, Development of Microstructure in Iron–Carbon Alloys.

MODULE II   FERROUS AND NON FERROUS METALS   6

Plain carbon steel and cast iron – classification, microstructure, properties and applications. Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W). Stainless steel, tool steels, HSLA and Maraging steel - properties and applications, Copper and its alloys. Aluminium and its alloys, Magnesium and its alloys, Titanium and its alloys – microstructure, properties and applications.

MODULE III   NON-METALLIC MATERIALS   5

Properties and Applications of various Engineering Polymers, Properties and applications of various Ceramics, Composites and their types, properties and

applications.

MODULE IV   HEAT TREATMENT AND STRENGTHENING   7 MECHANISMS

Fundamentals, Classification of processes - Full annealing, normalizing, Hardening and tempering of steel. Isothermal transformation diagrams, Continuous Cooling Transformation Diagrams. Case hardening processes - carburising, nitriding, cyaniding, carbo nitriding, Flame and Induction hardening. Grain size strengthening, Solid solution strengthening, strain hardening, yield point phenomenon, dispersion strengthening, fibre strengthening, precipitation strengthening.

MODULE V   MECHANICAL PROPERTIES AND TESTING   6

Mechanism of plastic deformation, slip and twinning, types of fracture. Testing of materials: ASTM standards, Metallographic Examination, Hardness tests, Impact test Tension test, Wear test, Fatigue test and Creep test.

PRACTICALS
List of Lab Experiments
1. Metallographic Examination-Demonstration and Practice
   a. Study of metallurgical microscope.
   b. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.
   c. Selections of etchants for various metals and alloys.
2. Identification of microstructures of Plain Carbon Steel, Tool Steel, Gray C.I, SG Iron, Aluminium, Bronze.
3. Heat treatment: Annealing, normalizing, hardening of steel by Quenching - Hardness and its microstructure.
4. Study of microstructure of welded (HAZ) and cast component.
5. Harden ability test - Jominy End quench test.
6. Tension test
7. Compression test
8. Torsion test.
9. Deflection test
10. Impact test
11. Double shear test

L – 30 ; P – 30 ; Total Hours – 60

TEXT BOOKS:

1. W.D. Callister, David G. Rethwisch, "Materials Science and Engineering: An Introduction", 9th edition, Wiley & Sons, 2013.

REFERENCES:

1. Syndney H Avner, "Introduction to Physical Metallurgy", McGraw Hill Education, 2nd Edition, 2017.
2. Raghavan. V. "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd, 6th Edition 2015.
3. Kenneth G. Budinski and Michael K. Budinski "Engineering Materials", PHI / Pearson Education, 9th Edition, 2010.
4. George E. Dieter, Mechanical Metallurgy, McGraw Hill, 2007.

COURSE OUTCOMES:

Upon successful completion of the course the students will be able to

CO1: identify various phases of metals and alloys through appropriate phase diagrams, describe the structure of materials, defects and suggest suitable engineering materials for different application

CO2: evaluate the effect of alloying elements, properties and application of ferrous and non-ferrous metals

CO3: apply advanced materials such as polymers, ceramics and composites in product design

CO4: select and apply appropriate heat treatmentprocess and strengthening mechanisms to modify the mechanical behaviour of various materials

CO5: Evaluate the mechanical behavior of materials for different applications

Board of Studies (BoS) :

13th BoS of AUTO held on 15.12.2021

Academic Council:

18th AC held on 24.02.2022

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

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

SDG No. 9: Having an ability to design a component or a product by selecting materials from different category applying all the relevant standards and with realistic constraints, including public health, safety, society and environment.

Statement :The holistic understanding of the course related concepts will lead to identify, formulate and analyze different materials for an automobile.

AUD 2213   **AUTOMOTIVE TRANSMISSION**   L   T   P   C
SDG: 9   3   1   0   4

COURSE OBJECTIVES:

COB1: To know about the various components in drive line of automobiles.

COB2: To know about the working principle of clutch and hydro dynamic transmission.

COB3: To know about the various gearboxes and working principle of automatic gearbox.

COB4: To know about the hydro-static drives

COB5: To know about the working of electric drive in a vehicle.

MODULE I   CLUTCH-HYDRODYNAMIC DRIVE   9+3

Requirement of transmission system, Different types of clutches, principle & Construction of Single plate, multi-plate clutch, centrifugal clutch. Design aspects and torque capacity of a clutch- materials and components, Automatic clutch (hydrodynamic) - Fluid coupling- Torque converter-working principle and Constructional details, Torque capacity and Performance characteristics. Reduction of drag torque in fluid coupling.

MODULE II   GEAR BOX – EPICYCIC GEARBOX   9+3

Necessity and functions of Gear box, classification- selective type, progressive type, epicycle type, construction & operation of Sliding mesh, Constant mesh and Synchromesh gearboxes –Requirements of Epicycle gear system- working principle and constructional details of planetary gear trains, Hydraulic Control system for automatic transmission. Determination of gear ratios calculations and gearbox design.

MODULE III   AUTOMATIC TRANSMISSIONS   9+3

AMT- Automated manual transmission, Need and requirements for automatic transmission application, Continuously Variable Transmission– construction and operations of a typical CVT -pulley cvt, Toroidal cvt and hydrostatic cvt, principles and working of IMT- Intelligent Manual Transmission, DCT-dual-clutch transmission.

MODULE IV   HYDROSTATIC DRIVE   9+3

Hydrostatic drive – principles of hydrostatic drive- various types – constant displacement pump and constant displacement motor, variable displacement

pump and constant displacement motor, Comparison of hydrostatic drive with hydrodynamic drive, Construction and working of typical Janny hydrostatic drive, applications of hydrostatic drive.

MODULE V   ELECTRIC DRIVE   9+3

Electric drive, Principle of electric drive – series and parallel hybrid vehicle-Performance characteristics in an electric and hybrid vehicle, Electrical Variable Transmission- working and construction details-types, Single speed Transmission and Multi-speed Transmission applications and working principle.

L – 45 T - 15 ; Total Hours – 60

TEXT BOOKS:

1. Fischer, R., Kucukay, F., Jurgens, G., Najork, R., Pollak, B. Automotive Transmission, 2015.
2. Heldt, P.M., "Torque converters", Chilton Book Co, 2015.
3. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.
4. Raghu Ram, Auto Transmission and Electrical systems by K.S 2017.
5. Naunheimer, H., Bertsche, B., Ryborz, J., Novak, W. Automotive Transmissions Fundamentals, Selection, Design and Application 2011.

REFERENCES:

1. Jones & Bartlett, CDX Automotive Fundamentals of Automotive Technology, 2013.
2. Hydrostatic transmissions for vehicle applications, I Mech E Conference, 2014.
3. Crouse,W.H., Anglin,D.L.," Automotive Transmission and Power Trains   construction", McGraw-Hill,2015.
4. P S Gill, Automobile Engineering Vol-II, S K Kataria& Sons, 2014.
5. Newton and Steeds, "Motor vehicles", Illiffe Publishers, 2016.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: explain the basic working principles of automobile transmission system.

CO2: explain the various types of automatic transmission.

CO3: design the clutch and gearbox for a vehicle.

CO4: analyze the hydrodynamic and hydrostatic transmissions.

CO5: demonstrate the electric and hybrid drives used in a vehicle.

Board of Studies (BoS) :

Academic Council:

13thBoS of AUTO held on 15.12.2021

18th AC held on 24.02.2022

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

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

SDG 9: The subject will be a pre requisite for understanding the advanced automotive transmission.

This subject will lead to effective understanding of automatic clutches, gearbox, automatic transmission, hydrostatic and electric drive

AUD 2214   **MECHANICS OF MACHINERY**   L   T   P   C

SDG: 9   3   0   2   4

COURSE OBJECTIVES:

COB1: To study about the kinematic links, different types of pairs, mechanisms and principles involved in assessing the displacement, velocity and acceleration at any point in a link of a mechanism

COB2: To understand the undesirable effects of unbalancing resulting from prescribed motions in mechanism

COB3: To understand the motion resulting from a specified set of linkages and cam mechanisms for specified output motions

COB4: To understand the basic concepts of toothed gearing and kinematics of gear trains

COB5: To study about the fundamentals of vibration and dynamics of mechanisms

MODULE I   **MECHANISM**   **10**

Introduction to mechanism and its elements. Kinematic link, pair and chain. Constrained motions. Degrees of freedom, Grubler's criterion. Inversion of kinematic chain: Four bar chain, Single and double slider crank chain. Velocity and acceleration analyses.

MODULE II   **BALANCING**   **10**

Need for balancing, Static and dynamic balancing, Balancing of several masses rotating in same plane by analytical and graphical methods, Balancing of several masses rotating in different planes using couple and force polygons, Balancing of reciprocating masses.

MODULE III   **CAM**   **10**

Cams, Types of cams, Design of profiles, Types of motion, Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions.

MODULE IV   **GEAR AND GEAR TRAINS**   **8**

Gear terminologies, Law of gearing, Path of contact, Arc of contact, Sliding velocity, Interference and Under cutting. Gear trains: Simple, Compound and Epicylic gear trains, Determination of speed and torque.

MODULE V   VIBRATION   7

Free, forced and damped vibrations of single degree of freedom systems, Force transmitted to supports, Vibration isolation, Vibration absorption, Torsional vibration of shaft, Critical speed of shaft.

PRACTICALS   30

List of Experiments:

1. Study of jump phenomenon and profile of the cam
2. Determination of gyroscopic couple
3. Determination of characteristics curves, sensitivity and speed range
4. Balancing of rotating & reciprocating masses
5. Whirling of shaft - Determination of critical speed
6. Torsional vibrations
7. Bifilar suspension
8. Trifilar suspension
9. Equivalent spring stiffness
10. Helical spring free vibrations

L – 45 ; P – 30 ; Total Hours – 75

TEXT BOOKS:

1. S.S. Rattan, "Theory of Machines", Tata McGraw Hill Education (India) Private Limited, 5th Edition, New Delhi, 2020.
2. J.J. Uicker, G.R. Pennock, J. E. Shigley, "Theory of Machines and Mechanisms", Oxford University Press, 2017.

REFERENCES:

1. R.L. Norton, "Kinematics and Dynamics of Machinery", McGraw-Hill Education, 2017.
2. R.S. Khurmi and J. K. Gupta, "Theory of Machines", Eurasia Publishing House, 2005.
3. Sadhu Singh, "Theory of Machines", Pearson Education India, 2013.
4. B.V.R. Gupta, "Theory of Machines Kinematics and Dynamics" I.K. International Publishing House Pvt. Limited, New Delhi, 2010.
5. Ballaney. P.L, "Theory of Machines", Khanna Publishers, New Delhi, 2002.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: analyze the fundamentals of mechanisms and their applications

CO2: demonstrate the balancing of any dynamic system

CO3: perform the kinematic analysis of cam

CO4: analyze the gear train kinematics

CO5: predict the different types of vibrations

Board of Studies (BoS) :
13th BoS of AUTO held on 15.12.2021

Academic Council:
18th AC held on 24.02.2022

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

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

SDG 9: Build durable machines, engines, and other automobile parts with foster innovation.

The deep understanding of kinematics & dynamics of the automotive components leads to production of advanced automobile parts in an effective manner.

AUD 2215   **AUTOMOTIVE CHASSIS**   **L   T   P   C**

SDG: 9   **3   0   0   3**

COURSE OBJECTIVES:

COB1: ToKnow the basics of Automotive Chassis Components.

COB2: To understand the constructional details of different frames used in a vehicle.

COB3: To impart the knowledge on problem–solving in steering mechanism, propeller shaft, braking and suspension systems.

COB4: To know about the various transmission and drive line units of automobiles.

COB5: Apply the fundamental knowledge to develop modern vehicle systems.

MODULE I   **CHASIS FRAMES, FRONT AXLE AND STEERING SYSTEMS**   **9**

Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, testing of frames. Types of Front Axles and Stub Axles, Front Wheel Geometry, Camber, Castor, King Pin Inclination and Toe–in, Condition for True Rolling Motion of Wheels during Steering, Ackerman's and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over–Steer and Under–Steer, Reversible and Irreversible Steering, Power and Power Assisted Steering.

MODULE II   **DRIVE LINE, FINALDRIVE & DIFFRENTIAL**   **9**

Effect of Driving Thrust, torque reactions and side thrust, Hotchkiss drive, torque tube drive, radius rods and stabilizers, Propeller Shaft, Universal Joints, Constant Velocity Universal Joints, Front Wheel drive, Final drive, different types, Double reduction andtwinspeedfinaldrives,Multi–axledvehicles,Differentialprincipleandtypes,Differential housings, Non–Slip differential, Differential locks, Final drive of Crawler Tractors.

MODULE III   **AXLES, WHEELS AND TYRES**   **9**

Construction and Design of Drive axles. Types of loads acting on rear axles. Full floating. Three quarter floating and semi-floating rear axles. Rear axle housing. Construction of different types of axle housings. Multi-axle vehicles.

Construction details of multi drive axle vehicles. Types of Wheels, Construction, Structure and Function, Wheel Dimensions. Structure and Function of Tyres, Static and Dynamic Properties of Pneumatic Tyres, Types of Tyres, Materials, Tyre Section & Designation, Factors affecting Tyre Life.

MODULE IV   SUSPENSIONSYSTEMS   9

Need for Suspension System, Types of Suspension Springs, Constructional details and Characteristics of Single Leaf, Multi Leaf, Coil, Torsion bar, Rubber, Pneumatic and Hydro elastic Suspension Systems, Independent Suspension System, Shock Absorbers-Types and Constructional details.

MODULE V   BRAKING SYSTEM AND RECENT TRENDS   9
**   IN CHASSIS SYSTEMS**

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Theory of Drum Brakes, Leading and Trailing Shoes, Braking Torque, Constructional Details of Drum Brake and its Actuators, Disc Brake Theory, Types and Construction, Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power–Assisted Braking System, Servo Brakes, Retarders, Types and Construction, Hill assist, Engine brakes (alias Jake brake) Special Steering Columns, Four Wheel Steering, Variable Ratio Steering System, Steer by Wire, Anti–Lock Braking System, Traction Control Systems, and Electronic Brake force Distribution Systems.

L– 45 ; Total Hours – 45

TEXT BOOKS:

1.   KripalSingh, Automobile Engineering, Standard Publisher, New Delhi, 2020.
2.   R.K. Rajput, A Text–Book of Automobile Engineering, Laxmi Publications Private Limited,2007
3.   N.K.Giri, Automotive Mechanics, Kanna Publishers, 2007

REFERENCES:

1.   Heldt P.M., Automotive Chassis, Chilton Co., NewYork, 1990
2.   Newton Steeds and Garret, Motor Vehicles, 13th Edition, Butterworth, London, 2005.
3.   Heinz Hazler, Modern Vehicle Technology, Butterworth, London, 2005.
4.   William H. Crouse and Donald L. Anglin Automotive Mechanics, 10th edition, 2007.

COURSE OUTCOMES:

Upon completion of this course, student will be able to:

CO1: understand the construction details of various types of automotive frames and basic chassis.

CO2: understand the basic function steering system and steering components.

CO3: select the appropriate transmission system for various automobiles.

CO4: infer the final drive system of a vehicle.

CO5: apply the knowledge for selection of suitable axles, wheels and tyres for a vehicle and distinguish the various types of suspension system, brake system.

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

13thBoS of AUTO held on 15.12.2021   18th AC held on 24.02.2022

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

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

SDG 9: Build durable chassis using frames, suspension systems, axles, wheels and tyres with foster innovation.

Statement: Deep understanding of various systems used in the automobiles for the transportation of passengers and goods.

AUD 2216

SDG: 9

AUTOMOTIVE CHASSIS LABARTORY

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

COB1: To study the constructional details of different types of frames used in a vehicle

COB2: To study mechanism of different types of steering system

COB3: To study mechanism of different types of driveline, final drive, wheels and tyres

COB4: To study the fundamental and working of different types of Suspension Systems of Automobiles

COB5: To study the fundamental and working of different types of Braking Systems of Automobiles.

PRACTICALS

List of Experiments:

1. Measurement of dimensional details of Automotive Chassis and Identification of various parts and types of frame and its Cross Section.

2. Evaluate the steering geometry practically by eye vision also find steering value angle of outside lock of front wheel and true turning circle radius.

3. Evaluate the function of different types of clutches and torque converter

4. Evaluate the function of transmission system (gearbox, propeller shaft, universal joint) also determine the gear ratios for different speed.

5. Dismantling, study and assembling of Differential

6. Evaluate the function of different types of wheel & tires also measure the various parameters of wheels and tyre.

7. Identification and functions of components of front and rear suspension system also find the deflection of springs.

8. Study the power steering and manual steering systems also find steering gear ratio.

9. Study the function of disc & drum brake systems and also find the hydraulic pressure values of drum and disc brake.

10. Project work.

P – 30 ; Total Hours – 30

TEXT BOOKS:

1. Kripal Singh, Automobile Engineering, Standard Publisher, New Delhi, 2020
2. R.K. Rajput, A Text–Book of Automobile Engineering, Laxmi Publications Private Limited,2007
3. N.K.Giri, Automotive Mechanics, Kanna Publishers, 2007

REFERENCES:

1. HeldtP.M.,AutomotiveChassis,ChiltonCo.,NewYork,1990
2. Newton Steeds and Garret, Motor Vehicles,13thEdition, Butterworth, London, 2005.
3. Heinz Hazler, Modern Vehicle Technology, Butterworth, London, 2005.
4. William H. Crouse and Donald L. Anglin Automotive Mechanics, 10th edition, 2007

COURSE OUTCOMES:

On completion of the course student should be able to

CO1: select suitable frame for different vehicle with justification

CO2: select suitable steering system for different vehicles.

CO3: analyze various drive line systems for automobiles and select the suitable wheels and tyres

CO4: evaluate the different types of suspension and braking systems for vehicle.

CO5: select and analyze different types of vehicle layouts

Board of Studies (BoS) :
13thBoS of AUTO held on 15.12.2021

Academic Council:
18th AC held on 24.02.2022

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

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

SDG 9: Build durable chassis using frames, suspension systems, axles, wheels and tyres with foster innovation.

Statement: Deep understanding of various systems used in the automobiles for the transportation of passengers and goods.

GED 2201

SDG: 8

WORKPLACE SKILLS AND APTITUDE FOR ENGINEERS

L	T	P	C
0	0	2	1

COURSE OBJECTIVES:

COB1: To expose them to reading for specific purposes, especially in professional contexts

COB2: To expose them to the process of different kinds of formal writing

COB3: To prepare the students to be successful in their career

COB4: To familiarize various problem-solving techniques in aptitude and puzzles.

MODULE I EXTENSIVE READING & WRITING 07

Reading for comprehension - inferring and note-making – Process of writing- paragraph development - elements of business writing: Email, memos.

MODULE II INTENSIVE READING & WRITING 08

Intensive reading and reviewing - Interpretation of charts, graphs - Résumé - Letter of enquiry, thanksgiving letters.

MODULE III QUANTITATIVE APTITUDE 08

Percentage - Ratio and Proportion - Profit and Loss – Averages, Allegations and Mixtures.

MODULE IV LOGICAL COMPETENCY 07

Syllogism – Blood Relations- Number, Alpha and Alpha numeric series - Puzzles – Cubes and Dice - Odd One Out-Coding and Decoding

L – 30; Total Hours - 30

REFERENCES:

1. Sharma, R.C. and Mohan, Krishna (2010). Business Correspondence and Report Writing. 4th edition. Tata McGraw Hill Education Private Limited, New Delhi
2. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK
3. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
4. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017

5. R. S. Aggarwal , A Modern Approach to Verbal & Non-Verbal Reasoning , S. Chand Limited, 2010

6. Khattar Dinesh , The Pearson Guide to Quantitative Aptitude for Competitive Examinations, 3e, Pearson India , 2016

7. Rajesh Verma , Fast Track Objective Arithmetic Paperback , Arihant Publications (India) Limited , 2018

8. Arun Sharma Teach Yourself Quantitative Aptitude Useful for All Competitive Examinations, McGraw Hill Education (India) Pvt. Limited, 2019.

COURSE OUTCOMES:

CO1: Demonstrate reading skills with reference to business related texts

CO2: Draft professional documents by using the three stages of writing

CO3: Apply various short cut techniques for solving complicated aptitude problems

CO4: To understand various problems and patterns of different ways to solve it

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

Academic Council:
17th AC held on 15.07.2021

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

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

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

Statement:Demonstrating, Drafting and applying various techniques for sustainable growth to employment.

GED 2202	**INDIAN CONSTITUTION AND**	L	T	P	C
SDG: 16	**HUMAN RIGHTS**	2	0	0	0

COURSE OBJECTIVES:

COB1: To explicate the emergence and evolution of Indian Constitution.

COB2: To have an insight into the philosophy of fundamental rights and duties, and Directive Principles.

COB3: To differentiate the structure of executive, legislature and judiciary.

COB4: To understand human rights and its implication - local and international and redressal mechanism.

MODULE I   INTRODUCTION AND BASIC INFORMATION   8
ABOUT INDIAN CONSTITUTION

Meaning of the constitution law and constitutionalism - Historical Background of the Constituent Assembly - Government of India Act of 1935 and Indian Independence Act of 1947 - The Constituent Assembly of India - Enforcement of the Constitution - Indian Constitution and its Salient Features - The Preamble of the Constitution. Citizenship.

MODULE II   FUNDAMENTAL RIGHTS, DUTIES AND   7
DIRECTIVE PRINCIPLES

Fundamental Rights and its Restriction and limitations in different complex situations - Directive Principles of State Policy (DPSP) & its present relevance in our society with examples- Fundamental Duties and its Scope and significance in nation building - Right to Information Act 2005.

MODULE III   GOVERNANCE IN INDIA   8

The Union Executive – the President and the Vice-President – The Council of Ministers and the Prime Minister – Powers and functions. The Union legislature – The Parliament – The Lok Sabha and the Rajya Sabha, Composition, powers and functions – Government of the State - The Governor – the Council of Ministers and the Chief Minister – Powers and Functions-Elections-Electoral Process and Election Commission of India - Indian judicial system.

MODULE IV   HUMAN RIGHTS AND INDIAN CONSTITUTION   7

Human rights – meaning and significance - Covenant on civil and political rights - Covenant on Economic, Social and Cultural rights - UN mechanism

and agencies - The Protection of Human Rights Act, 1993 – watch on human rights and enforcement - Roles of National Human Rights Commission of India - Special Constitutional Provisions for SC & ST, OBC - Special Provision for Women, Children & Backward Classes.

L – 30; Total Hours – 30

TEXT BOOKS:

1. B.K. Sharma, Introduction to the Constitution of India, 6th ed., PHI Learning Private Limited, New Delhi 2011
2. Durga Das Basu "Introduction to the Constitution on India", (Students Edition.) Prentice –Hall EEE, 19th / 20th Edn. 2008
3. M.P. Jain, Indian Constitutional Law, 7th ed., LexisNexis, Gurgaon. 2014.

REFERENCES:

1. Fadia B.L "Indian Government and Politics", Sahitya Bhavan Publications. 2010
2. Kashyap Subhash C "Our Constitution: An Introduction to India's Constitution and constitutional Law, NBT. 2017
3. M.V.Pylee "An Introduction to Constitution of India", Vikas Publishing. 2002
4. Sharma Brij Kishore "Introduction to the Indian Constitution", 8th Edition, PHI Learning Pvt. Ltd. 2015
5. Latest Publications of NHRC - Indian Institute of Human Rights, New Delhi.

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

CO1: describe the emergence and evolution of Indian Constitution.

CO2: realize the status and importance of fundamental rights, fundamental duties and directive principles of state policy and relation among them by understanding the articulation of its basic values under the Constitution of India.

CO3: compare the various structure of Indian government.

CO4: recognize the human rights, cultural, social and political rights and its relationship with Indian constitution. .

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

4thBoS of SSSH held on 28.06.2021   17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			M			H	M	L	M		M	
CO2			H			M	H	M			H	
CO3			M			H	M	L			L	
CO4			H			H	H	M	M			H

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

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

Application of human, legal and political rights leading to empowerment in real-life situations for protection of fundamental freedoms and freedom from violence, abuse, trafficking and exploitation are at the core of human rights.

PROFESSIONAL ELECTIVE - IV SEMESTER

AUDX 01	ALTERNATIVE FUELS	L	T	P	C
SDG: 13		2	0	2	3

COURSE OBJECTIVES:

COB1: To acquire knowledge of alternate fuels

COB2: To utilize alcohol fuels effectively for lower emissions

COB3: To utilize different gaseous fuels and predict their performance and combustion characteristics

COB4: To elaborate on the utilization of Bio-Diesel and its types as a suitable fuel in CI engines

COB5: To use appropriate synthetic fuels and fuel additives for better combustion characteristics

MODULE I   INTRODUCTION TO ALTERNATIVE FUELS   4
Introduction to fossil fuel, type of fossil fuel, fossil fuel effect on environmental, availability of fossil fuel – Need for alternate fuel – Availability of alternate fuels.

MODULE II   ALCOHOL FUELS   7
Properties of alcohols, engine modifications required to use alcohols in SI engines, performance, combustion and emission characteristics in SI engines, alcohol – gasoline blends, fuel flexible vehicle, methanol reformed gas engine, use of alcohols in CI engines-emulsions, dual fuel system, spark assisted diesel engine, surface ignition engine, ignition accelerators, performance, combustion and emission characteristics in CI engines.

MODULE III   GASEOUS FUELS   7
Properties of hydrogen, production and storage methods, safety precautions , use in SI and CI engines, biogas production and its properties, use in SI and CI engines, properties of LPG and CNG, use in SI and CI engines. Performance, combustion and emission characteristics of hydrogen, biogas, LPG and CNG in SI and CI engines.

MODULE IV   BIO-DIESEL FUELS   6
Vegetable oils and their important properties. Fuel properties characterization. Methods of using vegetable oils – Blending, preheating,

Transesterification and emulsification – Performance, combustion and emission Characteristics in diesel engines. Third generation biofuels, Ternary and Quaternary fuels, Issues & limitation of using vegetable oils in IC engines.

MODULE V   SPECIAL AND SYNTHETIC FUELS   6

Different synthetic fuels, Merits and demerits, Dual, Bi-fuel and Pilot injected fuel systems, Fuel additives – types and their effect on performance and emission characteristics of engines, Flexi-fuel systems, Ethers - as fuel and fuel additives, properties and characteristics.

PRACTICALS

List of Experiments
1. ASTM distillation test of liquid fuels.
2. Aniline Point test of diesel.
3. Calorific value of liquid fuel.
4. Calorific value of gaseous fuel.
5. Reid vapour pressure test.
6. Flash and Fire points of petrol and diesel.
7. Copper strip Corrosion Test.
8. Temperature dependence of viscosity of lubricants & Fuels by Redwood Viscometer.
9. Viscosity Index of lubricants & Fuels by Saybolt Viscometer.
10. Ash content and Carbon Residue Test.

L – 30; P – 30; Total Hours – 60

TEXT BOOKS:
1. Handbook of Alternative Fuel Technologies, Second Edition. United Kingdom: Taylor & Francis, 2014.
2. Bechtold, Richard L., Alternative fuels guidebook : properties, storage, dispensing, and vehicle facility modifications. United States: Society of Automotive Engineers, 1997.
3. Alternative Fuels for Transportation. United States: CRC Press, 2016.

REFERENCES:
1. Yang, Zongming., Serbin, Serhiy., Gorbov, Viktor., Mitienkova, Vira., Yang, Xinglin., Wen, Huabing. Alternative Fuels in Ship Power Plants: Application of Alternative Fuels. Singapore: Springer Singapore, 2021.
2. Council, National Research., Systems, Board on Energy and

Environmental., Sciences, Division on Engineering and Physical. Transitions to Alternative Vehicles and Fuels. United States: National Academies Press, 2013.

COURSE OUTCOMES:

After Completion of this course the student will able to:

CO1: explain the needs for alternative fuels.

CO2: select the suitable alcohol fuels for automotive engines.

CO3: predict their performance and combustion characteristics of gaseous fuel.

CO4: select suitable various vegetable oils for engines.

CO5: use appropriate synthetic fuels and their additives for better combustion.

Board of Studies (BoS) :

13th BoS of AUTO held on 15.12.2021

Academic Council:

18th AC held on 24.02.2022

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

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

SDG No.13: Take urgent action to combat climate change and its impacts.

Statement : To understand the need of alternative fuel in the application of automobile and its leads to reduce impact on climate change.

AUDX 02	SIMULATION OF I.C ENGINE	L	T	P	C
SDG: 7	PROCESSES	3	0	0	3

COURSE OBJECTIVES:

> **COB1:** To learn the basic concept of simulation of I.C Engine.
>
> **COB2:** Impart the knowledge on simulation processes of SI engine combustion
>
> **COB3:** Impart the knowledge on simulation processes of CI engine combustion
>
> **COB4:** To learn the simulation techniques of two stroke engine.
>
> **COB5:** To impart the knowledge of gas turbine simulation processes.

MODULE I   FUNDAMENTAL OF SIMULATION   9

First and second laws of thermodynamics – Estimation of properties of gas mixtures – Structure of engine models – Open and closed cycle models - Cycle studies. Chemical Reactions, First law application to combustion, Heat of combustion – Adiabatic flame temperature, Hess Law, Lechatlier principle, Heat transfer in engines – Heat transfer models for engines. Simulation models for I.C. Engines. (Ideal and actual cycle simulation) Chemical Equilibrium and calculation of equilibrium composition.

MODULE II   SIMULATION OF SI ENGINE COMBUSTION   9

Combustion in SI engines, Flame propagation and velocity, Single zone models – Multi zone models – Mass burning rate, Turbulence models – One dimensional models – Chemical kinetics modeling – Multidimensional models, Flow chart preparation.

MODULE III   SIMULATION OF CI ENGINE COMBUSTION   9

Combustion in CI engines Single zone models – Premixed-Diffusive models – Wiebe' model – Whitehouse way model, Two zone models - Multizone models- Meguerdichian and Watson's model, Hiroyasu's model, Lyn's model – Introduction to Multidimensional and spray modeling, Flow chart preparation.

MODULE IV   TWO STROKE ENGINES SIMULATION   9

Thermodynamics of the gas exchange process - Flows in engine manifolds – One dimensional and multidimensional models, Flow around valves and

through ports Models for scavenging in two stroke engines – Isothermal and non-isothermal models, Heat Transfer and Friction.

MODULE V   GAS TURBINES SIMULATION   9

Gas Turbine Power plants – Flame stability, Combustion models for Steady Flow Simulation – Emission models. Flow chart preparation.

L – 45 ; Total Hours – 45

TEXT BOOKS:
1. Onorati, Angelo., Montenegro, Gianluca. 1D and Multi-D Modeling Techniques for IC Engine Simulation. United States: SAE International, 2020.
2. Heywood, JohnB.. Two-Stroke Cycle Engine: It's Development, Operation and Design. United Kingdom: CRC Press, 2017.

REFERENCES:

1. Stiesch, Gunnar., Merker, GonterP.., Otto, Frank., Schwarz, Christian., Merker, Gunter P.. Simulating Combustion: Simulation of combustion and Pollutant Formation for Engine-development. Germany: Physica-Verlag, 2005.
2. Ganesan, V., Computer Simulation of Compression-Ignition Engine Processes. India: Universities Press (India) Pvt. Limited.
3. Rogers, G. F. C.., Nix, Andrew, Cohen, Henry, Saravana muttoo, H. I. H. Gas Turbine Theory. United Kingdom: Pearson, 2017.
4. Ganesan, V., Computer Simulation of Spark-Ignition Engine Processes. India: Universities Press (India) Pvt. Limited, 1996.

COURSE OUTCOMES:
After Completion of this course the student will able to:

CO1: analyze the thermodynamic cycles.

CO2: evaluate the process of SI engine combustion.

CO3: evaluate the process of CI engine combustion.

CO4: examine the process of two stroke engine combustion.

CO5: compute the process of gas turbine combustion.

Board of Studies (BoS) :   **Academic Council:**
13th BoS of AUTO held on 15.12.2021   18th AC held on 24.02.2022

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

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

SDG No.7: Ensure access to affordable, reliable, sustainable and modern energy for all.

Statement : The holistic understanding of automotive engines and leads to optimal uses of fossil energy.

AUDX 03   **COMBUSTION THERMODYNAMICS**   **L   T   P   C**

SDG: 7   **3   0   0   3**

COURSE OBJECTIVES:

> **COB1:** To learn the basic concept of combustion.
>
> **COB2:** Impart the knowledge on combustion kinetics.
>
> **COB3:** Impart the knowledge on different types of flame.
>
> **COB4:** To learn the stages of combustion and its variables.
>
> **COB5:** To impart the knowledge of heat transfer in engines.

MODULE I   COMBUSTION THERMODYNAMICS   9

Combustion equations - Theoretical air, excess air - Air fuel ratio, equivalence ratio - Exhaust gas composition - Air fuel ratio from exhaust gas composition and heating value of fuels. Thermo-chemistry, first law analysis of reacting systems - Adiabatic combustion temperature - Second law analysis of reacting systems - Criterion for chemical equilibrium - Equilibrium constant for gaseous mixtures - Evaluation of equilibrium composition - Energy availability.

MODULE II   KINETICS OF COMBUSTION   9

Rates of reaction - Reaction order and molecularity complex reactions – Chain reactions - Arrhenius's rate equation, collection theory - Activated complex theory - Explosive and general oxidative characteristics of fuels.

MODULE III   FLAMES   9

Laminar and turbulent flames - Premixed and diffusion flames - Burning velocity and its determination - Factors affecting burning velocity - Quenching, flammability and ignition - Flame stabilization in open burners.

MODULE IV   ENGINE COMBUSTION   9

Combustion in SI and CI engines - Stages of combustion in SI and CI engines, normal combustion and abnormal combustion - Emissions from premixed combustion - Emission from non-premixed combustion - Control of emissions.

MODULE V   HEAT TRANSFER IN IC ENGINES   9

Basic definitions - Convective heat transfer - Radiative heat transfer – Heat energy apportion, temperature distribution and thermal stresses in piston - Cylinder liner - Cylinder head - fins and valves.

L –45 ; Total Hours – 45

TEXT BOOKS:
1. Powers, Joseph. Combustion Thermodynamics and Dynamics. United Kingdom, Cambridge University Press, 2016.
2. Ferguson, Colin R.., Kirkpatrick, Allan T., Internal Combustion Engines: Applied Thermosciences. United Kingdom: Wiley, 2015.

REFERENCES:
1. Glassman, Irvin., Yetter, Richard A.., Glumac, Nick G.. Combustion. Netherlands: Elsevier Science, 2014.
2. Chen, Jyh-Yuan., Fernandez-Pello, A. Carlos., McAllister, Sara. Fundamentals of Combustion Processes. United Kingdom: Springer New York, 2011.

COURSE OUTCOMES:
After Completion of this course the student will able to:
CO1: compute the thermodynamic cycle.

CO2: analysis the combustion using chemical kinetics.

CO3: explain the flame of combustion.

CO4: analysis the stage of combustion.

CO5: compute and evaluate the heat transfer from the engine.

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

13th BoS of AUTO held on 15.12.2021   18th AC held on 24.02.2022

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

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

SDG No.7: Ensure access to affordable, reliable, sustainable and modern energy for all.

Statement : The holistic understanding of automotive engines and leads to optimal uses of fossil energy.

AUDX 04   **POWER PLANT ENGINEERING**   L   T   P   C

SDG: 12   3   0   0   3

COURSE OBJECTIVES:

COB1: Know the functions of various auxiliary combustion equipment

COB2: Understand the thermal power plant systems.

COB3: Familiarize with operation of nuclear Plants.

COB4: To learn about the diesel engine and gas turbine power plant.

COB5: To impart the knowledge of renewable energy.

MODULE I   FUEL COMBUSTION AND EQUIPMENTS   9

Types of combustion, stokers, fuel and ash handling equipments. Draft - forced, induced and balanced drafts. Selection of fans. Heat recovery equipments economisers, air preheaters and reheaters, different types of superheaters and desuperheaters. Emission control, flue gas cleaning, particulate and gaseous emission control methods.

MODULE II   THERMAL POWER PLANT SYSTEMS   9

Steam generators - forced circulation, high-pressure boilers and super critical boilers, fluidized bed boiler, boiler accessories and mountings. Boiler testing. Condensers: Different types, design factors, air removal, performance calculation. Cooling towers - natural and mechanical draft types.

MODULE III   NUCLEAR POWER PLANTS   9

General nuclear fuels used in reactors, elements of nuclear reactor, moderator, control rods, coolants, description of different types of reactors. Radiation hazards, radioactive waste disposal.

MODULE IV   DIESEL AND GAS TURBINE POWER PLANTS   9

Diesel power plant - Classifications, components, selection of engine type. Gas turbine plant - closed and open cycles. Combined power cycles.

MODULE V   RENEWABLE ENERGY SOURCES   9

Solar energy - measurement, methods of utilization, flat plate and concentrating collectors, water heater, air driers, photovoltaic cell. Wind energy - Horizontal and vertical axis wind turbines. Geothermal plants, tidal power plant, biomass and biogas plants, Ocean thermal energy conversion plants.

L –45 ; Total Hours – 45

TEXT BOOKS:

1. P.K Das, A.K Das. An Introduction to Thermal Power Plant Engineering and Operation: For Power Plant Professionals. N.p., Notion Press, 2018.

2. Nag, P. K.. Power Plant Engg. India, McGraw-Hill Education (India) Pvt Limited, 2008.

REFERENCES:

1. Zabihian, Farshid. Power Plant Engineering. United States, CRC Press, 2021.

2. Hegde, R. K.. Power Plant Engineering. India, Pearson Education India, 2015.

COURSE OUTCOMES:

After Completion of this course the student will able to:

CO1: analyze various sub-systems in power plant.

CO2: evaluate the power plant sub-systems.

CO3: analyze entire power plants and its efficiency.

CO4: design and develop low cost power plant components.

CO5: explain the various renewable energy sources.

Board of Studies (BoS) :
13th BoS of AUTO held on 15.12.2021

Academic Council:
18th AC held on 24.02.2022

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

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

SDG No:12: Ensure the sustainable energy consumption and production patterns.

Statement: To understand, evaluate and develop the efficiency of energy producing systems leads to ensure the sustainable energy consumption.

AUDX 05   **HEAT AND MASS TRANSFER**   L   T   P   C

SDG: 12   2   0   2   3

COURSE OBJECTIVES:

COB1: To learn the principle mechanism of heat transfer under steady state and transient conditions.

COB2: Study the fundamental concept and principles in convective heat transfer.

COB3: To understand the theory of phase change heat transfer and heat exchangers.

COB4: To learn the fundamental concept and principles in radiation heat transfer.

COB5: To learn the relation between heat and mass transfer.

MODULE I   CONDUCTION HEAT TRANSFER   6

General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction – plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces.

MODULE II   CONVECTION HEAT TRANSFER   6

Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

**MODULE III   PHASE CHANGE HEAT TRANSFER AND HEAT   6
                  EXCHANGER**

Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling, correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Introduction to TEMA Standards.

MODULE IV   RADIATION HEAT TRANSFER   6

Radiation laws, Black Body and Gray body Radiation. Shape Factor. Electrical Analogy. Radiation Shields.

MODULE V   MASS TRANSFER   6

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion. Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

PRACTICALS

List of Experiments

1. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
2. Determination of thermal conductivity of a composite wall, insulating powder, oils and water.
3. Determination of heat transfer coefficient of air under natural convection and forced convection.
4. Heat transfer from pin-fin under natural and forced convection.
5. Determination of heat flux under pool boiling and flow boiling in various regimes.
6. Determination of heat transfer coefficient in film-wise and drop-wise condensation.
7. Determination of Stefan – Boltzmann constant.
8. Determination of emissivity of a grey surface.
9.

L – 30 ; P – 30 ; Total Hours – 60

TEXT BOOKS:

1. Ghajar, Afshin Jahanshahi., Çengel, Yunus A., Heat and Mass Transfer: Fundamentals and Applications. United Kingdom: McGraw-Hill Education, 2020.
2. Bergman, Theodore L.., Incropera, Frank P.., DeWitt, David P.., Lavine, Adrienne S.. Fundamentals of Heat and Mass Transfer. United States: Wiley, 2017.

REFERENCES:

1. Nag PK..Heat and Mass Transfer. India: Tata McGraw-Hill, 2011.
2. Zhang, Yuwen., Faghri, Amir., Howell, John R.. Advanced Heat and Mass Transfer. United States: Global Digital Press, 2010.
3. SOM, S. K., INTRODUCTION TO HEAT TRANSFER. India: PHI Learning, 2008.

COURSE OUTCOMES:

After Completion of this course the student will able to:

  CO1: Apply the principle mechanism of heat transfer under steady state and transient conditions.

  CO2: Analyze fundamental concept and principles in convective heat transfer.

  CO3: Compute the theory of phase change heat transfer and design of heat exchangers.

  CO4: Examine the fundamental concept and principles in radiation heat transfer.

  CO5: Analyze the relation between heat and mass transfer and to solve simple mass transfer problems.

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

13th BoS of AUTO held on 15.12.2021   18th AC held on 24.02.2022

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

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

SDG No.12: Ensure the sustainable energy consumption and production patterns.

Statement : To understand, evaluate and develop the efficiency of energy transfer as energy leads to ensure the sustainable energy consumption.

AUDX 06 **FUEL CELL TECHNOLOGY** **L T P C**

SDG: 13 **3 0 0 3**

COURSE OBJECTIVES:

> **COB1:** Understand the basic principles involved fuel cell operation.
>
> **COB2:** Gain knowledge of various fuel cells
>
> **COB3:** To learn the fuel cell process design
>
> **COB4:** To learn about the electrode models of fuel cell.
>
> **COB5:** To impart the knowledge of fuel cell stack.

MODULE I FUELS **9**

Fuel cell reactions - Fuels and its properties - Fuel processing: steam, reforming, partial oxidation, auto thermal reforming - Water gas shift reaction - Control of contaminants: CO and sulphur - Process integration.

MODULE II FUEL CELL **9**

Proton Exchange Membrane Fuel Cell (PEMFC) –Direct Methanol Fuel Cell (DMFC) - Phosphoric Acid Fuel Cell (PAFC) - Alkaline Fuel Cell (AFC) – Molten Carbonate Fuel Cell (MCFC) – Solid Oxide Fuel Cell (SOFC).

MODULE III FUEL CELL PROCESS DESIGN **9**

Fuel cell applications and systems overview - Operating and design variables - Examination of process flow diagrams - Theoretical and practical efficiencies: trade off of heat and work - Rankine and Brayton cycles - Gas turbine combined cycle system - PEM system: material recycle and heat integration.

MODULE IV ELECTRODE MODELS **9**

Fuel utilization and the envelope of polarization curves - Influence of the Nernst equation (concentration polarization) - Mass balance on SOFC electrode – Energy balance on SOFC electrode - Multiple reactions in fuel cells: reforming, water gas shift, coking - Temperature profiles.

MODULE V STACK DESIGN AND SYSTEM INTEGRATION **9**

Basic geometry approaches: flat plate vs. tubular - Flow field plate and interconnect design - Fluid mechanics: manifold, pressure drop - Fuel utilization, efficiency, and current distribution - Internal heat exchange and recovery,

internal reforming – Seals and insulation - Safety.

L – 45 ; Total Hours – 45

TEXT BOOKS:

1. Colella, Whitney, et al. Fuel Cell Fundamentals. United Kingdom, Wiley, 2016.
2. Dicks, Andrew L., and Rand, David A. J., Fuel Cell Systems Explained. Germany, Wiley, 2018.

REFERENCES:

1. Behling, Noriko Hikosaka. Fuel Cells: Current Technology Challenges and Future Research Needs. Netherlands, Elsevier Science, 2013.
2. Srinivasan, Supramaniam. Fuel Cells: From Fundamentals to Applications. Germany, Springer, 2006.

COURSE OUTCOMES:

After Completion of this course the student will able to:

CO1: evaluate the fuel cells fuel properties.
CO2: compare the different types of fuel cell.
CO3: analyze the process flow of fuel cell.
CO4: design and develop electrode for fuel cell.
CO5: evaluate the fuel cell stack design.

Board of Studies (BoS) :
13th BoS of AUTO held on 15.12.2021

Academic Council:
18th AC held on 24.02.2022

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

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

SDG No.13: Take urgent action to combat climate change and its impacts

Statement : To understand the fuel cell technology and its application in automobile leads to reduce impact on climate change.

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**	L	T	P	C
SDG: 4	**ENGINEERING**	**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   7
                  IMPERFECTIONS

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) :   **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	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**   6
                      SCREENING OF BIOMATERIALS

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.

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PHDX 05

SDG: 4

SEMICONDUCTOR PHYSICS FOR INFORMATION TECHNOLOGY

L	T	P	C
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

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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) :   **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	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.

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PHDX 07

SDG: 4

FUNDAMENTALS OF NANOTECHNOLOGY AND ITS APPLICATIONS

L	T	P	C
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

CHDX 01	CHEMISTRY OF CONSTRUCTION	L	T	P	C
SDG: 9	MATERIALS	2	0	0	2

COURSE OBJECTIVES:
To impart knowledge on
COB1: chemistry of cement and concrete
COB2: properties of steel and mechanism of corrosion
COB3: quality of water and its impact on concrete
COB4: 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   7
RESEARCH**
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	PO1 1	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

SDG: 9

		L	T	P	C
CHEMISTRY OF MATERIALS AND ELECTROCHEMICAL DEVICES		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.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	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
SDG: 9

CHEMISTRY AND INSTRUMENTATION FOR ELECTRICAL AND ELECTRONIC APPLICATIONS

L	T	P	C
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**   **L   T   P   C**
                              APPLICATIONS   **2   0   0   2**

SDG: 11 & 12

COURSE OBJECTIVES: To make the students conversant with

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

COB2: selection of advanced materials for various current applications

COB3: materials for the fabrication of sensors

COB4: essential characterization techniques and software tools with chemistry background

**MODULE I   MATERIALS FOR HARDWARE AND DATA   7
                 STORAGE**

Specific materials for electrical and electronic gadgets-computers, instruments (Semiconductors-N, S doped Silicon, CdX QDs, metal nano and other applications). Networking of networks and connecting devices - materials used in robotic construction (metal alloys, 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   8
                  APPLICATIONS**

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

free solder (Conductive inks).

MODULE III   MATERIALS FOR FABRICATION OF   8
                     SENSORS

Wireless Sensors – Introduction to sensors (chemo/bio/gas sensors)-Wearable/touch sensors-Components - selection of materials - Device fabrication and function monitoring - wireless, Smartphone based and IOT enabled-Properties of materials, anti-corrosive, water proof, insulation and lamination. Robotics in surgery, gene coding and molecular modelling. Biochips and DNA microarray chips (fluorescent dyes, glass/nylon).

MODULE IV   ANALYTICAL TECHNIQUES AND SOFTWARE   7
                     SOLUTIONS

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

L – 30; Total Hours– 30

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

REFERENCES:
1. B.J. Cafferty, A.S. Ten, M.J. Fink, S. Morey, D.J. Preston, M. Mrksich, G.M. Whitesides, Storage of Information Using Small Organic Molecules, ACS Central Science, 2019, 5, 911−916.
2. Nabeel Ahmad P. Gopinath and Rajiv Dutta, 3D Printing Technology in Nanomedicine (Book), Elsevier, 2019.
3. 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: The students will be able to

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

CO2: Application of specific functionalized materials for advanced applications

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

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

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

15th BoS of Department of Chemistry   17th AC held on 15.07.2021
held on 15.06.2021

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

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

SDG : 11 & 12

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

CHDX 05

SDG: 9

CHEMISTRY OF FUELS, COMBUSTION AND LUBRICANTS

L	T	P	C
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:

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
CO1	-	-	-	L	-	-	-	-	-	-	-	-	M	-	-
CO2	-	-	-	M	-	-	-	-	-	-	-	-	M	-	-
CO3	-	-	-	-	-	-	M	-	-	-	-	-	L	-	-
CO4	-	-	-	M	-	-	-	-	-	-	-	-	L	-	-

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

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

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

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

COURSE OBJECTIVES:
To impart knowledge on
COB1: basic factors governing drug design.
COB2: software tools for molecular docking.
COB3: synthetic pathway of antinfective, antineoplastic, cardiovascular and steroidal drugs.
COB4: 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   8
                     DRUGS**
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) :   **Academic Council:**

11thBoS of Chemistry held on 17.06.2021   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
CO1	-	-	-	-	M	-	-	-	-	-	-	-	M	-	-
CO2	-	-	-	M	-	-	-	-	-	-	-	-	M	-	-
CO3	-	-	-	-	-	L	-	-	-	-	-	-	L	-	-
CO4	-	-	-	M	-	-	-	-	-	-	-	-	L	-	-

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

SDG 9 : Industry, Innovation & Infrastructure

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

HUMANITIES ELECTIVE
(SEMESTER III)

SSDX 01	ENGINEERING ECONOMICS	L	T	P	C
SDG: 4, 8, 9,12	AND MANAGEMENT	3	0	0	3

COURSE OBJECTIVES:

COB1: To present the major concepts and techniques of engineering economic analysis that is needed in the decision making process by providing insights to the basic microeconomic concepts of demand, supply and equilibrium.

COB2: To generate theoretical knowledge and understanding of macroeconomic aggregates such as national income and inflation and the major challenges associated with the measurement of these aggregates.

COB3: To develop analytical and critical thinking skills on money, banking and public finance and use them to judge the appropriateness of economic development and policy options.

COB 4: To introduce the basic concepts of management and planning and highlight the contribution of planning to the attainment of organization's objectives.

COB 5: To apprise the students about important management concepts and create awareness about the corporate social responsibilities and ethical aspects.

MODULE I   DEMAND AND SUPPLY ANALYSIS   9

Introduction to Engineering Economics – Engineering efficiency – Economic efficiency - Scope of Engineering Economics, Engineers' contributions to economic growth- Problem solving and decision making - Laws of Demand and Supply - Difference between Microeconomics and Macroeconomics - Equilibrium between Demand and Supply, Elasticity of Demand - Pricing strategies.

MODULE II   NATIONAL INCOME AND INFLATION   8

Concepts of National Income and measurement – GDP Growth Rate - Importance and difficulties of estimating National Income in India - Aggregate demand and aggregate supply, Macroeconomic equilibrium – Meaning of Inflation, its types causes and preventive measures.

MODULE III   **MONEY, BANKING AND PUBLIC FINANCE**   **10**

Money – Meaning, types, functions, importance - Commercial Banks - Central Bank - Monetary Policy – meaning, objectives, Methods of Credit Control By RBI, Government Budget – Government revenue and expenditures – Fiscal policy - Its objectives, instruments and limitations - Deficit Financing - The Fiscal Responsibility and Budget Management Act, 2003 (FRBMA) – Economic Reforms in India – LPG Policy.

MODULE IV   **PRINCIPLES OF MANAGEMENT AND**   **8**
                      PLANNING

Nature of management and its process - Importance of Management- Functions and Principles of Management - Nature, Purpose and Kinds of Planning.

MODULE V   **ENGINEERING MANAGEMENT**   **10**

Strategic Management-Manager and Environment - Globalization and Technology Intermediation, Corporate Social Responsibility of business - meaning, importance, arguments for and against Corporate Social Responsibility - Business Ethics- Role of Ethics in Engineering Practice- meaning, importance - State intervention in business - Pros and Cons of intervention.

L – 45 ; Total Hours – 45

TEXT BOOKS:
1. Krugman, P, Wells, R, and Graddy, K., "Essentials of Economics", Worth Publishers, 4th Edition, New York, 2016.
2. Hussain, Moon Moon, "Economics for Engineers", Himalaya Publishing House, 1stEdition, New Delhi, India, 2015.

REFERENCES:
5. Andrew Gillespie, "Foundations of Economics", OUP Oxford, England, 2007.
6. Acemoglu, D., Laibson, D., & List, J., "Microeconomics", Pearson Education, 2nd Edition, Boston, 2017.
7. Brinkman John , "Unlocking the Business Environment", Routledge, 1st Edition, London, United Kingdom, 2010.(ISBN 9780340942079)
8. Cleaver Tony, "Economics: The Basics", Routledge, 3rd Edition, London, United Kingdom, 2014.
9. H. L. Ahuja, "Macroeconomics", S Chand Publishing; Twenty Edition,

New Delhi, India, 2019.

10. Koutsoyiannis A, "Modern Microeconomics", Palgrave Macmillan, 2nd Edition, U.K, 2003.

11. R.A. Musgrave and P.B. Musgrave, "Public Finance in Theory and Practice" , McGraw Hill Education India, Fifth Edition, India, 2017.

12. Mell Andrew and Walker Oliver, "The Rough Guide to Economics", Rough Guide Ltd, 1st Edition, London, 2014.

13. R. Paneerselvam, "Engineering Economics", PHI Publication, 2nd Edition, New Delhi, India, 2014.

14. Robbins S.P. Decenzo David A and Coulter, "Fundamentals of Management: Essential Concepts and Applications", Pearson Education, 9th Edition, London, England, 2014.

COURSE OUTCOMES:

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

CO1: interpret the forces driving demand and supply and their impact on market conditions.

CO2: demonstrate various dimensions of macroeconomic variables like national income, money supply, employment, etc. in analyzing the effects on business.

CO3: explicate the different aspect of Governmental activities and their rationality and describe how they can be pursued through fiscal and monetary policy.

CO4: develop skills to plan, organize, direct and control the resources of the organization for obtaining common objectives or goals.

CO5: augment managerial skills and adopt ethical practices in various functional areas and engineering practices.

Board of Studies (BOS) :
5thBoS of SSSH held on 29.12.2021

Academic Council:
18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1		H	H	M		H	H				H	H
CO2		H	M			M					H	H
CO3			M	M		H	H		H			H
CO4						M	H	H	M		M	H
CO5						M	H	H	M		M	H

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

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

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

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

SDG 12: Ensure sustainable consumption and production patterns.

Inclusive and equitable quality education can make a critical difference to production patterns, consumer understanding of more sustainably produced goods, promote inclusive and sustainable economic growth along with productive employment and decent work for all.

SSDX 02

SDG: 17

SOCIOLOGY OF SCIENCE AND TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

COB1: To recognize and define the basic concepts of society and the ways in which sociologists use these concepts in constructing explanations for individual and group problems.

COB2: To illustrate the convergence and divergence of sociology with engineering subjects in terms of the subject matter, nature and scope of the discipline and its approach.

COB3: To demonstrate the relationship between science, technology and society.

COB4: To understand the issues relating to science, technology and change in India both in the historical and globalization contexts.

COB5: To appraise the impact of science and technology on different socio-cultural institutions and processes.

MODULE I   INTRODUCTION   8

Sociology - Definition, scope and importance, relationship with other social sciences - Major theoretical perspectives: Functionalism, Conflict Theorizing and Interactionism - Elements of social formation - Society, Community, Groups and Association - Institutions, family and kinship, religion, education, politics - Social process - Associative Social Process - Co-operation, Accommodation and Assimilation - Dissociative Social Process - Competition and Conflict.

MODULE II   INDIVIDUAL AND SOCIETY   9

Culture - characteristics, functions, types, cultural lag and civilization - Socialization – process, stages, agencies and anticipatory socialization - Social Control - characteristics, importance, types and agencies - Social stratification. - Meaning, forms - caste and class.

MODULE III   SCIENCE, TECHNOLOGY AND SOCIETY   9

Relationship between society and science and vice-versa - Science as a social system - Norms of science - Relationship between science and technology - History of modern science in India – colonial–independence and post-independence science - Science education in contemporary India – primary level to research level - Performance of universities in the

development of technology - Interrelationship between industry and universities.

MODULE IV   SCIENCE, TECHNOLOGY AND SOCIAL ISSUES   10

Technology, media, identity and global society - Conformity and deviance and role of science and technology - Technology and development issue - S&T and sustainable development - Role of science and technology in the creation of environmental crisis - Social inequality, social exclusion and digital divide - Science, technology and ethical issues -Gender and technology.

MODULE V   GLOBALIZATION,   SCIENCE,   TECHNOLOGY   9
AND CHANGE

Social Change - nature, direction, forms - Technology and rate of social change – Globalization - characteristics, historical and social context- Social consequences of science and technology on civil society -   Globalization - Liberalization - Their impact on Indian science and technology - WTO and issues related to intellectual property rights - MNCs and Indian industry.

L – 45; Total Hours – 45

TEXT BOOKS:
1. Giddens A. "Sociology" Wiley India Pvt. Ltd2017
2. Heald Haralambos, R.M "Sociology Themes and Perspectives", Oxford, New Delhi-92. 2014
3. Sergio Sismondo. An Introduction to Science and Technology Studies Malden: Wiley Blackwell.2010
4. R.K. Merton, Sociology of Science, Theoretical and Empirical Investigations, University of Chicago Press, 1973.

REFERENCES:
1. Atal Yogesh, "Changing Indian Society" Rawat Publications, Jaipur, 2006.
2. Bilton, T. et al "Introductory Sociology", Palgrave, New York. 2002
3. Das Gupta, Samir and   "An Introduction to Sociology", Pearson, Delhi. 2012.
4. Francis Abraham M. "Contemporary Sociology: An Introduction to Concepts and Theories", New Delhi, Oxford University Press. 2014
5. Inkless, A, "What is Sociology", Prentice Hall, New Delhi. 1987
6. Tumin, Melvin M "Social Stratification", Prentice Hall, New Delhi. 1969.

COURSE OUTCOMES:

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

CO1: recognize the fundamental tenets of Sociology.

CO2: interpret the relationship between individual and society in a sociological perspective.

CO3: categorize and constructively identify their own assumptions about the relationships among society, science and technology

CO4: appraise the dynamics of human society with special reference to the science, technology and contemporary trends of globalization.

CO5: able to link and reflect on current and ongoing sociological debates on development and role of technology.

Board of Studies (BOS) :

5thBoS of SSSH held on 29.12.2021

Academic Council:

18th Academic council held on 24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H			H	H	M	L	H	L	
CO2			M			H	H	M	H	H	M	L
CO3			H	M	H	H	M		M	H	H	M
CO4			M			H	H	L	L	M	H	H
CO5			M			H				M		L

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

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

To inculcate knowledge and socialize youth in building participation, institutions and partnership for inclusive development for the implementation of sustainable development goals.

MODULE V   **INDUSTRIAL GROWTH IN INDIA**   **9**

Industrial growth during the plans-an evaluation - Industrial Development in Five Year plans - Industrial growth- Private sector industrial policy resolutions and role of Small Scale Industries.

Total Hours: 45

COURSE OUTCOMES:

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

CO1: Understand the concept and classify the firms based on ownership and control.

CO2: Apply the theoretical and analytical knowledge on the different market structures, pricing practices and government policies.

CO3: Apply economic models in business strategy, competition policy and regulations.

CO4: Analyze the importance of Industrial Policy in the development of Industries in India.

CO5: Evaluate the industrial growth in India by examining its performance and problems in industrial sector.

TEXT BOOKS:

1. Barthwal, R.R., Industrial Economics: An Introductory Text Book, New Age International Publications, New Delhi, 3rd Edition, 2018.

2. Ahuja H.L., Advanced Economic Theory, S.Chand and Company Ltd., New Delhi, 21st Edition, 2017.

REFERENCE BOOKS:

1. Francis Cherunilam, Business Environment, Himalaya Publishing House, Mumbai, 22nd Edition, 2021.

2. Misra S.K and Puri V.K., Indian Economy, Himalaya Publishing House, Mumbai, 39th Edition, 2022.

3. Divya Kirti Gupta, Managerial Economics, Cengage Publications, First Edition, 2020.

MODULE V   INDUSTRIAL GROWTH IN INDIA   9

Trends and prospects - Public enterprises; efficiency - Productivity and performance constrain - Small scale industries: definition, role - Policy issues and performance - Capacity utilization - Industrial sickness and Exit - Technology transfer - Privatization.

L – 45 ; Total Hours – 45

TEXT BOOKS:

3. Barthwal R R "Industrial Economics: An Introductory Textbook", New Age International Pvt. Ltd Publishers, 2017
4. P.J. Devine, N. Lee, R.M. Jones, W.J. Tyson, "An Introduction to Industrial Economics", Routledge.2019.

REFERENCES:

1. Ferguson, Paul R. and Glenys J. Ferguson, "Industrial Economics - Issues and Perspectives", Macmillan, London. 1994
2. Gregory Mankiw "Principles of Microeconomics", Havcourt Asia Publishers, 2001.
3. Mohanty Binode Ed. "Economic Development Perspectives", Vol. 3, Public Enterprises and Performance, Common Wealth Publishers, New Delhi, 1991
4. Mote and Paul "Managerial Economics, Tata McGraw Hill, 2001
5. Peterson and Lewis "Managerial Economics", 4th Ed., Prentice Hall, 2004

COURSE OUTCOMES:

CO1: Develop knowledge on the concept and organization of firms and the implications of the separation of ownership and control.

CO2: Acquire familiarity with various market structures and formulate appropriate pricing strategies.

CO3: Think analytically using various economic models concerning market structures and apply them to the real world of industry.

CO4: To compare the various Industrial Policies introduced in India and recognize the role of these policies in making required industrial development in India.

CO5: Clearly diagnose and illustrate the challenges in industrial economy in India and develop effective and comprehensive solution on them.

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

Mention details of BoS   18th Academic council held on

5thBoS of SSSH held on 29.12.2021   24.02.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H	M			H		M		M	L
CO2			H		M		H		M		M	L
CO3			H				H		M		M	M
CO4			H				H		M		H	M
CO5			H				H		M		H	M

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

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

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

A comprehensive and holistic approach towards the way for sustainable development and economic growth through the inclusive economic strategy and thereby to reduce the poverty, hunger among people by familiarizing them industry and its importance as survival strategy for earning decent standard of living.

SSDX 04   **DYNAMICS OF INDIAN SOCIAL**   L   T   P   C

SDG: 10, 16   **STRUCTURE**   3   0   0   3

COURSE OBJECTIVES:

COB1: To provide knowledge on the components of the Indian social structure.

COB2: To learn the nature and contemporary structure of Indian social institutions.

COB3: To sensitize students about social stratification in Indian Society.

COB4: To create awareness about the social problems occurring in contemporary India.

COB5: To explicate the changing institutions, the processes, the agents and the interventions that brings about change in the Indian society.

MODULE I   INDIAN SOCIAL STRUCTURE   9

Demographic composition - Racial, religious, ethnic and linguistic -Types of communities - rural, urban, agrarian and tribal - Social backwardness - OBC, SC, ST and EWS - Indian minorities- religious, ethnic, linguistic and LGBT.

MODULE II   INDIAN SOCIAL INSTITUTIONS   9

Family - types, characteristics, functions of family - Joint Family- definition features, functions of joint family , dysfunctions of joint family, disintegration of joint family – Marriage - definition, characteristics, marriage as sacrament or contract.

MODULE III   SOCIAL STRATIFICATION IN INDIA   9

Social stratification - Concept of hierarchy - inequality, meaning and characteristics - Social Stratification and Social Mobility - Functions of Social Stratification - Caste, definition, principles, contemporary changes, dominant caste - Caste - class interface - Religious minorities.

MODULE IV   SOCIAL PATHOLOGY   9

Social Problem - nature, social disorganization - Population explosion- causes, effects, relationship with development - Child Labour- causes, magnitude and consequences – Unemployment - nature, types, causes and effects - Gender issues - social status of women, violence against women and women in work place - Contemporary issues - communalism, terrorism and corruption.

MODULE V   SOCIAL CHANGE IN INDIA   9

Socio-cultural change - Sanskritization – Westernization - Secularization, Modernization - Processes of Social change - Industrialization – Urbanization – Globalization - Social movement - concept, characteristics, functions - New social movement-Women and Environment movement.

L – 45; Total Hours – 45

TEXT BOOKS:

1. Sharma,K.L., "Indian Social Structure and Change", Jaipur: Rawat Publications, 2008.
2. Ahuja Ram., "Social Problems in India", Rawat Publication: New Delhi, 2014.
3. Ahuja Ram., "Society in India", Rawat Publication: New Delhi, 2014.

REFERENCES:

1. Atal Yogesh, "Changing Indian Society" Rawat Publications, Jaipur, 2006.
2. Dube S.C., "India's Changing Villages: Human Factors in Community Development", London, Routledge and Kegan Paul, 2003.
3. Hasnain N., "Indian Society: Themes and Social Issues", Mc Graw Hill, 2019.
4. Jayapalan, N., **"**Indian Society and Social Institutions" Atlantic Publishers, 2001.
5. Pandey Vinita., "Indian Society and Culture", Rawat Publications, New Delhi, 2016
6. Rao Sankar., "Sociology of Indian Society", S. Chand Publisher, New Delhi, 2004.

COURSE OUTCOMES:

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

CO1: explain about the social structure and social institutions that constitute society in India.

CO2: differentiate the various categories of inequalities and their challenges.

CO3: describe the social stratification and its impact in society.

CO4: analyze the social problems encountered in contemporary India.

CO5: correlate the various forms and trends of the social change in Indian society and realize the relevance of their role in bringing about development.

Board of Studies (BoS) :
5thBoS of SSSH held on 29.12.2021

Academic Council:
18th Academic council held on 24.02.2022

	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12
CO1			H			H	M			M		
CO2			M			M	H	L				H
CO3			M			M	H	L				H
CO4			H			H	H		M			M
CO5			H		H	M	H	M		H		H

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

SDG 10: Reduce inequality within and among countries.

SDG16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

To sensitize and impart pertinent knowledge to youths to combat the contemporary issues and challenges facing Indian society in order to remedy its social pathos and injustices in the path of achieving sustainable development in India.

MATHEMATICS ELECTIVE
(SEMESTER III)

MADX 01	TRANSFORMS AND PARTIAL	L	T	P	C
SDG: 4	DIFFERENTIAL EQUATIONS	3	1	0	4

COURSE OBJECTIVES:

COB1: To formulate and solve partial differential equations of first, second and higher orders

COB2: To introduce basics and engineering applications of Fourier series

COB3: To develop Fourier transform techniques

COB4: To introduce analytic solutions of PDEs by using Fourier series

COB5: To acquaint with Z -Transform techniques for discrete time systems

MODULE I   PARTIAL DIFFERENTIAL EQUATIONS   9+3

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

MODULE II   FOURIER SERIES   9+3

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

MODULE III   FOURIER TRANSFORMS   9+3

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

MODULE IV   APPLICATIONS OF FOURIER SERIES   9+3

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

MODULE V   Z – TRANSFORM   9+3

Introduction and Definition of Z-transform - Properties of Z- Transform - Convolution Theorem of Z-Transform - Inverse Z–transform - Convolution

Theorem of Inverse Z-Transform - Formation of difference equations - Solving Difference Equations using Z-Transform

L –45 ; T-15; TOTAL HOURS – 60

TEXT BOOKS:

1. Kreyszig .E., "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore, 2011.

2. Grewal B.S., "Higher Engineering Mathematics", 44th edition, Khanna Publishers, New Delhi, 2017.

3. Ramana, B.V, "Higher Engineering Mathematics" Tata Mc Graw Hill Publishing Co. New Delhi, 2010.

REFERENCES:

1. Veerarajan.T., "Engineering Mathematics", 5th edition, Tata Mc Graw Hill Publishing Co. New Delhi, 2012.

2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th edition, Cengage Learning, 2011.

3. Dennis G. Zill, Warren S. Wright, "Advanced Engineering Mathematics", 4th edition, Jones and Bartlett publishers, Sudbury, 2011.

4. Alan Jeffrey, "Advanced Engineering Mathematics", Academic Press, USA, 2002.

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: form and solve the partial differential equations using different methods

CO2: derive a Fourier series of a given periodic function by evaluating Fourier coefficients

CO3: apply integral expressions for the forward and inverse Fourier transform to a range of non-periodic waveforms

CO4: solve partial differential equations by using Fourier series

CO5: solve difference equations using Z-transform

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

MADX 02   **DISCRETE MATHEMATICS**   L   T   P   C

SDG: 4   3   1   0   4

COURSE OBJECTIVES:

> **COB1:** To introduce logical and mathematical ability to deal with abstraction
>
> **COB2:** To acquaint with the concepts of predicate calculus.
>
> **COB3:** To introduce the notations and concepts used in set theory
>
> **COB4:** To apply and use the terms function, domain, codomain, range, image, inverse image and composition
>
> **COB5:** To introduce basic concepts from abstract algebra, especially the essential concepts in group theory

MODULE I   PROPOSITIONAL CALCULUS   9+3

Propositions – Logical connectives – Compound propositions – Conditional and biconditional propositions – Truth tables – Tautologies and contradictions – Contrapositive – Logical equivalences and implications – DeMorgan's Laws – Normal forms – Principal conjunctive and disjunctive normal forms – Rules of inference – Arguments – Validity of arguments.

MODULE II   PREDICATE CALCULUS   9+3

Predicates – Statement function – Variables – Free and bound variables – Quantifiers – Universe of discourse – Logical equivalences and implications for quantified statements – Theory of inference – The rules of universal specification and generalization – Validity of arguments.

MODULE III   SET THEORY   9+3

Basic concepts –Notations-Subset –Algebra of sets –The power set – Ordered pairs and Cartesian product- Relations on sets – Types of relations and their properties – Relational matrix and the graph of a relation – Partitions –Equivalence relations –Partial ordering –Poset – Hasse diagram – Lattices and their properties– Boolean algebra – Homomorphism.

MODULE IV   FUNCTIONS   9+3

Functions – Classification of functions –– Composition of functions – Inverse functions – Binary and n–ary operations – Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions.

MODULE V   ALGEBRAIC SYSTEMS   9+3

Groups, Cyclic Groups, Subgroups, Cosets, Lagrange's theorem, Normal subgroups – Codes and group codes – Basic notions of error correlation – Error recovery in group codes.

L –45 ; T-15; TOTAL HOURS – 60

TEXT BOOKS:

1. Trembly J.P and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 30th Reprint 2011.
2. Kenneth H.Rosen, "Discrete Mathematics and its Applications:, 7th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, Special Indian Edition, 2011.

REFERENCES:

1. Ralph.P.Grimaldi, "Discrete and Combinatorial Mathematics: An Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
2. Thomas Koshy, "Discrete Mathematics with Applications", Elsevier Publications, 2006.
3. C.L.Liu, D.P.Mohapatra, "Elements of Discrete Mathematics", 4th Edition, Tata McGraw-Hill Pub. Co. Ltd, New Delhi, 2012.

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: form truth tables and write principal normal forms

CO2: write the negation of a quantified statement involving either one or two quantifiers.

CO3: prove that a proposed statement involving sets is true, or give a counterexample to show that it is false.

CO4: compute the connection between bijective functions and inverses. Be able to find the inverse of an invertible function.

CO5: give intrinsic structure of groups both abstract and specific examples illustrating the mathematical concepts involved.

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 will lead to knowledge of applications in Communication Engineering

MADX 03   **PROBABLITY AND STATISTICS**   **L**   **T**   **P**   **C**

SDG:4   **3**   **1**   **0**   **4**

COURSE OBJECTIVES:

      COB1: To impart knowledge on the basic concepts of probability

      COB2: To understand random variables and distribution functions

      COB3: To acquaint with joint density function and generating functions

      COB4: To introduce sampling techniques and estimation

      COB5: To perform hypothesis testing and draw inference

MODULE I   PROBABILITY   9+3

Sample space, events- axioms of probability and interpretation – Addition, multiplication rules – conditional probability, Independent events - Total probability – Baye's theorem - Descriptive Statistics.

MODULE II   RANDOM VARIABLE AND DISTRIBUTION   9+3
                               FUNCTIONS

Discrete random variable –continuous random variable – Expectation - probability distribution - Moment generating function – Binomial, Poisson, Geometric, Uniform (continuous), Exponential and Normal distributions.

MODULE III   TWO DIMENSIONAL RANDOM VARIABLES   9+3

Joint, marginal, conditional probability distributions –covariance, correlation - transformation of random variables- Generating functions.

MODULE IV   SAMPLING AND ESTIMATION   9+3

Sampling distributions – basic knowledge on Random , simple random , stratified and cluster samplings – Test of Hypotheses - concepts- Point estimation and Interval estimation.

MODULE V   THEORY OF INFERENCE   9+3

Large sample tests – test for single and difference on proportions, single mean, difference of means, difference of variances – confidence intervals. Small sample tests – Student's t test, F test and Chi square test on theory of goodness of fit and analyses of independence of attributes.

                                     L – 45 ; T - 15; TOTAL HOURS – 60

TEXT BOOKS:

1. T.Veerarajan, "Probability and Statistics", Tata McGraw-Hill New Delhi, 2008.
2. Miller, I., Miller, M.,Freund, J. E., "Mathematical statistics", 7th Edition, Prentice Hall International, New Jersey 1999.
3. S.P.Gupta, "Applied Statistics", Sultan Chand & Sons 2015.

REFERENCES:

1. S.M.Ross, "Introduction to Probability and Statistics for Engineers and Scientists" Fifth Edition, Elesvier 2016
2. S.C.Gupta and V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons New Delhi 2012
3. Arora and Arora, "Comphrensive Statistical Methods", S. Chand, New Delhi 2007.

COURSE OUTCOMES:

At the end of the course students will be able to

CO1: do problems on probability, Baye's theorem and descriptive statistics.

CO2: evaluate moment generating functions and calculate probabilities using distributions.

CO3: calculate probabilities and derive the marginal and conditional distributions of bivariate random variables

CO4: classify random samplings and calculate point and interval estimates

CO5: make an informed decision, based on the results of inferential procedures

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	L													
CO2	M	L													
CO3	M	L													
CO4	M	L		M											
CO5	H	L		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 statistical methods will lead to knowledge of applications in Electronics and communication Engineering

MADX 04

SDG: 4

	RANDOM PROCESSES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

> **COB1:** To acquire knowledge of the theory of probability, Baye's theorem and Tchebechev inequality
>
> **COB2:** To understand random variables and discrete and continuous probability distributions
>
> **COB3:** To demonstrate the techniques of two dimensional random variables and its distributions
>
> **COB4:** To introduce the random process, stationary, Markov process and the study of correlation functions
>
> **COB5:** To study spectral analysis and Weiner-Khinchine theorem

MODULE I   PROBABILITY   9+3

Sample space, events- axioms of probability and interpretation – Addition, multiplication rules – conditional probability, Independent events - Total probability – Baye's theorem - Tchebychev's inequality.

**MODULE II   RANDOM VARIABLES AND ROBABILITY   9+3
                    DISTRIBUTIONS**

Discrete random variable –continuous random variable – Expectation - probability distribution - Moment generating function – Binomial, Poisson, Geometric, Uniform (continuous), Exponential and Normal distributions

MODULE III   TWO DIMENSIONAL RANDOM VARIABLES   9+3

Joint, marginal, conditional probability distributions - covariance, correlation and regression lines - transformation of random variables.

MODULE IV   RANDOM PROCESSES   9+3

Classification of Random process - Stationary process - WSS and SSS processes - Poisson process – Markov Chain and transition probabilities- Autocorrelation function and its properties - Cross Correlation function and its properties.

MODULE V   SPECTRAL DENSITY   9+3

Linear system with random inputs – Ergodicity-Power spectral Density Function - Properties - System in the form of convolution - Unit Impulse Response of the System – Weiner-Khinchine Theorem - Cross Power Density Spectrum

L –45 ; T-15; TOTAL HOURS – 60

TEXT BOOKS:

1. Veerarajan T., "Probability, Statistics and Random Processes", Tata McGraw Hill,3rd edition, New Delhi, 2008.
2. Papoulis, "Probability, Random Variables and Stochastic Processes", 4th Edition, Tata McGraw Hill Company, New Delhi,2002.
3. S.M.Ross, "Introduction to Probability and Statistics for Engineers and Scientists" Fifth Edition, John Wiley & Sons, New Jersey 2007.

REFERENCES:

1. Scott L. Miller,Donald G. Childers, Probability and Random Processes, Academic Press,London,2009.
2. Trivedi K S, " Probability and Statistics with reliability, Queueing and Computer Science Applications",Prentice Hall of India, 2nd edition, New Delhi, 200

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

CO1: evaluate probability, apply Baye's theorem and calculate bounds using Tchebechev inequality

CO2: calculate probabilities and expected values for distributions

CO3: calculate probabilities and derive the marginal and conditional distributions of bivariate random variables

CO4: evaluate stationary process, compute correlation functions and related identities

CO5: compute power spectral density functions and apply Weiner-Khinchine theorem

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	H	L													
CO2	M	L													
CO3	M	L													
CO4	H	M													
CO5	H	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 techniques in Random Processes will lead to knowledge required for applying in many projects.

MADX 05   NUMERICAL METHODS

SDG: 4

L	T	P	C
3	1	0	4

COURSE OBJECTIVES:

COB1: To familiarize with the methods of solving equations numerically

COB2: To introduce interpolation techniques and finite difference concepts

COB3: To acquire knowledge on Numerical differentiation and integration

COB4: To solve ordinary differential equations numerically

COB5: To solve partial differential equations numerically

MODULE I   NUMERICAL SOLUTIONS OF EQUATIONS   9+3

Bisection method - Regula Falsi method – Secant method - Fixed point iteration method - Newton's Raphson method –Gauss Elimination method - Gauss-Jordon method – Gauss Jacobi method - Gauss-Seidel method.

MODULE II   INTERPOLATION   9+3

Finite difference operators – Gregory Newton's forward and backward interpolations – Cubic spline interpolation - Lagrange interpolation - Newton's divided difference formula.

MODULE III   NUMERICAL DIFFERENTIATION AND INTEGRATION   9+3

Numerical differentiation using Newton's forward and backward formulae – Numerical integration : Trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Gaussian Two Point and Three Point Quadrature formulae – Double integrals using Trapezoidal and Simpson's 1/3 rule.

MODULE IV   INITIAL VALUE PROBLEMS FOR FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS   9+3

Numerical solutions by Taylor's Series method, Euler's method, Modified Euler's Method - Runge – Kutta Method of fourth order – Milne's and Adam's Bashforth Predictor and Corrector methods.

MODULE V   BOUNDARY VALUE PROBLEMS FOR PDE   9+3

Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional

Laplace equation

L – 45 ; T-15; TOTAL HOURS – 60

TEXT BOOKS:

1. Grewal, B.S., "Numerical methods in Engineering and Science", 7th edition, Khanna Publishers,New Delhi, 2007.
2. Gerald C.F., P.O.Wheatley, "Applied Numerical Analysis" , Pearson Education, New Delhi, 2002.

REFERENCES:

1. Chapra S.C, Canale R.P. "Numerical Methods for Engineers", 5th Ed., McGraw Hill, New York, 2006.
2. Jain M.K., S.R.K.Iyengar, R.K.Jain, "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003
3. Sastry.S.S,"Introductory Methods of Numerical Analysis",Fifth Edition,PHI Learning Private Ltd., New Delhi, 2012.

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

CO1: solve algebraic, transcendental and system of equations by numerical methods

CO2: apply various interpolation techniques and finite difference concepts

CO3: carry out numerical differentiation and integration using different methods whenever regular methods are not applicable

CO4: solve first order ODE using single and multi step methods

CO5: solve the boundary value problems in PDE by finite differences

Board of Studies (BoS) :

12th BOS of Mathematics and AS department held 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	L													
CO2	M														
CO3	M	L													
CO4	M	L													
CO5	M	L													

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 methods in numerical analysis will lead to use of applications in many projects in Engineering.