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

Regulations 2021
Curriculum and Syllabi
(Updated upto April 2023, as per 20th Academic Council)

B.Tech.
(Automobile Engineering)

REGULATIONS 2021

CURRICULUM AND SYLLABI

(Updated upto April 2023, as per 20th Academic Council)

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)

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

1.0 PRELIMINARY DEFINITIONS & NOMENCLATURE

In these Regulations, unless the context otherwise requires:

i) **"Programme"** means B.Tech. Degree Programme.

ii) **"Branch"** means specialization or discipline of B.Tech. Degree Programme like Civil Engineering, Mechanical Engineering, etc.,

iii) **"Course"** means theory / practical / laboratory integrated theory / seminar / internship / project and any other subject that is normally studied in a semester like English, Mathematics, Environmental Science, Engineering Graphics, Electronic Devices etc.,

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

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

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

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

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

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

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

2.0 ADMISSION

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

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

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

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

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

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

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

3.0 BRANCHES OF STUDY

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

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

4.0 STRUCTURE OF THE PROGRAMME

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

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

4.1.1 Mandatory Induction Programme for First year Students

The first year students upon admission shall undergo a mandatory three week induction programme consisting of physical activity, creative arts, universal human values, literary, proficiency modules, lectures by eminent people, visits to local areas, familiarization with departments / schools and centres, etc.,

4.1.2 Personality and Character Development

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

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

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

4.1.3 Online Courses for Credit Transfer

Students are permitted to undergo department approved online courses under SWAYAM up to 40% of credits of courses in a semester excluding project semester with the recommendation of the Head of the Department / Dean of School and with the prior approval of Dean (Academic Affairs) during his / her period of study. The credits earned through online courses ratified by the respective Board of Studies shall be transferred following the due approval procedures. The online courses can be considered in lieu of core courses and elective courses.

4.1.4 Value Added Courses

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

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

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

4.1.5 Industry Internship

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

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

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

4.1.6 Industrial Visit

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

4.2 Each course is normally assigned certain number of credits:

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

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

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

5.0 DURATION OF THE PROGRAMME

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

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

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

6.0 REGISTRATION AND ENROLLMENT

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

6.2 Change of a Course

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

6.3 Withdrawal from a Course

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

7.0 BREAK OF STUDY FROM PROGRAMME

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

7.1.1 Medical or other valid grounds

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

7.1.3 Debarred due to any act of indiscipline

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

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

7.4 During the break of study, the student shall not be allowed to attend any regular classes or participate in any activities of the Institution.

However, he / she shall be permitted to enroll for the 'I' grade courses and appear for the arrear examinations.

8.0 CLASS ADVISOR AND FACULTY ADVISOR

8.1 Class Advisor

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

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

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

8.2 Faculty Advisor

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

9.0 COURSE COMMITTEE

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

10.0 CLASS COMMITTEE

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

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

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

10.2 The composition of the class committee for each branch from 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 i^{th} course and GP_i is the Grade Point in the i^{th} course,

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

Where n = number of courses

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

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

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

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

Percentage equivalent of marks = CGPA X 10

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

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

16.6.1 Eligibility for First Class with Distinction

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

16.6.2 Eligibility for First Class

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

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

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

17.0 SUPPLEMENTARY EXAMINATION

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

18.0 DISCIPLINE

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

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

19.0 ELIGIBILITY FOR THE AWARD OF DEGREE

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

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

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

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

iv) No disciplinary action pending against him/her.

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

20.0 MINOR DEGREE PROGRAMMES OFFERED FOR STUDENTS

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

• Civil Engineering	• Mechanical Engineering
• Electronics and Communication Engineering	• Electrical and Electronics Engineering
• Automobile Engineering	• Aeronautical Engineering
• Polymer Engineering	• Biotechnology Engineering
• Electronics and Instrumentation Engineering	• Computer Science and Engineering

• Information Technology	• Artificial Intelligence and Data Science
• Computer Science and Engineering (IoT)	• Computer Science and Engineering(Cyber Security)

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

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

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

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

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

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

21.0 POWER TO MODIFY

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

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B.S. ABDUR RAHMAN CRESCENT INSTITUTE OF SCIENCE 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
			Credits				**25**

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
			Credits				**24**

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
			Credits				**22**

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	3	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 4201	Project work				9
			Credits				**9**

Overall Total Credits – 167

* Laboratory Integrated Theory course

** Laboratory Course

\# Three Week Orientation Programme – Mandatory Non-Credit Course

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

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

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

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LIST OF PROFESSIONAL ELECTIVE COURSES

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

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	0	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

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	3	0	0	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

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 Principles	3	0	0	3	CSE

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

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

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

16	GEDX 116	Green Design and 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) :

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	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 APPLICATIONS**	**L**	**T**	**P**	**C**
SDG: 9		**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:**
11^{th}BoS of Chemistry held on 17.06.2021	17^{th} 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	**ALGEBRA AND DIFFERENTIAL CALCULUS**	**L**	**T**	**P**	**C**
SDG: 4		**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

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

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

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

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

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

MODULE I MATRICES 9+3

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

MODULE II THEORY OF EQUATIONS 9+3

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

MODULE III DIFFERENTIAL CALCULUS 9+3

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

MODULE IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 9+3

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

MODULE V ORDINARY DIFFERENTIAL EQUATIONS 9+3

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

L – 45; 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, 53rd Edtion, 2014.
2. Venugopal. K, and V. Prabhu Raja, “Engineering Graphics”, New Age International (P) Ltd., Publication, Chennai, Edition 15, 2017.

REFERENCES:

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

COURSE OUTCOMES:

After completion of the course, students should be able to

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

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

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

CO4: apply the concept of isometric and perspective projection to draw the 3-D views of simple solids
CO5: draw the orthographic views of simple objects using drafting software

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

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

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

COURSE OBJECTIVES:

COB1: To learn the basic concepts of design in engineering

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

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

COB4: To introduce the role of innovation in engineering

MODULE I INTRODUCTION TO DESIGN 08

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

MODULE II DESIGN THINKING PROCESS 08

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

MODULE III PROTOTYPE DESIGN 07

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

MODULE IV INNOVATION 07

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

L – 30; Total Hours– 30

TEXT BOOKS:

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

REFERENCES:

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

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

COURSE OUTCOMES:

After completion of the course, students should be able to

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

CO2: analyse the problems and perform design thinking process

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

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

Board of Studies (BoS):

18th BoS of Mech held on 21.06.2021

Academic Council:

17th AC held on 15.07.2021

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

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

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

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

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

COURSE OBJECTIVES:

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

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

COB3: To impart knowledge onsand mould preparation for simple components

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

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

PRACTICALS

List of Experiments:

CIVIL ENGINEERING PRACTICE:

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

MECHANICAL ENGINEERING PRACTICE:

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

ELECTRICAL ENGINEERING PRACTICE:

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

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

ELECTRONICS ENGINEERING PRACTICE:

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

P – 30; Total Hours– 30

TEXT BOOK:

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

REFERENCES:

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

COURSE OUTCOMES:

After completion of the course, students should be able to

CO1: demonstrate Plumbing requirements of domestic buildings.

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

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

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

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

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

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

COURSE OBJECTIVES:

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

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

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

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

COB5: To understand pointer and file operation concepts.

MODULE I INTRODUCTION TO C PROGRAMMING 05

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

MODULE II DECISION MAKING AND ARRAY 05

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

MODULE III USER-DEFINED FUNCTIONS AND FILE OPERATIONS 05

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

PRACTICALS

LIST OF PROGRAMS IN C:

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

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

L – 15; P – 30 ; Total Hours– 45

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

Students who complete this course will be able to

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

CO2: bring out the importance of structural and procedural programming

CO3: write C coding using conditional and iteration statements

CO4: develop programs using Functions, Pointers and Files

CO5: implement program to build a real time application.

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

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

COURSE OBJECTIVES:

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

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

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

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

COB5: To sharpen their academic writing skills

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

MODULE I HUMAN RESOURCES 10

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

S: Introducing one self – exchanging personal info.

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

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

Voc. development: Prefixes, Suffixes

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

MODULE II TRANSPORT 10

L: Listening to long scientific talks

S: Sharing personal information – greeting, leave taking.

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

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

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

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

MODULE III ENERGY 9

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

S: Asking about routine actions & expressing opinions.

R: Locating Specific Information

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

Voc. development: Sequence words, misspelt words.

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

MODULE IV OUR LIVING ENVIRONMENT 8

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

S: Speaking about one's friend.

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

W: Argumentative writing.

Voc. Development: Synonyms, antonyms, phrasal verbs.

Lang. development: If clauses, Subject - Verb Agreement

MODULE V TECHNOLOGY 8

L: Listening to talks (General & Scientific).

S: Short group conversations.

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

W: Short essays, Dialogue writing.

Voc. Development: Idioms & Phrases.

Lang. development: Modal verbs.

L - 45; Total Hours- 45

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

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

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

CO3: Comprehend conversations and short talks delivered in English

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

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

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

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

MAD 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) :

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
CO 1	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	H	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	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.

GED 1202 SDG: 3, 5, 8, 12	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 APPLICATIONS 14

Introduction to semiconductors - Characteristics of PN Junction Diode – Zener Diode and its characteristics – SCR and its characteristics –– Bipolar Junction Transistorand its characteristics – JFET & MOSFET – their characteristics.
Applications: Half wave and full wave rectifiers - Voltage Regulation – Regulator ICs.

MODULE V INTRODUCTION TO DIGITAL CIRCUITS 14

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

PRACTICALS

List of Experiments

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

L – 45 ; P – 30 ; Total Hours– 75

REFERENCES:

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

8. Thomas L. Floyd, "Digital Fundamentals", 10th Edition Pearson Education Inc., New Delhi, 2008.

COURSE OUTCOMES:

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

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

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

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

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

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

Board of Studies (BoS) :

15th meeting of BoS of EEE held on 25.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	H	-	H	L	M	-	M	-	L	L	M	L	-	-	-
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 MANAGEMENT 8

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

MODULE IV HUMAN POPULATION, HEALTH AND SOCIAL ISSUES 6

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

Case studies related to current situation.

L – 30; Total Hours– 30

TEXT BOOKS:

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

REFERENCES:

1. Masters G.M., “Introduction to Environmental Engineering and Science”, Prentice Hall, New Delhi, 1997.

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

COURSE OUTCOMES:

The student will be able to

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

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

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

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

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

Academic Council:
17th AC held on 15.07.2021

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	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 FIRST LAW OF THERMODYNAMICS 9+3

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 RELATIONS 9+3

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) :

13th BoS 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 . & Short Description: 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) :

13th BoS 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	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 (*PC) (*PBL)	L	T	P	C
SDG: 9		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) :
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 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 (*PC)**

SDG: 7

L	T	P	C
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 OPERATION 9

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 CHARACTERISTICS 9

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) :

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	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.

		L	T	P	C
AUD 2105	**AUTOMOTIVE COMPONENT MODELLING LABORATORY**	**L**	**T**	**P**	**C**
SDG: 9		**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:

1. 2D – Drawing
2. 3D - Modelling
3. Modelling of piston, piston pin and piston rings.
4. Modelling of the connecting rod assembly.
5. Modelling of the crankshaft assembly.
6. Modelling of propeller shaft with universal joint.
7. Modelling of leaf spring
8. Modelling of helical spring
9. Modelling of Alloy wheel rim
10. Modelling of an oil pump
11. Modelling of a Disc brake
12. 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) :

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 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	**ESSENTIAL SKILLS AND APTITUDE FOR ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 17		**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) :

13th 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
CO 1										H					
CO 2									M	H					
CO 3					L	L									
CO 4		M		L											
CO 5															

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 TECHNOLOGY (* PBL)**	**L**	**T**	**P**	**C**
SDG: 9		**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) :

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: 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	**AUTOMOTIVE MATERIALS AND METALLURGY (*PC)**	**L**	**T**	**P**	**C**
SDG: 9		**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 MECHANISMS 7

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, 2ndEdition, 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) :
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	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) :
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: 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	**(Practical Component)**	**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 IN CHASSIS SYSTEMS 9

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) :
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		
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	**AUTOMOTIVE CHASSIS LABARTORY**	**L**	**T**	**P**	**C**
SDG: 9		**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
CO 1			H											M	
CO 2				L									L		
CO 3								M			L				
CO 4			H										M		
CO 5	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	**WORKPLACE SKILLS AND APTITUDE FOR ENGINEERS**	**L**	**T**	**P**	**C**
SDG: 8		**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) :
13thBoS 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	PSO1	PSO2	PSO3
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 HUMAN RIGHTS	L	T	P	C
SDG: 16		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 ABOUT INDIAN CONSTITUTION 8

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

MODULE II FUNDAMENTAL RIGHTS, DUTIES AND DIRECTIVE PRINCIPLES 7

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

MODULE III GOVERNANCE IN INDIA 8

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

MODULE IV HUMAN RIGHTS AND INDIAN CONSTITUTION 7

Human rights – meaning and significance - Covenant on civil and political rights - Covenant on Economic, Social and Cultural rights - UN mechanism and agencies - The Protection of Human Rights Act, 1993 – watch on human rights and enforcement - Roles of National Human Rights Commission of India - Special Constitutional Provisions for SC & ST, OBC - Special Provision for Women, Children & Backward Classes.

L – 30; Total Hours – 30

TEXT BOOKS:

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

REFERENCES:

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

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

CO1: describe the emergence and evolution of Indian Constitution.

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

CO3: compare the various structure of Indian government.

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

Board of Studies (BoS) :	**Academic Council:**
4^{th}BoS of SSSH held on 28.06.2021	17^{th} 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.

SEMESTER V

MSD 3281	**ENTREPRENEURSHIP**	**L**	**T**	**P**	**C**
SDG: All 1-17.		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the fit between individual and their entrepreneurial ambitions.

COB2: To identify the customers and find a problem worth solving.

COB3: To create a business model for solving the problems of customer, forming solution and present the Business Model Canvas

COB4: To develop a solution for customers' problem and analyze the problem solution fit & product market fit.

COB5: To build and demonstrate a Minimum Viable Product (MVP) for startup

MODULE I PROBLEM IDENTIFICATION AND OPPORTUNITY DISCOVERY 9

Entrepreneurial Thinking, Business Opportunities, Problem Identification, Design Thinking, Potential solutions, Presentation of the problem- Case Study

MODULE II CUSTOMER, SOLUTION AND BUSINESS MODEL 10

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

MODULE III VALIDATION AND FINANCIALS 10

Blue Ocean Strategy, Solution Demo, Problem – Solution Fit, Minimum Viable Product- Product Market Fit, Prototype – Case Study. Cost, Revenues, Pricing, Profitability Checks, Bootstrapping, Initial Financing and Pitching.

MODULE IV GO TO MARKET 8

Positioning and Branding, Golden Circle model: Sinek's theory value proposition, Branding Elements, Market Penetration Strategy, Collaboration Tools and Techniques, Channels – Case Study

MODULE V MANAGING GROWTH AND FUNDING 8

Sales Planning, Customer Acquisition Strategy, Selling Skills, Identifying Funding Sources, Mapping Start-Up Cycle to Funding Options, Funding Plan, , Creating business valuation

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Entrepreneurship Rajeev Roy oxford, 2012.

2. https://web.nen.wfglobal.org/en/home - Wadhwani Foundation

3. W. Chan Kim , Renée A. Mauborgne**,** “Blue Ocean Strategy: How to Create Uncontested Market Space and Make the Competition Irrelevant”, Harvard Business Press, 2015.

REFERENCES:

1. Anil Lamba , “Romancing the Balance Sheet: For Anyone Who Owns, Runs Or Manages a Business”, HarperCollins Publishers India, 2016.

2. The Process of social value creation: A multiple case study on Social Entrepreneurship in India, Archana Singh Springer 2016.

3. “Anatomy of Business Plan” – Linda Pinson, OMIM publication , Seventh Edition, 2008.

4. Running Lean: Iterate From Plan A To a Plan That Works, Ash Maurya, "O'Reilly Media, Inc.", 28-Feb-2012.

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Build an entrepreneurial mindset and reach out the customer to identify the problem using design thinking process

CO2: Craft solution to the problem through value proposition canvas and develop a business model using lean canvas

CO3: Provide product solution demo and deliver a minimum viable product

CO4: Work as a team and create brand strategy marketing for product/service

CO5: Prepare, make an outstanding sale pitch for startup

AUD 3101 **DESIGN OF AUTOMOTIVE COMPONENTS (*PBL)** **L T P C**

SDG: 9 **3 0 0 3**

COURSE OBJECTIVES:

COB1: To familiarize the various steps involved in the design process in automotive components

COB2: To familiarize various forces, stresses and strains on driveshaft

COB3: To learn to about the design of suspension systems

COB4: To understand the principle involved in designing the shapes and dimensions of bearings in various types of automotive

COB5: To study different automotive gears in accordance with standard design procedure and design criteria

MODULE I INTRODUCTION TO DESIGN 9

Stages of design, Types of design,Customer & functional requirements, General design considerations,Engineering materials and their physical properties as applied to design -Theories of failure - Factors of safety in design - Design for variable loading – Soderberg, Goodman and Gerber relations.

MODULE II DESIGN OF DRIVESHAFT 9

Introduction - Material and design stresses - Design of shafts on the basis of strength -Design of shaft on the basis of rigidity - Design of hollow shafts.

MODULE III DESIGN OF AUTOMOTIVE SPRINGS 9

Design of close coiled helical spring subjected to axial loading,torsion of helical springs - Design of leaf springs,laminated leaf springs and semi-elliptical leaf spring.

MODULE IV DESIGN OF BEARINGS 9

Design of bearings - Journal and ball bearings,bearing life,static load capacity, dynamic load capacity,bearing material,oil flow and temperature rise.

MODULE V DESIGN OF GEARS 9

Design considerations - Strength of gear teeth - Terminology of gears - Design of spur,helical andbevel gears.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Richard G. Budynas, J. Keith Nisbett, “Shigley’s Mechanical Engineering Design”, 11thEdition, McGraw Hill, 2020.

2. R.S. Khurmi and J.K. Gupta, “Machine Design”, 25th Edition, S Chand & Co Ltd, 2020.

REFERENCES:

1. V B Bhandari, “Design of Machine Elements”, 4th Edition, McGraw Hill Education India Private Limited, 2017.
2. Norton, “Machine Design: An Integrated Approach”, 5th Edition, Pearson Education India, 2013.
3. Design Data: Data Book of Engineers by PSG College, KalaikathirAchchagam, Coimbatore, 2020.

COURSE OUTCOMES:

On completion of the course students should be able to

CO1: Illustrate various design aspects and design procedures

CO2: Design drive shafts for automobile

CO3: Design helical and leaf springs in automotive

CO4: Design journal and ball bearings used in automotive

CO5: Design various gears used in automobile

Board of Studies (BoS) :

14thBoS held on 22.08.2022

Academic Council:

19thAC held on 29.09.2022

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

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

SDG 9: This subject will provide information aboutthe designing of different automobile components with proper knowledge.

Statement: The understanding of design procedure of the various automotive parts will guide to effectual designing of automotive components.

AUD 3102	**VEHICLE DYNAMICS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide fundamental knowledge of the dynamics of groundvehicles.

COB2: Understand characteristics of tyres in different surfaces.

COB3: Gain knowledge about the suspension related vibrations for improving passenger comfort.

COB4: Know about the stability of vehicle in various terrains.

COB5: To study about basic analysis of vehicle dynamics in performance, handling andridemodes

MODULE I BASIS OF VIBRATION 9

Definitions, Modeling and Simulation, Global and Vehicle Coordinate System, Free, Forced, Undamped and Damped Vibration, Response Analysis of Single DOF, Two DOF, Multi DOF, Magnification factor, Transmissibility ratio, Vibration absorber, Vibration measuring instruments, Torsional vibration,Critical speed. Modal analysis.

MODULE II TYRES 9

Tyre forces and moments, Tyre structure, Longitudinal and Lateral force at various slip angles,rolling resistance, Tractive and cornering property of tyre. Performance of tyre on wet surface.Ride property of tyres. Magic formulae tyre model, Estimation of tyre road friction. Test onVariousroadsurfaces.Modes oftyrevibration.

MODULE III VERTICAL DYNAMICS 9

Humanresponsetovibration,SourcesofVibration.StateSpaceRepresentation. Design,analysis, simulation of Passive, Semi-active and Active suspension using Quarter car, half car and full car models. Influence of suspension stiffness, suspension damping, and tyre stiffness. Control law for LQR, H-Infinite, Skyhook damping. Air suspension system and their properties.

MODULE IV LONGITUDINAL DYNAMICS AND CONTROL 9

Aerodynamic forces and moments. Equation of motion. Static load distribution for threewheelerand four wheeler. Determination of CG point. Calculation of maximum acceleration, Reactionforces for different drives.

Braking and driving torque. Prediction of Vehicle performance. Traction control.

MODULE V LATERAL DYNAMICS 9

Steady state handling characteristics. Steady state response to steering input – Yaw velocity gain, Lateral acceleration gain, curvature response gain. Testing of handling characteristics. Transient response characteristics, Direction control of vehicles. Roll center, Roll axis, Vehicle under side forces. Camber and camber thrust. Stability of vehicle resting on slope, running onbanked road, during turn. Effect of suspension on cornering. Minuro Plot for Lateral Transient Response.

L - 45 : TOTAL HOURS – 45

TEXT BOOKS:

1. Singiresu S. Rao, Mechanical Vibrations, 6th Edition, Pearson, 2018
2. Giri N.K – Automotive Mechanics, Khanna Publishers, 2008.
3. Rao J.S and Gupta. K “Theory and Practice of Mechanical Vibrations”, New Age International, 1999
4. J. Y. Wong, Theory of Ground Vehicles, 4th Edition, Wiley, 2017
5. Gillespie T.D, “Fundamentals of Vehicle Dynamics”, Revised Edition R 506,SAE USA 2021

REFERENCES:

1. DeanKarnopp,VehicleStability, 1stedition,MarcelDekker,2004
2. G.NakhaieJazar,VehicleDynamics:TheoryandApplication,1stedition,Springer,2017
3. HansBPacejka,TyreandVehicleDynamics,3rdedition, Elsevier,2012
4. JanZuijdijk,Vehicledynamicsanddamping,First revised edition ,2013

COURSE OUTCOMES:

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

CO1: Evaluate the vehicle system performance in dynamic condition

CO2: Analyze the characteristics of wheels and tyres dynamic control systems.

CO3: Develop mathematical model and study the performance characteristics of suspension

CO4: Apply the knowledge in longitudinal dynamics and modern control methods

CO5: Analyze the performance at different surfaces like curved track, slope and a banked road

Board of Studies (BoS) :
14thBoS held on 22.08.2022

Academic Council:
19thAC held on 29.09.2022

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

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

SDG 9: This subject will provide information aboutthe dynamics of avehicle which will be useful in the development of customer friendly vehicles.

Statement: The understanding of the dynamic behavior of the vehicle in the various operating conditions are used for the development of comfortable vehicle to the passengers

AUD 3103 **SDG: 9**	**VEHICLE INSPECTION AND MAINTENANCE** **(Practical Component)**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

COB1: To know about the various methods of maintaining procedure, vehicle insurance and basic problems in a vehicle.

COB2: The student able to impart knowledge in maintaining of engine components and subsystems.

COB3: The student able to impart knowledge in maintaining of transmission, driveline, steering, suspension, braking and wheels.

COB4: The student able to impart carefully maintaining their vehicle and can increase driving safety.

COB5: To study about the fundamentals of air conditioning maintenance and battery maintenance.

MODULE I VEHICLE INSPECTION TOOLS 7

Maintenance – Need, importance, primary and secondary functions, policies - classification of maintenance work - vehicle insurance - basic problem diagnosis. Automotive service procedures – workshop operations – workshop manual - vehicle identification. Safety – Personnel, machines and equipment, vehicles, fire safety - First aid. Basic tools – special service tools – measuring instruments – condition checking of seals, gaskets and sealants. Scheduled maintenance services – service intervals - Towing and recovering.

MODULE II ENGINE MAINTENANCE 6

Inspection- General Engine service- Dismantling of Engine components- Engine repair- working on the underside, front, top, ancillaries- Service of basic engine parts, cooling and lubricating system, fuel system, Intake and Exhaust system, electrical system - Electronic fuel injection and engine management service - fault diagnosis- servicing emission controls. Maintenance of batteries, starting system, charging system and body electrical -Fault diagnosis using Scan tools.

MODULE III TRANSMISSION AND DRIVELINE MAINTENANCE 6

Clutch- general checks, adjustment and service-inspection- Dismantling, identifying, checking and reassembling transmission, transaxle- road testing- Removing and replacing propeller shaft, servicing of cross and yoke joint and constant velocity joints- Rear axle service points- removing axle shaft and bearings- servicing differential assemblies- fault diagnosis.

MODULE IV STEERING AND SUSPENSION MAINTENANCE 6

Maintenance and Service of Mc person strut, coil spring, leaf spring, shock absorbers. Dismantling and assembly procedures. Inspection, Maintenance and Service of steering linkage, steering column, Rack and pinion steering, Recirculating ball steering service- Worm type steering, and power steering system.

MODULE V BRAKE AND WHEEL INSPECTION 5

Inspection, Maintenance and Service of Hydraulic brake, Drum brake, Disc brake, parking brake. Bleeding of brakes. Wheel alignment and balance, removing and fitting of tyres, tyre wear and tyre rotation.

PRACTICALS

STUDY EXPERIMENTS:

1. Study and layout of an automobile repair, service and maintenance shop.
2. Safety aspects with respect to man, machine and tools.
3. General procedures for servicing and maintenance schedule.
4. Fault diagnosis and service of transmission system.
6. Fault diagnosis and service of Electrical system like battery, starting system, charging system, lighting system etc.
7. Fault diagnosis and service of vehicle air conditioning system.

LIST OF EXPERIMENTS

1. Minor and major tune up of gasoline and diesel engines.
2. Calibration of Fuel injection pump.
3. Cylinder reboring - checking the cylinder bore, Setting the tool and reboring.
4. Calibration of fuel injection nozzle and tester.
5. Removal and fitting of tire and tube.
6. Fault diagnosis of ignition system and spark plug cleaner & tester.
7. Adjustment of pedal play in clutch, brake, hand brake lever and steering wheel play.
8. Wheel alignment procedure for servicing and maintenance.
9. Fault diagnosis of brake/clutch.
10. Calibration of head lamp aligner.

11. Calibration of Refacer of valve.

L – 30 ; P – 30 ; TOTAL HOURS – 60

TEXT BOOKS:

1. JigarA.DoshiDhruU.Panchal, JayeshP.Maniar, Vehicle maintenance and garage practice, 2014.
2. Allan Bonnick, A Practical Approach to Motor Vehicle Engineering and Maintenance 5th Edition, 2017.

REFERENCES:

1. Bosch Automotive Handbook, Sixth Edition, 2014.
2. Tom Denton, Advanced Automotive Fault Diagnosis, 2011
3. Haynes Manuals, Nissan Patrol Automotive Repair Manual: Inc.2014.
4. Automobile electrical manual a comprehensive guide by Haynes manual car repair, 2012.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Analyze the maintenance schedules and procedures with appropriate tools

CO2: Demonstrate the procedure and methods to repair and calibrate the engine.

CO3: Analyze the causes and remedies for fault in transmission and drive line systems.

CO4: Analyze the causes and remedies of steering and suspension systems.

CO5: Predict the causes and remedies of brake system and demonstrate the procedure for wheel alignment and wheel balanced.

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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

SDG 9: The subject will be a pre requisite for understanding the vehicle maintenance and inspection in vehicle.

This subject will lead to effective understanding of tools and instruments used for analyzing the defects in vehicle components and in systems.

AUD 3104	VEHICLE BODY ENGINEERING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To know about the construction of car body, design criteria, types of car and safety aspects of car.

COB2: To know about the construction of bus body and dimensions of bus body and safety aspects.

COB3: To know about the types of commercial vehicles; design of cab and in aerodynamic testing- forces and moments.

COB4: To know about the modern painting process and painting defects and corrosion methods.

COB5: To know well versed in the design and construction of external body of the vehicles and materials used in vehicles.

MODULE I CAR BODY 9

Types of Car body - Saloon, convertibles, Limousine, Estate Van, Racing and Sports car – Visibility regulations, driver's visibility, improvement in visibility and tests for visibility. Driver seat design -Car body construction-Various panels in car bodies. Car body construction; design criteria. Crash tests on full scale model, Dummies and Instrumentation. Safety aspect of car body.

MODULE II BUS BODY 9

Types of bus body: based on capacity, distance traveled and based on construction. Bus body lay out for various types, floor height, engine location, entrance and exit location, seating dimensions. Types of metal sections used – Regulations – Constructional details: Conventional and integral.

MODULE III COMMERCIAL VEHICLE 9

Types of commercial vehicle bodies - Light commercial vehicle body. Construction details of commercial vehicle body - Flat platform body, Trailer, Tipper body and Tanker body, Drivers cab design - Regulations.

MODULE IV PAINTING METHODS AND PROCESS 9

Modern painting process – structure of painting coat-pretreatment –electro coat-sealing- primer coat- basecoat- clear coat- procedure, inspection-paint depth-swirl marks, paint problems and defect, Trim mechanisms-body repair, anti corrosion-cavity wax injection-electronic rust protection.

MODULE V BODY MATERIALS 9

Types of materials used in body construction-Steel sheet, timber, plastics, GRP, properties of materials. Hand tools-power tools-panel repair-repairing sheet metal repairing plastics-body fillers-passenger compartment service- corrosion and Anticorrosion methods.

L - 45: TOTAL HOURS – 45

TEXT BOOKS:

1. Powloski, J., "Vehicle Body Engineering", Business Books Ltd., 2015.
2. James E Duffy, "Body Repair Technology for 4-Wheelers", Cengage Learning, 2009.
3. A.K Babu, "Vehicle Body Engineering",Khanna Book Publishing, 2021.
4. Davies “Materials for Automobile bodies”, ElsevierIndia, 2013.

REFERENCES:

1. Giles, G.J., "Body construction and design", Illiffe Books Butterworth & Co., 2012.
2. John Fenton, "Vehicle Body layout and analysis", Mechanical Engg. Publication Ltd., London, 2015.
3. Braithwaite, J.B., "Vehicle Body building and drawing", Heinemann Educational Books Ltd., London, 2005.
4. Dieler Anselm., The passenger car body, SAE International, 2010.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Design the car body and identify the car body parts in a vehicle.

CO2: Evaluate about different aspects of car body and bus body, types, commercial vehicle.

CO3: Analyze the Role of various aerodynamic forces and moments, measuring instruments.

CO4: Painting process for a commercial vehicle and tools used for body repairs.

CO5: Find the material which can be used in car body, bus body for automobile.

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	H	H	M	L	M					L	L	M	H	H
CO2	H	H	M	L	M					L	L	M	H	H
CO3	H	H	M	L	M					L	L	M	H	H
CO4	H	H	M	L	M					L	L	M	H	H
CO5	H	H	M	L	M					L	L	M	H	H

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

SDG 9: The subject will be a pre requisite for understanding the vehicle body design and materials.

This subject will lead to effective understanding of methods of painting process. Painting problems, defects and corrosion methods.

		L	T	P	C
GED 3101	**COMMUNICATION SKILLS FOR CAREER SUCCESS**	**L**	**T**	**P**	**C**
SDG: 4		**0**	**0**	**2**	**1**

COURSE OBJECTIVES:

COB1: To develop students' proficiency in English at CEFR B2 level (Business Vantage)

COB2: To develop students' receptive skills (Listening and Reading) in a wide range of situations

COB3: To develop students' productive skills (Speaking and Writing) in a wide range of situations

COB4: To expose students to the nuances of the English language, grammar and usage.

MODULE I BRIEF EXCHANGES OF COMMUNICATION 08

Listening to telephonic conversations - gap filling exercises- short conversations – Promoting a product-Reading short passages and answering matching tasks- Writing short notes and messages. - Framing questions

MODULE II WORKPLACE COMMUNICATION 07

Listening to monologues - gap filling exercises - Mini presentations- role play- Reading longer texts – gap filling- Writing memo , emails and Fax - Writing reports on conferences, seminars

MODULE III INTERPERSONAL COMMUNICATION 08

Listening to conversations – Collaborative discussion using prompts - Reading comprehension-multiple choice-texts - Writing enquiry letters & replies to customers

MODULE IV NEGOTIATING AND PERSUADING 07

Listening to interviews - Group Discussions - Multiple choice and gap filling- writing work reports- cause and effect - Complaint letter and sales letter

P-30: TOTAL HOURS - 30

REFERENCES:

1. Guy Brook-Hart, 'Business Benchmark-Upper Intermediate, 2nd edition, Cambridge University Press, Shree Maitrey Printech Pvt. Ltd, Noida, 2016.
2. Leo Jones, 'New International Business English' Students book. Cambridge University Press, Cambridge, 2003.

3. Simon Sweeney, ‘Communicating in Business’ Teacher’s Book. Cambridge University Press, Cambridge, 2004.
4. Simon Sweeney, ‘Communicating in Business’ Student’s Book. Cambridge University Press, Cambridge, 2003.
5. Bill Mascull. ‘Business Vocabulary in Use’. Advanced. Cambridge University Press, Cambridge, 2004

COURSE OUTCOMES:

CO1: Use the LSRW skills effectively in business and general situations

CO2: Demonstrate receptive skills effectively in various formal and informal communication situations.

CO3: Demonstrate productive skills effectively in various formal and informal communication situations

CO4: Use appropriate grammar and vocabulary in any context.

Board of Studies (BoS) :
13th 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	PS O1	PS O2	PS O 3	PSO 4	PSO 5
CO1									M	H							H
CO2									M	H							H
CO3									M	H							H
CO4										H							M

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

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

This course helps the students to enhance their communication skills, critical thinking, problem solving, conflict resolution, team building and public speaking. This course also helps them to achieve success in their professional and personal life.

AUD 3105 **Internship I** **L T P C**

SDG: 9 **0 0 0 1**

COURSE OBJECTIVES:

COB1: To expose the students to industrial environment

COB2: To understand the principle involved in industrial processes, products and services

COB3: To study the different resources used in automotive industries

Guidelines:

- The students shall undertake internship training in automotive and related industry for the period of 15 days during the summer vacation.
- The student should submit a report and make presentation about learning outcome from the industry training.
- The credit will be awarded in the 5th semester.

COURSE OUTCOMES:

On completion of the course students should be able to

CO1: Familiarize with the complete structure and domains involved in an industry environment

CO2: Illustrate various design, manufacturing, quality and service aspects of an automobile

CO3: Analyze the various resources and make use of the skills to solve the industry issues

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

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

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

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

Statement: Internship develops the professional aptitude promotes sustainable industrialization and foster innovation.

SEMESTER VI

AUD 3211	**AUTOMOTIVE EMISSIONS AND CONTROL**	**L**	**T**	**P**	**C**
SDG: 13	**(Practical Component)**	**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

COB1: To learn about air pollution from automotive engines

COB2: Impart the knowledge of emission formation from engines

COB3: To learn the emission control techniques in SI engines

COB4: To learn the emission control techniques in CI engines

COB5: Impart the knowledge of emission measurement techniques and driving cycles.

MODULE I AIR POLLUTION FROM ENGINES 6

Air pollution from automotive engines, regulated and unregulated emissions, effect of emission on global warming, green gas, ozone and human health, photochemical smog, air quality standard, emissions standards

MODULE II FORMATION OF POLLUTANTS 6

Combustion generated and other emissions - Carbon monoxide,NO_x formation from SI and CI engines, unburned hydrocarbon from SI and CI engines, soot and particulates formation, NO_x-particulate trade off, effect of SI engines design and operation variable on emission formation, effect of CI engines design and operation variable on emission formation

MODULE III SI ENGINE EMISSION CONTROL TECHNOLOGY 6

Engine design parameters, positive crank case ventilation, evaporative emission control, exhaust gas recirculation, thermal reactor, catalytic exhaust after treatment, types of catalytic converter, gasoline direct injection stratified charge engines.

MODULE IV CI ENGINE EMISSION CONTROL TECHNOLOGY 6

Fuel injection variables, electronic fuel injection system, exhaust gas recirculation(EGR), EGR cooling, EGR in turbocharged engines, EGR control, turbocharging, diesel oxidation catalysts, diesel de-NO_x catalysts, selective catalysts reduction (SCR), urea injection, diesel particulate filters.

MODULE V EMISSION MEASUREMENT TECHNIQUES AND DRIVING CYCLE 6

Non Dispersive Infrared Gas Analyzer, Chemiluminescent Analyzer, Flame

Ionization Detector, Smoke Opacity And Filter Paper Measurements, Particulate Matter, Full Flow And Partial Flow Dilution Tunnel, Gas Chromatography.
Transient Dynamometer, Test Cells, Driving Cycles For Emission Measurement, Chassis Dynamometer, CVS System, National And International Emission Standards.

PRACTICALS

List of Experiments

1. Performance study of single cylinder petrol engine at full throttle and part throttle conditions.
2. Performance study of twin cylinder constant speed diesel engine.
3. Performance and combustion study of single cylinder constant speed CI engine.
4. Performance study of variable speed single cylinder compression ignition engine.
5. Performance study of variable speed twin cylinder compression ignition engine.
6. Determination of volumetric efficiency and optimum cooling water flow rate in IC engines.
7. Head balance test of a Automotive diesel engine.
8. Measurement of HC, CO, CO_2, O_2 and NO_x using exhaust gas analyzer.
9. Diesel smoke measurement.

L – 30 ; P – 30 ; TOTAL HOURS – 60

TEXT BOOKS:

1. Karthikeya Sharma, T.., Prasad Rao, G. Amba. Engine Emission Control Technologies: Design Modifications and Pollution Mitigation Techniques. United States: Apple Academic Press, 2020.
2. Pundir, B. P. Engine emissions: pollutant formation and advances in control technology. United Kingdom: Alpha Science International Limited, 2007.

REFERENCES:

1. Kuwahara, Takuya, and Okubo, Masaaki. New Technologies for Emission Control in Marine Diesel Engines. Netherlands, Elsevier Science, 2019.
2. Schäfer, Fred.,Basshuysen, Richard van. Reduced Emissions and Fuel Consumption in Automobile Engines. Austria: Springer Vienna, 2014.

COURSE OUTCOMES:

After Completion of this course the student will able to:

CO1: Explain about the atmospheric pollution from engines and its impact on human health and environment.

CO2: Analysis the formation of emissions in both SI and CI engines.

CO3: Identify the various control methods/techniques used in SI engine to control the engine out emissions.

CO4: Analysis the various control methods/techniques used in CI engine to control the engine out emissions.

CO5: Explain the emissions measurement techniques and driving cycles.

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	H	H	H				H			H		M	H	H
CO2	H	H	H				H			H		M	H	H
CO3	H	H	H				H			H		M	H	H
CO4	H	H	H				H			H		M	H	H
CO5	H	H	H				H			H		M	H	H

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

SDG: 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.

AUD 3212	**BATTERY TECHNOLOGY FOR ELECTRIC VEHICLES (*PBL)**	**L T P C**
SDG: 9		**3 0 0 3**

COURSE OBJECTIVES:

COB1: To understand the chemistry behind the working of battery

COB2: To gain knowledge in battery pack architecture

COB3: To study methods in battery charging

COB4: To know the principles behind battery management system

COB5: To know the principles behind thermal management system

MODULE I BATTERY CHEMISTRIES 9

Types of batteries- Lithium-Ion, Nickel-Metal Hydride, Lead-Acid Batteries, Ultra capacitors. Anode and cathode chemistries. Electrical characteristics - Capacity, C-rate, impedance, DOD, SOC, SOH, Life cycles, Mechanical characteristics – case study on specifications of electric vehicle battery. Factors affecting the choice of EV battery.Future batteries for Electric Vehicles - Metal/Air Cells,Zinc/Air Cells,Lithium/Air Cells, Lithium/Sulfur Cells.

MODULE II BATTERY PACK ARCHITECTURE 7

Factors to be considered for architecture. Cell architecture. Pack designs involving cylindrical, pouch or prismatic. Size and shape of cell. Assembly methods. Design consideration - Thermal, Electrical, Mechanical and Safety.

MODULE III BATTERY CHARGING 11

Battery Charging Curve, Charging Methods - Current Control Method, Voltage Control Method, Constant Current-Constant Voltage, Five-Step Charging Pattern, Pulse Charging Method and Modern Intelligent Charging Method. Charger hardware technology - On-board Charger, Off-Board Charger and wireless. Charging characteristics – charging capacity, efficiency and time. Connectors - CHAdeMO technology, standards – CCS2, GB/T, Wire harness.

MODULE IV BATTERY MANAGEMENT SYSTEM (BMS) 9

Architectures of a BMS. Functions – Measurement, management, evaluation external communication, logging and telemetry - terminology for various types of BMS - Constant current/constant voltage (CCCV) chargers, Regulators, Meters, Monitors, Balancers, Protectors. Design of BMS - analog and digital. Topology – Centralized, Modular, Master-Slave and Distributed. Cell balancing. Battery charging management.

MODULE V THERMAL MANAGEMENT SYSTEM (TMS) 9

Functions of TMS, Methods - Air cooling, Liquid cooling, Direct refrigerant cooling, Phase change material cooling, Thermoelectric cooling and Heat pipe cooling. Heat pipe cooling - basic elements in the heat pipe TMS. Thermal Modelling of cooling system. Recent technology in TMS.

L - 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Jiuchun Jiang, Caiping Zhang, “Fundamentals and Applications of Lithium-ion Batteries in Electric Drive Vehicles”, 1stedition,Wiley Publications, United states, 2015. (ISBN: 978-1-118-41478-1)

REFERENCES:

1. David Linden, Thomas B. Reddy,“Handbook of Batteries”, McGraw-hillPublishing, 3rd Edition, 2002.
2. Bruno Scrosati, Jürgen Garche, Werner Tillmetz, “Advances in Battery Technologies for Electric Vehicles” ,Woodhead Publishing,5th edition,(ISBN: 9783658017835)
3. Thomas B. Reddy, “Linden's Handbook of Batteries”, McGraw-hillPublishing, 4th Edition, 2010.(ISBN:9780071624190)
4. Robert Bosch ,”Electric Vehicle Technology Explained”, 2nd Edition,Wiley Publications, 2012.(ISBN: 9781119942733)
5. Davide Andrea,“Battery Management Systemsfor Large Lithium-Ion Battery Packs”,Artech house Publications, London,1st Edition, 2010 (ISBN: 978-1608071043)
6. Gianfranco Pistoia, BoryannLiaw, “Behaviour of Lithium-Ion Batteries in Electric Vehicles”, Springer, 2018.(ISBN: 9783319699509)

COURSE OUTCOMES:

Students should able to

CO1: Illustrate the chemistries behind the working of batteries.

CO2: Develop a battery pack architecture for electric vehicle.

CO3: Demonstrate various methods of battery charging

CO4: Design Battery management system for electric vehicle

CO5: Analyze the problems due to heating and cooling in battery and give solution through thermal management system

Board of Studies (BoS) :	**Academic Council:**
14thBoS held on 22.08.2022	19thAC held on 29.09.2022

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

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

SDG No.9: To promote energy efficiency

Statement: The understanding of the course helps to increase performance of battery using innovative technologies which assists in pollution control.

AUD 3213	**AUTOMOTIVE ELECTRICAL AND ELECTRONICS**	**L T P C**
SDG: 9		**3 0 0 3**

COURSE OBJECTIVES:

COB1: To learn the working principle of battery and its types with Starting system circuit.

COB2: To impart knowledge in the working principles and various components in starting system and lighting systems.

COB3: To understand the working of sensor and actuators

COB4: To gain knowledge in basic of control system

COB5: To impart knowledge about controls system in automobile

MODULE I BATTERY AND STARTING SYSTEM 9

Vehicle Batteries –Lead acid battery Construction, Working Principle, Battery Rating, Lead Acid battery Charging methods and Testing Methods and Fault Diagnosis. Lithium ion Battery-construction and working. Modern Batteries. Construction and working. Starting System- Starter motor, starter drive mechanism, starting system circuit, fault diagnosis.

MODULE II CHARGING SYSTEM AND LIGHTING SYSTEM 9

Components of DC and AC Charging System for Automobile, construction, operating principle, characteristics, charging circuit controls – cut out, relays, voltage and current regulators, troubleshooting. Voltage regulator. Lighting Fundamentals and Lighting Circuit,Signalling circuits, Conventional Headlamps and LED Lighting System.

MODULE III SENSORS, ACTUATORS AND CONTROLS 9

Sensors for throttle position, mass air flow, Manifold Absolute Pressure (MAF) Sensor crank shaft position, cam position, engine and wheel speed sensor, steering position, tire pressure, steering torque, fuel level, crash sensor, Coolant Sensor, Engine Speed Sensor exhaust oxygen level (two step and linear lambda), knock, engine temperature, manifold temperature and pressure , actuators- various types of actuators.

MODULE IV ELECTRONIC ENGINE MANAGEMENT SYSTEM 9

Gasoline Engine electronic Injectors and types of injectors - Testing of Fuel Injectors and diagnosis of fault in injectors. Requirement of ignition system, components of ignition system, construction and working of Electronic Ignition system, Distributor less Ignition System, trouble shooting of ignition system, Spark plugs and mechanism.

MODULE V VEHICLE CONTROL SYSTEMS 9

Cruise Control System and Adaptive Cruise Control System Working –Throttle Actuator Stepper Motor Based Control, Electronic brakes- Antilock Braking Mechanism –Electric Power Assisted Steering Mechanism, Steering and Steer-by-Wire, Electronic Suspension System and vehicle control systems.

L - 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Tom Denton., "Automobile Electrical and Electronic Systems", 5th edition, Routledge, Taylor& Francis Group, United Kingdom, 2017.
   K. Babu., "Automotive Electrical and Electronics", 1st edition, Khanna Publishing, Delhi, 2018.
2. Kholi,P.L., "Automotive Electrical Equipment", McGraw Hill Education; 1st edition,2017

REFERENCES:

1. Sherry KwablaAmedorme, "Automotive Electrical Systems", LAP LAMBERT Academic Publishing, 1st Edition, Moldova, 2016. (ISBN 13: 978-3-659-97984-2)
2. Robert Bosch, "Bosch Automotive Electrics and Automotive Electronics" ,Springer Fachmedien Wiesbaden,5th edition,(ISBN: 9783658017835)
3. Robert Bosch , "Gasoline Engine Management", Wiley Publications, 2006
4. Robert Bosch ,"Diesel Engine Management", Wiley Publications, 2006
5. William Ribbens ,"Understanding Automotive Electronics", Elsevier ,8th Edition, 2017 (ISBN: 9780128104354)

COURSE OUTCOMES:

Students should able to

CO1: Illustrate the working principle of various batteries and starting systems.

CO2: Demonstrate the construction and working of charging and lighting system.

CO3: Identify various sensors and actuators.

CO4: Define the fundamentals of electronics control system

CO5: Demonstrate various control systems in automobiles

Board of Studies (BoS) :

14thBoS held on 22.08.2022

Academic Council:

19thAC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	H	M	M	M	M				M	H	H	H
CO2	H	H	H	M	M	M	M				M	H	H	H
CO3	H	H	H	M	M	M	M				M	H	H	H
CO4	H	H	H	M	M	M	M				M	H	H	H
CO5	H	H	H	M	M	M	M				M	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 Electrical and Electronic systems in vehicle.

Statement: This subject will lead to effective understanding of electric & and electronic components with control systems.

AUD 3214 **AUTOMOTIVE ELECTRICAL AND ELECTRONICS LABORATORY**

SDG: 9

L	T	P	C
0	0	3	1

COURSE OBJECTIVES:

COB1: To fault diagnosis in starting, charging and engine electronics control system.

COB2: To train students in testing of battery and its maintenance.

COB3: To train students in electrical test bench.

COB4: To understand working of various controls systems.

COB5: To examine the working of temperature and pressure sensor.

PRACTICALS

List of Experiments:

1. Fault diagnosis in Starting system using Starting system training panel.
2. Fault diagnostic system in Engine electronic control system training.
3. Testing of Batteries and battery maintenance.
4. Study of Power window raising mechanism
5. Demonstration and working of Airbag simulator.
6. Demonstration and working ACC control circuit.
7. Demonstration and working model of wiper circuit system.
8. IC 555 timer circuit.
9. BC547 transistor touch sensor.
10. Experiment of Temperature measurement using temperature sensor - thermistor.
11. Experiment of Pressure measurement using Pressure transducer.
12. Experiment on Working of Relay circuit.

P – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

2. David M. Jones, Kirk VanGelder, “Automotive Electricity and Electronics” Jones & Bartlett Learning, Burlington,2018
3. Sean Westcott,Jean Riescher Westcott, “Basic Electronics:Theory and Practice” ,Mercury learning and information, United States,2015.(ISBN: 978-1-937585-41-9)

REFERENCES:

1. Tom Denton, "Automobile Electrical and Electronic Systems",3rd edition, Elsevier Butterworth-Heinemann,2004.
2. Galip Ulsoy, Huei Peng, Melih C¸ akmakcı, "Automotive control systems",1st edition, Cambridge University Press,USA,2014. (ISBN 978-1-107-68604-5)
3. https://www.youtube.com/watch?v=UrqPxwsPWGk&ab_channel=OvensGarage (Pressure Measurement)
4. https://www.tutorialspoint.com/arduino/arduino_temperature_sensor.htm (Temperature Sensor)

COURSE OUTCOMES:

Students should able

CO1: To do fault diagnosis in starting, charging and engine electronics control system.

CO2: To test the condition of battery

CO3: To demonstrate power window, wiper and Air bag mechanisms.

CO4: To demonstrate working of various control systems.

CO5: To develop control circuits using sensors.

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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

SDG No.:9 To conduct Scientific research and innovation in the field of Electrical and electronics.

Statement: The understanding of electrical and electronics leads to new innovation in automobile controls to improve its efficiency.

GED 3201	REASONING AND APTITUDE FOR ENGINEERS	L	T	P	C
SDG: 4		0	0	2	1

COURSE OBJECTIVES:

COB1: To develop students' critical reading skills

COB2: To foster their writing skills

COB3: To enlighten the various methods of solving quantitative problems

COB4: To make students ready for clearing placement and competitive examination

MODULE I OBJECTIVE ENGLISH 07

Reading Comprehension - Sentence Rearrangement - Cloze Test – Error Spotting

MODULE II VOCABULARY DEVELOPMENT 08

Vocabulary (Synonyms and Antonyms, one word Substitutes, Spellings, Idioms and Phrases, etc) - Fill in the blanks - Paragraph Completion

MODULE III GENERAL MENTAL ABILITY 08

Time speed and Distance –Problems on Trains – Boats and Streams - Permutation and Combination - Probability

MODULE IV 07

Data Interpretation (charts, graphs, tables, data sufficiency, etc.) – Time and work-Pipes and Cisterns-Venn Diagrams-Mensuration

L – 30 ; TOTAL HOURS 30

REFERENCES:

1. Whitby, Norman (2014). Business Benchmark: Pre-Intermediate to Intermediate. Cambridge University Press, UK.
2. Swan, Michael (2005). Practical English Usage, Oxford University Press.
3. Tyra .M, Magical Book On Quicker Maths, BSC Publishing Company Pvt. Limited, 2009
4. R. S. Aggarwal , Quantitative Aptitude for Competitive Examinations, S. Chand Limited, 2017

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

COURSE OUTCOMES:

CO1: Demonstrate their reading ability

CO2: Exhibit their vocabulary and writing skills

CO3: Apply the problem-solving techniques

CO4: Gain confidence mentally and be successful in their career

Board of Studies (BoS) :

13thBoS 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
CO1										M		
CO2										H		
CO3										L		
CO4												M

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

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

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

SEMESTER VII

		L	T	P	C
AUD 4101	**HYBRID AND ELECTRIC VEHICLES (* PBL) (Practical Component)**	**L**	**T**	**P**	**C**
SDG: 9		**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

COB1: To understand the dynamic requirements of automobile sector/market and need of electric and hybrid vehicles.

COB2: To compare, design and integrate the two power sources of hybrid vehicle.

COB3: To classify and analyze various types of power electric and controller.

COB4: To perform the motor torque calculations and design the electrical drive and controller unit.

COB5: To understand the different types of hybrid/electrical vehicle, battery management and charging stations.

MODULE I HYBRID VEHICLE 6

Introduction – Terminology-Components of hybrid Vehicle, Comparison with Internal combustion Engine-Benefits, performance and Challenges, types of hybrid vehicle-series hybrid and parallel hybrid, comparison of series/parallel hybrid. Power electronics- features and specifications.

MODULE II ELECTRIC VEHICLE 6

Electric Vehicle -Types and components, Electric/hybrid vehicle features and system requirements, Battery Electric vehicle (BEV), Hybrid electric vehicle (HEV), Plug-in hybrid vehicle (PHEV), Fuel cell electric vehicle (FCEV), , Comparison of Electric vehicles with different energy sources.

MODULE III ELECTRICAL DRIVE AND CONTROLLER 6

Electric power train- components-elements-sensing/protection block-communication block, Motors types-single, dual etc. Performance characteristics, efficiency, selection and sizing of Motor, RPM and Torque calculation of motor, Motor Controllers- battery pack, Function of control unit, and development process.

MODULE IV ENERGY STORAGE SYSTEMS 6

Energy storage systems- essential for electric vehicles, plug-in hybrid electric vehicles (PHEVs), and hybrid electric vehicles (HEVs), lithium ion battery, Nickel metal hydride batteries, Lead Acid Batteries, Aluminium-Ion Battery (Al-Ion), ultra capacitors, solid state batteries, comparison- Reliability,Capacity,Life Cycle,Performance,Efficiency,Cost.

MODULE V CHARGING STATIONS 6

Electric recharging point - Charging systems and equipment's, components, AC charging stations and dc fast chargers, ac-to-dc converter, configurations, charging time-charging power, battery capacity, development of charging stations- developing infrastructure to charge electric vehicles, charging infrastructure terminology.

Practicals

LIST OF EXPERIMENTS

1. To test the battery using Hydrometer and Load test, etc.
2. Automobile charging system training panel and fault diagnosing system.
3. Automotive Electrical test bench.
4. To study the layout of Automotive Electrical system.
5. To understand and demonstrate jump-start of a vehicle.
6. To understand and test the starter motor working.
7. To understand and test alternator working.
8. To perform fault diagnostics using OBD.
9. Testing of high beam and low beam lamp.
10. Study of speedometer, Tachometer, Odometer, Trip odometer.
11. Study of electronic engine management system.
12. Study of safety and security systems of vehicle.

L – 30; P – 30; TOTAL HOURS – 60

TEXT BOOKS:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2017.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2013.
3. MehrdadEhsani, YiminGao, Ali Emadi, 'Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals', CRC Press, 2010.

REFERENCES:

1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2014.

2. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2015.
3. Hybrid Vehicles and the future of personal transportation, Allen Fuhs, CRC Press, 2011.
4. Vehicle Power Management: Modelling, Control and Optimization, Xi Zhang, Chris Mi, Springer, 2011.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Identify, choose and alter different types of Electric/Hybrid Vehicle Architecture Design based on the requirement.

CO2: Specify the specifications of hybrid/Electrical power drive and charging stations.

CO3: Evaluate appropriate electric drive and performance, RPM and Torque calculation of motor.

CO4: Present a comprehensive overview of Electric and Hybrid Electric Vehicles for current and futuristic market scenarios.

CO5: Determine the role of On-board diagnostics in vehicle function and develop basic skills for overhaul and testing of electrical and battery systems.

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	M	M	M	M	L	L	L	L	L	H	H	H
CO2	H	H	M	M	M	M	L	L	L	L	L	H	H	H
CO3	H	H	M	M	M	M	L	L	L	L	L	H	H	H
CO4	H	H	M	M	M	M	L	L	L	L	L	H	H	H
CO5	H	H	M	M	M	M	L	L	L	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 Electrical/hybrid vehicle design and challenges.

This subject will lead to effective understanding of electric & hybrid drive controller and charging stations.

AUD 4102 **INTERNSHIP II** **L T P C**

SDG: 9 **0 0 0 1**

COURSE OBJECTIVES:

COB1: To expose the students to industrial environment

COB2: To understand the principle involved in industrial processes, products and services

COB3: To study the different resources used in automotive industries

Guidelines:

- The students shall undertake internship training in automotive and related industry for the period of 15 days during the summer vacation.
- The student should submit a report and make presentation about learning outcome from the industry training.
- The credit will be awarded in the 7th semester.

COURSE OUTCOMES:

On completion of the course students should be able to

CO1: Familiarize with the complete structure and domains involved in an industry environment

CO2: Illustrate various design, manufacturing, quality and service aspects of an automobile

CO3: Analyze the various resources and make use of the skills to solve the industry issues

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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

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

Statement: Internship develops the professional aptitude promotes sustainable industrialization and foster innovation.

SEMESTER VIII

		L	T	P	C
AUD 4211	**PROJECT WORK**	**L**	**T**	**P**	**C**
SDG 4, 9		**0**	**0**	**18**	**9**

COURSE OBJECTIVES:

COB1: To use their acquired knowledge during the course of study and provide solutions

COB2: To do the literature survey critically related to the chosen problem

COB3: To improve the professional competency

COB4: To develop individual responsibility and team work

COB5: To adapt the skills towards report/documentation preparation

Guidelines:

- Project work can be design/experimental & testing/simulation based project on any of the topics of Automobile Engineering
- The project work is allotted individually or a group of students not more than 3
- The students shall be encouraged to do their project work in the parent institute & Industry.
- Department will constitute an Evaluation Committee to review the project work.
- The Evaluation committee consists of internal guide and experts in the specified area of the project.
- Project work consists of thesis work, three reviews of the work and the submission of project report with the viva-voce examination which includes and external member from other institutes.
- First review would highlight the topic, objectives, methodology and expected results.
- Second review evaluates the progress of the work.
- Third review evaluates the progress of the work, draft of the project report and demo of the prototype model.

COURSE OUTCOMES:

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

CO1: Apply the knowledge by framing appropriate methodology while solving real time problems

CO2: Analyze the literature & able to frame the objectives clearly

CO3: Implement the cost effective, environment friendly and performance efficient project models.

CO4: Able to work in a team and manage projects in multidisciplinary environments

CO5: Develop appropriate documentations.

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

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

Statement: The project work enables the student to implement the basic concepts of theory learnt, design process and applications helps for lifelong learning of newer technologies and concepts related to industrial/societal requirement.

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

Statement: The project work develops the professional aptitude promotes sustainable industrialization and foster innovation.

PROFESSIONAL ELECTIVE

COMBUSTION ENGINEERING

AUDX 01	**ALTERNATIVE FUELS**	**L**	**T**	**P**	**C**
SDG: 13	**(*PC)**	**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 & Short Description: 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 PROCESSES**	**L**	**T**	**P**	**C**
SDG: 7		**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) :

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
CO 2	H	H	H										H	H
CO 3	H	H	H										H	H
CO 4	H	H	H										H	H
CO 5	H	H	H										H	H

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

SDG No.7 & Short Description: 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) :

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
CO 2	H	H	H										H	H
CO 3	H	H	H										H	H
CO 4	H	H	H										H	H
CO 5	H	H	H										H	H

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

SDG No.7 & Short Description: 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	**(*PC)**	**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 EXCHANGER 6

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.

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) :
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	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 . & Short Description: 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
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.13 & Short Description: 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.

AUTOMOTIVE MATERIALS AND PRODUCTION PROCESSES

		L	T	P	C
AUDX 07	**ADVANCED MATERIAL TESTING AND FAILURE ANALYSIS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To gain knowledge about significances of material characterization.

COB2: To understand the procedure of mechanical testing and failure analysis

COB3: To acquire knowledge about importance of properties of plastics, elastomers and their composites.

COB4: To understand the various electrical & thermal properties of materials

COB5: To understand about the different instrumental techniques used in material characterization

MODULE I MATERIAL CHARACTERIZATION 9

Principles & characterization techniques related to tensile, compressive, hardness, fatigue, and fracture toughness properties, Super plasticity, Stress-strain diagram, Dynamic mechanical analysis (DMA).

MODULE II MECHANICAL TESTINGS 9

Deep drawn quality of sheets, Impact test, bend test, shear test, significances of property evaluation, SN curves and fatigue life, residual stress measurements, corrosion testing, wear & tear characteristics.

MODULE III PLASTICS, ELASTOMERS AND COMPOSITES PROPERTIES 9

Molecular weight distribution, MFI, HDT & VICAT softening point, cold temperature behaviors, Rheological behaviors, hardness and impact properties, identification of polymers, flammability, VOC and odor test, scratch resistance test, RoHS analysis.

MODULE IV ELECTRICAL & THERMAL PROPERTIES 9

Electrical properties of materials, Dielectric constant, electrical resistivity, wire harness test, Electrical-Magnetic-Optical properties of polymers.

Thermal properties of materials – Coefficient of thermal expansion & contraction, fire retardancy, Thermogravimetric analysis (TGA).

MODULE V INSTRUMENTAL TECHNIQUES 9

FTIR spectrometer, optical emission spectroscopy, ion, gas and liquid chromatography, high strain rate tester, x-ray diffraction, electron microscope (SEM, TEM), EDAX analysis, scanning probe microscopy (SPM, AFM).

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Yang Leng, "Materials Characterization: Introduction to Microscopic and Spectroscopic Methods", Wiley-VCH, 2nd Edition, 2013.
2. Suryanarayana A. V. K., "Testing of metallic materials", BS publications, 2020.

REFERENCES:

1. ASM Hand book, Materials characterization, Vol – 10, 2019.

COURSE OUTCOMES:

On completion of the course, students should be able to:

CO1: Identify the suitable material testing methods with justification

CO2: Analyze the relation among the different mechanical properties

CO3: Explain the various properties of plastics, elastomers and their composites

CO4: Summarize the characteristics of electrical and thermal effects of the material.

CO5: Analyze the instrumental techniques employed in material failure.

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

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

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

SDG 9: This subject provides the understanding of advanced technology for testing the various automobile components.

Statement: The understanding of testing, material characterization and instrument techniques will lead to effective designing of automotive parts.

AUDX 08	**COMPUTER AIDED DESIGN AND MANUFACTURING**	**L**	**T**	**P**	**C**
SDG: 9		**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

COB1: To provide an overview of how computers are being used in mechanical component design and manufacturing

COB2: To understand the representation of curve, surface and solids

COB3:To acquaint the different CAD standards

COB4:To know the fundamentals of part programming

COB5: To understand the Layout & Material Handling system

MODULE I INTRODUCTION 6

Product cycle, Design process, Sequential and concurrent engineering. Computer aided design – CAD system architecture, Computer graphics, co-ordinate systems, 2D and 3D transformation. Homogeneous coordinates, Line drawing -Clipping- viewing transformation. Brief introduction to CAD and CAM. Manufacturing Planning, Manufacturing control. Introduction to CAD/CAM – CAD/CAM concepts. Types of production. Manufacturing models and Metrics – Mathematical models of Production Performance.

MODULE II GEOMETRIC MODELING 5

Representation of curves- Hermite curve, Bezier curve, B-spline curves, rational curves. Techniques for surface modeling – surface patch, Coons and bicubic patches, Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep

MODULE III CAD STANDARDS 5

Standards for computer graphics- Graphical Kernel System (GKS) – standards for exchange images- Open Graphics Library (OpenGL) – Data exchange standards – IGES, STEP, CALS etc. – communication standards.

MODULE IV FUNDAMENTAL OF CNC AND PART PROGRAMING 7

Introduction to NC systems and CNC – Machine axis and Co-ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC- Introduction of Part Programming, types – Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.

MODULE V CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS) 7

Group Technology(GT),Part Families–Parts Classification and coding–Simple Problems in Opitz Part Coding system–Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility – FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control–Quantitative analysis in FMS.

PRACTICALS

1. Modelling of a part using any CAD software
2. Modelling and assembling of the mechanical assembly using any CAD software tool.
3. Structural analysis using FEA software – any analysis software.
4. Beam deflection analysis using FEA software
5. Part programming for Linear and Circular interpolation.
6. Part programming using standard canned cycles for Turning, Drilling, Peck drilling and Boring
7. Tool path generation and Mould design from 3D models using CAD/ CAM software
8. Design a simple product and its required tooling and simulate its 3D model.
9. Post processing for standard CNC Controllers like FANUC, Sinumerik etc
10. Generate NC codes and interface with CNC machine to realize the product.

L – 30 ; P – 30 ; TOTAL HOURS – 60

TEXT BOOKS:

1. Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill PublishingCo.2007.
2. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2016.
3. Radhakrishnan P, SubramanyanS.andRaju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2010.

REFERENCES:

1. CAD/CAM: Principles and Applications, P N Rao , 2016
2. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India, 2003.

COURSE OUTCOMES:

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

CO1: Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics

CO2: Explain the fundamentals of parametric curves, surfaces and Solids

CO3: Summarize the different types of Standard translators used in CAD

CO4: Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines

CO5: Summarize the different types of techniques used in Cellular Manufacturing and FMS

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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

SDG No.9: Enhance scientific research, upgrade the technological capabilities of industrial sectors

Statement: The understanding of computer Aided Design and Manufacturing leads to development in the automotive field.

AUDX 09	**DESIGN OF JIGS, FIXTURES AND PRESS TOOLS**	**L**	**T**	**P**	**C**
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the basic design of jigs and fixtures

COB2: To study about design of jigs for desired component

COB3: To know about fixture design principle for various machining process

COB4: To understand about press working elements of cutting dies

COB5: To study about different types of dies

MODULE I LOCATING AND CLAMPING PRINCIPLES 9

Objectives of tool design, Function and advantages of Jigs and fixtures. Basic elements, Principles of location, Locating methods and devices, Redundant Location. Principles of clamping, Mechanical actuation, Pneumatic and hydraulic actuation.

MODULE II DESIGN OF JIGS 9

Drill bushes, Different types of jigs, Plate latch, Channel, box, Post, Angle plate, Angular post, Turnover, Pot jigs, Automatic drill jigs, Rack and pinion operated. Air operated jigs components. Design and development of Jigs for different components.

MODULE III DESIGN OF FIXTURES 9

General principles of boring, lathe, milling and broaching fixtures. Grinding, planning and shaping fixtures. Assembly, inspection and welding fixtures. Modular fixtures. Design and development of fixtures for different components.

MODULE IV PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 9

Press Working Terminologies, Operations, Types of presses, Press accessories, Computation of press capacity, Strip layout, Press Work Materials, Center of pressure. Design of various elements of dies, Die Block, Punch holder, Die set, Guide plates, Stops. Strippers, Pilots. Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

MODULE V BENDING, FORMING AND DRAWING DIES 9

Bending, forming and drawing. Types of Bending dies, Press capacity, Spring back, knockouts, pressure pads, Ejectors – Variables affecting Metal flow in drawing operations, Design and development of bending, forming, drawing reverse re-drawing and combination dies.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

6. Joshi, P.H., “Jigs and Fixtures”, 2nd Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.

REFERENCES:

1. Donaldson, Lecain and Goold “Tool Design”, 3rd Edition, Tata McGraw Hill, 2000.
2. K. Venkataraman, “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2005.
3. Fundamentals of Tool Design, 6th Edition, Society of Manufacturing Engineers, 2010.

COURSE OUTCOMES:

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

CO1: Explain the various techniques of locating jigs & fixtures and clamping mechanisms

CO2: Design jigs for various components

CO3: Design fixtures for different components

CO4: Summarize the press working terminologies and elements of dies

CO5: Discuss about bending, forming and drawing dies

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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

SDG 9: This subject provides understanding about the functions and design principles of jigs, fixtures and press tools

Statement: The understanding of jigs, fixtures and press tools design procedures will lead to gain proficiency in the development of required views of the final design in manufacturing processes

AUDX 10	**COMPOSITE MATERIALS FOR AUTOMOBILES**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the composite materials and its applications in automotive industry

COB2: To have knowledge about polymer reinforced composites

COB3: To learn to about processing of metals matrix composites

COB4: To familiarize ceramics matrix composites

COB5: To have knowledge about composite structures

MODULE I INTRODUCTION TO COMPOSITES 10

Definitions: Composites, reinforcements and matrices, properties. Reinforcement materials: Particulate and whisker reinforcements. Glass fibre and carbon fibre. Matrix materials: Properties, wettability, effect of surface roughness, interfacial bonding.

MODULE II POLYMER MATRIX COMPOSITES 9

Types, processing: hand and spray layup techniques, filament winding, pultrution, resin transfer moulding, vacuum bagging, injection moulding, film stacking, diaphragm forming. Applications.

MODULE III METAL MATRIX COMPOSITES 9

Types, important metallic matrices, processing: Diffusion Bonding, hot isostatic pressing, hot powder extrusion, squeeze casting, pressure die infiltration, stir casting. Applications.

MODULE IV CERAMIC MATRIX COMPOSITES 9

Ceramic matrix materials (CMC), processing: Hot pressing, liquid infiltration technique, lanxide process, Insitu chemical reaction techniques: CVD, CVI, sol gel process. Interface in CMCs. Applications.

MODULE V COMPOSITE STRUCTURES 8

Types of structures: Honeycomb structures, hybrid composites, Laminate configuration. Sandwich Composite. Fatigue behaviours. Fatigue, S-N curves, Creep.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. M.Balasubramanian, “Composite materials processing”, CRC press, 1st edition, 2013.
2. K.K. Chawla, “Composite materials”, Springer-Verlag, New York, 3rd edition, 2012.

REFERENCES:

1. Ever J. Barbero, “introduction to composite materials design”, CRC Press, 2nd edition, 2010.
2. Mathews F L and Rawlings R D, “Composite Materials: Engineering and Science”, CRC Press and Woodhead Publishing Limited, 2002.

COURSE OUTCOMES:

On completion of the course students should be able to

CO1: Classify the characterization of different composite materials

CO2: Demonstrate the polymer matrix composite manufacturing processes

CO3: Identify different metal matrix composites and their productions with justification

CO4: Specify the applications of ceramic based composite materials

CO5: Analyse the effects of structural parameters on the properties of composite

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

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

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

SDG 9: This subject offers the understanding of composite technology used for manufacturing automobile components.

Statement: The understanding of polymer, metal and ceramic composites will lead to effective manufacturing of lightweight automotive parts.

AUDX 11	**PRODUCTION PROCESS OF AUTOMOTIVE COMPONENTS**	**L**	**T**	**P**	**C**
SDG: 9		**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

COB1: To acquire knowledge about the components produced by powder metallurgy method.

COB2: To understand the concepts of forming process and know the componentsproduced by forging and extrusion processes.

COB3: To impart knowledge about reciprocating machines and milling machines.

COB4: To know about the principle and methods of gear manufacturing process.

COB5: To give insight in to the recent trends on various production techniques used in automobile engineering domain.

MODULE I POWDER METALLURGY PROCESS 6

Process– Production of metal powders, blending, compaction:pressure compaction - Isostatic pressing, powder rolling, forging and extrusion; pressure less compaction - slip casting, and Sintering -theory and stages.Manufacture of friction lining materials for clutches and brakes. Testing andinspection of PM parts.Applications, advantages and limitations. Finishing operations – sizing, coining, machining, Impregnation, joining and heattreatment.

MODULE II FORMING PROCESS 6

Forging –Characteristics of the process, Open and closed die forging, Typical forging operations. Forging of valves, connecting rod, crank shaft, cam shaft, propeller shaft,and transmission gear blanks, foot brake linkage, steering knuckles.

Extrusions – Characteristics of the process, Forward and Backward Extrusion, Hot and Cold extrusion, rod and wire drawing. Extrusion of transmission shaft, steering wormblanks, brake anchor pins, rear axle drive shaft, axle housing spindles, piston pinand valve tappets.

MODULE III RECIPROCATING MACHINES AND MILLING MACHINES 5

Reciprocating machine tools: shaper, planer, slotter – milling,type of milling operations, attachments, types of milling cutter - machiningtime calculations.

MODULE IV GEAR MANUFACTURING 7

Different methods of Gear manufacturing – Gear hobbing and gear shaping - different methods, gear finishing and shaving, Grinding and lapping of hobs and shaping cutters, gear honing, gear broaching.

MODULE V RECENT TRENDS IN MANUFACTURING OF AUTOCOMPONENTS 6

Powder injection moulding, Shotpeen hardening of gears,CNC special features, Production ofaluminium MMC liners for engine blocks, Plasma spray coated engine blocks andvalves, Recent developments in auto body panel forming, Squeeze casting ofpistons,3D printing, Aluminium composite brake rotors.

PRACTICALS

List of Lab Experiments

- Milling Machines
  1. Milling Polygon Surfaces
  2. Keyway Milling
  3. spur gear milling
- Grinding / Polishing
  4. Surface Grinding
  5. Cylindrical Grinding
- Machining Components for Assembly of different fits.
  6. Bush and Shaft
  7. Step turning with drilling using capstan lathe
- Gear Machining
  8. Machining using CNC vertical machining
  9. Machining using CNC turning tap
- Project work
  10. Combined Skill (Each team has to make one simple product)

L – 30 ; P – 30 ; TOTAL HOURS – 60

TEXT BOOKS:

2. Rao, P.N. “Manufacturing Technology”, Metal Cutting and Machine Tools, Vol. 2, 4th edition, Tata McGraw–Hill, New Delhi, 2018.
3. Kalpakjian. S, “Manufacturing Engineering and Technology”, 7th edition Pearson, 2018.

REFERENCES:

1. Roy. A. Lindberg, Processes and materials of manufacture, 4th edition, PHI / Pearson education, 2006.
2. HMT – “Production Technology”, Tata McGraw-Hill, 2001

3. Hajra Choudry, “Elements of Work Shop Technology – Vol. II”, Media Publishers & Promoters. 2010.

COURSE OUTCOMES:

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

CO1: Apply the various steps involved in powder metallurgy for making various components.

CO2: Pick appropriate sheet metal forming process to make a desired shape of component.

CO3: Apply the principles of reciprocating, milling machines.

CO4: Apply the principles of gear cutting machines.

CO5: Use the recent trends in manufacturing for making auto components.

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
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.

AUDX 12	SURFACE ENGINEERING	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To impart knowledge on the tribology systems and its applications.

COB2: To give insight in to plating processes.

COB3: To acquire knowledge about hardfacing processes.

COB4: To acquire knowledge on the special diffusion processes.

COB5: To familiarise about thin film coating techniques.

MODULE I TRIBOLOGY PROCESSES 9

Introduction to tribology, Wear: Types of wear - adhesive, abrasive, oxidative,
corrosive, erosive and fretting wear, roles of friction and lubrication and wear testing.

MODULE II PLATING PROCESSES 9

Plating Processes: Fundamentals of electrodeposition, plating of nickel, chromium, tin and copper, pulsed plating, hydrogen embrittlement, plating adhesion, electroless plating, electrochemical conversion coating, selective plating for repair, plating properties, hard anodizing.

MODULE III HARDFACING PROCESSES 9

SMAW, GTAW, GMAW, FCAW, SAW, PAW, Oxy-Acetylene Welding, Furnace fusing, Thermal -spray, flame spray processes - HVOF, Detonation gun and jet kote processes, hard facing consumables.

MODULE IV SPECIAL DIFFUSION PROCESSES 9

Principle of diffusion processes – Boriding, Aluminising, Siliconising, Chromising, Sursulf - Selection of diffusion processes – Characteristics of diffused layer – micro structure and micro hardness evaluation – properties and applications.

MODULE V THIN FILM COATINGS 9

Physical vapour deposition processes – Thermal evaporation - sputter coating – Ion plating – Chemical vapour deposition – reactive sputtering - TiC, TiN, Alumina, CBN, Diamond and DLC coatings. Structure, properties and applications.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. William D. Callister, “Materials Science and Engineering: An Introduction”, 7th Edition, John Wiley & Sons, New York, 2013.
2. M. Kamaraj., “Basics of Surface Technology”, New Age Int. publishers., 1st Edition, 2016.

REFERENCES:

1. Donald L. Smith, Thin-Film Deposition: Principles and Practice, McGraw-Hill, Boston, 1995.
2. Peter Martin, “Introduction to Surface Engineering and Functionally Engineered Materials”, John Willey, 2010
3. M. Ohring, “The Materials Science of Thin Films”, Academic Press Inc, 2005.
4. Devis, J.R., “Surface Engineering for Corrosion & Wear Resistance”, Maney Publishing. 2001.

COURSE OUTCOMES:

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

CO1: Identify appropriate testing approaches to evaluate tribology performance.

CO2: Demonstrate different plating processes.

CO3: Summarize the principles and key characteristics of technologies used in hardfacing processes.

CO4: Select and apply the appropriate special diffusion processes.

CO5: Identify and apply the appropriate thin film coatings.

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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 the aspect of surface engineering with 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.

AUTOMOTIVE INSTRUMENTATIONS AND DIAGNOSTICS

AUDX 13 HOMOLOGATION AND TESTING L T P C

SDG: 9 1 0 0 1

COURSE OBJECTIVES:

COB1: To provide knowledge on vehicle certification and standards

COB2: To get familiarized with Vehicle testing procedures

MODULE I HOMOLOGATION AND TESTING STANDARDS 7

Certification of vehicles, ARAI, NATRIP, GARC, Standards, Testing procedures, Testing conditions, Preparation of vehicles for testing.

MODULE II STATIC AND DYNAMICS TESTING OF VEHICLE 8

Testing of Vehicles, components, systems such as Engine, Powertrain, Passive safety, EMC (Electrical and Electronic components), NVH, Fatigue, Material, Tyres and Vehicle dynamics, Brakes, HVAC, Crash worthiness

L - 15 ; TOTAL HOURS – 15

TEXT BOOKS:

1. K.V.Fadadu, B.H.Kadiya, "Vehicle testing and homologation", Books India publications, 1st edition, 2016.

REFERENCES:

1. ARAI Standards and case studies
2. www.araiindia.com

COURSE OUTCOMES:

Students should able to

CO1: Demonstrate the procedure for vehicle certification

CO2: Perform testing procedure of vehicle systems and components.

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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

SDG 9 : Promote inclusive and sustainable industrialization

Statement : the understanding of testing methods and standards leads to sustainable industrialization

		L	T	P	C
AUDX 14	**GEOMETRIC DIMENSIONING AND TOLERANCE**	**L**	**T**	**P**	**C**
SDG: 9		**1**	**0**	**0**	**1**

COURSE OBJECTIVES:

COB1: To provide knowledge on standards and Tolerancing.

COB2: To get familiarized with geometric dimensioning and engineering Drawings

MODULE I DRAWING STANDARDS AND TOLERANCE 8

Drawing standards, Dimensions, Tolerances, Notes used in drawings, Limits, Fits and Tolerance, Key GD&T Terms, Symbols and ,Modifiers, Rules and Concepts

MODULE II GEOMETRIC DIMENSIONING 7

Datum system. Targets and Features, Orientation, Runout, Concentricity, Symmetry and profile, Applications.

L - 15 ; TOTAL HOURS – 15

TEXT BOOKS:

1. P.S. Gill, "Geometric Dimensioning & Tolerancing", S.K. Kataria & Sons, 1st edition, 2013. (ISBN: 978-9350143780)

REFERENCES:

1. Alex Krulikowski, "Fundamentals of Geometric Dimensioning and Tolerancing", Delmar Cengage Learning, 3rd edition, 2012. (ISBN : 9781111129828)
2. BipinKumar Singh, "Advanced Geometric Dimensioning and Tolerancing", Bluerose Publishers Pvt. Ltd, 1st edition,2021.(ISBN: 978-9354277313)
3. Gene R. Cogorno, "Geometric Dimensioning and Tolerancing for Mechanical Design", McGraw-Hill Education, 1st edition, 2006. (ISBN: 978-0071460705)

COURSE OUTCOMES:

Students should able to

CO1: Select suitable dimensions and tolerances for particular application

CO2: Prepare engineering drawings for components

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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

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

Statement : Brief description in two - three lines connecting the course outcomes with the SDG

AUDX 15 SDG: 12	VEHICLE ENGINEERING AND INTEGRATION	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

COB1: To provide knowledge on latest practices in the vehicle manufacture

COB2: To get familiarized with practices on vehicle packaging and integration

MODULE I VEHICLE ENGINEERING 7

Production of components, testing of components, making of sub-systems, testing of sub-systems, prototype of vehicle.

MODULE II VEHICLE INTEGRATION 8

Integration of vehicle components, subsystems and systems into vehicle, Integration of soft wares to test the design of vehicle, Vehicle packaging such as engine packaging, interior packaging, auto jewels etc for a particular model to the requirement.

L – 15 ; TOTAL HOURS –15

TEXT BOOKS:

1. Macey, Stuart, and Wardle, Geoff. H-Point: The Fundamentals of Car Design & Packaging. United States, Design Studio Press, 2014.

REFERENCES:

1. Bhise, Vivek D.. Ergonomics in the Automotive Design Process. Ukraine, CRC Press, 2016.

COURSE OUTCOMES:

CO1: Ability to select suitable components for making a particular vehicle.

CO2: Ability to suggest packages for particular vehicle model

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	H									H		H		H	H
CO 2	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 vehicle engineering and integration.

AUDX 16	**VEHICLE DIAGNOSTICS**	**L**	**T**	**P**	**C**
SDG: 9		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To understand in diagnostic procedure and instrumentation.

COB2: To provide adequate knowledge in engine diagnostics and scanners.

COB3: To give basic knowledge in OBD and fault diagnosis systems.

COB4: To understand the concept of stability of control system and methods of stability analysis.

COB5: To study about different control systems and diagnosing in electronic components.

MODULE I INTRODUCTION 8

Diagnostic process, Mechanical techniques, Electrical techniques, Fault codes, Data sources, Basic equipment, Piecoscope oscilloscope, Scanners, Emission testing, pressure testing, Automotive pressure oscilloscope transducer.

MODULE II ENGINE DIAGNOSTICS 7

Si engine management, OBD, Monitors, Misfire detection, Ignition faults, Fuel system, CI engine management, Fuel system and Injection system faults.

MODULE III CHASSIS SYSTEMS 7

Fault Diagnosis of brake system, ABS, Traction control system, Steering system, Suspension system, Transmission systems, Manual and Automatic, Tires.

MODULE IV COMFORT SYSTEM CONTROL 8

Diagnosis of Electronic components and circuits, Multiplexing, Diagnosis of lighting and electrical system and components, Instruments, Auxiliaries.

L - 30: Total Hours – 30

TEXT BOOKS:

1. Tom Denton, Advanced Automotive Fault Diagnosis, 4th Ed: Automotive Technology, Vehicle Maintenance and Repair, 2013.
2. Peter Subke, Road vehicles - Diagnostic communication Paperback – 2014.

REFERENCES:

1. Tracy Martin William B.Ribbens, Automotive Diagnostic Scanners (Motor books Workshop) Paperback – Import, 1 Aug 2015.
2. Understanding Automotive Electronics, 9th edition, Butter worth Heinemann Woburn, 2018.
3. Bosch, "Automotive Hand Book", 9th edition, SAE, 2014.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Ability to analyze the faults of vehicle systems and set up instrumentation for identifying the faults.

CO2: Analyze the knowledge in engine faults and rectification of faults.

CO3: Analysis the different sensors and actuators faults for automotive applications.

CO4: Explain faults in automotive system and in electronic systems.

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	L	L	L	L	L	L	L	L	M	M	M	H	H	H
CO2	L	L	L	L	L	L	L	L	M	M	M	H	H	H
CO3	L	L	L	L	L	L	L	L	M	M	M	H	H	H
CO4	L	L	L	L	L	L	L	L	M	M	M	H	H	H
CO5	L	L	L	L	L	L	L	L	M	M	M	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 vehicle diagnostic and detection in automotive components.

This subject will lead to effective understanding of fault codes and basic testing systems in Automobile.

AUDX 17	**AUTOMOTIVE INSTRUMENTATION AND EMBEDDED SYSTEM**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To impart knowledge on the instrumentation systems.

COB2: To give insight in to onboard disgnostics.

COB3: To acquire knowledge about the analysis part of measurement.

COB4: To know about the functions of embedded systems.

COB5: To familiarise about RTOS concept.

MODULE I AUTOMOTIVE INSTRUMENTATION 9

Modern automotive instrumentation – computerized instrumentation system, multiplexing, sampling and advantages – Measurements – fuel quality, coolant temperature, oil pressure vehicles speed, Display devices – LED, LCD, VFD, CRT and types, CAN network, the glass cockpit and information system

MODULE II DIAGNOSTICS 9

Onboard diagnostics – fault code displays. Off board diagnostics – engine data display, expert system occupant protection system – Airbag deployment system security and warning systems.

MODULE III MEASUREMENT ANALYSIS 9

Chemical, thermal, magnetic and optical gas analyzers, measurement of smoke, dust and moisture, gas chromatography, spectrometry, measurement of pH, Review of basic measurement techniques.

MODULE IV INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to functional building blocks of embedded systems – Register, memory devices, ports, timer, interrupt controllers using circuit block diagram representation for each categories – Devices & buses for devices network - serial communication using I2C, CAN, USB buses - parallel communication using ISA, PCI - device drivers in a system – Serial port & parallel port.

MODULE V REAL TIME OPERATING SYSTEMS 9

Introduction to basic concepts of RTOS, Basics of real time & embedded system operating systems, RTOS – Interrupt handling, task scheduling; embedded system design issues in system development process – Action plan, use of target system, emulator, use of software tools.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Willard H.H., Merritt L.L., Dean J.A. and Settle F.A., Instrumental Methods of Analysis, 7th Edition, CBS Publication, New Delhi Reprint, 2004.
2. Rajkamal, “Embedded System – Architecture, Programming, Design”, Tata McGraw Hill, 2003.
3. Qing Li and Carolyn Yao," Real-Time Concepts for Embedded Systems", CMP Books, 2003.

REFERENCES:

1. Edward Ashford Lee and Sanjit Arunkumar Seshia, “Introduction to Embedded Systems”, Second Edition, 2017.
2. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons, 2002.
3. David E. Simon, ‘An Embedded Software Primer’, Pearson Education, 2004.

COURSE OUTCOMES:

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

CO1: Identify appropriate instrumentation systems to evaluate performance.

CO2: Demonstrate different onboard diagnostic processes.

CO3: Analyze & evaluate measurement data.

CO4: Select and apply the functions of embedded systems.

CO5: Identify and apply the appropriate RTOS concept in system development process.

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

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

SDG No. 9. Having an ability to design a component or a product with 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.

AUDX 18 SDG: 9	MEASUREMENTS AND INSTRUMENTATION (PC)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

COB1: To study the basic concepts of measurement.

COB2: To learn the linear and angular measuring techniques.

COB3: To impart knowledge on form and finish measurements.

COB4: To acquire knowledge on laser and advanced metrology.

COB5: To educate about measurement of power flow and temperature related properties.

MODULE I CONCEPT OF MEASUREMENT 6

Definition of metrology, General Concepts of measurement system-Units and standards-measuring instruments- sensitivity, readability, range of accuracy, precision-static and dynamic response-repeatability-Measurement system behavior: General model for dynamic measurement system and special cases: zero order, first order and second order system, determination of time constant and settling time, phase linearity- systematic and random errors-correction, calibration, interchangeability, traceability. Statistical concepts: Mean, Range, Variance and Standard deviation in error analysis.

MODULE II LINEAR AND ANGULAR MEASUREMENTS 6

Linear measuring instruments: Slip gauges, Tool Maker's microscope, limit gauges. Comparators: Mechanical, pneumatic and electrical types, applications. Angular measurements: Sine bar, bevel protractor-Taper angle measurements.

MODULE III FORM AND FINISH MEASUREMENT 6

Form measurement - Measurement of screw threads - floating carriage micrometer - measurement of gears-tooth thickness-constant chord and base tangent method straightness, flatness and roundness measurements- surface finish-surface roughness tester.

MODULE IV LASER AND ADVANCES IN METROLOGY 6

Precision instruments based on laser-Principles- laser interferometer-application in measurements and machine tool metrology- Coordinate measuring machine (CMM): need, construction, types, applications - computer aided inspection. Machine Vision systems - principle and functions.

MODULE V MEASUREMENT OF POWER FLOW AND TEMPERATURE 6

Response of Measuring System: Amplitude, Frequency and Phase - Force, torque measurement- mechanical, pneumatic, hydraulic and electrical type- Flow measurement-Temperature measurement- bimetallic strip, pressure thermometers, thermocouples, electrical resistance thermistor

PRACTICALS

List of Lab Experiments

1. Calibration and Error analysis of measuring Instruments.
2. Complete all measurements including intricate internal details of the given component using standard equipment and by other measuring procedures (Quick setting compounds, moulds etc.).
3. Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical).
4. Measurement of angle using Sine bar / Sine Center /Toolmakers microscope/Slip gauge.
5. Measurement of taper using standard balls / rollers.
6. Measurement of straightness and flatness.
7. Measurement of gear & thread parameters.
8. Scanning the surface using Coordinate Measuring Machine (CMM).
9. Measurement using vision system.
10. Measurement of Displacement, Force and Torque.
11. Measurement of Temperature, Acoustic emission
12. Measurement of radius and surface roughness.

L – 30 ; P – 30 ; TOTAL HOURS – 60

TEXT BOOKS:

1. Jain R.K., “Engineering Metrology”, Khanna Publishers, 2009.
2. Alan S. Morris, “The Essence of Measurement”, Prentice Hall of India, 1997.
3. Gupta S.C, “Engineering Metrology”, Dhanpat rai Publications, 2005.

REFERENCES:

1. Raghavendra, Krishnamurthy, “Engineering Metrology & Measurements”, Oxford Univ. Press, 2013.
   Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education, 2014.
2. Charles Reginald Shotbolt, “Metrology for Engineers”, 5th edition, Cengage Learning, Cengage Learning EMEA, 1990.

COURSE OUTCOMES:

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

CO1: Explain the basic concepts of measurement.
CO2: Perform the linear and angular measurements.
CO3: Execute form and finish measurements.
CO4: Demonstrate the laser measurement and advanced metrology.
CO5: Measure the power flow and temperature.

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
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 with 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 evaluate different manufacturing process for an automobile.

DYNAMICS OF AUTOMOBILE

AUDX 19	**AUTOMOTIVE AERODYNAMICS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the fundamentals of automotive aerodynamics

COB2: To gain knowledge in forces and moments acting on vehicle

COB3: To study the effect of drag on cars

COB4: To gain knowledge in effect of aerodynamics on vehicle performance

COB5: To study the testing methods for aerodynamics

MODULE I INTRODUCTION TO AUTOMOTIVE 9

Scope - historical development trends - Fundamental of fluid mechanics - Flow phenomenon related to vehicles -External & Internal flow problem –basic terminology-the boundary layer concept – Bernoulli's equation - flow over bodies and pressure co-efficient.

MODULE II AERODYNAMIC FORCES AND MOMENTS 9

The origin of forces and moments on vehicle - side wind problems - methods to calculate forces and moments - vehicle dynamics under side winds - the effects of forces and moments - Characteristics of forces and moments - Dirt accumulation on the vehicle - wind noise - drag reduction in commercial vehicles.

MODULE III ANALYSIS OF DRAG OF CARS 9

Analysis of aerodynamic drag - drag coefficient of cars - strategies for aerodynamic development - low drag profiles.Front end modification - front and rear wind shield angle - Boat tailing - Hatch back, fast back and square back - Dust flow patterns at the rear - Effects of gap configuration - effect of fasteners.

MODULE IV AERODYNAMICS AND VEHICLE PERFORMANCE 9

Basic vehicle body concept – aerodynamics of complete vehicle – flow over wheels – sliding seals and skirts – underbody channels – simple add-ons: spoiler, wings, vortex generator etc. – internal flow – race car wings – tire performance – effect of aerodynamics on vehicle performance

MODULE V TESTING METHODS 9

Introduction - Principle of wind tunnel technology - Limitation of simulation – pressure co-efficient measurement – pressure tapping - preparation of scaled models – full scale wind tunnels - measurement techniques - Equipment and transducers - road testing methods.

L - 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Joseph Katz, “Automotive Aerodynamics (Automotive Series)”, Wiley Publications, 1st edition, 2016. (ISBN: 978-1-119-18572-7)

REFERENCES:

1. Hucho.W.H, "Aerodynamics of Road Vehicles: From Fluid Mechanics to Vehicle Engineering",Society of Automotive Engineers, U.S, 4th edition, 1998.
2. Joseph Katz, “Race Car Aerodynamics: Designing for Speed”Robert Bentley PModifying the Aerodynamics of Your Road Carublication, 2nd edition,1996.
3. Julian Edgar, “Modifying the Aerodynamics of Your Road Car”, Veloce Publishing, 2019
4. Pope. A., "Wind Tunnel Testing", John Wiley & Sons, 2nd Edition, New York, 1974.
5. Thomas Christian Schuetz, “Aerodynamics of Road Vehicles”, SAE International, 2015. (ISBN:0768082536)
6. Colin Britcher, Drew Landman, “Wind Tunnel Test Techniques:Design and Use of Low- and High-Speed Wind Tunnels”,Elsevier, 1st edition, 2022 (ISBN: 9780128180990)

COURSE OUTCOMES:

Students should able to

CO1: Identify the key parameters for improving aerodynamics

CO2: Analyze the forces and moments acting on the vehicle

CO3: Analyze the coefficient of drag of different profiles of vehicle

CO4: Validate vehicle performance with respect to aerodynamics

CO5: Demonstrate various the testing methods

Board of Studies (BoS) :	**Academic Council:**
14th BoS held on 22.08.2022	19th AC held on 29.09.2022

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

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

SDG No. 9: Enhance scientific research, upgrade the technological capabilities of automotive industrial sectors.

Statement: The complete understanding of aerodynamics leads to innovation in body shape optimization and improving energy efficiency.

AUDX 20	COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
SDG: 9		2	0	2	3

COURSE OBJECTIVES:

COB1: To understand the governing equations in CFD

COB2: To study the approximation methods

COB3: To study the fundamentals of discretization

COB4: To understand time diffusion type problems

COB5: To gain Knowledge in Finite volume method

MODULE I — INTRODUCTION TOCOMPUTATIONAL FLUID DYNAMICSAND PRINCIPLES OF CONSERVATION — 6

Need of CFD as tool, CFD Applications, Numerical vs Analytical vs Experimental, Modeling vs Experimentation, Fundamental principles of conservation, Reynolds transport theorem, Conservation of mass, Conservation of linear momentum: Navier-Stokes equation, Conservation of Energy, General scalar transport equation.Mathematical classification of Partial Differential Equation, Illustrative examples of elliptic, parabolic and hyperbolic equations,Physical examples of elliptic, parabolic and hyperbolic partial differential equations

MODULE II — APPROXIMATE SOLUTIONS OF DIFFERENTIAL EQUATIONS — 6

Error Minimization Principles, Functional involving higher order derivatives, Approximate solution of differential equations through variational formulation, Boundary conditions in the variational form, Primary and secondary variables,
Essential and natural boundary conditions, Approximate solutions of differential equations,Properties of variational form, Weighted residual approach: trial function and weighting function, Requirement of trial function and weighting function, Least square method, Point Collocation method, Galerkin’s method, Rayleigh-Ritz method.

MODULE III — FUNDAMENTALS OF DISCRETIZATION — 6

Discretization principles:Preprocessing,Solution,Postprocessing, Finite Element Method, Finite difference method, Well posed boundary value problem, Possible types of boundary conditions, Conservativeness, Boundedness, Transportiveness, Finite volume method (FVM), Illustrative examples: 1-D steady state heat conduction without and with constant source term,1-D unsteady state diffusion problems: implicit, fully explicit and Crank-Nicholson scheme.

MODULE IV — CONSEQUENCES OF DISCRETIZATIONOF TIME DEPENDENT DIFFUSION TYPE PROBLEMS — 6

Consequences of time-discretization in finite discretization, Consistency, Stability, Convergence, LAX Equivalence theorem, Grid independent and time independent study, Stability analysis of parabolic equations (1-D unsteady state diffusion problems): FTCS (Forward time central space) scheme, Stability analysis of parabolic equations (1-D unsteady state diffusion problems): CTCS scheme (Leap frog scheme), Dufort-Frankel scheme, Stability analysis of hyperbolic equations: FTCS, FTFS, FTBS and CTCS Schemes, Stability analysis of 2ndorder hyperbolic equations: CTCS scheme, Discretization of the Momentum Equation using unstructured grid.

MODULE V FINITE VOLUME METHOD 6

Some Conceptual Basics and Illustrations through 1-D Steady State Diffusion Problems: Physical consistency, Overall balance, FV Discretization of a 1-D steady state diffusion type problem, Composite material with position dependent thermal conductivity, Four basic rules for FV Discretization of 1-D steady state diffusion type problem, Source term linearization, Implementation of boundary conditions.

PRACTICALS

List of Experiments

1. Overview of software used for CFD simulation.
2. Pre-processing of models for CFD simulation.
3. Flow in a convergent-divergent nozzle.
4. Heat Transfer Analysis In a Longitudinal Finned Pipe
5. Simulation of fluid flow over the car body
6. Simulation of fluid flow over spoiler
7. Simulation of Fluid Flow inside a bend pipe
8. Simulation of fluid flow inside a turbocharger

Any CFD software like Ansys-Fluent, OpenFOAM,SimScale, Paraview etc can be used.

L – 30 ; P – 30 ; TOTAL HOURS – 60

TEXT BOOKS:

1. H. K. Versteeg, W. Malalasekera "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", PHI Publishers, 2nd edition, 2007. (ISBN-13 : 978-0131274983)
2. S. C. Gupta, "Applied Computational Fluid Dynamics",Wiley Publications, 1st edition, 2019. (ISBN: 978-8126577538)

REFERENCES:

1. Hirsch, "Numerical Computation of Internal and External Flows", Wiley publications, Vol. 2, 1988.

2. Anderson, Tannehill, and Pletcher , "Computational Fluid Mechanics and Heat Transfer," Second Edition, Taylor & Francis, 1997.
3. Joel H. Ferziger, Milovan Perić, Robert L. Street, "Computational Methods for Fluid Dynamics", Springer; 4th ed. 2020. (ISBN-13: 978-3319996912)
4. John Anderson, "Computational Fluid Dynamics", McGraw-Hill Education, 1st edition, 1995. (ISBN : 978-0071132107)
5. John F. Wendt, "Computational Fluid Dynamics: An Introduction", Springer; 3rd edition, 2010.(ISBN: 978-3642098734)
6. John Matsson, "An Introduction to ANSYS Fluent", SDC Publications; 1st edition, 2020. (ISBN: 978-1630573966)

COURSE OUTCOMES:

CO1: Identify suitable governing equation based on the problem

CO2: Derive approximate solutions for differential equations

CO3: Demonstrate the various principle in discretization

CO4: Select and apply suitable discretization procedure for problem

CO5: Apply the FVM in CFD simulations

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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

SDG 9 :Enhance scientific research, upgrade the technological capabilities of industrial sectors

Statement : The holistic understanding of CFD leads to innovations in effective utilization of resources.

		L	T	P	C
AUDX 21	**FINITE ELEMENT ANALYSIS OF AUTOMOTIVE COMPONENTS**				
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To study the basic concepts of mathematical modeling of engineering problems

COB2: To learn the principles of discretization and finite element formulation

COB3: To acquire knowledge on application of FEA in beams

COB4: To impart knowledge on the use of FEM to a complex structures and steady state thermal problems

COB5: To learn isoparametric formulation and numerical integration

MODULE I INTRODUCTION 7

Basic Concept, comparison with FDM and FVM, advantages and disadvantages, history of development, application. – Application to the continuum – Discretization – Governing equations for continuum – Variational methods - Weighted residual method

MODULE II BASICS OF FINIETE ELEMENT FORMULATION 9

Finite Element Analysis of 1D Problems - Element type - Spring element, two noded line element - lower order and higher order element types - discretization, displacement function, shape function, formulation, element equations, assembly, boundary conditions, solution of equations- post processing, convergence criteria, examples from solid mechanics.

MODULE III BEAM ELEMENT AND ITS APPLICATIONS 9

Element Shape Functions - C0, C1 continuity- completeness and compatibility condition, formulation, element equations, assembly, boundary conditions, solution of equations and examples - types of beam and different loading conditions.

MODULE IV TWO DIMENSIONAL STRUCTURAL AND THERMAL ANALYSIS 11

Theory of Elasticity – Plane Stress – Plain Strain and Axisymmeteric Concept – CST - LST - shape function - strain - displacement matrix - constitutive matrix - stiffness matrix - assembly - solutions - examples - finite element formulation of plate, dam, pipe, pressure vessels problems. Governing equation - 1D heat flow and finite element formulation – 2D thermal element and its formulation - Conduction and Convection - Simple problems - heat transfer in composite wall, fins

MODULE V ISOPARAMETRIC FORMULATION AND NUMERICAL INTEGRATION 9

Natural co-ordinate systems–Lagrangian Interpolation Polynomials-Serendipity Formulation- Isoparamatric Elements Formulation - Rectangular elements - Numerical integration – simple Problems using Gauss quadrature Technique.

L – 45 ; TOTAL HOURS –45

TEXT BOOKS:

1. Reddy J.N. – "A Introduction to Finite Element Method", McGraw Hill,International Edition, 2020.
3. Seshu. P – "Textbook of Finite Element Analysis", Prentice-Hall India Pvt. Ltd, 2006.

REFERENCES:

1. George R. Buchanan - Schaum's Outline of Finite Element Analysis, 2020
Cook,Robert Devis etal, - "Concepts and Application of finite Element Analysis", Wiley &sons, 2001.
2. Rao.S.S - Finite Element Method in Engineering, Butterworth-Heinemann, 2017.
3. Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering", Pearson Education, 4th Edition, 2011.

COURSE OUTCOMES: Students should be able to

CO1: Formulate a mathematical modeling of engineering problems

CO2: Discretize the given problem

CO3: Solve various beam problems using FEA

CO4: Apply FEM to a complex structures and steady state thermal problems

CO5: Explain isoparametric formulation and numerical integration

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO 12	PSO1	PSO2
CO1	H	H	H	H	H	M	M	L	L	L	L	L	H	H
CO2	H	H	H	H	H	M	L	L	L	L	L	L	H	H
CO3	H	H	H	H	H	L	L	L	L	L	L	L	H	H
CO4	H	H	H	H	H	L	L	L	L	L	L	L	H	H
CO5	H	H	H	H	H	L	L	L	L	L	L	L	H	H

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

SDG No. 9 : Used to develop environmental friendly vehicles

Statement :

The complete knowledge in the FEA will be used for the simulation and which will leads to the time required for the new product development.

AUDX 22	**VEHICLE DESIGN DATA**	**L**	**T**	**P**	**C**
SDG: 9	**CHARACTERISTICS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the basics of vehicle design

COB2: To gain knowledge in power estimation

COB3: To learn chassis design and analysis

COB4: To study braking system and its design

COB5: To study powertrain and overall performance

MODULE I BASICS OF VEHICLE DESIGN 9

Fundamentals of vehicle design, Gross Vehicle, Weight, laden and un-laden weights, Front and rear axle weights, Frontal Area, maximum speed, maximum acceleration, gradability in different gears

MODULE II POWER ESTIMATION 9

Analysis of air and rolling resistances at various vehicle speeds - Calculation, Tabulation and Plotting of Curves, Estimation of Driving force, determination of power requirement for different loads and speeds, Maximum Power calculation. Calculation, Tabulation and Plotting of Torque and Mechanical Efficiency for different vehicle speeds.

MODULE III CHASSIS DESIGN AND ANALYSIS 9

Load case, Bending case, Torsion case, Combined bending and torsion, Lateral loading, Longitudinal loading Asymmetric loading Bending stiffness Torsional stiffness, types of frames, Structural analysis by simple structural surfaces method, computational methods for structural analysis

MODULE IV BRAKING SYSTEM 9

Functions and conditions of use of a brake system, Brake system components and configurations, Kinematics of a braking vehicle, Brake proportioning and adhesion utilization, Static analysis, Braking with a constant brake ratio, Braking efficiency, Wheel locking, Effect of axle lock on vehicle stability, Pitch motion of the vehicle body under braking, Braking with a variable braking ratio, Materials design- rotor.

MODULE V POWERTRAIN AND OVERALL PERFORMANCE 9

Need for a powertrain, Determination of Gear Ratios, Acceleration and Gradability, Typical Problems on Vehicle performance. Over all vehicle performance, Characteristics of different vehicle sub systems.

L – 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Julian Happian-Smith, “An Introduction to Modern Vehicle Design”, Butterworth-Heinemann publications, 1st edition, 2002. (ISBN: 07506 50443)
2. Dr. Abhishek Choubey, Dr. Neha Choubey, “Design Concepts of VehicleBraking System: A Book for Disc Brake Rotor Design”, Scholars' Press, 1st edition, 2021.(ISBN: 978-6138958918)

REFERENCES:

1. Hilliers, “Fundamentals of Motor Vehicle Technology”, Oxford Publisher, 6th Edition, 2014. (ISBN-13: 978-1408515181)
2. Giancarlo Genta, Lorenzo Morello, “The Automotive Chassis Vol. 1: Components Design”, Springer, 2009. (ISBN: 978-1-4020-8674-8)
3. N. K. Giri, “Automotive Mechanics”, Khanna Publishers, 8th edition, New Delhi, 2008.(ISBN: 9788174092168)
4. Heinz Heisler, “Advanced Vehicle Technology”, 2nd edition, Butterworth-Heinemann, 2nd edition, 2002.(ISBN: 978-0750651318)
5. Vehicle Powertrain Systems”, Wiley Publications, 1st edition, 2012.(ISBN: 9780470666029)

COURSE OUTCOMES:

Students should able to

CO1: Define the basic parameters for design

CO2: Calculate the power estimation for vehicles

CO3: Design and analyze the chassis for vehicle

CO4: Design the braking system for vehicle

CO5: Design the powertrain and calculate overall performance of vehicle

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO1	PSO2
CO1	H	M	H	L	L	L	L						H	H
CO2	H	M	H	L	L	L	L						H	H
CO3	H	M	H	L	L	L	L						H	H
CO4	H	M	H	L	L	L	L						H	H
CO5	H	M	H	L	L	L	L						H	H

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

SDG 9: To promote energy efficiency in the Automobile sector.

Statement: The understanding of the design of vehicle helps in developing vehicle with fuel efficient

AUTOMOTIVE OFF ROAD VEHICLE

AUDX 23	**DESIGN OF HYDRAULICS & PNEUMATICS SYSTEMS FOR AUTOMOTIVES**	**L T P C**
SDG: 9		**3 0 0 3**

COURSE OBJECTIVES:

COB1: To gain knowledge in fundamentals of fluids, hydraulics system and components.

COB2: To have exposure in hydraulic system & components

COB3: To impart knowledge in hydraulic circuit design

COB4: To gain knowledge in pneumatic circuit design

COB5: To understand design of fluidic systems

MODULE I FUNDAMENTALS OF FLUID POWER SYSTEMS 7

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids. General types of fluids, Fluid power symbols. Basics of hydraulic system.

MODULE II HYDRAULIC SYSTEM & COMPONENTS 11

Pumping theory, Pump classification, Gear pump, Vane Pump, Piston Pump, Construction and working of pumps, Pump performance, Fluid Power Actuators, Types of hydraulic cylinders, Fluid motors, Gear, Vane and Piston motors. Construction of Control Components: Direction control valve - 3/2 way valve - 4/2 way valve, Shuttle valve, Check valve, Pressure control valve, Pressure reducing valve, Sequence valve, Flow control valve, Fixed and adjustable, electrical control solenoid valves, Relays, Ladder diagram.

MODULE III DESIGN OF HYDRAULIC CIRCUITS 9

Reciprocation, Quick return, Sequencing, Synchronizing circuits, Simple industrial circuits, Press circuits, Earth movers, Grinding machines. Safety and emergency modules. Accumulators and intensifiers: Types of accumulators, Accumulators circuits, Sizing of accumulators, Applications of Intensifier, Intensifiercircuit.

MODULE IV PNEUMATIC SYSTEMS AND CIRCUIT DESIGN 9

Pneumatic Components: Properties of air, Compressors, Filter, Regulator, Lubricator Unit, Air control valves, Quick exhaust valves, Pneumatic actuators, Pneumatic power circuit design, Speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, Sequential circuit design for simple industrial applications using cascade method.

MODULE V DESIGN OF FLUIDIC SYSTEMS 9

Fluidic systems, Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, PLC applications in fluid powercontrol. Fluid power circuits; failure and troubleshooting.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Andrew Parr., "Hydraulics and Pneumatics: A Technician's and Engineer's Guide", Butterworth-Heinemann, 3rd Edition, 2011.
2. Anthony Esposito, "Fluid Power with Applications", Pearson, 7th edition, 2008.

REFERENCES:

1. Jagadeesha T., "Hydraulics and Pneumatics",Dreamtech Press,2019.

COURSE OUTCOMES:

On completion of the course, students should be able to:

CO1: Analyze the characteristics of fluid power.

CO2: Identify the various hydraulic systemsandtheir components.

CO3: Design the various hydraulic circuits.

CO4: Analyze and design the different pneumatic circuits.

CO5: Design the various fluidic systems.

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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

SDG 9: This subject provides the understanding of advanced technology for designing the various hydraulic & pneumatic systems.

Statement: The understanding of hydraulic & pneumatic systemsandtheir component design will lead to effective designing of fluid systems used in automobiles.

		L	T	P	C
AUDX 24	**TRACTOR AND AGRICULTURAL MACHINERIES**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the general design of tractor

COB2: To gain knowledge in engines, valve mechanism and fuel systems

COB3: To gain knowledge in cooling and lubricating system

COB4: To study the working of tillage equipment's.

COB5: To study the working of Sowing, Fertilizing Equipment and harvesting Machinery

MODULE I GENERAL DESIGN OF TRACTORS 9

Classification of tractors – Main components of tractor – Safety rules. Tractor controls and the starting of the tractor engines – Basic notions and definition – Engine cycles – Operation of multicylinder engines – General engine design – Basic engine performance characteristics.

MODULE II TRACTOR ENGINE, VALVE MECHANISM AND FUEL SYSTEM 9

Cylinder and pistons – Connecting rods and crankshafts – Engine balancing – Construction and operation of the valve mechanism – Valve mechanism troubles. – Fuel tanks and filters – Fuel pumps.

MODULE III COOLING AND LUBRICATING SYSTEM OF TRACTOR 9

Cooling system – Classification – Liquid cooling system – Components, Lubricating system servicing and troubles – Air cleaner and turbo charger

MODULE IV PRIMARY AND SECONDARY TILLAGE IMPLEMENTS 9

Mould board plough- attachments – mould board shapes and types. Disc plough – force representation on disc – Types of disc ploughs – Subsoiler plough – Rotary plough. Cultivators -types – construction. Disc harrows – Bund former – ridger – leveller. Basin lister-Wetland preparation implements.

MODULE V SOWING, FERTILIZING EQUIPMENT AND HARVESTING MACHINERY 9

Crop planting – methods – row crop planting systems – Devices for metering seeds – furrow openers – furrow closers- types – Types of seed drills and planters – calibration-fertilizer metering devices – seed cum fertilizer drills – paddy transplanters – nursery tray machines. Principles of cutting crop, types of harvesting machinery, vertical conveyor reaper and binder combine harvesters, balers, threshers, tractor on top combine harvester, combine losses

L - 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. K. Srinivasan, “Tractors and Agricultural Machinery”, New India Publishing Agency, 2nd edition, 2015.(ISBN: 9380235607)

REFERENCES:

1. Carroll E. Goering, Allen C. Hansen, “Engine and Tractor Power”, American Society of Agricultural and Biological Engineers, 4th edition, 2004. (ISBN: 1892769425)
2. Harry L. Field, John M. Long, “Introduction to Agricultural Engineering Technology: A Problem Solving Approach”, Springer, 4th Edition, 2018. (ISBN: 9783319696799)
3. John B. Liljedahl, Paul K. Turnquist, David W. Smith, Makoto Hoki, “Tractors and their power units”, An AVI Book Published by Van Nostrand Reinhold, 4th edition, 1989.(ISBN: 978-1-4684-6634-8)
4. R. H. Macmillan, “The Mechanics of Tractor - Implement Performance”, Custom Book Centre at the University of Melbourne, 2010. (ISBN: 0980759412)
5. Frank M. Zoz, Robert D. Grisso, “Traction and Tractor performance”, American Society of Agricultural Engineers, 2003.
6. Dr. Manjit Singh, Dr. L. N. Shukla, “Tractor Design and Testing”, Department of Farm Machinery and Power Engg., 2001.

COURSE OUTCOMES:

Students should able to

CO1: Design the layout of tractor with major systems

CO2: Troubleshoot the problems in engines, valves and fuel systems

CO3: Troubleshoot the problems in cooling and lubricating system

CO4: Specify the purpose and demonstrate the working of all tillage implements

CO5: Specify the purpose and demonstrate the working of Sowing, Fertilizing Equipment and Harvesting Machinery

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

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

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

SDG 9 : Enhance scientific research, upgrade the technological capabilities of industrial sectors

Statement : The holistic understanding of tractors agricultural machineries enhances the effective usage and innovation in the agricultural domain.

AUDX 25	**MOTORSPORT ENGINEERING**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To study the fundamentals of motorsport engineering

COB2: To gain knowledge in working of powertrain

COB3: To understand the properties of materials

COB4: To study about motor vehicle chassis

COB5: To understand the electronic components

MODULE I OVERVIEW OF MOTORSPORT ENGINEERING 9

Introduction about motor sport vehicles, various types of motor sport vehicles and their requirements, competitions and requirements, Preparing for the competitions, bench marking, project planning, Case studies of completed events.

MODULE II POWER TRAIN 9

Engine management systems, sensors, alternative fuels, oxidizing agents, chemical composition of fuels, ignition systems and components. Engine and transmission configurations – front/ rear/mid-engine and associated driveline Transmission systems – clutches, torque converters, manual gearbox types, automatic gearbox types, electronic and hydraulic transmission control, traction control, launch control, KERS systems. Final drive systems – differentials, Torsen, torque biasing, LSD, Salisbury, air-locking, fluid coupling Hybrid Drive systems.

MODULE III MATERIALS AND PROCESSES 9

Selection criteria: material properties, including cost drivers, mechanical, physical, chemical and process characteristics. basic properties of materials such as ceramics, metals, composites and polymers. Testing of materials, ISI standards, standard published data sources, engineering drawings Joining techniques including, brazing and welding, effect on structure and properties,

MODULE IV MOTOR VEHICLE CHASSIS 9

Frame design for different vehicles, layout of components, weight distribution, weight transfer and braking requirements, suspension system, steering system, body design and fabrication, driver seat and safety requirements, Electrical systems and wiring, wheels and tires. Testing and validation. Failure Mechanism in materials.

MODULE V VEHICLE ELECTRONICS 9

Electronics – semiconductors, electronic circuitry, integrated circuits. ignition systems, Engine management systems, sensors transistorized and capacitor discharge types, fuel injection systems and sensors, ECU programming and mapping., ABS, TRS, active suspension system.

L - 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Andrew Livesey, "Basic Motorsport Engineering", Routledge publications, 1st edition, 2016.(ISBN-13: 978-1138172326)

REFERENCES:

1. Hillier, VAW (2006) Fundamentals of Motor Vehicle TechnologyStanleyThornes
2. Davis & Davis (2001) Supercharging, Turbocharging and Nitrous Oxide permance. Motorbooks.
3. Marek, J. (2003) Sensors applications: sensors for automotive technology. Wiley
4. Andrew Livesey, "Advanced Motorsport Engineering", Routledge publications, 1st edition, 2016. (ISBN: 9780750689083)
5. Walker, D. (2001) Engine management. Haynes
6. Staniforth, A (2002)Race and rally car sourcebook Haynes
7. Staniforth, A (2006)Competition car suspension Haynes
8. Van Valkenburg, P (2001) Race car engineering and mechanics, Motorbooks International Milliken & Milliken (1997) Vehicle dynamics. SAE

COURSE OUTCOMES:

Students should able to

CO1: Classify and benchmark the motorsport vehicle for various competition

CO2: Design the powertrain for motorsport competition

CO3: Select the suitable material for different components

CO4: Analyze the forces and moments acting on the chassis

CO5: Identify and fault diagnosis the electronic components in motorsport vehicle.

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

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

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

SDG 9 : Enhance scientific research, upgrade the technological capabilities of automobile industrial sectors.

Statement : The holistic understanding of motorsport engineering leads to innovation in energy efficiency.

AUDX 26	**AUTOMOTIVE SUSPENSION AND STEERING SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To learn about shock absorbers and struts

COB2: To study about front and rear suspension

COB3: To learn the computer-control suspension system

COB4: To study the steering system

COB5: To learn the steering dynamics

MODULE I SHOCK ABSORBERS AND STRUTS 9

Introduction,Shock Absorber Design,Shock Absorber Operation,Gas-Filled Shock, Absorbers and Struts, Heavy-Duty Shock Absorber Design, Shock Absorber Ratios, Strut Design, Front Suspension, Shock Absorber and Strut Design, Rear Suspension, Travel-Sensitive Strut, Adjustable Struts, Load-Leveling Shock Absorbers, Electronically Controlled Shock Absorbers and Struts.

MODULE II FRONT AND REAR SUSPENSION SYSTEMS 9

Front suspension: Short-and-Long Arm Front Suspension Systems, MacPherson Strut Front Suspension System Design, Modified MacPherson Strut Suspension, High-Performance Front Suspension Systems, Torsion Bar Suspension, Curb Riding Height, Front Spring Sag and Caster Angle.

Rear suspension: Live-Axle Rear Suspension Systems, Semi-Independent Rear Suspension Systems, Independent Rear Suspension Systems, Curb Riding Height, Spring Sag, and Caster Angle.

MODULE III COMPUTER-CONTROLLED SUSPENSION SYSTEMS 9

Programmed Ride Control System, Electronic Air Suspension System Components, Electronic Air Suspension System Operation, Air Suspension System, Design Variations, Vehicle Dynamic Suspension System, Electronic Suspension Control (ESC) System, Integrated Electronic Systems and Networks, Vehicle Stability Control, Active Roll Control Systems, Adaptive Cruise Control (ACC) Systems, Lane Departure Warning (LDW) Systems, Collision Mitigation Systems, Telematics.

MODULE IV STEERING SYSTEM 9

Steering mechanism: worm system, worm and sector, worm and roller, recirculating ball steering, rack and pinion steering. Power steering: Power Steering Pump Drive Belts, Types of Power-Assisted Steering Systems, Power

Steering Pump Design, Power Steering Pump Operation. Steering Columns: Conventional Nontilt Steering Column, Tilt Steering Column, Electronic Tilt/Telescoping Steering Column, Active Steering Column, Driver Protection Module, Steering Linkage Mechanisms.

MODULE V STEERING DYNAMICS 9

Wheel alignment: camber, steering axis inclination (SAI), Toe, caster, wheel alignment. Steering geometry errors. Four wheel drive influences: drive line torque, loss of cornering stiffness due to tractive force. Four wheel steering: low speed turn, high speed turn. Vehicle rollover: Quasi-static model, quasi-static rollover with suspension.

L – 45; TOTAL HOURS – 45

TEXT BOOKS:

1. Vangelder, Kirk. Automotive Steering and Suspension. United States, Jones & Bartlett Learning, 2017.
2. Schnubel, Mark. Today's Technician: Automotive Suspension & Steering Classroom Manual and Shop Manual. United States, Cengage Learning, 2014.

REFERENCES:

1. Ball, Jeffrey K., and Stone, Richard. Automotive Engineering Fundamentals. United States, SAE International, 2004.
2. Birch, T. W. Automotive Suspension and Steering System. N.p., Delmar Cengage Learning, 1998.

COURSE OUTCOMES:

students can able to

CO1: demonstrate the shock absorbers and struts.

CO2: illustrate the front and rear suspension systems.

CO3: outline the function of air suspension systems.

CO4: interpret the function of steering system.

CO5: discuss the steering dynamics.

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	H	M	M							H		M	H	H
CO2H	H	M	M							H		M	H	H
CO3	H	M	M							H		M	H	H
CO4	H	M	M							H		M	H	H
CO5	H	M	M							H		M	H	H

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

SDG No. 9 : sustainable development in the transport

Statement : Improve the safety and sustainable development in the steering and suspension system.

AUDX 27	OFF ROAD VEHICLE	L	T	P	C
SDG: 9		1	0	0	1

COURSE OBJECTIVES:

COB1: To gain knowledge on earth moving machines

COB2: To understand the hydraulic and pneumatic systems in offroad vehicle

MODULE I EARTH MOVING MACHINES 7

Construction layout, capacity and applications. Power Plants, Chassis and Transmission. Earthmovers like dumpers, loaders - single bucket, Multi bucket and rotary types - bulldozers, excavators, backhoe loaders, scrappers, drag and self-powered types, Bush cutters, stumpers, tree dozer, rippers etc. – Power and capacity of earth moving machines. scrappers ,graders, shovels and ditchers

MODULE II HYDRAULIC AND PNEUMATIC CONTROL SYSTEMS 8

Brake system and actuation – OCDB and dry disc caliper brakes. Body hoist and bucket operational hydraulics. Hydro-pneumatic suspension cylinders. Power steering system. Kinematics for loader and bulldozer operational linkages. Safety features, safe warning system for dumper. Design aspects on dumper body, loader bucket and water tank of sprinkler.

TOTAL HOURS – 15

TEXT BOOKS:

1. Carroll E Goering, "Off-Road Vehicle Engineering Principles", American Society of Agricultural Engineers, 1st edition, 2006. (ISBN: 1-892769-26-3)

REFERENCES:

1. Craig Cheetham, "Trucks and Off-Road Vehicles", Motorbooks International, Annotated edition, 2004. (ISBN : 978-0760320044)
2. Giant Earth Moving Equipment, "Giant Earth Moving Equipment", Motorbooks International, 1995. (ISBN : 978-0760300329)
3. Robert L. Schmitt, P.E.Clifford J. Schexnayder, P.E.Aaron B. Cohen, "Moving the Earth: Excavation Equipment, Methods, Safety, and Cost", McGraw-Hill Education, 7th Edition, 2019. (ISBN: 9781260011647)
4. Sharma S. C, "Construction Equipment and Management", Khanna Publishers, 1st Edition, 2019. (ISBN: 9789382609056)
5. CAT Heavy Equipment Manuals.

COURSE OUTCOMES:

Students should able to

CO1: Identify the applications of different earth moving machines

CO2: Demonstrate the working of various hydraulic and pneumatic controls in offroad vehicle.

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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

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

Statement : The holistic understanding of offroad vehicle leads to sustainable industrialization.

ELECTRIC VEHICLE AND TECHNOLOGY

AUDX 28	ELECTRIC VEHICLE CHARGING STATION	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To gain knowledge in EV charger

COB2: To understand fast and slow charger

COB3: To gain knowledge on connectors

COB4: To study about public charging infrastructure

COB5: To gain knowledge on EV Charger Integration with Solar Power Plant

MODULE I EV CHARGERS 9

EV classification and their electrification levels, EV Terminology, Electric Vehicle Technology and Charging Equipment's Basic charging Block Diagram of Charger Difference between Slow charger and fast charger Slow charger design rating Fast charger design rating AC charging and DC charging Inboard and off board charger specification Type of Mode of charger Mode -2 , Mode-3 and Mode-4 EVSE associated charge times calculation

MODULE II FAST AND SLOW CHARGER (AC & DC) 9

AC Pile Charger DC Pile Charger EVSE Power Module selection and technical specification Selection of EVSE Communication Protocol (PLC / Ethernet / Modbus/ CAN Module) Communication gateway Specification of open charge point protocol (OCCP 1.6/2.0) Bharat DC001 & AC001 Charger specificationCommunication Interface between charger and CMS (central management system) , Payment apps.

MODULE III CONNECTORS 9

EV Charging Connector Types , AC charger type-1 , type -2 and type -3 Communication between AC charger and EV Selection of DC charger connector GB/T, CHAdeMO , CCS-1 and CSS-2 Communication methodology of DC fast chargers IS/ IEC/ARAI/ standard of Charging topology ,Communication and connectors (IEC 61851-1, IEC 61851-24,62196-2) Selection sizing of Charger connector cable.

MODULE IV PUBLIC CHARGING INFRASTRUCTURE / ELECTRICAL SYSTEM DESIGN 9

Assessment of site Location for Public charging station, Selection and Sizing of Distribution transformer, HT Equipment (VCB , CT , PT , Metering), HT Cables and LT cables, Distribution Board / feeders, calculation of LT and HT cable, Compact Substation (CSS for EV CS)/ Power Substation), Preparation of EV Charger Single

Line Diagram, Assessment of site Location for Public charging station, Distribution transformer.

MODULE V CHARGING STATION IN HOUSE AND WITH SOLAR ENERGY 9

Selection of location, charger- Level 1 electric vehicle charger, Level 2 electric vehicle charger,Install an EV charger with your solar panel system, PV module technology, Crystalline technology, Thin film technology, Bi-facial technology, Comparison between PV module technology, Comparison between solar power, plant energy output, Selection of inverter, Selection of Cable and Earthing.

L - 45 ; TOTAL HOURS – 45

REFERENCES:

1. Mohammad Saad Alam, Reji Kumar Pillai, “Developing Charging Infrastructureand Technologies for Electric Vehicles '',IGI Global, U.S.A, 2022. (ISSN 2328-8205)
2. “Plug-In Electric Vehicle Handbook”National Renewable Energy Laboratory,U.S. Department of Energy, 2012.
3. “Handbook of electric vehicle charging infrastructure implementation”,NITI Aayog,Ministry of Power, Department of Science and Technology,Bureau of Energy Efficiency and WRI India.
4. “Electric vehiclecharging infrastructure'', ANITI aayog, RMI india, 2022.
5. “Installation guide for electric vehicle supply equipment”, The Massachusetts Department of Energy Resources, 2014.
6. “Electric Vehicle Charging Station GuidebookPlanning for Installation and Operation”, Vermount energy investment corporation, Burlington.

COURSE OUTCOMES:

Students should able to

CO1: Select the suitable EV charger based on requirement

CO2: Demonstrate fast and slow charger process

CO3: Select the suitable connector for Electric vehicle

CO4: Design the public charging infrastructure

CO5: Demonstrate process in integrating solar power with EV charging station

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

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

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

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

Statement : The holistic understanding of charging station leads to a develop sustainable charging infrastructure for Electric vehicles

AUDX 29	**ELECTRIC BIKE DESIGN , SERVICING AND MAINTENANCE**	**L**	**T**	**P**	**C**
SDG:13		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: to learn the e-bike equilibrium and suspension.

COB2: to learn the e-bike motor drives.

COB3: to study the control systems used in e-bikes.

COB4: to learn the batteries and electrical system in e-bikes.

COB5: to study the service and maintenance in e-bikes.

MODULE I ELECTRIC BIKE EQUILIBRIUM AND SUSPENSION 8

Dynamic equilibrium of motorbike, steering angle, driving style and roll angle, motorbike sway, diving and rising of suspension, front and rear suspension design.

MODULE II ELECTRIC MOTOR DRIVES 9

DC motor drives, Induction motor drive, Permanent magnet brush-less motor drive, Switched Reluctance Motor Drives, Stator-Permanent Magnet Motor Drives.

MODULE III CONTROLLER 9

Controller overview, switch controller, solid state controller, electronic controller, AC controller, DC motor controller, Zilla controller.

MODULE IV BATTERIES AND ELECTRICAL SYSTEM 10

Types of batteries, Battery thermal management, battery charging and discharging cycle, battery charging solution, High voltage and current system, low voltage and current system, terminal strip, shunts, ammeter, voltmeter, battery indicator, temperature meter, rotary switch, fans, DC to DC converter, wiring.

MODULE V MAINTENANCE 9

Battery maintenance, testing and servicing of battery, servicing of motor, testing of controller, maintenance and serving of suspension system. Maintenance: brakes, steering, frame, final drive, suspension, wheels and tyres.

L – 45 ; TOTAL HOURS –45

REFERENCES:

1. Brant, Bob, and Leitman, Seth. Build Your Own Electric Vehicle, Third Edition. United States, McGraw-Hill Education, 2013.
2. Chau, K. T.. Electric Vehicle Machines and Drives: Design, Analysis and Application. Germany, Wiley, 2015.
3. Zimmerman, Mark. The Essential Guide to Motorcycle Maintenance. United States, Motorbooks, 2016.
4. Agostinis, Massimiliano, and Croccolo, Dario. Motorbike Suspensions: Modern Design and Optimisation. Netherlands, Springer London, 2013.
5. Hamut, Halil S., et al. Thermal Management of Electric Vehicle Battery Systems. United Kingdom, Wiley, 2017.

COURSE OUTCOMES:

CO1: demonstrate the electric bike equilibrium and suspension system.

CO2: describe the motor drives used in electric bike system.

CO3: illustrate the e-bike control systems.

CO4: demonstrate the batteries and electrical system in e-bike.

CO5: solve the issues in the e-bike.

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	H	H							H		M	H	H
CO2	H	H	H							H		M	H	H
CO3	H	H	H							H		M	H	H
CO4	H	H	H							H		M	H	H
CO5	H	H	H							H		M	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 electric vehicle in the application of automobile and its leads to reduce impact on climate change.

		L	T	P	C
AUDX 30	**EV TECHNOLOGY AND BUSINESS MANAGEMENT**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To acquire elemental technologies and knowledge necessary for advanced driver assistance systems.

COB2: To understand the advanced driver assistance system, and acquisition of how to survey this research field.

COB3: To gain knowledge about the concept and configuration of a new advanced driver assistance system according to the needs.

COB4: To know about the Present Advanced Driver Assistance System Technology.

COB5: To know about the autonomous cars and application in a vehicle.

MODULE I INTRODUCTION 9

History & Evolution –Introduction- Overview of EV Challenges, Pure Electric Vehicle, Hybrid Electric Vehicle, Gridable Hybrid Electric Vehicle, Fuel-Cell Electric Vehicle, EV Technologies- Types of EVs, Electric Drive-train, Tractive effort in normal driving, Energy consumption Concept of Electric Drive Trains, Architecture of Electric Drive Trains, Electric Propulsion unit, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, switched reluctance motor, Introduction to Energy Storage.

MODULE II REQUIREMENTS IN ELECTRIC VEHICLES 8

Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system, Design of Electric Vehicle and Plug-in Electric Vehicle, Energy Management Strategies, Automotive networking and communication, EV and EV charging standards, V2G, G2V, V2B, V2H.

MODULE III VEHICLE TESTING & HOMOLOGATION 9

Need of vehicle testing and homologation, testing organizations, testing standards (AIS), Hierarchy of testing: Individual component approval/testing, System level approval and Whole vehicle approval/testing. Conformity of production tests, Crash test, side impact test, rollover test, Impact test, Track testing.

MODULE IV E-MOBILITY BUSINESS 9

E-mobility business, electrification challenges, Connected Mobility and Autonomous Mobility- case study E-mobility Indian Roadmap Perspective.

Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs, case studies- Emerging Technologies for Electric Vehicle Drives, Case Studies of Two Wheeler, Three-Wheeler, and Four-Wheeler Electric Vehicles.

MODULE V EV-BUSINESS MANAGEMENT 10

Setting up Electric Vehicle Retrofitting Business, Service, Maintenance & Repair of Evs for EV Dealers, Homologation of Electric Vehicle (Testing & Infrastructure), Setting up charging station infrastructure, Swappable Battery vs Fixed Battery (Separate Vehicle & Energy Business), City Electric Bus Fleet on Opex Model, Multi-Modal Electric transportation solution in cities (auto, taxi, bus, metro), Electric Shared Fleet (Ola & Uber)-Electric Fleet for delivery, E-Commerce services, Electric retro-fitment solutions for the in-use vehicles.

L – 45 ; TOTAL HOURS –45

TEXT BOOKS:

1. Lentin Joseph, Amit Kumar Mondal, Autonomous Driving and Advanced Driver-Assistance Systems (ADAS): Applications, Development, Legal Issues, and Testing CRC Press December 16, 2021.
2. John Wiley, Advanced Driver Assistance Systems (ADAS) Professional Engineering Publishing, 2020.

REFERENCES:

1. John G. Hayes and G. Abas Goodarzi, Wiley, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, 2016.
2. Electric Vehicle Technology Explained, By James Larminie, John Wiley & Sons Ltd, 2017.
3. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, By Mehrdad Ehsani, Yimin Gao, Stefano Longo and Kambiz M. Ebrahimi, CRC Press, 2020.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Demonstrate the use of advanced technologies for EVs.

CO2: Describe the various requirements that enhance electric vehicle and recent developments.

CO3: Analyze the various need of vehicle testing and homologation for EV.

CO4: Identify the E-mobility business and management.

CO5: Identify and locate the most important application of an EV and marketing.

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

This subject will lead to effective understanding of future technology and E-mobility business and management.

AUDX 31	ADVANCED DRIVER ASSISTANCE SYSTEMS	L	T	P	C
SDG: 9		3	0	0	3

COURSE OBJECTIVES:

COB1: To acquire elemental technologies and knowledge necessary for advanced driver assistance systems.

COB2: To understand the advanced driver assistance system, and acquisition of how to survey this research field.

COB3: To gain knowledge about the concept and configuration of a new advanced driver assistance system according to the needs.

COB4: To know about the Present Advanced Driver Assistance System Technology.

COB5: To know about the autonomous cars and application in a vehicle.

MODULE I INTRODUCTION 9

History & Evolution -Introduction to ADAS-Important- Concept of Advanced Driver Assistance Electronic Systems, NHTSA-consideration, next generation of mobile-connected devices accuracy, power efficiency, and performance to ADAS systems. Levels of driving automation, human monitors-automated monitors-safety, and security-future of ADAS.

MODULE II SENSOR TECHNOLOGY FOR ADAS 8

Basics of Radar Technology and Systems -Ultrasonic Sonar Systems - Lidar Sensor Technology and Systems -Camera Technology-Night Vision Technology, Use of Sensor Data Fusion, Integration of Sensor Data to On-Board Control Systems.

MODULE III CONNECTED CAR TECHNOLOGY 9

Connectivity Fundamentals- Navigation and Other Applications, Vehicle-to-Vehicle Technology and Applications, Vehicle-to-Roadside and Vehicle-to-Infrastructure Applications, Wireless Security Overview.

MODULE IV VEHICLE PROGNOSTICS TECHNOLOGY 9

Monitoring of Vehicle Components- Basic Maintenance -End-of-Life Predictions, Advanced Driver Assistance System-Sensor Alignment and Calibration, Autonomous Vehicles - Driverless Car Technology - Moral, Legal, Roadblock Issues, Technical Issues, Security Issues, Present Advanced Driver Assistance System Technology.

MODULE V ADAS APPLICATIONS 10

Essential safety-critical ADAS applications-significant automotive safety improvement-Pedestrian detection/avoidance, Lane departure warning/correction, Traffic sign recognition, Automatic emergency braking, Adaptive Cruise Control-Glare-Free High Beam and Pixel Light, Adaptive Light Control-Automatic Parking, Autonomous Valet Parking, Navigation System, Night Vision-Blind Spot Monitoring.

L – 45 ; TOTAL HOURS –45

TEXT BOOKS:

1. Lentin Joseph, Amit Kumar Mondal, Autonomous Driving and Advanced Driver-Assistance Systems (ADAS): Applications, Development, Legal Issues, and Testing CRC Press December 16, 2021.
2. John Wiley, Advanced Driver Assistance Systems (ADAS) Professional Engineering Publishing, 2020.

REFERENCES:

1. Tsapi Anastasia, Introducing Advanced Driver Assistance Systems (ADAS) into drivers' training and testing: The young learner drivers' perspective, December 2015.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Acquire the significant of ADAS.

CO2: Describe the various systems that enhance vehicle safety and recent technologies.

CO3: Analyze the various features in an ADAS.

CO4: Identify the connected cars and sensor technology in a vehicle.

CO5: Identify and locate the most important application of an ADAS.

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO2	M	M	L	L	L	L	L	L	M	M	M	H	H	H
CO3	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO4	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO5	M	L	L	L	L	L	L	L	M	M	M	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 vehicle warning system and collision avoidance systems.

This subject will lead to effective understanding of future technology and safety systems in an Automobile.

		L	T	P	C
AUDX 32	**CONNECTED AND AUTONOMOUS VEHICLE ENGINEERING**	**3**	**0**	**0**	**3**
SDG: 9					

COURSE OBJECTIVES:

COB1: To understand working of Connected, automated and Intelligent cars.

COB2: To provide knowledge related to Sensor Technology for Advanced Driver Assistance Systems.

COB3: To study fundamentals of Wireless Technology.

COB4: To know about recent driver assistance system technology.

COB5: To know well versed in the design and development in automated technology.

MODULE I INTRODUCTION 9

Introduction to Connected, automated and Intelligent cars: Automotive Electronics Overview, Advanced Driver Assistance Electronic Systems, Connected Car Technology: Connectivity Fundamentals, Navigation and Other Applications, Connected Car Display Technology, Connected cars, V2V Communication vehicle- V2I Communication vehicle.

MODULE II SENSOR TECHNOLOGY 9

Sensor Technology for Advanced Driver Assistance Systems: Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, Lidar Sensor Technology and Systems, Camera Technology, Night Vision Technology, Impaired Driver Technology: Driver Impairment Sensor Technology, Sensor Technology for Driver Impairment Detection, Transfer of Control Technology.

MODULE III WIRELESS TECHNOLOGY 9

Overview of Wireless Technology: Wireless System Block Diagram and Overview of Components, Transmission Systems – Modulation/Encoding, Receiver System Concepts – Demodulation/Decoding, Signal Propagation Physics, Basic Transmission Line and Antenna Theory, Wireless System Standards and Standards Organizations: Wireless Networking and Applications to Vehicle Autonomy: Basics of Computer Networking – the Internet of Things, Wireless Networking Fundamentals, Integration of Wireless Networking and On-Board Vehicle Networks

MODULE IV RECENT DRIVER ASSISTANCE SYSTEM AND VEHICLES 9

Recent Driver Assistance System Technology: Basics of Theory of Operation, Applications – Legacy, Applications – New, Applications – Future, Integration of ADAS Technology into Vehicle Electronics, System Examples, Role of Sensor Data Fusion, Recent Driver Assistance System Technology applied in various automobile companies dealing with Non-Passenger Car, mini project to apply knowledge of various technologies related to connected vehicles.

MODULE V AUTOMATED AND INTELLIGENT CARS 9

Autonomous Vehicle Technology: Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles Autonomous Vehicles: Driverless Car Technology, Moral, Legal, Roadblock Issues, Technical Issues and Security Issues.

L – 45 ; TOTAL HOURS –45

TEXT BOOKS:

1. G. Mullett, Wireless Telecommunications Systems and Networks, Thomson – Delmar Learning, ISNB#1-4018-8659-0, 2016
2. 3Dietmar P.F. Möller, Roland E. Haas, Guide to Automotive Connectivity and Cybersecurity: Trends, Technologies, 2015.

REFERENCES:

1. G. Mullett, Basic Telecommunications: The Physical Layer, Thomson – Delmar Learning, ISBN#1-4018-4339-5, 2013.
2. Tom Denton, Automobile Electrical and Electronic Systems, 2017.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Apply knowledge of sensor and wireless technology to execute mini projects for connected cars and analyze the technology applied in connected Cars.

CO2: Describe the basics and advancement in and Automated and intelligent.

CO3: Explore basics related to sensor technology in automated vehicles.

CO4 Learn fundaments related to wireless technology in connected vehicles.

CO5: Understand recent driver assistance system technology associated with automated vehicles.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	H	M	M	M	M	M	M	M	M	L	L	H	H	H
CO2	H	M	M	M	M	M	M	M	M	L	L	H	H	H
CO3	H	M	M	M	M	M	M	M	M	L	L	H	H	H
CO4	H	M	M	M	M	M	M	M	M	L	L	H	H	H
CO5	H	M	M	M	M	M	M	M	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 future technology in automated vehicle.

This subject will lead to effective understanding of connected cars and intelligent cars fundamental.

		L	T	P	C
AUDX 33	**VEHICLE CONTROL SYSTEM**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the methods of representation of system and their transfer function models.

COB2: To provide adequate knowledge in the time response of systems and steady state error analysis.

COB3: To give basic knowledge in obtaining the open loop and closed loop frequency responses of systems.

COB4: To understand the concept of stability of control system and methods of stability analysis.

COB5: To study about different sensors, actuators and three way of designing compensators for a control system.

MODULE I CHASSIS CONTROL SYSTEM 9

Components of chassis management system – role of various sensors and actuators pertaining to chassis system – construction – working of chassis management system .

MODULE II BASICS OF CONTROL SYSTEM 9

Transfer function- Time response - Types Steady state error - Frequency response - Bode plot- Polar plot- Nichols chart- Determination of closed loop responses from open loop response.

MODULE III SAFETY SYSTEM CONTROL 9

Speed control – cylinder cut - off technology, Gear shifting control – Traction / braking control, brake by wire – Adaptive cruise control, throttle by wire. Steering - automatic parking – steer by wire.

MODULE IV COMFORT SYSTEM CONTROL 9

Active suspension systems, requirement and characteristics, different types, Vehicle Handling and Ride characteristics of road vehicle, pitch, yaw, bounce control, power windows, thermal management system, adaptive noise control.

MODULE V ROUTING AND TRAFFIC CONTROLS 9

Traffic routing system - Automated highway - Lane departure warning system, Data communication within the car, Future Cars – Case studies..

L -45; TOTAL HOURS – 45

TEXT BOOKS:

1. U. Kiencke, and L. Nielsen, Automotive Control Systems, SAE and Springer-Verlag, 2014.
2. Ljubo Vlacic, Michel Parent, Fumio Harashima, “Intelligent Vehicle Technologies”, Butterworth Heinemann publications, Oxford, 2013.

REFERENCES:

1. Crouse, W.H. & Anglin, D.L., “Automotive Mechanics”, Intl. Student edition, 9thedition, TMH, New Delhi, 2012.
2. Crouse, W.H. & Anglin, D.L., “Automotive Mechanics”, Intl. Student edition, 9thedition, TMH, New Delhi, 2012.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Apply the fundamentals of chassis management system and its control.

CO2: Analyze the knowledge to evaluate open loop and closed loop frequency responses of systems

CO3: Analysis of different sensors and actuators for automotive applications.

CO4: Explain in stability of control system development and analysis

CO5: Apply the knowledge in the time response of systems and steady state error analysis.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO2	M	M	L	L	L	L	L	L	M	M	M	H	H	H
CO3	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO4	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO5	M	L	L	L	L	L	L	L	M	M	M	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 vehicle body design and materials.

This subject will lead to effective understanding of control system and management systems in Automobile.

AUDX 34 SDG: 9	MODERN AND INTELLIGENT VEHICLE SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

COB1: To acquire knowledge about the principle of modern vehicle systems.

COB2: To learn about different sensors and actuator used in the vehicle.

COB3: To gather knowledge about the modern techniques in the vehicle.

COB4: To learn control systems like steering, suspension, and braking system.

COB5: To gain knowledge of the different controls system in vehicle navigation systems.

MODULE I INTRODUCTION 9

Fundamental of modern and intelligent vehicle systems, different types, functions, Unmaned vehicle technologies.

MODULE II SENSOR AND ACTUATORS 9

Working principle of wheel speed sensor, steering position, oxygen sensor, tyre pressure, brake pressure, steering torque, exhaust temperature sensor, fuel level sensors.

MODULE III SAFETY AND SECURITY SYSTEM 9

Airbags, seat belt tightening system, collision warning systems, child Lock, anti-lock braking systems, Vision enhancement, road recognition system, Anti-theft technologies, smart card system, number plate coding, central locking system.

MODULE IV MODERN VEHICLE SYSTEMS 9

Integrator starter, Alternator, Starts stop operation, Un man vehicle technology, Regenerative energy recovery, advanced lead acid batteries, alkaline batteries, Lithium batteries, Development of new energy storage systems, Deep discharge and rapid charging, ultra-capacitors. In-Vehicle Computing –Vehicle Diagnostics system – Hybrid / Electric and Future Cars – Case studies.

MODULE V INTELLIGENT TRANSPORTATION SYSTEM 9

Radar guide brakes, radar guided lane assist, Global positioning system. Data communication within the car, Driver conditioning warning -Route Guidance and Navigation Systems – vision enhancement system.

L-45; TOTAL HOURS – 45

TEXT BOOKS:

1. U. Kiencke, and L. Nielsen, Automotive Control Systems, SAE and Springer-Verlag, 2014.
2. Ljubo Vlacic, Michel Parent, Fumio Harashima, "Intelligent Vehicle Technologies", Butterworth Heinemann publications, Oxford, 2013.

REFERENCES:

7. Crouse, W.H. & Anglin, D.L., "Automotive Mechanics", Intl. Student edition, 9th edition, TMH, New Delhi, 2012.
8. William B.Ribbens -Understanding Automotive Electronics, 9th edition, Butter worth Heinemann Woburn, 2018.
9. Bosch, "Automotive Hand Book", 9th edition, SAE, 2014.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1 Analysis of different sensors and actuators for automotive applications.

CO2: apply the knowledge to develop future technology cars.

CO3: knowledge to develop different controls system in vehicle navigation systems.

CO4: Explain the different modern vehicle development.

CO5: Analysis the different vehicle system to develop intelligent transportation system.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO2	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO3	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO4	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO5	M	L	L	L	L	L	L	L	M	M	M	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 development of modern vehicle and intelligent systems.

This subject will lead to effective understanding of control system and future technology in Automobile.

AUDX 35 SDG: 9	VEHICLE NETWORKING AND INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand thevehicle system networks and exposure to aspects of design.

COB2: To provide adequate knowledge in the development, application and performance issues associated with those systems.

COB3: To give basic knowledge in obtaining the local interconnect network of the systems.

COB4: To understand the concept of protocols and satellite networks for communication between the vehicles.

COB5: To study about different sensors, actuators and control systems in vehicle.

MODULE I FUNDAMENTALS OF VEHICLE NETWORKING 9

Need of Networking - Overview of data communication and networking - need of vehicle networking - layers of communication (Link Layer, Network layer , transport layer, Application layer) multiplexing and de-multiplexing concepts - vehicle buses and types.

MODULE II PROTOCOLS AND NETWORK 10

Multiple access protocols - Ethernet, TCP, UDP, IP, ICMP, ARP, RARP - Hubs, Bridges, and switches - PPP - Overview of CAN - fundamentals - selecting CAN Controllers - CAN development tools - CAN application areas.CAN Protocol: Principles of data exchange - real time data transmission - message frame formats, bit encoding - bit timing and synchronization - data rate and bus length - network topology - bus access - physical layer standards.

MODULE III LOCAL INTERCONNECT NETWORK (LIN) PROTOCOL 9

Introduction to LIN Protocol - Standard overview - applications - LIN communications real time data transmission - message frame formats, bit encoding - bit timing and synchronization - data rate and bus length - network topology - bus access - physical layer standards.

MODULE IV WAN AND SATELLITE NETWORKS 8

Introduction to WAN Networks - GPS - setting receivers - Positioning - activating the navigation function -Concept of latitude and longitude grid system - Mapping and location technologies - application.

MODULE V SENSORS AND ACTUATORS 9

Electronics and Embedded computing fundamentals - Sensors - Actuators - Microcontrollers - simple microcontroller coding introduction - system on chips - platform considerations - power supply and ranges.

L – 45 ; TOTAL HOURS –45

TEXT BOOKS:

1. B.Hoffman - Wellenhof, H.Lichtenegger and J.collins, “GPS Theory and Practice" 4 th revised edition, Springer, wein new york, 2014.
2. Wireless systems, W.C.Y.lee, prentice hall publ. (LBS) - mobile and wireless design essentials - Martyn Mallick - Wiley publishing, inc. – 2016.

REFERENCES:

1. Indira Widjaja, Alberto Leon-Garcia, communication networks: Fundamental concepts and Key Architectures, Mcgraw- Hill college, 1st edition, January, 15, 2010.
2. Konrad Etschberger, Controller Area Network, IXXAT Automation August 22, 2011.
3. Olaf Pfeiffer, Andrew Ayre, Christian Keydal, Embedded Networking With CAN and CANopen, Annbooks/Rtc Books, November 1, 2013.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Ability to analyze information for intensive applications that are being enabled for vehicles by a combination of telecommunications and computing technology.

CO2: Ability to develop communications, and navigation/routing, in automotive telematics.

CO3: Apply the knowledge in the Embedded Networking with CAN and Controller Area Network.

CO4: Explain in protocol system development and in advanced protocols.

CO5: Analysis the different sensors and actuators for automotive applications.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO2	M	M	L	L	L	L	L	L	M	M	M	H	H	H
CO3	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO4	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO5	M	L	L	L	L	L	L	L	M	M	M	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 vehicle computing technology and telecommunications.

This subject will lead to effective understanding of satellite networksand navigation systems in Automobile.

AUTOMOTIVE SAFETY AND COMFORT SYSTEM

AUDX 36	**AUTOMOTIVE SAFETY SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: The students will have good exposure in automotive safety aspects including the understanding of the various safety equipment.

COB2: The students able to know the design of body for safety, dimensions of a body and about the impact of a vehicle.

COB3: The students also able to know about the safety systems in a vehicle and deformation behavior of a vehicle.

COB4: The students also able to know about the acceleration and deceleration impact with obstacles.

COB5: The students also able to know about the automatic working systems and features in a vehicle.

MODULE I INTRODUCTION 9

Design of the body for safety, dummy performance, stiff cage structural concepts, crush zone, energy equation, engine location and vehicle size and structure. Energy-absorbing bumpers, bumper design for safety and pedestrian, pedestrian protection systems.

MODULE II VEHICLE COLLISION 10

Deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, acceleration curve, concept of crumble zone, safety sandwich construction.

MODULE III VEHICLE SAFETY 9

Active safety- driving safety, conditional safety, perceptibility safety, operating safety, passive safety- exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of vehicle body, velocity and time graph.

MODULE IV SAFETY EQUIPMENTS 8

Seat belt and tightener system, collapsible steering column, tiltable steering wheel, Air bags, Antilock braking system, Adaptive cruise control system, Stability control systems, Automatic parking system, Blind spot detection, night vision and adaptive headlamps, traction control systems, Cornering Brake Control systems.

MODULE V COLLISION AVOIDANCE SYSTEMS 9

Collision warning system, causes of rear end collision, front and rear vehicle object detection system, Automatic braking system, Lane departure warnings system, Electronic brake force distribution systems, Emergency brake assist system, Tyre pressure monitoring system, Rain sensor system, Central locking, remote control system.

L – 45: TOTAL HOURS – 45

TEXT BOOKS:

1. Bosch, "Automotive Handbook", 8th Edition, SAE publication, 2011.
2. Powloski, "Vehicle Body Engineering", Business books limited, London,–2012.

REFERENCES:

1. Ronald. K. Jurgen, "Automotive Electronics Handbook", Second Edition, McGraw-Hill Inc., 2013.
2. Ulrich Seiffert, Lothar Wech, Automotive Safety Handbook, Volume 325, Society of Automotive Engineers, 2011.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Analyze how the vehicle's structure absorbs impact in a crash.
CO2: Ability to develop various systems that enhance vehicle safety, passenger Comfort, recent technologies in automobile field etc.
CO3: Analyze the various safety equipment in an automobile vehicle.
CO4: Identify the comfort system and essential system in a vehicle.
CO5: Identify and locate the most important parts of a vehicle.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO2	M	M	L	L	L	L	L	L	M	M	M	H	H	H
CO3	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO4	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO5	M	L	L	L	L	L	L	L	M	M	M	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 vehicle safety and collision avoidance systems.

This subject will lead to effective understanding of comfort and safety systems in Automobile.

AUDX 37	**AUTOMOTIVE ACCIDENT INVESTIGATION AND RECONSTRUCTION TECHNIQUES**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the good exposure in vehicle accidents and safety equipment's.

COB2: To understand about the design of body for safety, dimensions of a body and about the impact of a vehicle.

COB3: To know about the Analysis of Motorcycle and passenger car Crashes in a vehicle and deformation behavior of a vehicle.

COB4: To know about the acceleration and deceleration impact with obstacles and vehicles.

COB5: To understand about the human factors and reconstruction services systems in a vehicle.

MODULE I VEHICLE ACCIDENT INVESTIGATION 9

Automotive & Vehicle Accident Analysis- various types- accidents involving- Vehicle accident reconstruction-major-minor accident- Vehicle speed injury and collision avoidance-Sight distance-Collision severity, vehicle accident types- Low-Speed Vehicle Accident Reconstruction- Commercial Vehicle Accident Analysis & Reconstruction, Investigated accidents involving in -Passenger cars, Light truck, Heavy truck/combination vehicles (singles, doubles and triples), Motorcycles, Recreational vehicles, ATV/UTV, Emergency vehicles, Construction equipment, Earth moving equipment, Mining equipment, Railroad equipment.

MODULE II ACCIDENT RECONSTRUCTION 10

Safety and accident reconstruction- the autonomous vehicle-ADAS, vehicle crash Reconstruction - Principles and Technology- Reconstruction and Analysis of Motorcycle and passenger car Crashes- Reconstruction and Analysis of Rollover Crashes of Light Vehicles.

MODULE III OCCUPANT AND VEHICLE SAFETY 9

Cyber security- Introduction for the Automotive Sector - High Voltage Vehicle Safety Systems and PPE Analysing electrical components, systems, and power sources- tools required to determine the status of electrical components- Grounding- Insulators-Safety interlocks-Controls- Side Impact Occupant Safety and CAE Vehicle Frontal Crash Occupant Safety and CAE, Driver Distraction from Electronic Devices: Insights and Implications, Introduction to Highly Automated Vehicles.

MODULE IV HUMAN FACTORS 8

Product Safety- Warnings, Signage, and Safety Instructions-Standards-Failure Mode and Effect Analysis-Accident Investigations and Root Cause Analysis-Perception Reaction Time-Distracted Driving and Attention-Fatigue and Work Scheduling-Blind Spot Detection-Usability-Biomechanics- Injuries, Anatomy, Biomechanics & Federal Regulation -movement and function of biological systems-Fusion Engineering's biomechanists-interact in a complex environment- various equipment and vehicles.

MODULE V VEHICLE ACCIDENT RECONSTRUCTION SERVICES 9

Reconstruction of accidents involving all types vehicles, Analysis of pedestrian and vehicle accidents, Evaluations of vehicle systems and components, Vehicle maintenance analysis, Component fracture analysis, Accident scene documentation, Computer aided accident reconstruction, Event data recorder data retrieval, Braking system and performance analysis, Commercial vehicle maintenance analysis, Department of Transportation regulation issues, Accident animations, Photogrammetric analysis, Vehicle dynamics analysis, Visibility analysis.

L – 45 ; TOTAL HOURS –45

TEXT BOOKS:

1. SAE-INTERNATIONAL, Safety and Accident Reconstruction Technology Education & Training Guide, 2019.
2. Donald J Van Kirk, Vehicular Accident Investigation and Reconstruction 1st Edition, 2021.

REFERENCES:

1. Dukkipati, Rao V., "Road Vehicle Accident Reconstruction", New Age International (P) Ltd., Publishers 2018.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Analyze the vehicle accident investigation is carried and absorbs impact in a crash.

CO2: Ability to analysis the rollover Crashes of Light weight Vehicles.

CO3: Analyze the various occupant safety equipment's in an automobile.

CO4: Evaluate the human fatigue and failure analysis in a vehicle.

CO5: Describe and locates the accident reconstruction services of a vehicle.

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	PO1	PO2	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	L	L	L	L	M	M	M	H	H	H
CO2	M	M	L	L	L	L	L	L	M	M	M	H	H	H
CO3	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO4	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO5	M	L	L	L	L	L	L	L	M	M	M	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 vehicle accident reconstruction and collision analysis.

This subject will lead to effective understanding of accident analysis and reconstruction techniques in Automobile.

AUDX 38	**AUTOMOTIVE SENSORS AND APPLICATIONS**	**L**	**T**	**P**	**C**
SDG: 9		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To understand the underlying concepts, methods and application of different sensors.

COB2: To learn and apply the basic terminology associated with different fields of sensors and applications.

COB3: To gather knowledge about the role and use of sensors in automobile applications.

COB4: To learn Automotive standards and protocol for the vehicle and BMS of a vehicle.

MODULE I INTRODUCTION 7

Introduction of automobile system Current trends in automobiles with emphasis on increasing role of electronics and software, overview of generic automotive control ECU functioning, overview of typical automotive subsystems and components, AUTOSAR.

MODULE II ENGINE MANAGEMENT SYSTEMS 8

Basic sensor arrangement, types of sensors such as oxygen sensors, crank angle position sensors, Fuel metering/ vehicle speed sensors, flow sensor, temperature, air mass flow sensors, throttle position sensor, solenoids etc., algorithms for engine control including open loop and closed loop control system, electronic ignition, EGR for exhaust emission control.

MODULE III AUTOMOTIVE STANDARDS AND BMS 8

Automotive standards like CAN protocol, Lin protocol, flex ray, OBD-II, CAN FD, automotive Ethernet etc. Automotive standards like MISRA, functional safety standards (ISO 26262). System design and energy management BMS (battery management system), FCM (fuel control module), principles of system design, assembly process of automotive and instrumentation systems.

MODULE IV SAFETY SYSTEMS 7

Body electronics including lighting control, remote keyless entry, immobilizers etc., electronic instrument clusters and dashboard electronics, aspects of hardware design for automotive including electro-magnetic interference suppression, electromagnetic compatibility etc., (ABS) antilock braking system, (ESP) electronic stability program.

L – 30:TOTAL HOURS – 30

TEXT BOOKS:

1. William B. Ribbens, Butterworth Heinemann Woburn, Understanding Automotive Electronics, 2019.
2. Jiri Marek, Hans Peter Trah, Wiley, Sensors Applications, Sensors for Automotive Technology, 2018.
3. U.Kiencke, and L. Nielson, Automotive Control Systems, Springer Verlag Berlin, 2016.

REFERENCES:

1. Automotive Electrical Equipment by Young A.P., Griffiths, ELBS & New Press, 2011.
2. Understanding Automotive Electronic by Bechhold, SAE, 2018.
3. Tom Weather Jr. & Cland C. Hunter, Prentice Hall Inc., New Jersey, Automotive computers and control system 2012.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Describe the characteristics and importance of sensors in automotive technology.

CO2: Identify the relevant automotive standards with regard to protocols.

CO3: Analysis a vehicle safety system based on automotive design standards.

CO4: Analyze the various sensors applications in an automobile.

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO2	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO3	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO4	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO5	M	L	L	L	L	L	L	L	M	M	M	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 development of sensors and vehicle standards.

This subject will lead to effective understanding of sensors application and design in Automobile.

AUDX 39	**TRAFFIC ENGINEERING**	**L**	**T**	**P**	**C**
SDG: 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To understand the basics of traffic engineering

COB2: To gain knowledge in traffic survey

COB3: To understand the methods in traffic control

COB4: To study the procedures for servicing HVAC system

COB5: To gain knowledge traffic regulation

MODULE I INTRODUCTION TO TRAFFIC ENGINEERING 9

Objectives and scope of traffic engineering, Organizational set up of traffic engineering department in India, Importance of traffic characteristics, Road user characteristics, Vehicular characteristics, Max dimensions and weights of vehicles allowed in India, Effects of traffic characteristics on various design elements of the road.

MODULE II TRAFFIC SURVEYS 9

Methods of conducting the study and presentation of the data for traffic volume study; speed study and origin and destination study. Speed and delay study. Parking surveys; On street parking; off street parking. Accident surveys. Causes of road accidents and preventive measures; Use of photographic techniques in traffic surveys.

MODULE III HIGHWAY CAPACITY 9

Importance. Space and time headway. Fundamental diagram of traffic flow. Relationship between speed; volume and density. Level of service. PCU. Design service volume. Capacity of non-urban roads. IRC recommendations. Brief review of capacity of urban roads.

MODULE IV TRAFFIC SIGNAL DESIGN 9

Types of traffic control devices. Traffic signs; general principles of traffic signing; types of traffic signs. Road markings; types; general principles of pavement markings. Design of rotary. Grade separated intersections. Miscellaneous traffic control aids and street furniture. Types of signals. Linked or coordinated signal systems. Design of signal timings by trial cycle method; approximate method; Webstor’s method and IRC method

MODULE V TRAFFIC REGULATION AND MANAGEMENT

Need and scope of traffic regulations. Regulation of speed; vehicles and drivers. General traffic regulations. Motor vehicle act. Scope of traffic management. Traffic management measures: restrictions on turning movements; one way streets; tidal flow operations; exclusive bus lanes; traffic restraint; road pricing.

L - 45 ; TOTAL HOURS – 45

TEXT BOOKS:

1. Nicholas J Garber, Lester A Hoel, “Traffic and Highway Engineering”, Wadsworth Publishing Co Inc, 5th edition, 2014.(ISBN : 978-1133605157)
2. Roger P. Roess, William R. McShane, Elena S. Prassas, “Traffic Engineering”, Pearson publication, 5th edition, 2020. (ISBN-13 : 978-0134599717)

REFERENCES:

1. Kadiyali L. R., “Traffic engineering and Transport planning”, Khanna Publishers, 1st edition, 1999. (ISBN: 978-8174092205)
2. Matson T. M., Smith W. S. and Hurd F. W., “Traffic Engineering”, McGraw Hill, New York.
3. Coleman A., O'Flaherty, “Transport Planning and Traffic Engineering”, A Butterworth-Heinemann, 1st edition, 1996.(ISBN: 978-0340662793)
4. Dr Alexa Delbosc, Professor William Young, “Traffic Engineering and Management”, Monash University, 7th Edition, 2007. (ISBN: 9780648189800)
5. Brian Wolshon, Anurag Pande, “Traffic Engineering Handbook”, Institute of Transportation Engineers, 7th Edition, 2016.(ISBN: 978-1-118-76226-4)

COURSE OUTCOMES:

Students should able to

CO1: Recognize the key function of traffic engineering

CO2: Perform traffic survey using various techniques

CO3: Analyze the highway capacity for better traffic control

CO4: Perform complete servicing of HVAC

CO5: Design a traffic signal based on traffic survey

Board of Studies (BoS) :
14th BoS held on 22.08.2022

Academic Council:
19th AC held on 29.09.2022

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

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

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

Statement : The holistic understanding of traffic engineering improves the infrastructure of the country in efficient way

AUDX 40	**AUTOMOTIVE HVAC SYSTEMS**	**L**	**T**	**P**	**C**
SDG: 9		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To understand the fundamentals of HVAC system

COB2: To gain knowledge in working of cooling and heating system

COB3: To study various controls and refrigerants

COB4: To study the procedures for servicing HVAC system

MODULE I AUTOMOTIVE AIRCONDITIONING FUNDAMENTALS 7

Purposes of Heating, Ventilation and Air Conditioning- Environmental Concerns- Ozone layer depletion- Location of air conditioning components in a car – Schematic layout of a vehicle refrigeration system. Psychometry – Basic terminology and Psychrometric mixtures- Psychrometric Chart- Related problem

MODULE II AUTOMOTIVE COOLING AND HEATING SYSTEM 8

Vehicle Refrigeration System and related problems- Fixed thermostatic and Orifice tube system- Variable displacement thermostatic and Orifice tube system- Vehicle air conditioning operation Types of compressor- Compressor Clutches- Compressor Clutch electrical circuit- Compressor lubrication- Condensers- Evaporators- Expansion devices- Evaporator temperature and pressure controls- receiver-drier- Accumulators- refrigerant hoses, Connections and other assemblies- Heating system.

MODULE III AIR-CONDITIOING CONTROLS, DELIVERY SYSTEM AND REFRIGERANTS 7

Types of Control devices- Preventing Compressor damage- Preventing damage to other systems- Maintaining drive ability- Preventing Overheating Ram air ventilation- Air delivery Components- Control devices- Vacuum Controls Containers – Handling refrigerants – Discharging, Charging & Leak detection – Refrigeration system diagnosis – Diagnostic procedure – Ambient conditions affecting system pressures.

MODULE IV AUTOMATIC TEMPERATURE CONTROL AND A/C SERVICING 8

Different types of sensors and actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system. Special tools for servicing vehicle air conditioning – Diagnosing components and air conditioning systems- Diagnosing cooling system- Air delivery system Automatic temperature Control system diagnosis and service

L - 30 ; TOTAL HOURS – 30

TEXT BOOKS:

1. Warren Farnell and James D.Halderman, "Automotive Heating, Ventilation, and Air Conditioning systems", Classroom Manual, Pearson Prentice Hall, 7th edition, 2014.
2. Steven daly, "Automotive air-conditioning and climate control systems", Butterworth-Heinemann; 1st edition, 2011. (ISBN: 9789380931364)

REFERENCES:

1. Mitchell Information Services, Inc., "Mitchell Automatic Heating and Air Conditioning Systems", Prentice Hall Inc., 1989.
2. Paul Weisler, "Automotive Air Conditioing", Reston Publishing Co. Inc., 1990.
3. McDonald,K.L., "Automotive Air Conditioning", Theodore Audel series, 1978.
4. Goings,L.F., "Automotive Air Conditioning", American Technical services, 1974.
5. William H Crouse and Donald L Anglin, "Automotive Air conditioning", McGraw Hill Inc., 1st edition,1990. (ISBN-13 : 978-0070148581)
6. D. James Halderman, "Automotive Heating And Air Conditioning", Pearson publications, 2017.(ISBN: 9780134603698)

COURSE OUTCOMES:

Students should able to

CO1: Identify the fundamental working of HVAC system

CO2: Inspect HVAC system and locate obvious troubles.

CO3: Perform repair works in controls, delivery systems and refrigerant

CO4: Perform complete servicing of HVAC

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

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

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

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

Statement : The holistic understanding of HVAC leads to construction of resilient infrastructure

AUDX 41 SDG: 9	VEHICLE COMFORT SYSTEM AND ERGONOMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

COB1: To understand the engineering principles that underpins the design of an automotive vehicle for the comfort of the occupants and other road users.

COB2: Recognize the future direction of the design of comfort systems within the automotive engineering sector.

COB3: To gather knowledge about the role and use of comfort systems in automobile engineering.

COB4: To learn safety systems in a vehicle and deformation behavior of a vehicle.

COB5: To gain knowledge of the vehicle ergonomics and in cockpit design.

MODULE I INTRODUCTION 9

Introduction to automotive comfort systems for both the vehicle occupants and other road users. Driver assistance systems-Traffic jam assist, Road sign assistant, Intelligent headlight control, Remote park assist, Side view assist, Interior comfort systems-Seat and comfort actuation, Window lift and sunroof drives.

MODULE II DRIVER COMFORT 9

Driving comfort for a passenger car and commercial vehicle – driving, seating, visibility, man-machine system, Psychological factors – stress and attention of a driver.

MODULE III PASSENGER COMFORTS 9

Passenger comforts - Ingress and egress, spaciousness, ventilation, temperature control, dust and fume prevention and vibration.

MODULE IV CONVENIENCE SYSTEM 9

Steering and mirror adjustment, Central locking system- Garage door opening system, Tyre pressure control system, Rain sensor system, Environment information system.

MODULE V VEHICLE ERGNOMICS 9

Introduction to human body, Anthropometrics and its application to vehicle ergonomics and cockpit design. Ergonomic research methods / ergonomic audit, Practical work aimed at integrating design and ergonomics.

L -45; TOTAL HOURS – 45

TEXT BOOKS:

1. Vivek D. Bhise, Ergonomics in the Automotive Design Process, Taylor & Francis Group, 2012.
2. Robert Bosch GmbH Safety, Comfort and Convenience Systems, 2016.

REFERENCES:

1. B.Peacock, Waldemar Karwowski; Automobile ergonomics. Publisher: CRC; 5th edition, 2012.
2. Bosch, "Automotive Handbook", 5th Edition, SAE publication, 2010.
3. Ronald.K.Jurgen, "Automotive Electronics Handbook", 5th Edition, McGraw-Hill Inc, 2010.

COURSE OUTCOMES:

On completion of the course the students should be able to

CO1: Describe the characteristics and importance of ergonomics in automotive design technology.

CO2: Identify relevant automotive design standards with regard to ergonomics.

CO3: Design a vehicle system based on automotive design standards with regard to ergonomics.

CO4: analyze the various comfort system in an automobile vehicle.

CO5: Analyze vehicle design performance related to ergonomic aspect.

Board of Studies (BoS) :

14th BoS held on 22.08.2022

Academic Council:

19th AC held on 29.09.2022

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO2	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO3	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO4	M	L	L	L	L	L	L	L	M	M	M	H	H	H
CO5	M	L	L	L	L	L	L	L	M	M	M	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 development of comfort systems and vehicle ergonomics.

This subject will lead to effective understanding of convenience system and design in Automobile.

PHYSICS ELECTIVE

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

COURSE OBJECTIVES:

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

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

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

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

MODULE I CLASSIFICATION OF MATERIALS 6

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

MODULE II PROPERTIES OF MATERIALS 10

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

MODULE III CRYSTALLOGRAPHIC STRUCTURES AND IMPERFECTIONS 7

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

MODULE IV THERMODYNAMICS AND KINETICS 7

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

L – 30; Total Hours–30

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES

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

CO1. select suitable material for specific application.

CO2.analyse crystallographic structure of metals and their imperfections.

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

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

Board of Studies (BoS) :

BOS of Physics was held on 21.6.21

Academic Council:

17th AC held on 15.07.2021

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

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

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

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

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

COURSE OBJECTIVES:

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

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

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

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

MODULE I INTRODUCTION TO BIOMATERIALS 8

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

MODULE II IMPLANT MATERIALS 10

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

MODULE III BIOCOMPATIBILITY AND TOXICOLOGICAL SCREENING OF BIOMATERIALS 6

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

MODULE IV PRACTICAL ASPECTS OF BIOMATERIALS 6

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

L – 30; Total Hours– 30

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

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

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

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

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

CO4: reflect upon the practical ideas of using biomaterials

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

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

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

COURSE OBJECTIVES:

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

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

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

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

MODULE I INTRODUCTION TO OPTICAL FIBRES 7

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

MODULE II FIBER OPTICAL SOURCES 7

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

MODULE III FIBER OPTICAL RECEIVERS AND SENSORS 8

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

MODULE IV OPTICAL AMPLIFIERS AND NETWORKS 8

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

L – 30; Total Hours– 30

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

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

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

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

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

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

Board of Studies (BoS) :

BOS of Physics was held on 21.6.21

Academic Council:

17th AC held on 15.07.2021

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

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

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

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

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

COURSE OBJECTIVES:

COB1:To understand the physics of semiconductor devices

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

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

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

MODULE I INTRODUCTION TO SEMICONDUCTOR DEVICES 6

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

MODULE II FABRICATION OF SEMICONDUCTOR DEVICES 6

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

MODULE III OPTOELECTRONIC DEVICES 10

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

MODULE IV MEMORY STORAGE DEVICES 8

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

L – 30; Total Hours– 30

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

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

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

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

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

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

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

Academic Council:
17th AC held on 15.07.2021

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

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

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

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

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

COURSE OBJECTIVES:

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

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

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

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

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

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

MODULE II SENSORS : LIGHT, MAGNETIC FIELD AND ACOUSTIC 8

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

MODULE III SENSORS FABRICATION TECHNIQUES 7

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

MODULE IV MICROSYSTEMS AND ACTUATORS 7

Microelectro-mechanical systems (MEMS) - RF- MEMS, Micro fabrication and Applications, Classification of transducers: electrostatic, piezoelectric, thermal, Microsystem design and fabrication.working principles of Actuators. Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications Solid-state switches, relays Solenoids, D.C. Motors, A.C. Motors, Stepper motors. Shape memory alloy actuators.

L – 30; Total Hours– 30

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

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

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

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

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

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

Board of Studies (BoS) :

BOS of Physics was held on 21.6.21

Academic Council:

17th AC held on 15.07.2021

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

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

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

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

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

COURSE OBJECTIVES:

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

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

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

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

MODULE I BASICS OF NANO SCIENCE 7

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

MODULE II SYNTHESIS OF NANOMATERIALS 8

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

MODULE III CHARACTERIZATION OF NANOMATERIALS 8

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

.

MODULE IV APPLICATION OF NANO MATERIALS 7

Applications of Carbon based nanomaterials (CNT, CNF, Graphene) - Biosensor (principle, component, types, applications) - agriculture (nano-fertilizers, herbicides, nano-seed science, nano-pesticides) and food Systems (encapsulation of functional foods, nano-packaging) – Nano - electronics, Nano-optics.

L – 30; Total Hours– 30

TEXT BOOKS:

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

REFERENCES:

1 Nanotechnology: basic science and emerging technologies by Mick Wilson, Kamali Kannangara, Geoff Smith, and Michelle Simmons, Chapman & Hall/CRC; I edition, 2002.
2 Handbook of NanoScience, Engineering and Technology by Gaddand. W., Brenner. D., Lysherski. S. and Infrate. G.J., CRC Press, 2012.
3 Nanocomposite Science and Technology by P. M. Ajayan, L. S. Schadler, P. V. Braun, WILEY-VCH Verlag GmbH, 2003.
4 Nanotechnology Applications in Agriculture – C.R. Chinnamuthu, B.Chandrasekaran and C. Ramasamy – 2008.

COURSE OUTCOMES:

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

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

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

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

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

Board of Studies (BoS) :	**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.

CHEMISTRY ELECTIVE

		L	T	P	C
CHDX 01	**CHEMISTRY OF CONSTRUCTION MATERIALS**	**L**	**T**	**P**	**C**
SDG: 9		**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 RESEARCH 7

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

L – 30; Total Hours– 30

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

CO1: Explain the properties of cement and concrete

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

CO3: Enumerate the impact of water quality on the concrete

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

Board of Studies (BoS) :	**Academic Council:**
11th BoS 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	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	**CHEMISTRY OF MATERIALS AND ELECTROCHEMICAL DEVICES**	**L**	**T**	**P**	**C**
SDG: 9		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

The students will be conversant with

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

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

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

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

MODULE I CORROSION AND ITS CONTROL 8

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

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

MODULE II ELECTROCHEMICAL DEVICES 8

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

MODULE III REFRACTORIES AND ABRASIVES 7

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

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

MODULE IV LUBRICANTS 7

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

L – 30; Total Hours – 30

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

The students will be able to

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

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

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

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

Board of Studies (BoS) :

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	PO5	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 APPLICATIONS**	**L**	**T**	**P**	**C**
SDG: 11 & 12		**2**	**0**	**0**	**2**

COURSE OBJECTIVES: To make the students conversant with

- **COB1:** specific materials for hardware components fabrication, data storage and their related properties
- **COB2:** selection of advanced materials for various current applications
- **COB3:** materials for the fabrication of sensors
- **COB4:** essential characterization techniques and software tools with chemistry background

MODULE I MATERIALS FOR HARDWARE AND DATA STORAGE 7

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

MODULE II ADVANCED MATERIALS AND APPLICATIONS 8

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

MODULE III MATERIALS FOR FABRICATION OF SENSORS 8

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

MODULE IV ANALYTICAL TECHNIQUES AND SOFTWARE SOLUTIONS 7

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

L – 30; Total Hours– 30

TEXT BOOKS:

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

REFERENCES:

1. B.J. Cafferty, A.S. Ten, M.J. Fink, S. Morey, D.J. Preston, M. Mrksich, G.M. Whitesides, Storage of Information Using Small Organic Molecules, ACS Central Science, 2019, 5, 911−916.
2. Nabeel Ahmad P. Gopinath and Rajiv Dutta, 3D Printing Technology in Nanomedicine (Book), Elsevier, 2019.
3. Aaftaab Sethi, Khusbhoo Joshi, K. Sasikala and Mallika Alvala, Molecular Docking in Modern Drug Discovery: Principles and Recent Applications, IntechOpen, (2019), DOlI: 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) :

15th BoS of Department of Chemistry held on 15.06.2021

Academic Council:

17th AC held on 15.07.2021

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
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	**CHEMISTRY OF FUELS,**	**L**	**T**	**P**	**C**
SDG: 9	**COMBUSTION AND LUBRICANTS**	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

The students will be conversant with

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

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

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

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

MODULE I FUELS 8

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

MODULE II COMBUSTION 8

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

MODULE III CHEMISTRY OF CORROSION 7

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

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

MODULE IV LUBRICANTS 7

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

L – 30; Total Hours– 30

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES:

The students will be able to

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

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

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

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

Board of Studies (BoS) :

11th BoS 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) :	**Academic Council:**
11thBoS of Chemistry held on 17.06.2021	!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 DRUGS 8

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

MODULE IV STEROIDS AND RELATED DRUGS 7

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

L – 30; Total Hours– 30

TEXT BOOKS:

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

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

REFERENCES:

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

COURSE OUTCOMES:

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

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

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

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

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Academic Council:
17th AC held on 15.07.2021

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

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

SDG 9 :Industry, Innovation & Infrastructure

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

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
CO 1	M														
CO 2	M														
CO 3	H														
CO 4	M														
CO 5	M														

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

Learning of various mathematical techniques like 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
CO 1	M														
CO 2	M														
CO 3	H														
CO 4	M														
CO 5	M														

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

Learning of various mathematical techniques will lead to knowledge of applications in Communication Engineering

		L	T	P	C
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 FUNCTIONS 9+3

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											

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	RANDOM PROCESSES	L	T	P	C
SDG: 4		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 DISTRIBUTIONS 9+3

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
CO 1	H	L													
CO 2	M	L													
CO 3	M	L													
CO 4	H	M													
CO 5	H	M													

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	L	T	P	C
SDG: 4		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
CO 1	M	L													
CO 2	M														
CO 3	M	L													
CO 4	M	L													
CO 5	M	L													

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.

HUMANITIES ELECTIVE
(SEMESTER III)

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

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

MODULE V ENGINEERING MANAGEMENT 10

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

L – 45 ; Total Hours – 45

TEXT BOOKS:

1. Krugman, P, Wells, R, and Graddy, K., "Essentials of Economics", Worth Publishers, 4th Edition, New York, 2016.
2. Hussain, Moon Moon, "Economics for Engineers", Himalaya Publishing House, 1st Edition, 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) :

5th BoS 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	**SOCIOLOGY OF SCIENCE AND TECHNOLOGY**	**L**	**T**	**P**	**C**
SDG: 17		**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 AND CHANGE 9

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

L – 45; Total Hours – 45

TEXT BOOKS:

1. Giddens A. “Sociology” Wiley India Pvt. 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) :

5th BoS 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.

SSDX 03	**INDUSTRIAL ECONOMICS AND MANAGEMENT**	**L**	**T**	**P**	**C**
SDG: 8 and 9		**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

COB1: To provide a wholesome idea about the concept of industrial economics and identify the classifications of firms based on ownership and control.

COB2: To impart theoretical and analytical knowledge on the different market structures, pricing practices and government policies.

COB3: To equip the students with the framework that will be useful for applying economic models in business strategy, competition policy and regulations.

COB4: To understand the importance of Industrial Policy in the development of Industries in India.

COB5: To elucidate industrial growth in India by examining its performance and problems in industrial sector.

MODULE I INTRODUCTION TO INDUSTRIAL ECONOMICS 9

Definition and scope of industrial economics - Concept and importance of industry; Concept and organization of a firm - Classification of firms based on ownership - sector (industries, formal vs. Informal) - size and use - based classification - Separation of ownership and control - Localization of industries .

MODULE II MARKET STRUCTURE 9

Perfect Competition – Imperfect Competition: Monopoly – Monopolistic – Oligopolistic Strategy, Cartels, Cournot Kinked Demand and Price Leadership – Measurement of economic concentration – Policy against monopoly and restrictive trade practices – Competition Law – Pricing Practices: Objectives – Determinants – Pricing Methods – Government Policies and Pricing.

MODULE III PRODUCTION ECONOMICS AND THEORY OF FIRM 9

Production and Production function – Types, Factor Inputs – Input-Output Analysis**,** Undifferentiated Products - Cournot, Stackelberg, Dominant firm model, Bertrand-Heterogeneous products - Chamberlin’s small and large number case - Kinked demand curve theory - Bain’s limit pricing – Production Possibility Frontier.

9

MODULE IV INDUSTRIAL POLICY

Industrial Policy: Industrial Policy in India -1948, 1956, 1977, 1980, 1990, 1991 - Industrial Performance after Independence.

MODULE V INDUSTRIAL GROWTH IN INDIA 9

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

L – 45 ; Total Hours – 45

TEXT BOOKS:

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) :
Mention details of BoS
5th BoS 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	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 STRUCTURE**	**L**	**T**	**P**	**C**
SDG: 10, 16		**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) :
5th BoS 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.

HUMANITES ELECTIVES – VI SEMESTER

SSDX 11	**ECONOMICS OF SUSTAINABLE DEVELOPMENT**	**L**	**T**	**P**	**C**
SDG: 1-17		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To inculcate the knowledge base on sustainable development with a view to balance our economic, environmental and social needs, allowing prosperity for now and future generations.
COB2: To develop a capacity to undertake a theoretically grounded analysis of environment issues and identify and describe what the United Nations and other governing bodies are doing to assist in a more sustainable world.
COB3: To have an insight of the emerging debate about reconciling ecological sustainability with poverty alleviation in the context of globalization and development.
COB4: To establish a clear understanding of the policy instruments of sustainable development.

MODULE I CONCEPT OF SUSTAINABLE DEVELOPMENT 8

Evolution of the Concept – Rio Summit and sustainable development - various definitions of sustainable development - Components of sustainable development: Social, environmental and economic components – Sustainable Development Goals – Quality education, Gender equality, innovation and infrastructure, peace and justice - Sustainable engineering practices.

MODULE II NEED FOR SUSTAINABLE DEVELOPMENT 6

Need for sustainability – Global environmental challenges: population growth, resource depletion, pollution, energy use, climate change, pollution, growing water scarcity, other urban problems, loss of biodiversity, hazardous wastes disposal.
International responses to environmental challenges - Global policy such as Kyoto Protocol, Paris Agreement, Montreal Protocol, Basel Convention.
Community Participation in Sustainable Development, Common Property Resource Management, Innovation, Industry and Sustainable Development.

MODULE III GLOBALIZATION AND ENVIRONMENT SUSTAINABILITY 7

Impact of Globalization on sustainable development, Co - existence of globalization and Environment sustainability - Globalization and Global Governance.

Green economy - Renewable energy, sustainable transport, sustainable construction, land and water management, waste management.

MODULE IV POLICIES FOR ACHIEVING SUSTAINABLE DEVELOPMENT 9

Principles of environmental policy for achieving sustainable development: precautionary principle and polluter pays principle – Business Charter for Sustainable Development.

Policy instruments for sustainable development: direct regulation – market based pollution control instruments such as pollution tax, subsidy, pollution permits.

L –30 ; TOTAL HOURS – 30

TEXT BOOKS:

1. Peter P. Rogers, Kazi F. Jalal, John A. Boyd, "An Introduction to Sustainable Development", Glen Educational Foundation, 1st Edition, England, UK, 2008.

2. Sayer, J. and Campbell, B, "The Science of Sustainable Development: Local Livelihoods and the Global Environment" (Biological Conservation, Restoration &Sustainability), Cambridge University Press, London, 2003.

REFERENCES:

1. Anderson, David A, "Environmental Economics and Natural Resource Management", Routledge, 3rd edition, England, UK, 2010.
2. Berck, P., "The Economics of the Environment", New Delhi: Pearson India, 2015.
3. Karpagam M, "Environmental Economics: A Textbook.pdf", Sterling Publishers Pvt. Ltd, New Delhi, 2021.
4. Kumar, Pushpam, "Economics of the Environment and Development",Ane Book Publication, New Delhi, India, 2009.
5. Karpagam M and Jaikumar Geetha, "Green Management Theory and Applications", Ane Books Pvt. Ltd, New Delhi, India, 2010.
6. Sengupta Ramprasad, "Ecology and Economics: An Approach to Sustainable Development", Oxford University Press, New Delhi, 2004.
7. Muthukrishna, S, "Economics of Environment", PHI Learning Pvt. Ltd., New Delhi, India, 2010.

COURSE OUTCOMES:

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

CO1: Develop awareness of the ethical, economic, social and political dimensions that influence sustainable development.

CO2: Clearly articulate their views and beliefs with regards to environmental issues.

CO3: Identify and describe the major economic forces that shape our approach to the environment issues and demonstrate responsible globalization through global governance.

CO4: Account for strategies, international agreements and major policy instruments for a sustainable use of resources and ecosystem services.

Board of Studies (BoS) :
4th BoS of SSSH 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	PO11	PO 12
CO1		H	H		H	H	H		H		H	H
CO2			H			H	H		H		H	H
CO3	M	M	H			H	H		H		H	H
CO4			H			H	H	H	H		H	H

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

SDG 1: End poverty in all forms and everywhere.

SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.

SDG 3: Ensure healthy lives and promote well-being for all at all ages

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

SDG 5: Achieve gender equality and empower all women and girls

SDG 6: Ensure availability and sustainable management of water and sanitation for all.

SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all.

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

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

SDG 10: Reduce income inequality within and among countries

SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable.

SDG 12: Ensure sustainable consumption and production patterns

SDG 13: Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.
SDG 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
SDG 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
SDG 17: Strengthen the means of implementation and revitalize the global partnership for sustainable development.

The holistic understanding of all the 17 SDGs aims to end poverty, ensure prosperity, and protect the planet.

SSDX 12	**SOCIOLOGY OF INDUSTRIAL RELATION**	**L**	**T**	**P**	**C**
SDG: 8, 9		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To familiarize sociological approaches and perspectives to understand the social relationship in manufacturing industries and corporate sector.

COB2: To highlight the structure and functions of industrial organizations

COB3: To explicate the dynamics of organizational behavior, leadership and communication.

COB4: To provide an overview in labour legislation and labour welfare

MODULE I INTRODUCTION 7

Sociology of Industrial relation - definition, scope and importance - Theoretical approaches- scientific management, human relations approach, theory of bureaucracy- Fordism and post-fordism - Production system- concept and characteristics of factory system - automation and rationalization -The Industrial Employment (Standing Orders) Act, 1946 Industrial conflict- strike, lockout and trade unions- Emerging role of trade unions in India.

MODULE II INDUSTRIAL ORGANIZATION 7

Formal organization- definition, features, utility - Informal organization- definition, characteristics, types and relevance - Structure of industrial organization- features and functions of line organization, characteristics and roles of staff organization, distinction- Industrial hierarchy-white collar, blue collar, supervisors and managers.

MODULE III DYNAMICS OF INDUSTRIAL RELATIONS 7

Group dynamics- Definition, Group behaviour model - Group decision making process, group cohesiveness - Leadership- definitions, style and effective supervision- Communication- concepts, types, model barriers - Job satisfaction- nature, employee compensation and job satisfaction. Grievance Handling and Disciplinary Action, Code of Conduct, Industrial Relations in changing scenario, Employers' organisations.

MODULE IV LABOUR LEGISLATION AND LABOUR WELFARE 9

Labour Legislation-Objectives, Principles, Classification and Evolution. International Labour Organisation. Social Justice and Labour Legislation, Indian Constitution and Labour Laws- The Factories Act, 1948, The Inter-state Migrant Workmen Act, 1979, The Contract Labour (Regulation and Abolition) Act, 1970, The Child Labour (Prohibition and Regulation) Act, 1986. Labour welfare-Concept, Scope, Types, and Principles, Industrial Health and Hygiene, Industrial Accidents and safety, Occupational Diseases. Social Security-Concept and Scope, Social Assistance and Social assurance.

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Mamoria ,Gankar., "Dynamics of Industrial relations", Himalaya Publishing House,Mumbai, 2007.
2. Narender Singh ., "Industrial Sociology", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2012.
   Kumar., "Industrial Sociology", Lakshmi Narain Agrawal Publishers, Agra, 2019.
3. SharmisthaBhattacharjee, "Industrial Sociology", Aavishkar Publishers, Jaipur, 2016.

REFERENCES:

1. Bhatnagar M., "Industrial Sociology",S. Chand Publications, New Delhi, 2012.
2. MisraRajan., "Industrial Sociology", University Science Press (An Imprint of Laxmi Publications Pvt. Ltd.), New Delhi, 2013.
3. Newstorm W John, "Organizational Behavior", Mc. Graw Hill Publishing Co., New Delhi, 2006.
4. Nina, Bandlej (ed)., "Economic Sociology of Work", Bingley: Emerald Group Publishing Ltd, 2009.
5. Richard Brown, John Child, S.R. Parker, "The Sociology of Industry", Routledge Publisher, 2015.
6. Sushil Kumar Saxena, Satish Mittal, "Industrial Sociology",Common Wealth Publishers, 2012.
7. Watson, Tony, "Sociology, Work and Industry (5th edition), Oxon: Routledge, 2008.

COURSE OUTCOMES:

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

CO1: Understand the sociological perspectives for dealing with social relationships in production and service organizations.

CO2: Have deeper knowledge in structure of authority, roles and responsibility in organizational settings.
CO3: Assess the role of leadership, communication and behavioral acumen to govern the organization.
CO4: Describe the importance of labour legislation and labour welfare

Board of Studies (BoS) :
4th BoS of SSSH 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	PO11	PO 12
CO1			H						M	H		M
CO2						M	L	M	M		H	M
CO3			M			M		M	H	H	H	M
CO4						H						H

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

SDG 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
SDG 9 : Build resilient Infrastructure, promote inclusive and sustainable industrialization and foster innovation

The holistic understanding of industrial relations leads to equal access to opportunity, and equal pay for work of equal value for male and female contributions is necessary for gender equality as well as for inclusive economic growth. Explore work opportunities, understand career processes and appreciate the meaning and purpose of work in people’s lives which leads to decent work and safe working practices.

SSDX 13	**PROFESSIONAL ETHICS AND HUMAN VALUES**	**L**	**T**	**P**	**C**
SDG: 8		**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

COB1: To render basic insights and inputs to the students to inculcate human values to grow as responsible human beings with a proper personality.

COB2: To create awareness on senses of engineering ethics.

COB3: To inculcate knowledge and exposure on safety and risk, risks benefit analysis and professional rights.

COB4: To instill social values and loyalty and to appreciate the rights of others

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MODULE I HUMAN VALUES 7

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

MODULE II ENGINEERING ETHICS 7

Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles - Theories about right action - Self-interest - Customs and Religion - Uses of ethical theories - Valuing Time – Co-operation – Commitment.

MODULE III SAFETY, RESPONSIBILITIES AND RIGHTS 8

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

MODULE IV CONTEMPORARY ISSUES 8

Globalisation-Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Ethics-Ethics and codes of business conduct in MNC.

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Govindarajan M, Natarajan S, Senthil Kumar V. S., “Engineering Ethics”, Prentice Hall of India, New Delhi, 2019.
2. Kiran. D R, “Professional Ethics and Human Values”, Mc Graw Hill Publishers,New Delhi, 2013.
3. Naagarazan R.S., “Professional Ethics and Human Values”, New Age International Publishers, New Delhi, 2006.
4. R Sangal, RR Gaur and G P Bagaria, “Foundational Course in Human Values & Professional Ethics”, Excel Books, India, 2010.

REFERENCES:

1. Charles D. Fleddermann , “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004.
2. Charles E Harris, Michael S.Protchard and Michael J Rabins., “Engineering Ethics – Concepts and Cases”, Wadsworth Thompson Leatning, United States, 2000.
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
5. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
6. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York, 2010.
7. Subramanian. R,“Professional Ethics - Includes Human Values”, Oxford HED Publishers, 2017.\

COURSE OUTCOMES:

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

CO1: Apply moral and ethical values scrupulously that ought to guide the engineering profession.

CO2: Understand the ethical issues related to engineering aspects.

CO3: Assess safety and risk and execute risk benefit analysis.

CO4: Become responsible engineers, experimenters, researchers or businessmen

Board of Studies (BoS) :

4thBoS of SSSH 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	PO11	PO 12
CO1			H				H	H				M
CO2			M			M		H		H	M	
CO3			M		M	H		H				H
CO4			L				H	H	H		M	M

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

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

Holistic understanding of professional ethics explores work opportunities, understand career processes and appreciate the meaning and purpose of work in people’s lives leading to a decent work and safe working practices and environments.

SSDX 14 SDG: 8	GENDER, TECHNOLOGY AND DEVELOPMENT	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

COB1: To conceptualize what is gender and sex and draw a line of distinction between the two.
COB2: To develop students' sensibility to the difference in gender roles, responsibilities, rights and injustice.
COB3: To reflect critically on the ways in which new technologies have sharpened and/or blurred gender difference.
COB4: To develop an insight to the gender and development with the paradigm shift from time to time.

MODULE I UNDERSTANDING GENDER 7

Basic Concepts: Sex/Gender, Gender roles, Gender socialization, - Construction of Gender- Making Women, Making Men Gender stereotyping, Femininity and Masculinity, Patriarchy, Heteronormativity, LGBTIQ - Theoretical Background to gender and feminist thinking: Liberal, Radical, Marxist, Socialist, Post-modern Feminism.

MODULE II GENDER ROLES AND GENDER INJUSTICE 7

Gender Roles and Relations-Types of Gender Roles Gender Roles and Relationships Matrix. Health conditions, Sex Ratio, Education: Literacy & Gender Bias - Work Related Issues: Existing Prejudices, gender Related Violence, Gender Discrimination - Political participation: Lack of women's representation - Economic Conditions- Social Conditions: divorce, rape, domestic violence.

MODULE III GENDER, TECHNOLOGY AND CHANGE 8

A historical perspective – Technology as masculine culture – Household technology – medical technology: New Reproductive technologies – Impact of Technological Change on Women. The Digital Divide: Unequal Access, Unequal Effects – Outcome and impact of ICT's Policies and projects for women. How gender influences technologies and the social organization of scientific and technical workspaces.

MODULE IV GENDER AND DEVELOPMENT 8

Gender, Governance and Sustainable Development - Women's role in Development - Women in Development (WID), Women and

Development (WAD) - Gender and Development (GAD); Gender Mainstreaming and Gender Budgeting - Gender and Human Rights

L – 30; TOTAL HOURS –30

TEXT BOOKS:

1. Bhasin, Kamala., "Understanding Gender", New Delhi: Kali for Women, 2000.
2. John, Mary E., "Gender and Development in India, 1970-90's: Some reflections on the constitutive role of context' Chaudhuri, Maitrayee. (ed.) Feminism in India", New Delhi: Kali for women. pp. 246-258, 2004.
3. Menon, Nivedita, "Embodying the Self: Feminism, Sexual Violence and the Law" in Partha Chatterjee and Pradeep Jeganathan (ed)- Subaltern Studies XI: Community, Gender and Violence", Permanent Black and Ravi Dayal, 2000.
4. Gender and Technology: A reader ., Edited by Nina E. Lerman, Ruth Oldenziel, and Arwen P. Mohun, John Hopkins University Press, Baltimore , 2003.

REFERENCES:

1. Lourdes Beneria , GünseliBerik , Maria Floro .,"Gender, Development and Globalization: Economics as if All People Mattered", 2nd edition , Routledge, 2015.
2. Moser, Caroline, "Gender Planning and Development: Theory, Practice and Training", Routledge, 1993.
3. Rege, Sharmila., "Sociology of Gender: The Challenge of Feminist Sociological Knowledge", Sage publications: New Delhi, 2003.
4. Jain S.C., Women and Technology, Rawat Publication, Jaipur Begh, 1985.

COURSE OUTCOMES:

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

CO1: Distinguish important concepts related to gender in contemporary society.

CO2: Interpret the gender discrimination works in our society and how to counter it.

CO3: Illustrate how the intersection of gender and technology involves gender shaping technology and technology shaping gender.

CO4: Apply gender sensitive perspective on development and human rights.

Board of Studies (BoS) :
4th BoS of SSSH 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	PO11	PO 12
CO1			H			H	H		H		H	L
CO2			H			H	M			H		L
CO3			H			H	H	H			M	H
CO4			H			H	H		H			H

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

SDG 5: Achieve gender equality and empower all women and girls

To imbibe gender concern and gender perspective in the invention, and application of technology, planning and designing production and innovating strategies for engendering gender equality.